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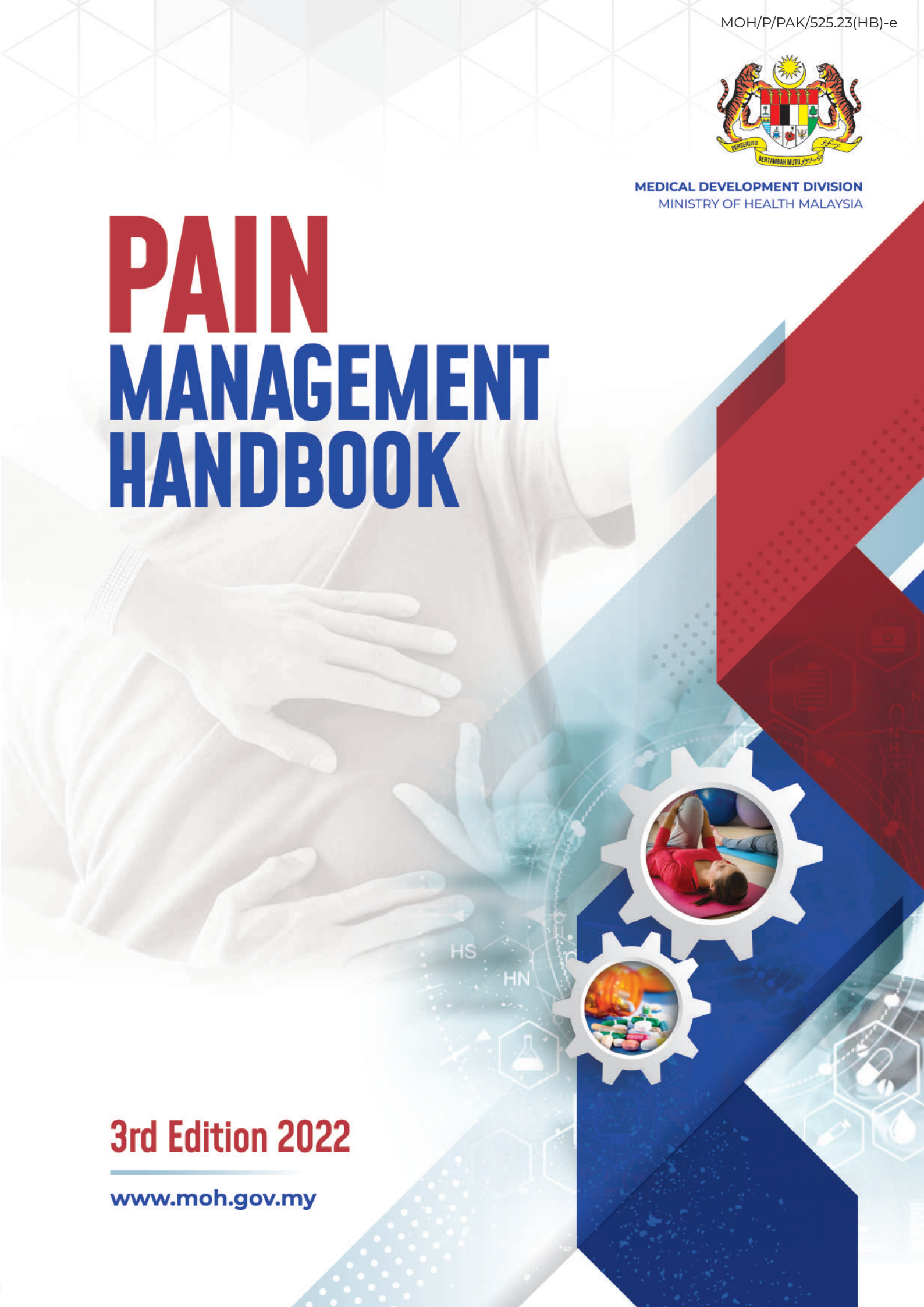
MEDICAL DEVELOPMENT DIVISION
MINISTRY OF HEALTH MALAYSIA

PAIN MANAGEMENT HANDBOOK



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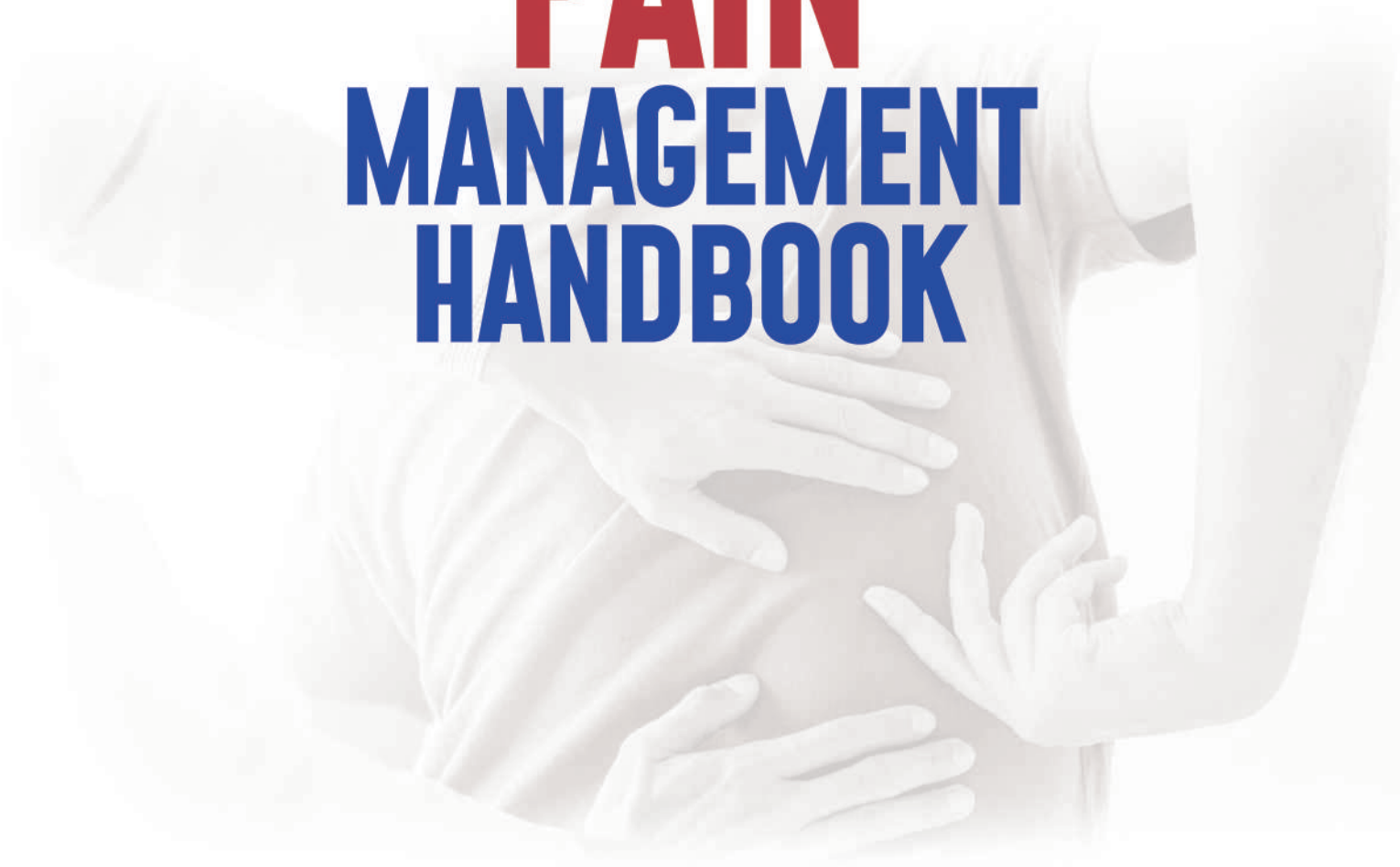
PAIN MANAGEMENT HANDBOOK



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PREFACE

THIS BOOK IS INTENDED FOR A WIDE RANGE OF SPECIALITIES, FROM ANAESTHESIOLOGISTS TO MEDICAL OFFICERS IN ALL DISCIPLINES, NURSES, PHYSIOTHERAPISTS, OCCUPATIONAL THERAPISTS, AND EVEN PHARMACISTS WHO ENCOUNTER PATIENTS WITH PAIN IN THEIR DAILY PRACTICE.

This third edition of our Pain Handbook was developed after acknowledging the latest updates in the field of pain management and considering the suggestions and expertise of our practising Pain Management Specialists in Malaysia who have devoted their careers to the treatment of pain. It took our task force a year to compile the information in this book, and it has been an exciting journey.

The handbook has facts on a wide range of topics, from analgesic medication, dosages of drugs, protocols, algorithms made easy to follow, and newer pain management techniques. It includes revised versions of existing topics and the addition of new topics like Enhanced Recovery After Surgery (ERAS) and non-pharmacological management of acute pain, which have all been thoughtfully written. Detailed information on acute, chronic, and cancer pain is emphasized upon, and the handbook is packed with helpful hints, tables, and appendices for easy access to information when required.

This book is intended for a wide range of specialities, from anaesthesiologists to medical officers in all disciplines, nurses, physiotherapists, occupational therapists, and even pharmacists who encounter patients with pain in their daily practice. This aligns with establishing Pain as the Fifth Vital Sign in our hospitals and our working towards accreditation of more Pain-Free Hospitals in Malaysia.

Those who are managing pain in our health care system will have a practical and quick reference book that is simple to comprehend in order for them to maintain high standards of pain management in their clinical practice.

We, the editorial board, sincerely hope to take the pain management of our patients in our country to greater heights by empowering our healthcare workers in our hospitals and Primary Care facilities with the information available in this handbook.

Editorial Team

FOREWORD

Pain specialists are specially trained anaesthesiologists who lead pain management services in Ministry of Health hospitals. There are at least 20 chronic pain clinics, with anaesthesiologists providing acute pain services in 75 hospitals.

Pain is among the most common complaints seen in outpatient clinics one in five complaints in outpatient clinics is related to pain, and more than half of the patients visit their primary care provider for pain. Healthcare providers must understand how to manage patients with pain, particularly chronic pain.

Within this context, Pain Medicine emerges as a clinical service specialty with a multidisciplinary approach to relieving pain and improving quality of life.

Pain specialists, anesthesiologists, occupational therapists, physiotherapists, clinical psychologists, and pain nurses constitute a multidisciplinary pain management team. This team assists in developing a care plan tailored to individual patients. Effective chronic pain management often necessitates coordinated efforts of the team.

The future of pain management in MoH hospitals includes the development of standard practices,as outlined in this handbook. Additionally, ongoing awareness and training programmes for medical and allied health professionals are required. This handbook will serve as a valuable guide for ongoing pain management training and practice.

I wholeheartedly congratulate the Editorial Team and the Medical Development Division for their commitment to develop this handbook. I sincerely hope this handbook will improve the quality of pain management in MoH Hospitals.

Datuk Dr Muhammad Radzi bin Abu Hassan
Director General of Health, Ministry of Health, Malaysia.

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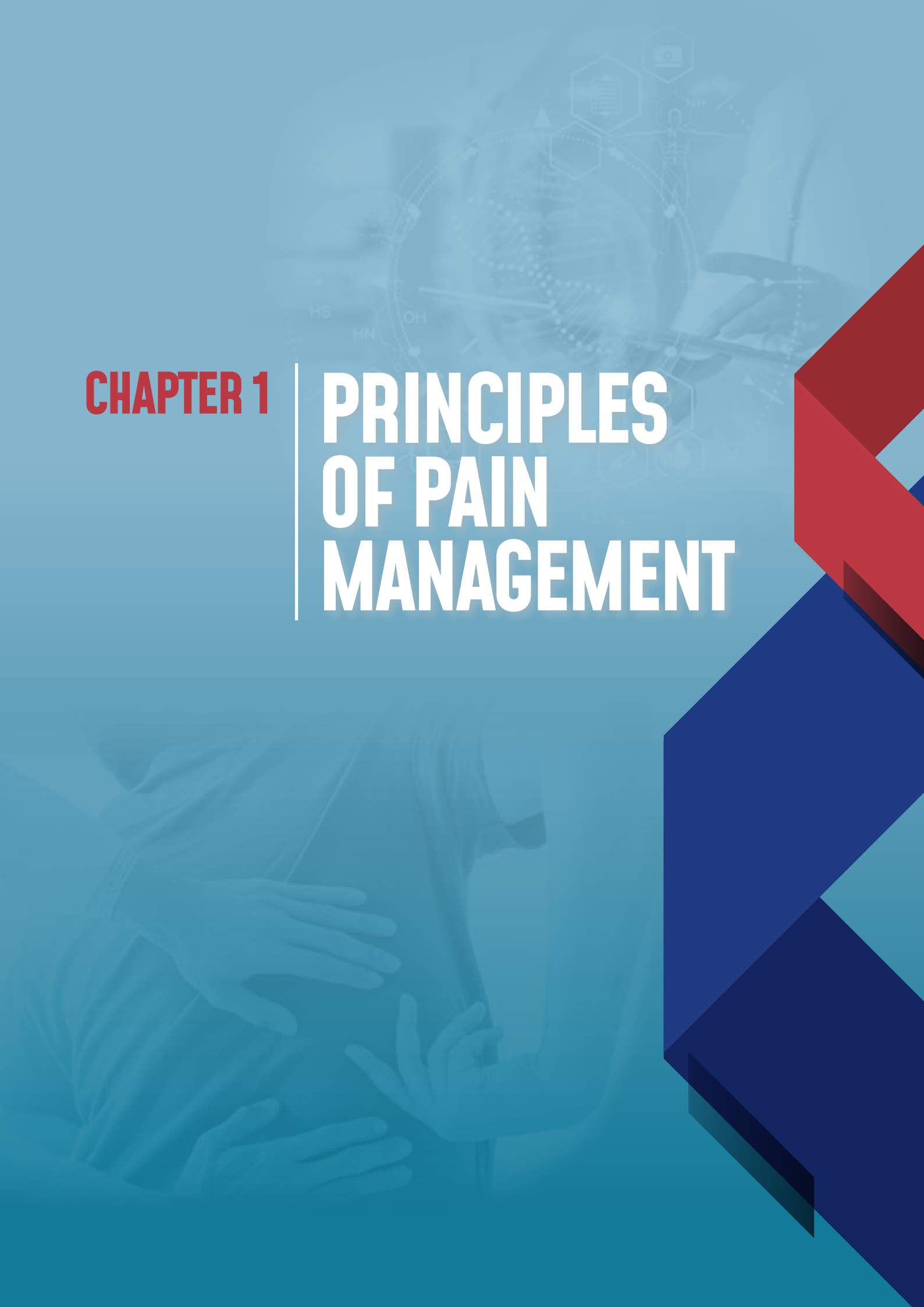
This book is based on the “Pain Management Handbook Second Edition 2013” published by Medical Development Division



CHAPTER 1 PRINCIPLES OF PAIN MANAGEMENT

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PRINCIPLES OF PAIN MANAGEMENT

Pain is a common symptom in hospitalized patients. Acute pain is pain that is associated with tissue injury. It is usually limited in duration (less than three months) and diminishes as the tissues heal. Chronic pain is pain that persists or recurs for more than three months. (IASP Task Force for the classification of chronic pain 2016)

Pain is a complex physiological and psychological phenomenon that is subjective. Pain may be acute or chronic and may persist even when tissue healing has occurred. Assessing pain and documenting any intervention's effectiveness are the basic principles of successful pain management. Pain should be evaluated at rest, movement, and any other intervention. Postoperative pain must be monitored regularly and should begin as soon as the patient is admitted to the recovery room and continue in the ward till discharged.

Implementing Pain as the 5th Vital Sign and a "Pain-Free Program" in MOH aims to ensure that all medical staff is trained in the assessment and management of pain so that patients admitted to the hospital will not have to suffer unrelieved pain.

There is good evidence that effective pain relief reduces patient morbidity and helps facilitate early recovery, mobilization, and discharge from the hospital. As pain is subjective, drug regimens must be tailored to meet individual patients' requirements.

Objectives of Pain Management Services

- To improve the quality of pain management in all patients.
- To increase the safety and efficacy of analgesia.
- To avoid or effectively manage the side effects of treatment.
- To facilitate the recovery process for the patient.
- To educate healthcare providers on the importance of optimal pain management and the availability of new analgesic techniques
- To implement cost-effective therapy.
- Audit and research.

Principles of Pain Management

- Good pain management is necessary to avoid adverse physiological and psychological effects from unrelieved severe acute pain.
- Multimodal analgesia approach to pain management and multidisciplinary involvement leads to improved pain relief and patient outcomes.
- Detailed pain assessment is essential. The patient's pain score and descriptors will help decide the choice of analgesic regimen the patient will require. Adequate control of pain requires patient involvement, frequent assessment, reassessment of pain intensity, and charting of analgesia.
- Pain that is established and severe is difficult to control; therefore, the pain has to be treated early and continuously. Treatment should be individualized. Postoperative analgesia should be planned preoperatively and with consideration given to the type of surgery, medical condition of the patient, perioperative use of analgesics, and regional anaesthetic techniques.
- The aim is to reduce pain to a comfortable level. It may not be possible to eliminate pain.
- Adequate monitoring of side effects is necessary to prevent morbidity and mortality of patients on analgesic medications. Protocols are available for monitoring and treating adverse effects.
- Multimodal analgesia may be used to improve efficacy and reduce side effects. This means using a combination of analgesic agents such as paracetamol, NSAIDs, and opioids. The aim is to minimize the consumption of opioids while providing optimal analgesia.
- Patients should be reviewed daily and at discharge, and analgesics titrated accordingly.
- Restoration of function should be a clear goal.

Table 1.1 : Definitions of pre-emptive and preventive analgesia

Pre-emptive analgesia	Preoperative treatment is more effective than the identical treatment administered after incision or during surgery. The essential clarification is the administration's "pre" insult/surgery timing. A treatment given pre-emptively can also be preventive if it satisfies the below definition.
Preventive analgesia	Postoperative pain and analgesic consumption is reduced relative to another treatment, a placebo treatment, or no treatment with the effect observed at a point beyond the expected duration of action of the intervention (e.g., 5.5 half-lives of the medicine). The intervention may or may not be initiated before surgery.

Sources: Moiniche 2002; Katz 2002; Katz 2011; Rosero 2014b

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CHAPTER 2

PHYSIOLOGY OF PAIN

CHAPTER 2 | PHYSIOLOGY OF PAIN

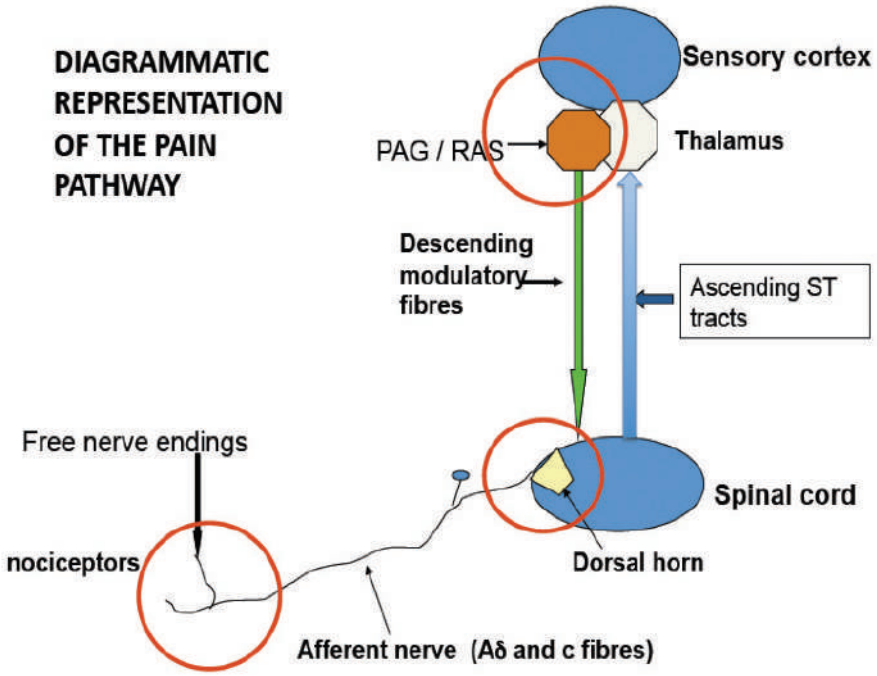
Definition of Pain (International Association for the Study of Pain)

Pain is defined as an unpleasant sensory and emotional experience associated with, or resembling that associated with actual or potential tissue damage," and is expanded upon by the addition of six key Notes and the etymology of the word pain for further valuable context.

- Pain is always a personal experience influenced by biological, psychological, and social factors.
- Pain and nociception are different phenomena. Pain cannot be inferred solely from activity in sensory neurons.
- Through their life experiences, individuals learn the concept of pain.
- A person's report of an experience of pain should be respected.
- Although pain usually serves an adaptive role, it may adversely affect the function and social and psychological well-being.
- Verbal description is only one of several behaviors to express pain; the inability to communicate does not negate the possibility that a human or a nonhuman animal experiences pain.

(A multi-national, multidisciplinary Task Force developed the revised definition with input from all potential stakeholders, including persons in pain and their caregivers, International Association for the Study of Pain 16.7.2020)

Figure 2.1 : The Pain Pathway



Source: Malaysian 5th Vital Sign Implementation: 2008-2010 5th Vital Sign: Doctors' training module. Pain Management Handbook, 2nd Edition, 2013.

The pain pathway is described in three components: Peripheral, Spinal, and Supraspinal.

1. Peripheral

a. Nociceptors (free nerve endings that respond exclusively to intense stimuli) are present in the skin, somatic structures, joints, and viscera.
b. When triggered, the stimulus is carried through A-delta and C nerve fibers to the next level (spinal cord).

2. Spinal

a. A-delta and C fibers (first-order neurons) synapse with second-order neurons in the dorsal horn (substantia gelatinosa).
b. The pathway continues through the contralateral spinothalamic/spinoreticular tract to the next level (supraspinal).

3. Supraspinal

a. Brainstem, thalamus relays stimuli to the sensory cortex where the pain is perceived.
b. Modulation (inhibition or excitation) of perception and response to pain occurs through descending pathways from the reticular activating system (RAS) and periaqueductal grey (PAG).

PROBLEMS WITH POSTOPERATIVE PAIN

a. Unpleasant to patient
b. Increases surgical stress response
c. Impedes nursing and physiotherapy
d. Delays mobilization
e. Increases postoperative complications
f. Prolongs postoperative stay
g. Detrimental physiological consequences

PHYSIOLOGIC CONSEQUENCES OF ACUTE PAIN

Major physiological systems are affected by pain as a form of the stress response.

1. Cardiovascular system

- Pain increases sympathetic response, increasing heart rate and blood pressure.
- This would increase myocardial work and oxygen consumption, which would be especially hazardous in patients with poor myocardial function.

2. Respiratory system

- Pain from thoracoabdominal wounds may produce widespread pulmonary changes, increased abdominal muscle tone, and decreased diaphragmatic function.
- This results in an inability to cough and clear secretions, which leads to atelectasis and pneumonia.

3. Gastrointestinal tract

Pain increases sympathetic tone, causing

- Increased gastric and intestinal secretions
- Decreased gut motility

~ Leading to ileus, nausea, and vomiting.

4. Genitourinary tract

Pain increases sympathetic tone, causing an increase in smooth muscle and sphincter tone, leading to urinary retention.

5. Musculoskeletal system

Pain prevents mobilization and causes increased muscle tone resulting in deep vein thrombosis.

6. Endocrine response

- Pain increases the release of stress hormones, resulting in an increased load on the cardiovascular and renal systems.
- Stress can also lead to sleeplessness and poor healing.

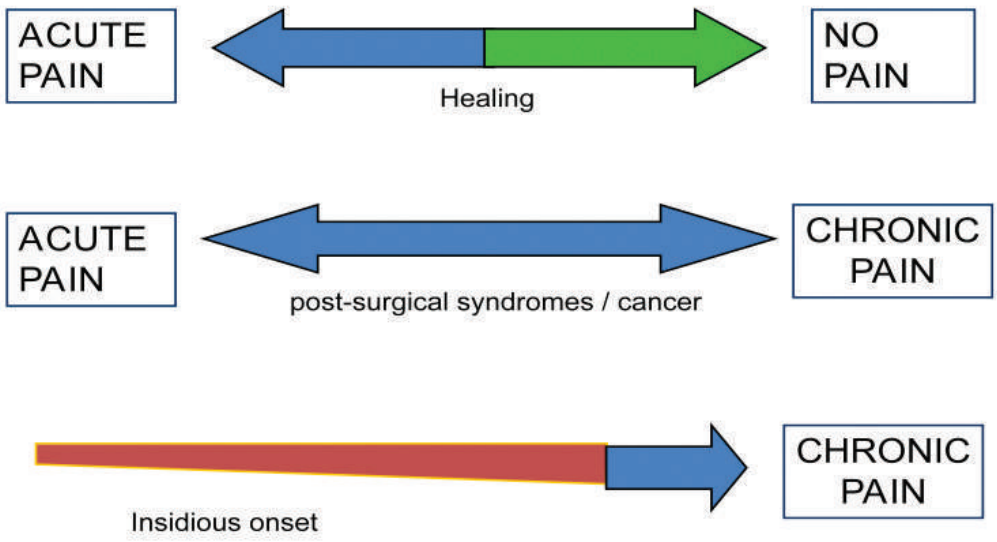
7. CNS complications

Anxiety, stress, and insomnia

8. Long-term complications

Increases risk of developing chronic pain via peripheral and central sensitization

Figure 2.2 : Spectrum of Pain



Source: Malaysian 5th Vital Sign Implementation: 2008-2010 5th Vital Sign: Doctors' training module. Pain Management Handbook, 2nd Edition, 2013.

- Pain can be acute or chronic.
- Acute pain usually resolves after a short while once the injured tissues have healed.
- Chronic pain may begin with acute pain, e.g., after an injury, accident, or surgery, which persists even after healing. Examples are neuropathic pain after brachial plexus injury, post-thoracotomy pain, chronic abdominal pain from adhesions
- However, there are also types of chronic pain that begin insidiously, with no apparent precipitating event. Examples are chronic back and neck pain.

Most patients managed by the Acute Pain Service have acute pain, mainly post-operative or post-trauma pain.

However, some patients referred to APS may have acute exacerbations of chronic pain, and it is essential to recognize these patients as they are best managed by a multidisciplinary pain management team.

For more information on the differences between acute and chronic and the principles of management of chronic non-cancer pain, please see Chapter 13

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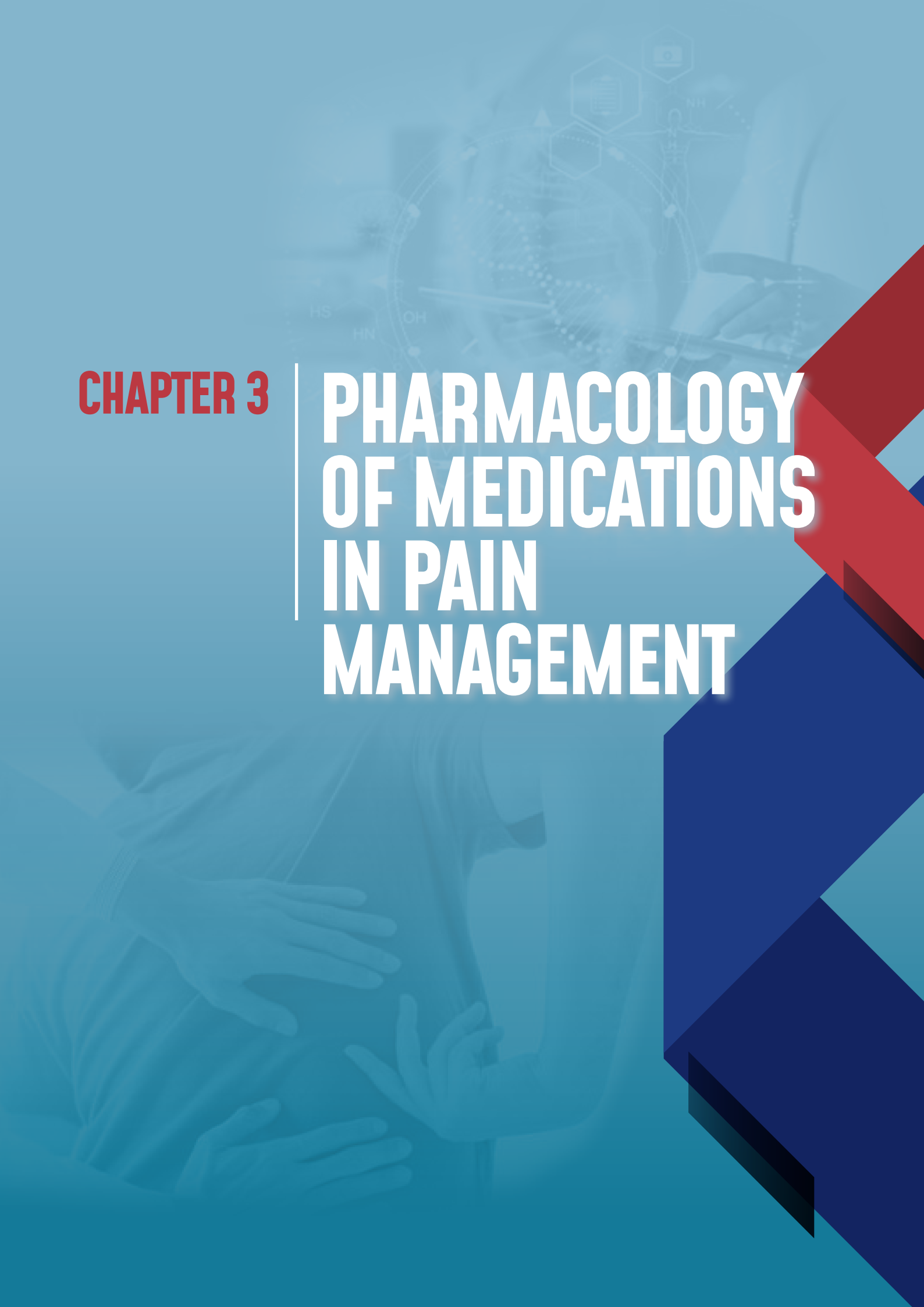

CHAPTER 3

PHARMACOLOGY OF MEDICATIONS IN PAIN MANAGEMENT

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Medications used in Pain Management include:

I . Analgesics: Opioids and non-opioids

II . Adjuvants

III. Other anaesthetic agents: local anaesthetics, ketamine, dexmedetomidine

Classification of Analgesics

Table 3.1 : Analgesic medications commonly used for acute pain management

Drug Group	Drug Class	Examples
Non Opioids	**Simple analgesics**	Paracetamol
	Non-selective NSAIDs	Diclofenac Sodium Mefenamic Acid Ibuprofen Naproxen Sodium Ketoprofen Meloxicam Ketorolac
	Selective COX-2 inhibitors	Celecoxib Etoricoxib Parecoxib
Opioids	**Weak opioids**	Dihydrocodeine Tramadol

Drug Group	Drug Class	Examples
Opioids	**Strong opioids**	Morphine Fentanyl Remifentanil Oxycodone Pethidine
	Partial agonist opioids	Nalbuphine Buprenorphine
	Opioid antagonist	Naloxone

OPIOID ANALGESICS

Mechanism of Action

Binds to opioid receptors (refer to Table 3.2), located throughout the central nervous system (CNS) and other tissues (somatic and peripheral nerves). Pharmacodynamic properties of specific opioids depend on which receptor it is bound to, the binding affinity and whether the receptor is activated.

Opioid receptor activation inhibits the presynaptic release and postsynaptic response to excitatory neurotransmitters (acetylcholine, substance P) from nociceptive neurons.

This is the current classification of opioid receptors. The nociceptin (NOP) receptor was the fourth G-protein-coupled endogenous opioid-like receptor found in 1994. It is similar to the known amino acid sequences of classical opioid receptors. Once activated, it produces identical action as the classical opioid receptors but lacks response to naloxone.

Table 3.2 : Changes in the classification of classical opioid receptors over time

Pre cloning Before 1992	Post cloning 1992-1996	IUPHAR* 1996	IUPHAR* 2000	Current NC-IUPHAR**
Δ	**DOR**	OP1	DOP	DOP or δ
K	**KOR**	OP2	KOP	KOP or κ
M	**MOR**	OP3	MOP	MOP or μ
		OP4	NOP	NOP

**IUPHAR: International Union of Basic and Clinical Pharmacology*
***NC-IUPHAR: nomenclature committee of IUPHAR*

Table 3.3 : Features of Opioid Receptors

Receptors	mu_1	mu_2	kappa	delta
Effects	Analgesia (supraspinal, spinal)	Analgesia (spinal)	Analgesia (supraspinal, spinal)	Analgesia (supraspinal, spinal)
	Euphoria	Depression of ventilation	Dysphoria, sedation	Depression of ventilation
	Low abuse potential	Physical dependence	Low abuse potential	Physical dependence
		Constipation (marked)		Constipation (minimal)
	Miosis		Miosis	
	Bradycardia			
	Hypothermia			
	Urinary Retention		Diuresis	Urinary Retention
Agonists	Endorphins Morphine Synthetic opioid	Endorphins Morphine Synthetic opioid	Dynorphins	Enkephalins
Antagonists	Naloxone Naltrexone Nalmefene	Naloxone Naltrexone Nalmefene	Naloxone Naltrexone Nalmefene	Naloxone Naltrexone Nalmefene

Pharmacokinetics of Opioids

This studies what happens to a drug once administered into the body. For effective analgesia, the plasma level of the analgesic is essential. This varies according to the dose of the drug given, the dosing interval, and the route of administration.

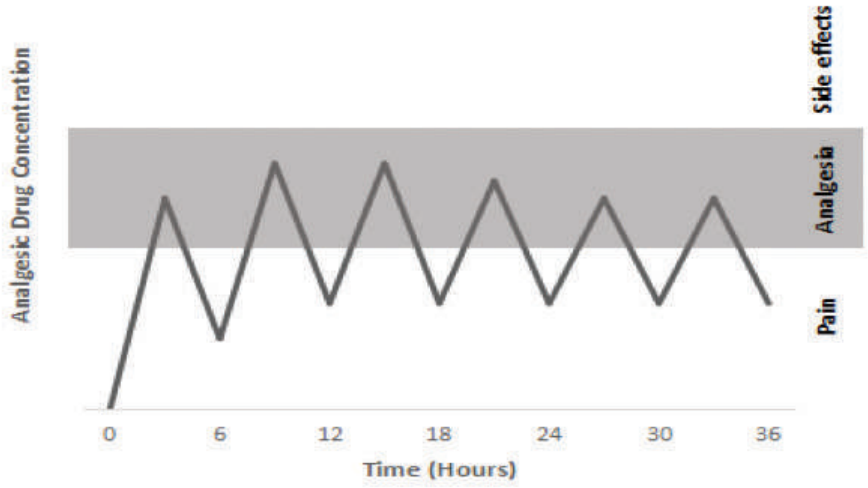
The Concept of the "Analgesic Corridor" :

a. When the plasma concentration of the analgesic drug is below the analgesic corridor, the patient feels pain, and when above the analgesic corridor, the patient experiences side effects

b. If within the analgesic corridor, the patient will have pain relief.
c. The aim is to achieve a plasma concentration of opioids within this "analgesic corridor" to provide comfort without serious side effects.
d. The actual plasma levels corresponding to the "analgesic corridor" will vary according to the patient and the severity of the acute pain.

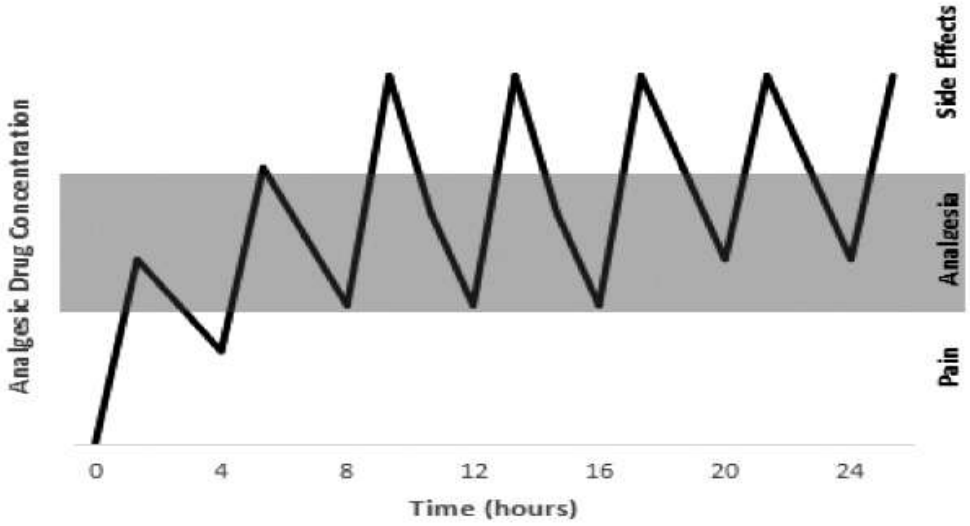
With opioids, there is up to a five-fold variation in the plasma concentration required for analgesia among different patients. It is, therefore, difficult to predict the dose of analgesic needed to reach an individual's analgesic corridor. Variability in dose requirements has led to titration to effect (i.e. pain relief) so that each patient is given adequate analgesia and what analgesia or administration technique is chosen. Patient Controlled Analgesia (PCA) is a technique which allows the self-titration of opioids to achieve safe and effective analgesia for patients with acute pain.

Figure 3.1 : Plasma levels of an opioid when given IM or SC 6 hourly



Figures 3.1 and 3.2 show the plasma level of an opioid when given IM or SC 6 hourly or 4 hourly. The pharmacokinetics of intramuscular and subcutaneous injections are the same, i.e. they have the same onset time and duration of action. When the plasma level of opioids is below the analgesic corridor, the patient experiences pain. If analgesia is required to last for 6 hours, a larger dose must be given, causing the risk of developing severe side effects like respiratory depression to be higher. Therefore, giving smaller doses of opioids is recommended more frequently (4 hourly), allowing the drug plasma levels to remain within the analgesic corridor while not increasing the risk of toxicity from high plasma levels.

Figure 3.2 : Plasma levels of an opioid when given IM or SC 4 hourly



Another problem with IM or SC opioid injections is that the onset of action is about 30 minutes. Thus, there is a delay in pain relief while the drug is absorbed. One way to overcome this slow onset of action of IM and SC injections is to give the opioids intravenously.

However, a word of caution- although the onset of analgesia is faster with IV opioids (5-10 minutes), the peak plasma levels are higher if the same dose as for IM / SC is used, thereby increasing the risk of severe side effects (Fig 3.3).

Figure 3.3 : Plasma levels for IV opioid given in large boluses 4 hourly

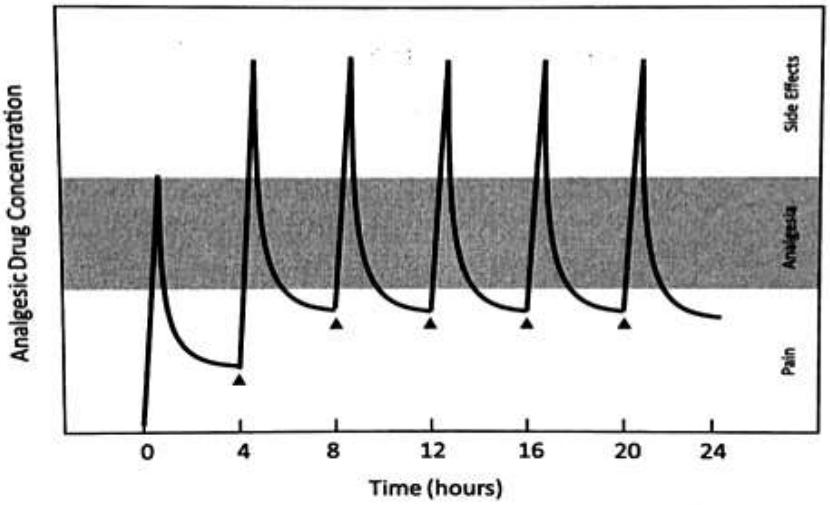
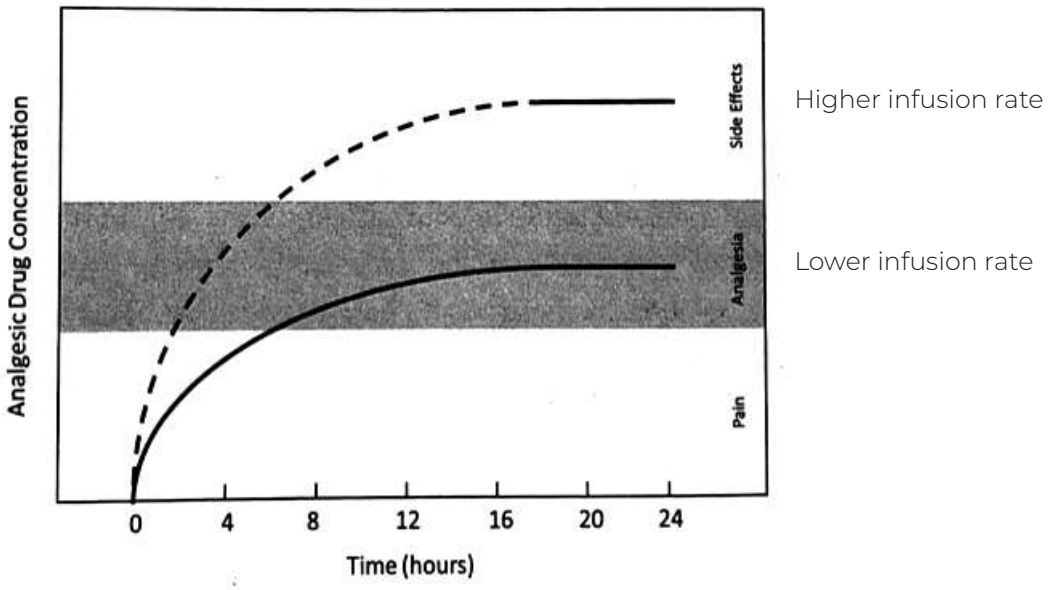


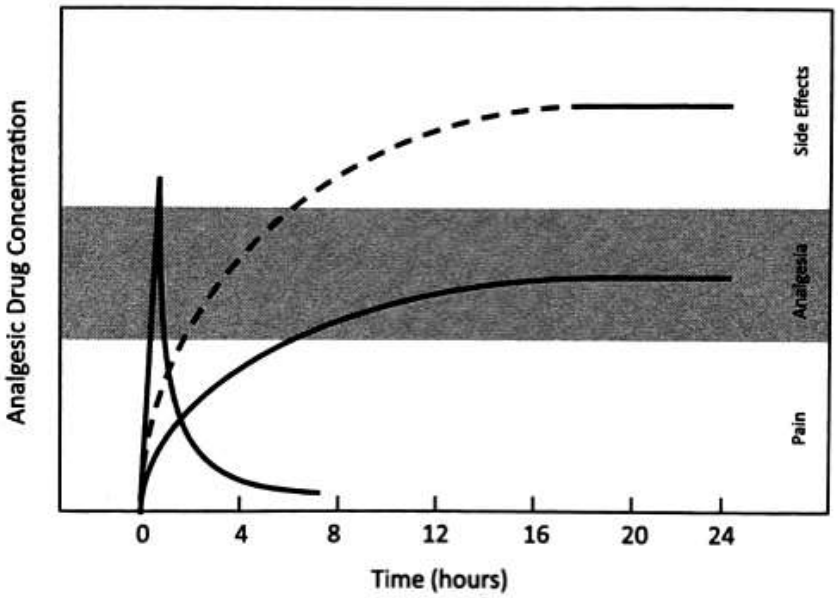
Figure 3.4: Plasma levels for continuous IV infusion



Continuous IV infusion alone is not a safe way to administer opioids, as the infusion pump will continue to deliver the opioid whether the patient is pain-free or sedated. The other problem is that when the infusion is given at a constant rate (e.g., 2 mg/H), 4 to 5 half-lives of the drug are required to reach a steady state concentration. This means that the morphine infused may take up to 20 hours to reach a steady state plateau within the "analgesic corridor".

To achieve the "analgesic corridor'' faster, we will have to use a higher infusion rate. This may cause the patient to reach toxic levels of morphine when a steady state plateau is attained. On the other hand, if slower infusion rates are used, the chances of toxicity are less, but at the expense of a longer time taken to achieve the "analgesic corridor".

Figure 3.5 : Plasma levels for continuous IV infusion plus loading dose



The time taken to achieve the "analgesic corridor" can be hastened by administering a loading dose of the analgesic (Fig 3.5). Alternatively, repeated small doses of analgesic,e.g., 1-2mg of IV morphine given every 5-10 minutes till the achievement of an "analgesic corridor" followed by repeated doses of the analgesic whenever necessary, forms the concept behind Patient Controlled Analgesia (PCA). The "analgesic corridor" is said to have been reached when the patient's pain is first relieved. This is also the concept behind the "Morphine Pain Protocol," which enables a physician to deliver adequate analgesia rapidly and safely (see Appendix 5). The morphine pain protocol may be used in the immediate postoperative period (in the recovery ward) and may also be used in the ward for procedures like wound dressing etc.

Figure 3.6 : Plasma levels of an opioid in a patient using PCA

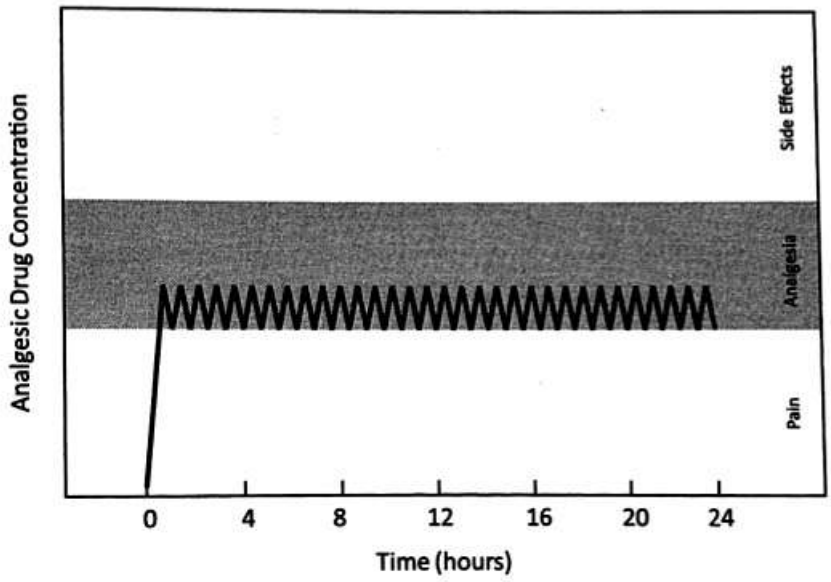


Table 3.4 : Opioids: Pharmacokinetic and Pharmacodynamic Profile

Drugs	Mechanism of action	Half-life (hour)	Duration (hour)	Metabolism	Excretion	Equivalent dose (mg) to Morphine 10 mg
Morphine	Agonist : μ, κ, δ receptors	4-5	2-4	L, K	L.K	10
Fentanyl	Agonist: μ receptor	3-4	1-2	L	K	0.1
Remifentanil	Agonist : μ receptor	0.2-0.3		plasma & tissue esterases	K	0.05
Oxycodone	Agonist : μ, κ, δ receptors	2-4	3-4	L, K	K, Sweat	6
Pethidine	Agonists: : μ, κ receptors Anticholinergic effect Na Ion channel: LA effect	3-4		L Metabolites with longer half-life cause neuroexcitation	K	100
Tramadol	Agonists: μ, TRPV 1 Receptors Antagonists: NMDA Receptors, 5-HT Receptors, Nicotinic Acetylcholine receptors, M1 and M3 Muscarinic receptors, Noradrenergic reuptake receptors	4-6		L	K	100
Codeine/ Dihydrocodeine	Agonist: μ, κ, δ receptors	2-4		L, K	L, K	-
Buprenorphine	Agonists: μ receptors Antagonists: κ, δ	10-12		L	L	20 mg/hour (transdermal)
Nalbuphine	Agonists: κ receptors Antagonists: μ	4-6		L, K	L, K	10
Naloxone	Antagonist: : μ, κ, δ	1-15		L	K	-

TRPV-Transient Receptor Protein Vanillin, L-Liver, K-Kidney

Pharmacodynamics of Opioids

1. Central Nervous System:

    a. Euphoria, sedation, miosis, reduced cough reflex, nausea & vomiting
    b. Decreased ICP and CBF
    c. Overdose: marked miosis, opioid-induced ventilatory impairment (OIVI), convulsions

2. Cardiovascular System:

    a. Decreased BP (large doses): decreased systemic vascular resistance
    b. Postural hypotension: peripheral vasodilatation
    c. Sinus bradycardia: central vagal stimulation

3. Respiratory System

    a. Bronchoconstriction: histamine-mediated
    b. OIVI: decreased sensitivity of brainstem respiratory centre to PaCO2

4. Gastrointestinal System

    a. Increased reflux: decreased lower oesophageal sphincter pressure
    b. Constipation: decreased peristaltic activity and increased (smooth muscle) tone of anal & ileocolic sphincters

5. Genitourinary System

    a. Difficulty in micturition: increased ureteric tone, contraction of detrusor & vesicular muscle
    b. Antidiuretic effect

6. Skin

    a. Pruritus and vasodilatation : histamine mediated

Indications :

1. Acute postoperative pain: moderate to severe
2. Cancer pain
3. Chronic pain (selected cases under the supervision of a pain specialist)

Precautions:

1. Hypersensitivity
2. Concomitant use of sedative drugs
3. Renal and liver impairment
4. Impaired respiratory function, e.g., Obstructive Sleep Apnoea (OSA), acute severe asthma
5. Head injuries

Side Effects:

1. Nausea and vomiting
2. Sedation
3. Opioid-Induced Ventilatory Impairment (OIVI)
4. Ileus/constipation
5. Urinary retention
6. Pruritus

Dosages: (refer to Appendix 9: Drug Formulary)

Commonly Used Strong Opioids (refer to Appendix 9: Drug Formulary):

1. Morphine
2. Fentanyl
3. Oxycodone
4. Buprenorphine
5. Pethidine

Commonly Used Weak Opioids (refer to Appendix 9: Drug Formulary)

1. Tramadol

    a. Atypical centrally acting with combined effects as opioid agonist, serotonin, and noradrenaline reuptake inhibitors
    b. Metabolised by CYP2D6: the active metabolite, O-desmethyl tramadol is a more potent mu (M1) receptor agonist than the parent drug
    c. Co-administration with other medications may cause pharmacological interactions
    d. Risk of serotonin toxicity (rare incidences) with:
        i. selective serotonin receptor inhibitors (SSRI)
        ii. monoamine oxidase inhibitors (MOAI)
        iii. tricyclic antidepressants (TCA)

    e. Antiemetics from the serotonin receptor antagonist class (ondansetron, granisetron) by inhibition of 5HT3 receptors decrease the analgesic effect of tramadol.
    f. Lower abuse and misuse potential than conventional opioids

2. Dihydrocodeine (refer to **Appendix 9: Drug Formulary**)

    a. Derivative of codeine. The active metabolite, dihydromorphine, has a higher mu receptor affinity than parent medicine. Oral administration produces twice the potency of codeine and 1/6 the potency of morphine.

PARACETAMOL

Introduction

1. Simple analgesic used for the relief of mild to moderate pain.
2. It may be given orally, per rectum, or intravenously.
3. Used as part of a multimodal technique along with NSAID/COX-2 inhibitors and opioids.

Mechanism of Action

1. Not completely understood. Various hypotheses suggested:

    a. Prostaglandin inhibition: weak inhibition of peripheral cyclooxygenase activity with apparent selectivity for COX-2.
    b. Serotoninergic pathway activation: descending spinal serotonergic pathways.
    c. Endocannabinoid enhancement.
    d. Transient Receptor Potential Vanillin type 1 (TRPV1) activation.

Indications

1. As a component of Multimodal analgesia for mild to moderate perioperative pain

Contraindications

1. Hypersensitivity to paracetamol or propacetamol hydrochloride (prodrug of paracetamol) or excipients (sodium phosphate dibasic dihydrate, hydrochloric acid, sodium hydroxide, cysteine hydrochloride and mannitol).
2. Hepatic failure or severe hepatocellular insufficiency
3. Concomitant administration of other medications which contain paracetamol.

Precautions

1. Hepatocellular insufficiency,
2. Severe renal insufficiency (creatinine clearance ≤ 30 mL/min),
3. Glucose 6 Phosphate Dehydrogenase (G6PD) deficiency (may lead to haemolytic anaemia),
4. Chronic alcoholism
5. Anorexia, bulimia or cachexia, chronic malnutrition (low reserves of hepatic glutathione),
6. Dehydration and hypovolemia.

Dosages: (refer to Appendix 9: Drug Formulary)

NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS) AND CYCLOOXYGENASE-2 (COX-2) SELECTIVE INHIBITORS

Introduction

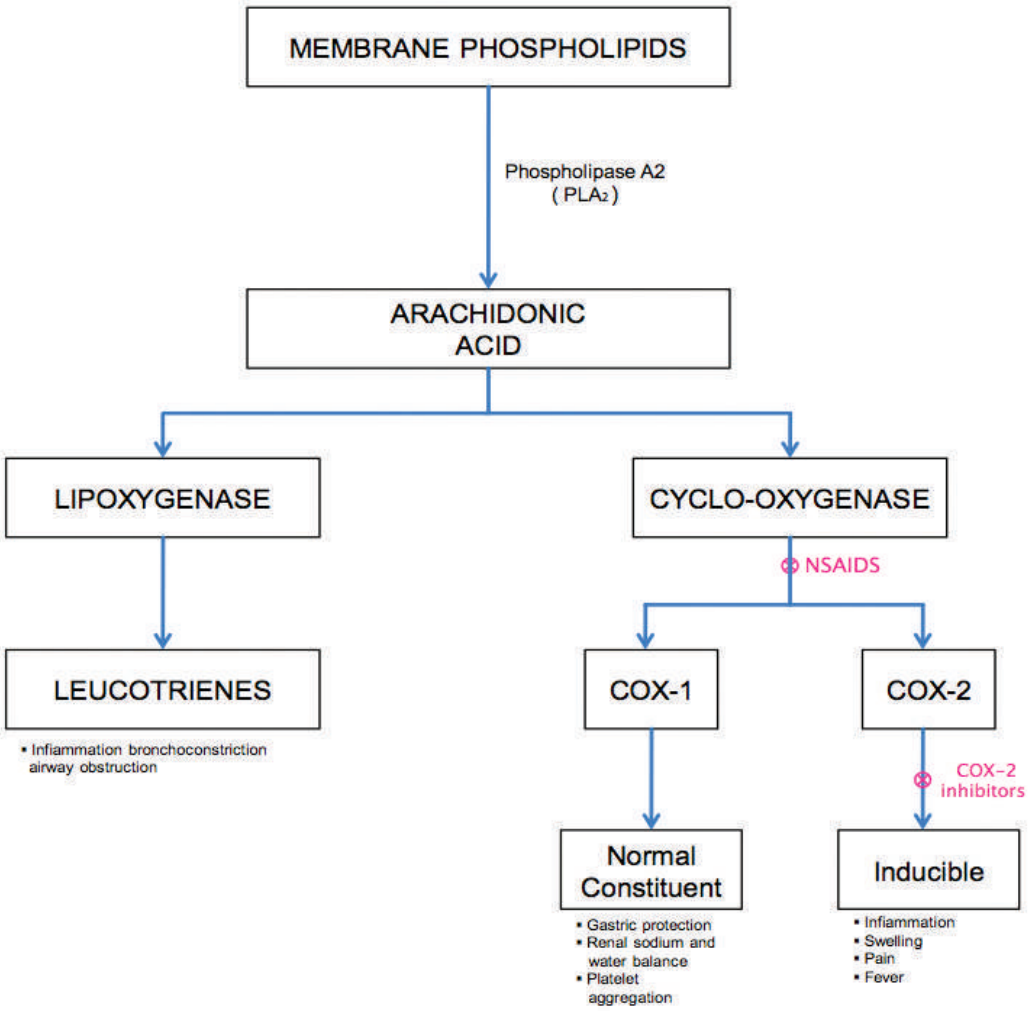
1. Non-steroidal anti-inflammatory drugs (NSAIDs) act by inhibiting the enzyme cyclo-oxygenase (COX), involved in the metabolism of arachidonic acid, thereby inhibiting the synthesis of prostaglandins. Prostaglandins are one of substances that play a part in the transmission of pain.
2. COX-2 inhibitors provide better overall safety than NSAIDs regarding GI side effects and platelet function. Still, they may lead to renal impairment and adverse cardiovascular events, particularly long-term use.
3. COX-2 inhibitors have the same analgesic efficacy compared to NSAIDs.

Table 3.5 : Commonly available NSAIDs and COX-2 inhibitors

NSAIDs	Diclofenac Mefenamic Acid Ibuprofen Naproxen Ketoprofen Indomethacin Ketorolac Meloxicam
COX-2 inhibitors	Celecoxib Etoricoxib Parecoxib

Mechanism of action

Figure 3.7 : Prostaglandin Pathway



1. The cyclo-oxygenase enzyme is present in two forms.

    b. COX-1 (Constitutive) – the physiological function of maintaining the normal prostaglandin functions of the kidney and gastric mucosa. Inhibition of this enzyme is responsible for NSAIDs' renal and gastric toxicity.
    c. COX-2 (Inducible) – expressed in response to tissue injury and inflammation, which releases the inflammatory mediators of pain.

2. NSAIDs inhibit both COX enzymes: COX-1 and COX-2
3. COX-2 inhibitors inhibit only COX-2 enzymes

Indication

1. As a component of multimodal analgesia for mild to severe perioperative pain

Contraindications

1. History of coagulopathy or bleeding tendencies
2. History of peptic ulcer disease
3. Renal impairment
4. Moderate hepatic impairment Child-Pugh Class B
5. Post-Coronary Artery Bypass Graft (CABG) - immediate post-op period
6. History of hypersensitivity to NSAIDs (there is cross-sensitivity to NSAIDs, so a patient allergic to one NSAID should not be given any other NSAID).

Side effects:

All NSAIDs have similar side effects, independent of the administration route. These include:

1. **Gastrointestinal:** Nausea, anorexia, abdominal pain, ulcers, anaemia, gastrointestinal haemorrhage, perforation, diarrhoea (less with COX-2 inhibitors)

2. **Platelet function:** Inhibition can lead to bleeding (less with COX-2 inhibitors)

3. **Cardiovascular:** increased risk of stroke and myocardial infarction, hypertension, decreased effectiveness of anti-hypertensive medications, stroke, and thromboembolic events inhibit platelet activation, the tendency for bruising and haemorrhage

4. **Renal:** Salt and water retention, oedema, deterioration of kidney function, decreased effectiveness of the diuretic medication, hyperkalemia, and analgesic nephropathy with long-term use

5. **Central Nervous System:** Headache, dizziness, vertigo, confusion, depression, lowering of seizure threshold, and hyperventilation (salicylates)

6. **Hypersensitivity reactions:** Vasomotor rhinitis, asthma, urticaria, flushing, hypotension, shock (cross allergy is common between NSAIDs /COX-2 inhibitors)

Dosages (refer to Appendix 9: Drug Formulary)

LOCAL ANAESTHETICS

Introduction

The local anaesthetics (LA) commonly used in MOH hospitals are Lignocaine, Bupivacaine, Levobupivacaine, and Ropivacaine.

Mechanism of Action

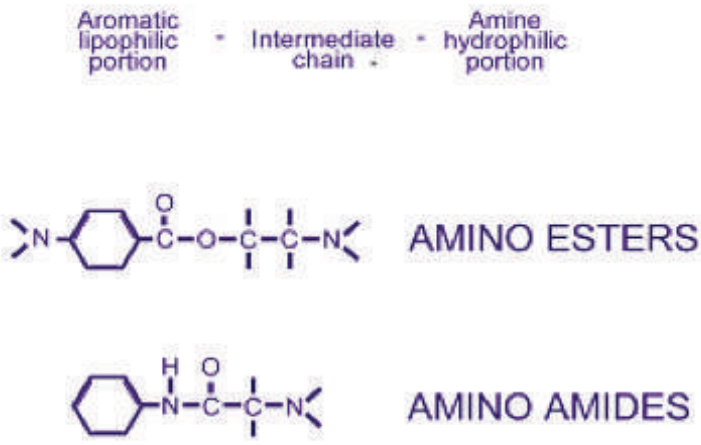
Local anaesthetics reversibly block the conduction of electrical impulses along central and peripheral nerve pathways by binding to the voltage-gated sodium channel receptors, thus preventing the conduction of action potential and, therefore, neural conduction.

Pharmacokinetics

1. Structural Classification: LA consists of 3 structural components:

    a. A lipid-soluble hydrophobic aromatic group
    b. An intermediate chain (ester or amide bond)
    c. An ionisable hydrophilic tertiary amide group.

Figure 3.8 : Chemical Structure of local anaesthetics



2. Examples of esters: cocaine and procaine

3. Examples of amides: lignocaine, bupivacaine, levobupivacaine and ropivacaine.

Table 3.6 : Commonly used local anaesthetics

Agent	Onset	Duration	Protein Binding	Potency	Maximum Dose (mg/kg)	Adverse Effects
Cocaine	rapid	medium	91%	Medium	1	CVS
Lignocaine	rapid	medium	60-80%	Medium	4 7 (with adrenaline)	CVS and CNS
Bupivacaine	slow	long	90-97%	High	2 2.5 (with adrenaline)	More cardiotoxic than lignocaine
Levobupivacaine	slow	long	> 97%	High	2-2.5	Less cardiotoxic than bupivacaine
Ropivacaine	slow	long	94%	High	3-4	Less cardiotoxic than bupivacaine

Factors affecting LA activity:

1. Site of injection –peak plasma concentrations are influenced by the injection site. Subarachnoid and subcutaneous routes are associated with a more rapid onset, whereas epidural and brachial plexus blocks are associated with slower onset of action.
2. Addition of vasoconstrictor – e.g. adrenaline, prolongs the duration of action and decreases systemic absorption
3. Tissue pH – infection produces acidic tissue and decreases the activity of local anaesthetics.
4. Plasma protein binding is inversely related to the plasma concentration - decreases in pregnancy, protein deficiency, neonate, malignancy, and increases in sepsis, stress, and renal failure
5. Hepatic impairment leads to decreased metabolism of local anaesthetics
6. Hyperkalemia leads to an increased resting membrane potential and an increased local anaesthetic effect
7. Hypercalcemia has the opposite effect as hyperkalemia
8. Pregnancy increases CNS sensitivity to local anaesthetics and increases cardiotoxicity
9. Overall circulatory state affects systemic absorption
10. Drugs can interfere with the action of local anaesthetics, e.g. metoprolol, cimetidine, Dextran

Indications

1. Central neuraxial block (subarachnoid block, epidural)
2. Nerve or plexus block
3. Infiltration anaesthesia and field block
4. Intravenous lignocaine infusion (acute & chronic neuropathic pain): refer to Chapter 7
5. Intravenous regional anaesthesia (Bier's Block)
6. Topical application (EMLA, Cocaine)
7. Transdermal : Lignocaine 5% patch
8. Surface anaesthesia : bronchoscopy, cystoscopy
9. Local anaesthesia of body cavities (e.g. intrapleural anaesthesia, intraarticular anaesthesia) and transincision (or transwound) catheter anaesthesia.
10. Ventricular arrhythmia : anti-arrhythmic (Class 1B).

Contraindication:

1. Porphyria: lignocaine is known to be porphyrogenic, although other LAs are known to be safe.
2. Serious adverse drug reactions to local anaesthetics

Caution

1. Cardiac arrhythmias:

    a. Heart blocks: second or third-degree (without pacemaker)
    b. Accelerated idioventricular rhythm

2. Concurrent treatment with quinidine, flecainide, disopyramide, procainamide (Class I antiarrhythmic agents)

Toxicity of Local Anaesthetics

Occurs with an overdose of local anaesthetics or an accidental intravascular injection. Increasing blood concentrations of local anaesthetics will result in progressive signs of local anaesthetic toxicity.

Local

Allergic reaction to para-aminobenzoic acid (PABA): ranging from urticaria to anaphylaxis

PABA is a metabolic product of the degradation of esters such as procaine, benzocaine, and to a lesser degree, amide class anaesthetics such as lignocaine. It is also a metabolic by-product of methylparaben, a preservative in multi-dose vials of lignocaine.

The amide class of local anaesthetics is far less likely to produce an allergic reaction.

Systemic

1. Immune system

- Allergic reaction to metabolic break-down of anaesthetic agents and preservatives (PABA) can cause anaphylaxis.

2. Hematologic

- Methemoglobinemia – lignocaine and, more notably, prilocaine

3. Central Nervous System

- Symptoms are progressive as the level of the anaesthetic agent in the blood rises.
- Initial symptoms suggest some form of central nervous system excitation, such as ringing in the ears (tinnitus), a metallic taste in the mouth, perioral tingling, or numbness.
- Advanced symptoms include motor twitching in the periphery followed by grand mal seizures, coma, and eventually respiratory arrest. (refer to Figure 3.9)

4. Cardiovascular

- Hypotension, myocardial depression, bradycardia, and cardiac arrhythmias
- Cardiovascular collapse

Figure 3.9 : The Relationship between Lignocaine Plasma Concentration and Pharmacological Effects

	Plasma Concentration (μg/ml)	
	26	CVS depression
	24	
	22	
	20	Respiratory arrest
	18	
	16	
	15	Coma
	14	
	12	Unconsciousness
	10	Convulsions
	8	Muscular twitching
	6	Visual disturbances
Positive Inotropy, ANTIARRHYTHMICS, Anti-convulsant	4	Light-headedness, tinnitus, circumoral, and tongue numbness
	2	

INHALATIONAL AGENTS

NITROUS OXIDE

- Potent, short-acting inhaled analgesic gas with a rapid and predictable onset and offset.
- Possesses synergistic effect if given with other analgesics and sedatives
- Entonox®: a mixture of N2O and oxygen in a ratio of 1:1. Used for its analgesic properties to provide short-term analgesia for minor surgical procedures, labour pain, or incident pain.

Indications for Entonox®

- Labour pain
- Procedures: removal of sutures, wound dressings, lumbar puncture, and venepuncture
- Outpatient treatments: laser for diabetic retinopathy, biopsies, lower GI scope, wound dressings, dental procedures, removal of drains and sutures.

Contraindications for Entonox®

- Pneumothorax, bowel obstruction, air embolism, pulmonary air cysts, intraocular air bubbles, tympanic membrane graft, and other conditions where air trapping may occur.
- Decompression sickness or after a recent underwater dive
- Maxillofacial injuries, head injury, impaired consciousness, or substance intoxication.

Side effects

- Nausea and vomiting
- Diffusion hypoxia
- Prolonged use results in the inactivation of methionine synthetase, leading to megaloblastic anaemia and neuropathy from subacute combined spinal cord degeneration.

Precautions

When N2O is used repeatedly:

- Exclude patients with known vitamin B12 deficiency
- Exclude female patients who may be in the early stages of pregnancy
- Limit exposure to N2O to the briefest possible time
- Monitor for clinical signs and symptoms of neuropathy regularly

As nitrous oxide may obtund conscious levels,

- Adequate fasting is required
- Monitoring is essential, including pulse oximeter
- Resuscitative equipment should be available.

METHOXYFLURANE

- Highly lipophilic inhalational anaesthetic agent no longer used in routine anaesthetic practice.
- Very low concentrations of methoxyflurane produce analgesia.
- Available via a disposable inhalational device (Penthrox™ inhaler) for analgesia in various clinical settings.
- Metabolised in the liver by the enzyme CYP 2AE into free fluoride, dichloro-acetic acid, oxalic acid, and difluromethoxyacetic acid. No toxic effects have been recorded if MOF is used for less than 2.5 MAC hours.

Advantages

- Potent analgesic with rapid onset (6 – 10 breaths)
- Cardiovascular and respiratory stability
- Easy administration
- Good pain relief
- No significant adverse effects

Indications

- Traumatic injuries in the Emergency Department
- Minor surgical procedures
- Incident or breakthrough pain in patients with advanced cancer
- Dressing of burns and other painful wounds

Contraindications

- Malignant hyperthermia
- Severe renal or hepatic impairment/failure
- Hypersensitivity
- Head injury

Precautions

- Patients should be warned not to drive for 24 hours after using methoxyflurane.

Side effects

- Drowsiness
- Headache
- Dizziness

NMDA-RECEPTOR ANTAGONISTS

KETAMINE

Anaesthetic and analgesic properties

Mechanism of action

- NMDA–receptor antagonist (the primary mechanism)
- Persistent nociceptive (e.g. tissue damage) and neuropathic pain states can activate N-methyl-D-aspartate (NMDA)-receptor in the spinal dorsal horn, producing the phenomenon of "wind-up" with spinal hyperexcitability, allodynia, and hyperalgesia (central sensitisation).
- Mild opioid agonists- mu (μ) and kappa (κ)
- Inhibit calcium and sodium channels at high doses
- Inhibit serotonin and noradrenaline reuptake
- Inhibit muscarinic and nicotinic receptors
- Acts on β2 receptor causing bronchodilatation
- Inhibits nitric oxide (NO) synthase, thereby inhibiting the production of NO

Pharmacokinetics

Oral and parenteral
Metabolised to norketamine in the liver and excreted through the kidneys

Pharmacodynamics

- CNS: euphoria, sedation, hallucination, delirium, emergent reactions, nystagmus, disorientation, lacrimation,
- Respiratory system: hypersalivation, bronchodilatation
- CVS: tachycardia, hypertension, increased cardiac output, myocardial depression in the absence of autonomic control
- GIT: nausea and vomiting
- GUT: bladder dysfunction (long-term use)

Indications

- Adjuvant to opioids in postoperative pain
- Reduction of opioid requirements in opioid dependant and tolerant patients
- Adjunct in bariatric surgeries and patients with obstructive sleep apnoea
- Rescue analgesia in difficult control of both acute and chronic pain
- Chronic neuropathic pain conditions include central pain syndromes, Complex Regional Pain Syndrome (CRPS), fibromyalgia, and ischaemic pain.
- Treatment of opioid-resistant cancer pain
- Analgesia for painful procedures in higher doses
  (Midazolam or haloperidol may be added to ketamine to minimise the dysphoric effects.)

Contraindications

Ketamine should be avoided in patients with the following:

- Raised intracranial pressure
- Severe systemic hypertension
- Raised intra-ocular pressure
- Recent history of epilepsy
- Recent history of psychosis
- History of hypersensitivity to ketamine
- Hepatic impairment
- Chronic alcoholism, acute alcohol intoxication and substance abuse
- Pregnancy

Ketamine should be used with caution in the following ways:

- Elderly patients
- Patients with cardiac arrhythmia
- Patients on long-acting opioids

Dosage and Administration

The typical subanaesthetic dose of ketamine used for perioperative analgesia is

Bolus dose: 0.3- 0.5mg/kg

Maintenance dose: 0.1–1.0 mg/kg/h continuous infusion depending on the patient's analgesic response duration.

Individual pharmacokinetic and pharmacodynamic differences and other factors (e.g., prior ketamine exposure) may warrant dosing outside this range.

Adverse effects prevent some patients from tolerating higher doses in acute pain settings.

Hallucinations and delirium may be reduced by the co-administration of an IV benzodiazepine (midazolam 5-10mg over 24H) or IV haloperidol (1.5mg – 3mg over 24H).

Ketamine should only be used in consultation with a specialist.

MAGNESIUM

Regarded as an NMDA receptor antagonist, which also has anti-inflammatory effects

Advantages:

1. Opioid-sparing effect
2. Prolongs duration of spinal anaesthesia as well as postoperative pain scores for 48H
3. Reduces incidences of PONV
4. Reduces Propofol requirement during TIVA

The typical regimen of magnesium sulphate administration

Loading dose: 30-50 mg/kg

(single bolus without maintenance infusion was reported effective for postoperative analgesia in some reports)

Maintenance dose: 6-20 mg/kg/h (continuous infusion) until the end of surgery.

ALPHA-2 AGONISTS

Dexmedetomidine

- Highly selective alpha-2 adrenoceptor agonist (alpha1: alpha2 1620:1)
- Sedative, analgesic, and anti-sympathetic effects
- Adjuvant in general anaesthesia, spinal anaesthesia, plexus anaesthesia, topical anaesthesia, and postoperative analgesia

Systemic action of dexmedetomidine

a. Alpha-2 adrenergic receptors act on the

   i. locus ceruleus area, inhibiting nociceptive neurotransmission through the posterior horn of the spinal cord.
   ii. presynaptic membrane, inhibiting the release of norepinephrine, which induces hyperpolarization and inhibits the pain signals to the brain.

b. Promotes the release of acetylcholine from spinal interneurons, causing increased synthesis and release of nitric oxide that could be involved in regulating analgesia.
c. Potential adverse effects such as hypotension and bradycardia must be considered when administered.

Intraoperative dosage

Bolus dose: 0.5–1 µg/kg

Maintenance dose: 0.5–2 µg/kg/h (continuous infusion) analgesic sparing effect observed after a pre or intraoperative administration usually lasts up to 24 hours, with the anxiolytic, sedative, and thymoleptic properties implicated as being partly responsible for this effect

ADJUVANT ANALGESICS

Commonly used adjuvants are as below:

Table 3.7 : Adjuvant Analgesics

Drug Classes	Examples	Commonly used in the following conditions
Antidepressants	Tricyclic Antidepressants (TCA): Amitriptyline, Imipramine, Desipramine Serotonin Norepinephrine Reuptake Inhibitor (SNRI) Duloxetine, Venlafaxine	Neuropathic pain
Anticonvulsants	Carbamazepine Gabapentin Pregabalin Sodium Valproate Topiramate Levetiracetam Oxcarbazepine Phenytoin	Neuropathic pain
Bisphosphonates	Pamidronate Zoledronate Clodronate	bone metastases
Radiopharmaceuticals	Strontium	bone metastases
Corticosteroids	Dexamethasone Prednisolone	brain & liver metastasis spinal cord compression bone metastases bowel obstruction
Anticholinergic	Hyoscine Butylbromide Glycopyrrolate Octreotide	Bowel obstruction
Muscle relaxants	Baclofen Eperisone	
Botulinum Toxin A		chronic limb and muscle spasms cervical disorders +/- cervicogenic headache
Salmon Calcitonin	Miacalcic intranasal spray	osteoporotic vertebral compression fractures

Pharmacology of Analgesics in Special Groups

Renal diseases

Two groups of patients to be considered

1. renal dysfunction
2. replacement therapy

Table 3.8 : Recommended Use of Selected Opioids In Patients with Renal Dysfunction and Patients on Dialysis

Opioid	Renal dysfunction		Haemodialysis Patient	
	Recommended use	Comments	Recommended use	Comments
Morphine	*Use cautiously; adjust the dose as appropriate.*	Metabolism can accumulate, causing increased therapeutic and adverse effects	*Use cautiously* and monitor the patient for rebound pain effect *or do not use*	Both parent drugs and metabolites can be removed with dialysis; watch for the "rebound "pain effect.
Oxycodone	*Use cautiously with monitoring; adjust the dosage if necessary*	Metabolites and parent drugs can accumulate, causing toxic and CNS – depressant effects	*Do not use*	No data on oxycodone and its metabolites in dialysis
Codeine	*Do not use*	Metabolites can accumulate, causing adverse effects.	*Do not use*	The parent drug and metabolites can accumulate, causing adverse effects.
Fentanyl	*It appears safe; however, a dose reduction is necessary*	No active metabolites and appears to have no added risk of adverse effects; monitor with long-term use	Appears safe	Metabolites are inactive, but use with caution because fentanyl is poorly dialysable.

Opioid	Renal dysfunction		Haemodialysis Patient	
	Recommended use	Comments	Recommended use	Comments
Buprenorphine	It appears safe; no dose adjustment is required but used with caution.	Pharmacokinetics is unchanged, predominantly biliary excretion of metabolites. Pharmacokinetics is also unchanged with dialysis.	It appears safe; no dose adjustment is required but used with caution.	
Dihydrocodeine	Do not use	The metabolic pathway is probably similar to codeine— time to peak concentration and the terminal half-life prolonged. Metabolites can accumulate, causing adverse effects.	*Do not use*	The metabolic pathway is probably similar to codeine— time to peak concentration and the terminal half-life prolonged. Metabolites can accumulate, causing adverse effects.
Tramadol	maximum dose < 200mg day		*maximum dose <100mg day*	

Adapted from

i. *Opioid Safety In Patients with Renal or Hepatic Dysfunction, Johnson 2007*
ii. *Acute Pain Management: Scientific Evidence, Fourth Edition 2015. Australian New Zealand College of Anaesthetists & Faculty of Pain Medicine*
iii. *2017 Update on Pain Management in Patients with Chronic Kidney Disease, Phuong 2017*

Table 3.9 : Recommended Dosage Adjustments in Renal Impairment - Selected Opioids

Creatinine Clearance (ml/min)	Morphine	Oxycodone	Fentanyl
> 50	100*	100*	100*
10-50	50-75*	50*	75-100*
< 10	25-50*	Do not use	50*

(Adapted from Aronoff 1999 & Dean 2004)
**= % of normal dose*

Clinically significant consequences can occur with several drugs used in pain relief.

1. Pethidine

- Metabolized to toxic metabolite norpethidine.
- Accumulation, especially with repeated dosing or renal impairment, can cause tremors, myoclonus, and seizures.
- Intramuscular pethidine demonstrates variable absorption and widely fluctuating plasma concentrations with varying levels of analgesia.
- Higher potential for abuse.

There is no evidence that pethidine is better than morphine in managing any type of acute pain, including renal colic and labour pain.

2. Morphine

- The elimination half-life of morphine is 1.5 - 2 hours, and the duration of the analgesic effect is 3-6 hours. These effects may be prolonged in renal impairment, as the active morphine metabolites can accumulate in renal disease
- The metabolites comprise mainly morphine-3-glucuronide (M3G) and morphine-6-glucuronide (M6G). Both depend on renal elimination and therefore tend to accumulate in patients with renal impairment.
- M6G: Potent analgesic and contributes to the analgesic effect when morphine is given for long term.

- M3G: No analgesic activity. May antagonize the analgesic activity of morphine and be responsible for neurotoxic symptoms:

  - Hyperalgesia
  - Allodynia
  - Myoclonus & seizures

- Patients should be commenced on a lower dose and/or extended dosage intervals. Doses should be slowly titrated upwards depending on the response to any side effects.
- In cases with renal impairment: fentanyl, alfentanil, and buprenorphine are suitable alternatives.

3. NSAIDs

- cause sodium and water retention and decrease the creatinine clearance
- may lead to impairment of renal function, especially in the

  - elderly
  - heart failure
  - volume depletion
  - concurrent ACE Inhibitors, ARBs or other nephrotoxic drugs.

  (*ACE: angiotensin-converting enzyme, ARB: angiotensin receptor blocker*)

- NSAIDs can induce acute renal failure in these vulnerable groups even with a single dose.
- may worsen renal function and should be avoided even in mild renal impairment.
- may be used in dialysis patients with complete anuria.
- End-stage renal failure (ESRF) patients are more prone to develop uraemic gastritis.
- regular use of heparin during haemodialysis predisposes them to gastrointestinal bleed

Liver Diseases

1. Opioids

Table 3.10 : Opioid Safety In Patients with Hepatic Dysfunction

Opioid	Recommended usage	Comment	Dosing recommendations*
Morphine	Use cautiously and monitor the patient for sedation.	The parent drug may not readily convert to metabolites in severe hepatic impairment.	Increase the dosing interval by twice the usual period
Oxycodone	Use cautiously and monitor the patient carefully for symptoms of opioid overdose	In severe hepatic impairment, the parent drug may not be readily converted to metabolites	Decrease initial dose by 1/2 to 1/3 of the usual amount
Codeine	Avoid use	In severe hepatic impairment, codeine may not be converted to the active metabolite morphine.	-
Dihydrocodeine	Avoid or reduce the dose.	Increased oral bioavailability due to reduced first-pass metabolism.	Limited data: dose adjustment required
Fentanyl	It appears safe. Generally, no dose adjustment is necessary	A decrease in hepatic blood flow affects metabolism more than hepatic failure	Dose adjustment is usually not needed
Buprenorphine		Lower blood concentrations of buprenorphine and norbuprenorphine	Limited data: no dose adjustment is required
Tramadol		Reduced clearance	Limited data: dose adjustment may be required if the impairment is severe. Not > 100mg /day in cirrhosis

Adapted from

i. *Opioid Safety In Patients with Renal or Hepatic Dysfunction, Johnson 2007*
ii. *Acute Pain Management: Scientific Evidence, Fourth Edition 2015. Australian New Zealand College of Anaesthetists & Faculty of Pain Medicine*
iii. *Management of Pain in Patients with Advanced Chronic Liver Disease or Cirrhosis, Schmerz 1999*

2. Paracetamol

Regular paracetamol can lead to possible hepato-toxicity, especially if the patient is in these conditions:

1. Fasting or dehydrated
2. Concurrent acute illness causing dehydration (e.g. fever, vomiting, diarrhoea)
3. Poor nutrition
4. Chronic alcohol intake
5. Underlying liver disease
6. Concurrent intake of liver enzyme-inducing drugs (e.g. phenobarbitone, phenytoin).

Elderly Patients

Refer to Guidelines for Pain Management in the Elderly 2018

Older adults are more likely to experience pain than the general population; in many cases, they are undertreated.

Problems with the elderly patient

1. Co-morbidities
2. Concurrent medications: higher risk of drug interactions
3. Age-related physiological, pharmacokinetic, and pharmacodynamic changes
4. Difficulties with pain assessment, e.g. dementia, postoperative delirium.
5. Reported frequency and intensity of acute pain may be reduced in the elderly patient

Principles of management

1. Consider non-pharmacological options to reduce reliance on medication.
2. Select each medication based on a balance of its risks and benefits.
3. Start with low doses and titrate upwards slowly.
4. Monitor for pain relief, functional improvement, and adverse effects, including worsening cognitive function.
5. Consider handling adverse effects by changing treatment, using a lower dose, or treating symptoms such as constipation or nausea.
6. Cease the medication if proven ineffective after an adequate trial.

Points to note when prescribing analgesics

- Paracetamol is the preferred non-opioid analgesic
- The use of NSAIDs and COX-2 inhibitors in older adults requires extreme caution.
- There are age-related decreases in opioid requirements and significant inter-patient variability.
- Oral opioids that may be used include Tramadol 50 mg daily to TDS
- PCA, epidural and peripheral nerve blocks should be considered in the elderly with severe acute pain.

Recommended drugs

- Dihydrocodeine 30mg 1-3 times a day
- Panadeine (paracetamol 500mg and codeine 8mg): 1-2 tablets, 1-4 times a day
- (maximum 8 tablets/day)
- Tramadol 50mg 1-3 times a day

Table 3.11 : Recommended Drugs for Persistent Pain in the Elderly

No.	Drug	Recommended dose	Comments
1	***Nonopioid analgesic***		
	Paracetamol	325-500 mg every 4 h or 500-1000 mg every 6 h	The maximum dose is usually 4 g daily Reduce maximum dose by 50%-70% in patients with hepatic impairment or a history of alcohol abuse
	Celecoxib	100 mg daily	Higher doses are associated with higher GIT and CVS side effects. Patients with indications for cardioprotection require aspirin supplements; therefore, older individuals will still require concurrent gastroprotection. Several studies implicate this agent as possessing less CV toxicity.
	Naproxen sodium	220 mg 2x daily	Concurrent use with aspirin inhibits aspirin's antiplatelet effect. May be associated with the lowest CV risk compared to other NSAIDs
	Ibuprofen	200 mg 3x a day	Relatively long half-life and minimal antiplatelet effect
	Diclofenac sodium	50 mg 2x daily or 75 mg extended-release once daily1	

No.	Drug	Recommended dose	Comments
2	***Opioid***		
	Oxycodone (immediate-release formulations)	2.5-5 mg every 4-6 hours	Useful for acute recurrent, episodic or breakthrough pain; daily dose limited by fixed-dose combinations with acetaminophen or NSAIDs
	Oxycodone (sustained-release formulations, e.g. Oxycontin®	10 mg every 12 hours	Usually started after the initial dose determined by the effects of the immediate-release opioid. It may also be used for opioid rotation as an alternative to a different long-acting opioid.
	Morphine Immediate release	2.5-10 mg every 4 hours	Available in tablet* form and as concentrated oral solution* for episodic or breakthrough pain *In Malaysia, only the oral solution is available
3	***Adjuvant drugs***		
	Tricyclic antidepressant Amitriptyline	10 mg at bedtime	Significant risk of adverse effects for the elderly
	Anticonvulsant Carbamazepine	100 mg daily	Monitor hepatic transaminases, blood count, serum creatinine, blood urea, electrolytes and serum carbamazepine levels.
	Gabapentin	100 mg daily	Monitor sedation, ataxia, peripheral oedema
	Pregabalin	50 mg at bedtime	Monitor sedation, ataxia, peripheral oedema
4	***Other drugs***		
	Corticosteroids Prednisolone	5 mg daily and taper as soon as feasible	Use the lowest possible dose to prevent side effects. Anticipate fluid retention and glycemic effects in short-term use and CV and bone demineralisation with long-term use Monitor for rash or skin irritation
	Lignocaine (topical)	1-3 patches for 12 hours per day	It is indicated for chronic neuropathic pain from postherpetic neuralgia.
	Muscle relaxant Baclofen	5 mg up to 3 times daily	Monitor muscle weakness, urinary function, cognitive effects, and sedation. Avoid abrupt discontinuation because of CNS irritability.

(Adapted from JAGS, August 2009-Vol 57, No 8)

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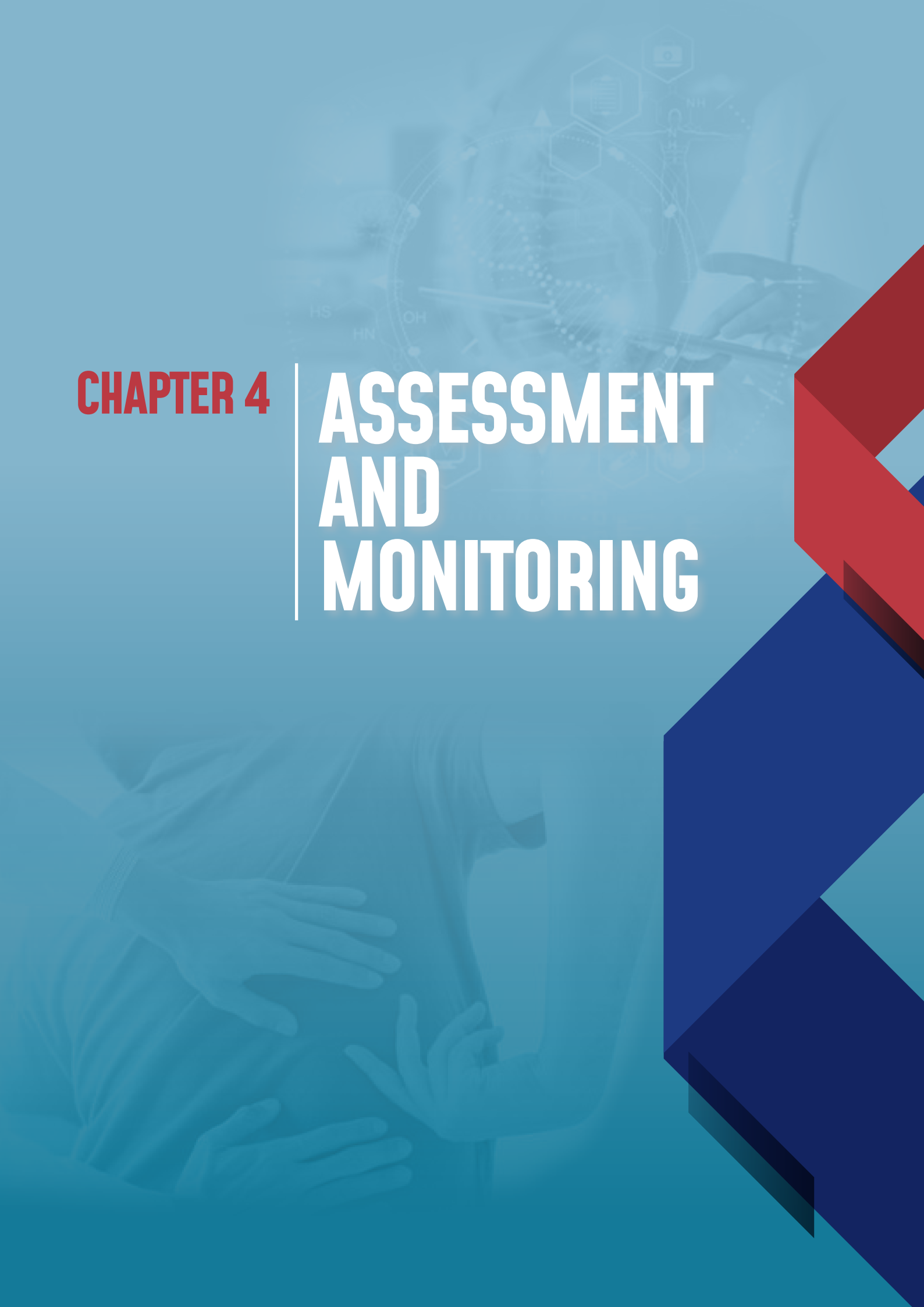
CHAPTER 4

ASSESSMENT AND MONITORING



CHAPTER 4 ASSESSMENT AND MONITORING

ASSESSMENT OF PAIN

Taking a Brief Pain History

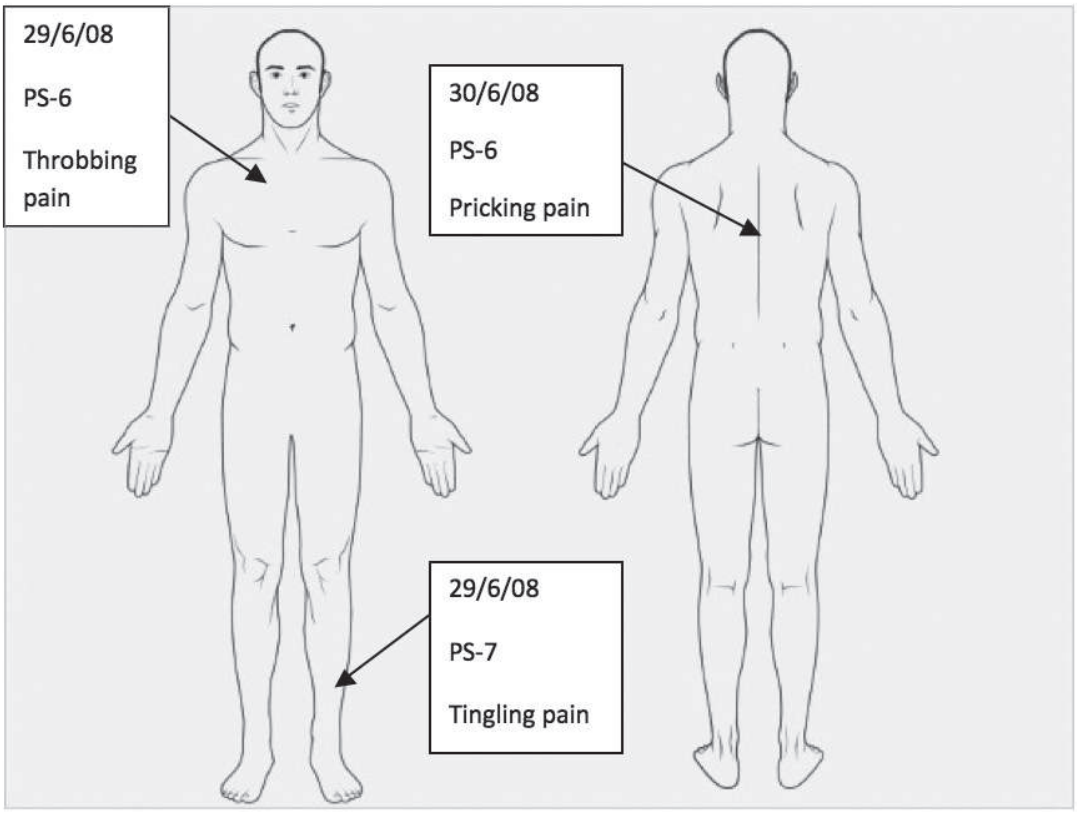
P: Place or site of pain - "Where does it hurt?"

A: Aggravating factors - "What makes the pain worse?"

I: Intensity - "What is your pain score at rest and on movement?"

N: Nature and neutralizing factors - "What does it feel like, e.g., aching, throbbing, burning, electric shock, shooting, stabbing, sharp, dull, deep, pressure...." "What makes the pain better?"

Figure 4.1 : Body chart to show pain sites and their characteristics



Other questions to ask on pain:

- **Duration of pain?**
- **Pattern of pain:** intermittent or continuous
- Associated symptoms: numbness, tingling, weakness
- Impact of pain: pain affecting sleep, appetite, mood, daily activities, relationships, and work
- Other important information: medical/surgical / psycho-social / drug / allergic history/ understanding and expectations about pain management.

In summary, history is essential to make a diagnosis and to differentiate the following:

1. Acute vs. Chronic pain
2. Nociceptive vs. Neuropathic or Mixed pain
3. Somatic vs. Visceral +/-referred pain
4. Severity - mild, moderate, or severe pain
5. Psycho-social factors contributing to the pain, as well as how pain affects function and mood

Pain measurement:

Why measure pain?

- To titrate the amount of analgesic drugs (e.g., morphine) to achieve the best analgesia with the least side effects.
- Facilitates communication between staff looking after the patient
- For research and documentation

Pain assessment tools

As pain is very subjective and varies significantly from patient to patient. Assessment subjectivity is reduced by using assessment tools.

Two types of Pain Assessment Tools

1. Self-Report.
   It is a gold standard, simple but requires complex cognitive abilities.

   - Unidimensional scales
   - Multidimensional scales

2. Observational and Behavioral

   Measure several dimensions of pain with differing combinations of pain intensity, quality, affect, interference with functioning, and general quality of life. The best alternative for people who cannot self-report is young children and adults with impaired cognitive function.

1. Self–Report

Unidimensional scales

- Numerical Rating Scale (NRS)
- Visual Analogue Score (VAS)
- Categorical Scale
- IASP Faces scale (Children and Infants)

Multidimensional scales

- Brief Pain Inventory (BPI)
- McGill Pain Questionnaire (MPQ)
- Memorial Pain Assessment Card

2. Observational and Behavioral

- FLACC (faces, legs, activity, cry, and consolability scale)
- CPOT (Critical Pain Observation Tool)
- The Pain Assessment In Advanced Dementia Scale (PAINAD)
- BPS (Behavioral Pain Scale)

Numerical Rating Scale (NRS)
"If '0' = no pain, and '10'= the worst pain you can imagine, what number is your pain now?"

Visual Analogue Score (VAS)
The patient is asked to indicate the severity of pain on a line of (100mm long)

MOH Pain Scale
Combined Rating Scale (NRS, VAS, and Faces Scale), Recommended by the Ministry of Health for adults and children over seven years old.

Figure 4.2 : Pain Scale

On a scale of zero to ten (show the pain scale), if 'zero' = no pain and '10' = worst pain you can imagine, what is your pain score now?"

The patient is asked to indicate the severity of their pain by pointing along a scale. The pain score is recorded as a number from 0 to 10

Categorical Scale:

The patient is asked to rate their pain on a score of 1 to 4, where

1 = No pain at all
2 = mild
3 = moderate
4 = severe

This is a simple way of scoring pain and is easy for patients to understand and respond to but not a preferred method (not sensitive, difficult to record).

Ministry of Health Pain scale – A combination of the Numerical Rating Scale (NRS) and Visual Analogue Score (VAS) is the most commonly used pain scoring system.

Faces Scale (adapted from IASP 2017) for children 3-7 years

In the following instructions, say "Hurt" or "Pain," whichever seems right for a particular child:

"These faces show how much something can hurt. This face [point to left-most face] shows no pain. The faces show more and more pain *[point to each from left to right] up to this one. [point to right-most face]* **It shows very much pain. Point to the face that shows how much you hurt** *[right now]*."

Score the chosen face 0, 2, 4, 6, 8, or 10, counting left to right, so "0" equals "No pain" and "10" equals "Very much pain." Do not use words like "happy" and '"sad." This scale is intended to measure how children feel inside, not how their face looks.

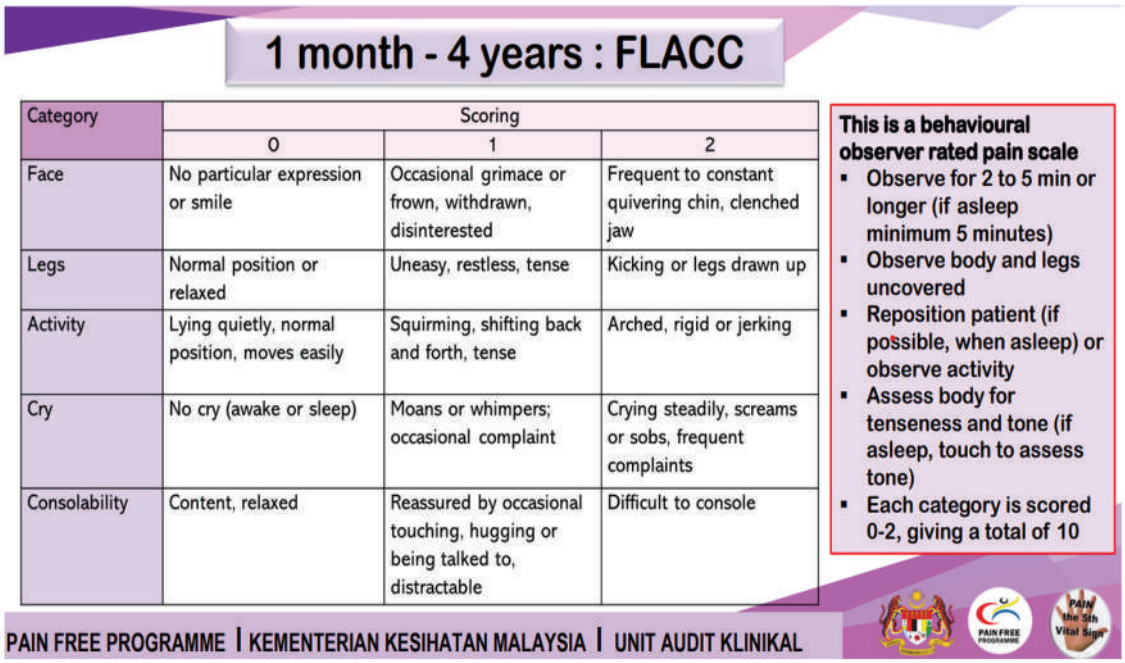
Figure 4.3 : Faces Scale (adapted from IASP 2017)

FLACC PAIN SCALE

It is a measurement used to assess pain for children between 1 month and four years or individuals unable to communicate their pain.

Each of the five categories (F) face, (L) legs, (A) Activity, (C) Cry, and (C) Consolability is scored from 0-2, resulting in a total range of 0-10

Figure 4.4 : FLACC scale for children 1 month-4 years and Cognitively Impaired Adults



Methods of assessing pain in critically ill patients who are sedated and intubated

- **Behavioral Assessment Method**
  - CPOT (Critical Pain Observation Tool)
  - BPS (Behavioral Pain Scale)

- **CPOT (Critical Pain Observation Tool)**

Figure 4.5 : Critical-care pain observation tool (CPOT)

Facial Expressions	Relaxed 0	Tense 1	Grimacing 2
Body Movements or	Absence of movements in normal position 0	Protection 1	Agitation 2
Muscle Tension	Relaxed 0	Tense, rigid 1	Very tense/rigid 2
Compliance with the ventilator (intubated)	Tolerating ventilator or movements 0	Coughing but tolerating 1	Fighting ventilator 2
Vocalisation (extubated)	Normal or silent 0	Sighing or moaning 1	Crying out or sobbing 2

Gelinas et al., AJCC 2006; 15(4): 420-42735

Pain measurement:

Why measure pain?

- The patient must have intact motor function and no brain injury, which could affect the consciousness.

- Observation period
  - 1 minute at rest (baseline)
  - During painful procedures
  - Before and at peak effect of analgesics

- Rating: the highest score observed. Assess the muscle tension last when the patient is at rest.
- A score of > 2 indicates the occurrence of pain
- Does not measure the severity of pain.

• BPS (Behavioral Pain Scale)

The BPS was developed by Payen *et al.* to assess pain in unconscious, mechanically ventilated patients.39 The scale is based on three types (ranges) of behavior: 1) facial expressions, 2) movements of the upper extremities and 3) compliance with a ventilator.

Figure 4.6 : Behavioral pain scale (BPS)

Item	Description	Score
Facial expression	Relaxed Partially tightened (e.g., brow lowering) Fully tightened (e.g., eyelid closing) Grimacing	1 2 3 4
Upper limb movements	No movement Partially bent Fully bent with finger flexion Permanently retracted	1 2 3 4
Compliance with mechanical ventilation	Tolerating movement Coughing but tolerating ventilation most of the time Fighting ventilator Unable to control ventilation	1 2 3 4

Payen et al., CCM 2001; 29 (12): 2258-2263

- Total score varies from 3 to 12
- Scores ≤3 no pain.
- Scores 4-5 mild pain.
- Scores 6-11, an unacceptable amount of pain.
- Scores ≥12 maximum pain.
- Target score < 5.

PAIN AS THE 5TH VITAL SIGN

Pain score should be measured at rest, or movement, coughing, and deep breathing. In addition, pain scores should be taken:

- Half to one hour after administration of analgesics and any intervention for pain relief
- During and after any painful procedure in the ward, e.g., wound dressing
- Whenever the patient complains of pain

MONITORING OF PATIENTS ON APS

- To provide adequate analgesia for patients
- To detect severe and potentially dangerous side effects and complications of analgesic techniques

What to monitor?

- Respiratory Rate
- Sedation Score
- Pain Score
- Blood Pressure
- Pulse Rate

RESPIRATORY RATE (RR)

- Respiratory depression is one of the most serious and potentially harmful side effects of opioids
- Respiratory depression is defined in an APS patient as a sedation score of 2 with RR less than 10 or a sedation score of 3 irrespective of RR
- Shallow respiration may occur without a significant decrease in respiratory rate
- An actual reduction in respiratory rate may occur later

SEDATION SCORE

- Increasing the sedation score is the best early clinical indicator of respiratory depression.

Sedation Score

0= Awake and alert
1= Mild (occasionally drowsy)
2= Moderate (frequently drowsy but easy to arouse)
3= Severe (difficult to arouse)
S= Sleeping

PAIN SCORE

- Given by patient
- Necessary to determine the effectiveness of analgesia
- Determines when to provide the next dose of the analgesic drug in techniques that use intermittent bolus doses
  - Pain Score (≥4) → inform ward doctor
  - Pain Score (<4) → maintain present dose

BLOOD PRESSURE AND PULSE RATE

- Usual vital signs that are monitored for all patients
- Usually not directly affected by opioids
- If an epidural cocktail infusion is administered, a sympathetic block may cause hypotension

NAUSEA AND VOMITING

- Frequency to be charted in APS observation chart
- Chart when and what anti-emetic is given
- Check if nausea and vomiting are relieved after the anti-emetic is given
- If there is no relief, call the APS doctor

When to call the APS doctor?

The APS doctor or anesthesiologist on call should be informed if

- Sedation score = 2, respiratory rate < 8
- Sedation score = 3, irrespective of RR
- The pain score is ≥ 4
- Vomiting is persistent despite anti-emetics
- Hypotension (systolic < 90 mmHg)
- Bromage score ≥ 2

What to do if the patient has respiratory depression?

- Confirm diagnosis: check for pinpoint pupils
- Stop APS technique – opioid/epidural
- Call for **HELP** - ward doctor and APS doctor
- Check Airway, Breathing, and Circulation (ABC)
- Give oxygen to patient - 3L/min via nasal prong/10L/min via face mask where necessary
- Try to wake the patient up and remind the patient to breathe
- Get a resuscitation trolley
- Establishing monitoring, e.g., cardiac monitoring, BP, SpO2
- IV Naloxone 0.1mg boluses every 2-3 mins up to a total of 0.4 mg or until the patient wakes up or RR >10
- Monitor SpO2 (continuous), RR, BP, PR, and Pain Score hourly
- If respiratory depression recurs:
  - Give another dose of Naloxone.
  - Consider airway protection if indicated
  - Admit patient to ICU / HDU for close monitoring. It may require Naloxone infusion.

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CHAPTER 5

MANAGEMENT OF ACUTE PAIN

CHAPTER 5 MANAGEMENT OF ACUTE PAIN

ACUTE PAIN SERVICE (APS)

In 1993 the first APS in the Ministry of Health (MoH) was set up in Hospital Kuala Lumpur.

The introduction of newer techniques of pain relief by the anaesthesiologist using regional techniques like epidural analgesia and nerve blocks, patient-controlled analgesia (PCA) and non-opioid-based analgesia with a **multi-modal approach** has resulted in an improvement in the management of acute pain.

The setting up of pain management clinics to evaluate and manage patients with persistent pain using a multidisciplinary approach is also beneficial in improving chronic pain management.

Acute pain management techniques

Objectives:

- To offer the best possible pain relief at reasonable cost and labour.
- To achieve early ambulation.
- To reduce postoperative morbidity and mortality
- To facilitate early discharge and shorten hospital stay
- To increase patient satisfaction

Factors to consider when choosing a technique:

1. Patient factors

- Patient acceptability (age, anxiety)
- Patient's ability to cooperate (children, senile, head-injured, language barrier)
- Patient co-morbidities, e.g. Obstructive Sleep Apnoea (OSA), End-Stage Renal Failure (ESRF) / Chronic Kidney Disease (CKD), Liver Failure, Morbid obesity

2. Surgical factors

- Site of surgery
- Severity of postoperative pain
- Duration that the patient will be kept Nil By Mouth

3. Nursing factors

- Adequacy of nursing staff
- Familiarity with the various techniques
- Availability of monitoring

4. Cost

- Equipment
- Drugs
- Disposables
- Manpower

5. Other factors

- Incidence of side-effects
- Risk of respiratory depression
- Risks associated with various techniques, e.g. epidural abscess
- Effectiveness of pain control

TECHNIQUES

Techniques include non-pharmacological and pharmacological approaches

Non-pharmacological techniques

1. Psychological techniques

- Pre-operative information/video: effective in reducing procedure-related anxiety and pain.
- Music: reduction in postoperative pain and opioid consumption.
- Distraction: effective in procedure-related pain in children
- Cognitive methods: training in coping strategies or behavioural instruction before surgery reduces pain and analgesic use
- Hypnosis and relaxation: inconsistent evidence of benefit in the management of acute pain
- Guided imagery

2. Complementary therapies and other techniques: including massage, acupuncture, TENS, and hot and cold packs.

Pharmacological approaches

- Oral analgesics: NSAIDs / COX-2 Inhibitors / Opioids
- Intravenous injections: NSAIDs / COX-2 Inhibitors / Opioids
- Patient-controlled analgesia (PCA): Morphine / Fentanyl / Oxycodone
- Epidural analgesia: Intermittent bolus/infusion/ Patient-controlled Epidural analgesia (PCEA)
  - Mixtures of local anaesthetics and opioids ("cocktail")
  - Opioids alone
- Intrathecal opioids
- Subcutaneous opioids
- Peripheral nerve blocks

Multi-modal Analgesia

This involves using two or more analgesic agents with different mechanisms of action or techniques for controlling pain.

Drugs with different mechanisms of action potentiate analgesia by additive or synergistic effects. They may reduce the severity of side effects due to the lower doses of the individual drugs used.

Examples are

- Epidural combined with NSAIDs/COX-2 Inhibitors and Paracetamol
- PCA morphine combined with NSAIDs/COX-2 Inhibitors, Paracetamol and local wound infiltration

PATIENT CONTROLLED ANALGESIA (PCA)

One of the most common methods for postoperative pain control
A computerized syringe pump is set to deliver bolus doses whenever the patient presses a button (patient demand). It allows small amounts of an opioid to be given at frequent intervals enabling the patient to titrate the analgesic dose according to individual needs.

- The following routes can be used – Intravenous, subcutaneous, epidural and peripheral nerve catheter.
- Modes of administration –
  - bolus dose
  - bolus dose and continuous infusion
- One opioid may be better tolerated than the others.
- The routine use of pethidine is strongly discouraged because pethidine has a neurotoxic metabolite, norpethidine, which can lead to CNS excitation, anxiety, tremors, and grand mal seizures. Pethidine may interact with Mono Amine Oxidase Inhibitor (MAOI), causing Malignant Hyperpyrexia Syndrome.

Indications

- Acute postoperative pain
- Severe acute pain, e.g. burns, trauma, invasive procedures
- Episodes of acute severe cancer pain
- Patients who are not taking orally

Contraindications

- Untrained staff
- Patient refuses to use the machine
- Patient inability to safely comprehend the technique (language barrier, confusion)
- Patients who cannot use the PCA (severe deformity, weakness, or injury of both hands).

Advantages

- Patients are actively involved with their recovery and feel better (high rating for patient satisfaction)
- Effective for severe pain regardless of the site of surgery
- Patient controls the amount of opioids used; therefore, the analgesic dose matches the patient's requirement.
- May reduce opioid consumption and side effects.
- Nursing is made easy when the patient is comfortable, thus reducing the nursing workload
- Risk of overdose is low
- Can be used for incident pain

Disadvantages

- Not suitable for all patients.
- Need to educate patients and relatives.
- Doctors and nurses need to be trained on PCA's safe and effective use.
- High cost of PCA machine and disposables.
- Human and pump errors

General Guidelines

The decision to use PCA for postoperative pain relief should be made preoperatively at the anaesthetic clinic. This will allow the patient to receive instructions on using the PCA machine.

- Patients on PCA must be mentally alert and able to comply with instructions. Friends and relatives must understand that **ONLY** the patient should activate the machine.
- The PCA is delivered through an IV line with a one-wone-way-reflux valve" to prevent accidental opioid overdose. If an anti-reflux valve is unavailable, use a dedicated line for the PCA.
- Patient monitoring which includes Pain Score, Sedation Score, Respiratory Rate, Blood pressure and Pulse rate, amount of drug used, and complications, must be recorded every hour for the first 4 hours, then every 4 hours.
- Patients on PCA are **NOT** to receive other opioids or sedatives, except while weaning off the PCA

Recommended settings for bolus dosing (see below): Age affects opioid dosing but not gender and body weight.

- Drug concentration should be standardised to reduce the chance of programming errors.

Specific Guidelines

Features of PCA pump

- Microcomputer for programming
- Syringe pump
- Device for activation by the patient (usually a button that the patient pushes)
- Lock & key for access only by trained staff
- Delivery system
- Display window
- Alarms

Programming of PCA machine

- Mode: PCA mode, Continuous mode, PCA + Continuous mode
- Drug concentration:
  - Morphine 1mg/ml
  - Fentanyl 10mcg/ml
  - Oxycodone 1mg/ml
- Bolus dose: dose delivered by the PCA machine when the demand button is pressed.

Table 5.1 : Recommended bolus dose for different opioids according to patient's age

	< 60 years	Score
PCA Morphine	1mg	0.5mg
PCA Fentanyl	10 -20mcg	5 - 10mcg
PCA Oxycodone	0.5-1mg	0.5mg

- **Lock-out interval:**
  - The period during which the patient cannot initiate another dose.
  - A safety feature to prevent overdose.
  - Usually set at 5 minutes

- **Continuous infusion/background infusion** (can be used with or without the patient demand facility)

  - Not routinely used. However, it is used routinely in children and maybe indicate, I,e opioid-tolerant patients.
  - The other use of a background infusion during PCA may increase opioid consumption and the risk of respiratory depression.
  - There is also an increased incidence of sedation, nausea, vomiting and hypoxaemia. It does not improve pain relief or sleep or reduce the number of PCA demands.
  - Therefore, background infusion is not recommended for routine postoperative analgesia in the ward, especially in patients with a risk of respiratory depression.
  - The background infusion rate should be less than or equal to the bolus dose.

- **Loading dose:**

  - It is the initial dose delivered on commencing PCA
  - Usually, patients receiving postoperative PCA are not set as they would have received opioids intra-operatively.
  - For those patients who have not received any opioids before starting the PCA, a titrating dose may be administered using the Morphine Pain Protocol.
  - (refer to Appendix 5)

- **4 Hourly Limit:**

  - Maximum drug doses which can be delivered within 4 hours
  - This may not be a feature in some PCA pumps
  - Usually not set

Continuous infusion/background infusion

1. **Patient is not comfortable** (i.e. patient continues to report high pain scores)

   - Repeat patient education
   - Review the history of the patient - look for a history of long-term opioid use (i.e. look for evidence of opioid tolerance)
   - Look at the times the patient has pressed the demand button each hour. Most patients will not continue to press if they get an appreciable effect from the bolus dose. If the patient needs more than 3 or 4 bolus doses every hour, the size of the bolus should be increased by 50%
   - Consider multi-modal analgesia and techniques

2. **Machine alarms**

   - Check cause – Rule out an empty syringe or line occlusion
   - Inform APS or ICU doctors on call if ward nurses cannot correct the cause.

When to stop PCA?

- Patient requests
- Low opioid requirements for analgesia and pain score < 4
- Patient is tolerating orally, and PCA may be substituted with oral analgesia

Analgesia after PCA is stopped

- Oral Tramadol 50 mg 6-8 hourly **OR**
- Oral Dihydrocodeine 30-60mg (1 to 2 tabs) 6-8 hourly **OR**
- Syrup Morphine 5mg 6-8 hourly **OR**
- Oral Oxycodone (see Appendix 4)
- NSAIDs or COX- 2 inhibitors (dose as appropriate) to be continued
- Oral Paracetamol 1 gm every 6 hours to be continued

Adverse effects of PCA opioids

1. Respiratory Depression

   Possible causes:

   - Drug interaction – especially if the patient is on another drug with a sedative effect
   - Continuous (background) infusion
   - Inappropriate use of PCA (e.g. demand button pressed by relatives)
   - Human error
   - Programming error
   - Equipment error

2. Nausea and vomiting
3. Pruritus
4. Sedation

Complications related to PCA

Complications associated with the use of PCA can be divided into

- Health care provider – the human factor
  - Programming errors (e.g. setting of a continuous infusion, wrong bolus dose)
  - Prescribing error
  - Wrong patient
  - Wrong route
  - Inexperienced staff
  - Insufficient patient monitoring
- Patient-related errors, e.g. family members activating PCA
- Problems due to the equipment

Responsibility of doctors and nurses

Although the patient has control of PCA, that does not free the nurse/doctor from managing and assessing the patient frequently. The nurses must be imperative to the **accuracy of the prescription** of the PCA pump.

The "just push the button" concept should be discouraged while using the PCA. Instead, the focus should be on **proper patient selection, patient education**, consistent assessment, **and patient monitoring.**

PCA should not be used as "stand-alone" therapy. Regular NSAIDs, LA wound infiltration, peripheral nerve blocks, and catheter techniques can all be used as part of a multi-modal regime, together with PCA, to improve analgesia and reduce opioid requirements.

CENTRAL NEURAXIAL BLOCK

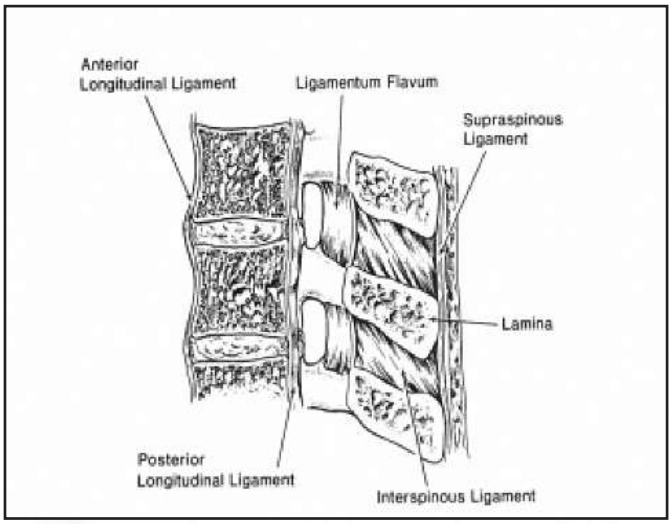
Anatomy relevant to epidural analgesia

The spinal cord and brain are covered by three membranes -- the meninges.

- Outer layer - **duramater**
- Middle layer - **arachnoid mater** (lies beneath the dura)
- Inner layer - **pia mater** (adheres to the surface of the spinal cord and brain)
- Outside the dura lies the ***epidural space***. This potential space contains blood vessels, fat, and connective tissue.

- Below the arachnoid membrane is the subarachnoid or intrathecal space, which is filled with cerebrospinal fluid (CSF), and the spinal cord (above L1/L2) or cauda equina (below L1/L2).

Figure 5.1 : Anatomy of the Vertebral Column



Definition

Epidural analgesia

This is the introduction of analgesic drugs into the epidural space, usually via an indwelling epidural catheter.

Intrathecal / Subarachnoid analgesia

This is the introduction of analgesic drugs into the CSF in the intrathecal space. This is usually done as a 'single shot' technique, but indwelling intrathecal catheters can be used.

Indications

- Management of acute pain in adults and children, particularly after surgery and in procedures involving the thorax, abdomen, perineum, or lower limbs
- Management of post-trauma pain
- For labour analgesia

Contraindications

- Patient refusal
- Untrained staff
- Local infection or general sepsis
- Coagulation disorders/patient on anticoagulants
- Central neurological disorders, e.g. stroke, head injury, brain tumour
- Hypovolemia
- Severe fixed cardiac output states

Advantages

- Compared to parenteral opioids, neuraxial block provides:
  - Good quality of analgesia at rest and on movement (incident/dynamic pain), early mobilisation and resumption of normal activities
  - Less sedation.
  - Less nausea and vomiting

- Reported benefits of epidural analgesia
  - Faster return to normal lung function, decreased risk of respiratory depression and reduced incidence of pulmonary infection, especially in patients with lung disease, chest injury, thoracotomy and upper abdominal surgery.
  - Reduced risk of arrhythmias and DVT
  - After open abdominal surgery in the setting of Enhanced Recovery After Surgery (ERAS), reduced duration of ileus, Post Operative Nausea and Vomiting (PONV), improved recovery of bowel function and prevention of protein loss

  - Reduced incidence of renal failure.
  - Thoracic Epidural Analgesia (TEA) for thoracotomy reduces the risk of persistent postsurgical pain
  - Reduced stress response markers (cortisol, glucose)
  - Earlier extubation, reduced intensive care unit (ICU) stay

- Epidural analgesia, compared to systematic analgesia, shows reduced mortality after surgery. In cancer surgery, it improves overall survival, particularly after colorectal cancer surgery. However, it did not improve recurrent-free survival.

Disadvantages

- Technical difficulty
- High cost of equipment
- Weakness and numbness with local anaesthetics
- Urinary retention
- Higher incidence of pruritus than IV PCA
- Hypotension

Drugs used

- Two classes of drugs are commonly used for neuraxial analgesia:
  - Local anaesthetics, e.g. bupivacaine, ropivacaine, levobupivacaine
  - Opioids, e.g. fentanyl, morphine

- Both produce analgesia but differ in their mechanisms of action and their side effects.
- Usually, a combination of local anaesthetics and fentanyl (“cocktail”) is used for postoperative epidural analgesia.

Table 5.2 : Comparison of Effects between Opioids and Local Anaesthetics

System	Opioids	Local Anaesthetics
CVS	Usually no drop in BP	Hypotension due to sympathetic blockade Bradycardia with a high block
RESPIRATORY	Early respiratory depression from systemic absorption Late respiratory depression due to rostral spread in CSF	Usually unimpaired unless there is a high block involving the intercostal muscles and diaphragm
MOTOR	No effect	Motor block resulting in muscle weakness
CNS	Nausea and vomiting Pruritus (more commonly seen with morphine)	Nausea and vomiting only as a sequel to hypotension No pruritus
URINARY	Urinary retention may occur	Urinary retention with lower motor blocks
GIT	Decreased motility	Increased motility

Mechanism of action of drugs used

Opioids

- An opioid introduced into the epidural space diffuses across the dura into the CSF and reaches the opioid receptors in the dorsal horn of the spinal cord to bring about analgesia
- Antinociception is further augmented by descending inhibition from mu-opioid receptor activation in the periaqueductal grey (PAG) area of the brain
- Affects the modulation of nociceptive input but does not cause motor or sympathetic blockade

Local Anaesthetics

- Block the conduction of impulses along nerves and the spinal cord

Epidural analgesia using mixtures of local anaesthetics (LA) and opioids ("cocktail")

- To obtain good analgesia with minimum side effects, mixtures of low concentrations of LA and opioids are used, i.e. epidural cocktail.
- LA introduced into the epidural space reaches the CSF via dural cuffs surrounding each spinal nerve root and gain access to the spinal cord.
- Combinations of low concentrations of LA and opioids provide superior pain relief with minimum side effects compared with either medicine alone.
- Methods of administration include
  - continuous infusion
  - patient-controlled (PCEA)

- Side effects occur as a result of:
  - sympathetic blockade
  - motor blockade
  - sensory blockade

- The extent of these side effects depends on the amount and concentration of local anaesthetic and the site of drug deposition.
- Once the epidural catheter is inserted, a bolus dose is given.
- **"Every dose is a test dose."**

Table 5.3 : Recommended Epidural Bolus Dosing (Adapted from NYSORA)

Drug	Concentration	Bolus	Interval	Remarks
Lignocaine	2%	3-5mls	3-5 min	Assess response to dosing and establish sensory level as required
Bupivacaine	0.25-0.5%	3-5 mls	3-5 min	
Ropivacaine	0.5-0.75%	3-5 mls	3-5 min	
Levobupivacaine	0.25-0.5%	3-5 mls	3-5 min	

Note:

1. Volume is the critical factor in the height of the block
2. The guideline for dosing and epidural in adults is 0.5-0.7 ml (thoracic) and 1-2 ml (lumbar) per segment to be blocked
3. Adjust the dose for shorter patients (less than 155 cm) or taller patients (more than 185 cm)
4. Beware of intravascular and intrathecal injections during the administration of the bolus dose

The usual epidural cocktails and rates of administration are shown below:

"Cocktail"

- 0.1% Bupivacaine + 2 mcg/ml Fentanyl
- 0.2% Ropivacaine + 2 mcg/ml Fentanyl
- 0.1% Levobupivacaine + 2 mcg/ml Fentanyl

Rate of infusion

- Varies according to the site of the epidural and surgical wound
- Recommended rates of infusion
  - Thoracic 4-8 mls/hr
  - Lumbar 6-12 mls/hr

Note:

1. Concurrent opioids or sedatives must not be given.
2. Local anaesthetic solutions **MUST** be diluted with normal saline. Water is hypotonic and, therefore, neurotoxic.
3. Ambulation may not be possible because of weakness or numbness of the lower limbs, but patients are allowed to sit up and out of bed with assistance.

Epidural analgesia using opioids alone

- An opioid introduced into the epidural space diffuses across the dura into the CSF and reaches the opioid receptors in the spinal cord to bring about analgesia.
- Epidural infusion of LA alone or combined with opioids is better than opioids alone.
- A bolus dose of epidural morphine alone may provide up to 24 hours of analgesia. Epidural fentanyl alone is not used as the duration of action is too short to be of significant benefit. (refer to Table 5.4)

Table 5.4 : Epidural Opioids: Dosage, Onset and Duration of Action

Opioid	Dose (mg)	Onset (min)	DURATION (hrs)
Fentanyl	0.05 – 0.1	5 - 10	2 - 3
Morphine	2 - 5	30 - 45	6 - 24

Note:

1. Risk of delayed respiratory depression is greater with morphine
2. Opioids and sedatives must not be given
3. Opioid solutions must be preservative-free (as preservatives may be neurotoxic).
4. Patients receiving epidural opioids alone may ambulate, as there is no motor blockade.

Patient-Controlled Epidural Analgesia (PCEA)

- PCEA decreases the requirement for epidural top-ups, lowers consumption of LA and decreases the incidence of motor block and reduces the consumption of systemic rescue analgesia, with a consequent reduction in the requirement for intervention by ward nurses, physicians, and the APS.
- PCEA with a background infusion is more effective in reducing incident pain than PCEA without a background infusion. Currently, in Malaysia, PCEA is used more in labour analgesia (refer to Chapter 11, Obstetric Analgesia Service).

Intrathecal Opioid Analgesia

- This is the introduction of opioid drugs into the CSF, which acts directly on the opioid receptors in the spinal cord and brain.
- The lipid solubility of opioids determines the onset and duration of intrathecal analgesia; hydrophilic drugs (e.g. morphine) have a slower onset of action and a longer half-life in cerebrospinal fluid compared with lipophilic opioids (e.g. fentanyl).
- Therefore, neuraxial administration of bolus doses of hydrophilic opioids has greater dorsal horn bioavailability and greater cephalad migration and thus carries an increased risk of delayed sedation and respiratory depression compared with lipophilic opioids.
- **Sedation Scores & Respiratory Rate must be monitored regularly for at least 24 hours after the last dose of intrathecal opioid.**

Table 5.5 : Pharmacological Properties of Common Opioids for Intrathecal Analgesia

Opioid	Usual dose range (µg)	Onset (mins)	Duration (hours)	IT: IV potency ratio	Time to peak Respiratory Depression
Morphine	100-500	45-75	18-24	1:200	6-10hrs
Fentanyl	5-25	5-10	1-4	1:10	5-20min

Indications

- Intraoperative and postoperative analgesia e.g.analgesia post caesarian section
- Intractable cancer pain

Contraindications

- Allergy to morphine
- Sensitivity to opioids, e.g. previous severe nausea/vomiting
- Additional sedative drug use
- Morbidly obese
- Severe Respiratory Disease
- Obstructive Sleep Apnoea (OSA)

Table 5.6 : Optimal Intrathecal Opioid Dose for Specific Surgical Procedures

Procedure	Optimal IT opioid & dose	Comments
Caesarean Delivery	Fentanyl 25 µg + Morphine 100 µg	Fentanyl improves intraoperative analgesia and faster block onset but does not produce significant postoperative analgesia.
Day Care Surgery under spinal anaesthesia (e.g. knee arthroscopy)	Fentanyl 10-25 µg	Intrathecal lipophilic opioids speed the onset of block, short duration of action and improve intraoperative and immediate postoperative analgesia without prolonging motor block. Minimal cephalad spread is least likely to cause delayed respiratory depression.
Transurethral resection of the prostate (TURP)	Morphine 50 µg	Ultra-low dose of intrathecal morphine was equivalent to 100 µg after TURP. Used to control pain by detrusor muscle spasm
Major orthopaedic surgery (e.g. joint arthroplasty)	Morphine 100-300 µg Total Hip Arthroplasty 100-200ug, Total Knee Arthroplasty 300ug)	Although these doses of intrathecal morphine provide excellent analgesia after total hip arthroplasty, they are inadequate for pain relief after total knee arthroplasty, reflecting the greater degree of pain reported by patients undergoing knee replacement.
Thoracotomy	Morphine 300-500 µg	Lumbar intrathecal morphine improves pain relief but does not eliminate the need for supplemental IV opioid analgesics.
Major abdominal/ vascular surgery (e.g., open abdominal aortic aneurysm repair)	Morphine 300- 500 µg	Lumbar intrathecal morphine provides more intense analgesia than IV patient-controlled analgesics with morphine. Its role in major abdominal surgery is less clear since the analgesic effects wear off after the first 24 hours necessitating the change in analgesia to either an epidural or PCA.
Spinal Surgery	Morphine 150-300ug	Effective in alleviating pain with minimal side effects, improved respiratory function and postoperative mobility after multilevel instrumentation and lumbar fusion surgery. It can be injected under direct vision at the end of surgery.

(Adapted from Rathmell JP et al.: Intrathecal Drugs for Acute Pain. Anesthesia Analgesia 2005; 101: S30-43)

Note: Intrathecal morphine doses of 300 mcg or more are required to produce superior analgesia in major thoracotomy and abdominal/vascular surgery. Nearly universally, patients who received this dose reported increased nausea and vomiting, pruritus, urinary retention, and respiratory depression.

Advantages:

- Higher intrathecal success rate
- Earlier onset of the sensory block than LA alone
- Enhanced intraoperative analgesia (sensory blockade) without increased motor blockade
- Allows lower dosage of LA with faster recovery from spinal anaesthesia
- Postoperative analgesia longer than duration of LA motor block
- Less nausea and vomiting in caesarean delivery
- Early extubation significantly reduces MAC

Disadvantages:

- Pruritus
- Sedation (mainly with hydrophilic opioids like morphine)
- Respiratory depression, rare with a lipophilic opioid, delayed/late with hydrophilic and more likely in parturients.
- Urinary retention (more likely with morphine).
- Herpes simplex reactivation - clear association after intrathecal morphine has not been established but avoid morphine if there is a strong history of herpes

Table 5.7 : Incidence, Proposed Mechanisms and Treatment for Intrathecal Opioid-Related Side Effects

Complication	Incidence	Proposed mechanism	Treatment	Commentary
Pruritus	· 30%-100% · Increased in parturients · More with Morphine · Dose dependent	The exact mechanism is unclear. Postulates include: · opioid receptor-mediated central mechanism · "itch centre" in the central nervous system, · modulation of the serotonergic pathway · prostaglandins	Reassurance Calamine Lotion IV Naloxone 40 mcg titrating to a max of 400mcg IV Propofol 10 mg bolus +/- low dose infusion. (30mg/24hr) IV Nalbuphine 4 mg IV Ondansetron 4-8mg IV Granisetron –3mg The sedative properties of antihistamines may help interrupt the itch-scratch cycle.	Propofol may be less effective for the parturient. Histamine release does not appear to be the cause.
Urinary retention	· 35% with morphine · morphine > fentanyl	Interacts with opioid receptors in the sacral spinal cord, causing detrusor muscle relaxation and an increase in maximal bladder capacity.	Opioid antagonists and agonist-antagonist, including naloxone. Insert CBD if unable to void for > 6 hours.	The inability to void postoperatively is a multifactorial problem. Look for the primary cause.
Nausea and vomiting	· 30% · Morphine > fentanyl · Likely dose-dependent	· Cephalad migration in the cerebrospinal fluid (CSF) interacts with opioid receptors in the area postrema · Sensitization of the vestibular system to motion	Use the smallest effective dose. For ambulatory procedures, use lipophilic opioids.	Intrathecal opioids appear to have a protective effect against intraoperative nausea and vomiting during caesarean delivery compared to LA alone.

Complication	Incidence	Proposed mechanism	Treatment	Commentary
		· Decreased gastric emptying.	Dexamethasone and droperidol have shown efficacy IV Ondansetron 4-8mg IV Granisetron 1-3mg	
Respiratory depression	· Infrequent <1% · Dose dependent · Fentanyl early-onset (<2 h) and morphine both early and late-onset (6-12 h)	Secondary to rostral spread in CSF	Prevention: training and monitoring · Opioid antagonist (naloxone)	Risk factors include · large dose. · hydrophilic opioids · concomitant use of opioids and sedatives, · age>65 years, · opioid naïve patients Late-onset depression more apparent with morphine

Adapted from Rathmell JP et al. Intrathecal Drugs for Acute Pain, Anesthesia Analgesia 2005; 101:S30-43)

Recommendations on Neural Blockade and Anticoagulant

Refer to Appendix 7

Subcutaneous Morphine

- Subcutaneous morphine injection is the injection of morphine into the fatty layer beneath the skin.
- The rate of uptake of morphine into the circulation is similar to the uptake following intramuscular injection.
- An indwelling cannula (22 G or less) is left in position, commonly just below the arm's clavicle or upper outer aspect.
- Injections are administered through this cannula, avoiding repeated skin punctures.
- Morphine is the drug of choice. Fentanyl, Tramadol and Oxycodone can also be given subcutaneously.

Table 5.8 : Dosages for Subcutaneous Injection of Opioids

All drugs given SC should not be diluted.

	>60 Years Old	>60 Years Old
MORPHINE	5-10 mg, 4-6 hourly	2.5-5mg, 6-8 hourly
OXYCODONE	5-10mg, 4-6 hourly	2.5-5mg, 6-8 hourly
TRAMADOL	50-100mg, 6-8 hourly	25-50mg, 6-8 hourly

Advantages

- Less pain on injection compared to intramuscular injections
- No need for needles, hence less risk of needle stick injury
- Patient can be mobile
- Useful if there is no PCA machine or infusion pump for epidural

Disadvantages

- May have a burning sensation at the injection site.
- Onset of pain relief is delayed compared to IV (but similar to IM).
- There may be a delay between the request for pain relief and actual administration, as this is usually administered by the nurse but ordered by the doctor.
- There is a risk of opioid overdose and respiratory depression.

Peripheral Nerve Block (PNB)

- Peripheral nerve block (PNB) is gaining popularity in managing postoperative pain relief and intra-operative anaesthesia, either as regional anaesthesia alone or in combination with general anaesthesia.
- The most significant potential benefit of this technique is that it reduces the use of perioperative opioids.
- It has been shown to reduce the incidence of postoperative nausea and vomiting (PONV).
- The other advantage of this technique is that it reduces the length of stay in the hospital and is very useful in ambulatory day-care surgical procedures.
- In recent years, with the introduction of ultrasound as a new technique for performing nerve blocks, PNB is easier to achieve with infrequent or lesser complications reported.

Indications

- To provide prompt and effective anaesthesia or analgesia
- To allow adequate examination, intervention, and mobilisation of an injured area without requiring sedation or general analgesia.

TYPES OF BLOCK

A. Peripheral Nerve Blocks

- Upper Extremity Nerve Blocks
- Lower Extremity Nerve Blocks

B. Nerve Blocks of the Abdomen and Thorax

- Two different pain pathways control pain in the abdomen and thorax, one for the organs (visceral) and another for the walls and other components (somatic) of those regions.
- Nerve blocks applicable for abdominal & thoracic surgery include:

  - Thoracic Paravertebral block (TPVB)
  - Lumbar Paravertebral block (LPVB)
  - Intercostal nerves block
  - Interfascial Plane Block

- Pectoralis Block (PECS)
- Serratus Anterior Plane Block (SAP)
- Erector Spinae Plane Block (ESP)
- Quadratus Lumborum Plane Block (QLB)
- Transversus Abdominis Plane (TAP) Block
- Rectus Sheath Block (RS)

Table 5.9 : Upper Extremity Blocks and Indications

Block	Indication
Interscalene Block	Shoulder surgery Rotator cuff repair
Supraclavicular/infraclavicular Block	Lower arm/elbow surgery Forearm surgery
Axillary Block	Forearm surgery Hand & Wrist surgery
Median/Radial/Ulnar Nerve Block, which may be done at the elbow or below	Hand Surgery Supplement to Brachial Plexus Block

Table 5.10 : Lower Extremity Blocks and Indications

Block	Indication
Lumbar Plexus Block or Fascia-iliaca Block. Femoral/Saphenous Nerve Block	Hip surgery / Knee Surgery Arthroplasty / Arthroscopy
Sciatic Nerve Block (with or without Femoral / Adductor Canal Block)	Knee Surgery PCL Repair Leg, ankle and foot surgery
Popliteal Sciatic Nerve Block Tibial/Peroneal Nerve Block Ankle Block	Ankle / Foot surgery

Table 5.11 : Truncal Blocks and Indications

Block	Indication
Thoracic Paravertebral Block	Breast surgery Chest Surgery Chest injury / Fracture Ribs
Thoraco-Lumbar paravertebral Block Intercostal Nerve Block	Lower abdominal surgery – Hernia Repair Lateral abdominal wall surgery Chest injury Fracture Ribs
Interfascial Plane Block for Upper and Lower Trunk	Thoracic and Abdominal Surgery or Trauma

Table 5.12 : LA selection and concentration

Local Anaesthetic	Initial Bolus	Infusion	Maximum dose mg/kg
Bupivacaine	0.2%-0.375%	0.1%	2
Ropivacaine	0.2%-0.5%	0.1 – 0.2%	3
Levobupivacaine	0.2%-0.375%	0.1%	2

Table 5.13 : Dose of LA for Continuous Infusion with or without Patient Controlled Regional Analgesia (PCRA) bolus

Type of block	Initial bolus (mls)	Basal Infusion (ml/h)	Bolus Volume (ml)	Lockout Interval (minutes)
Brachial plexus Block	10-30	5-10	2-5	20-60
Lumbar Plexus Block	30-40	5-10	2-5	20-60
Paravertebral Block	20-30	5-10	2-5	20-60
Interfascial Plane Block	15-40	5-10	5-10	20-60

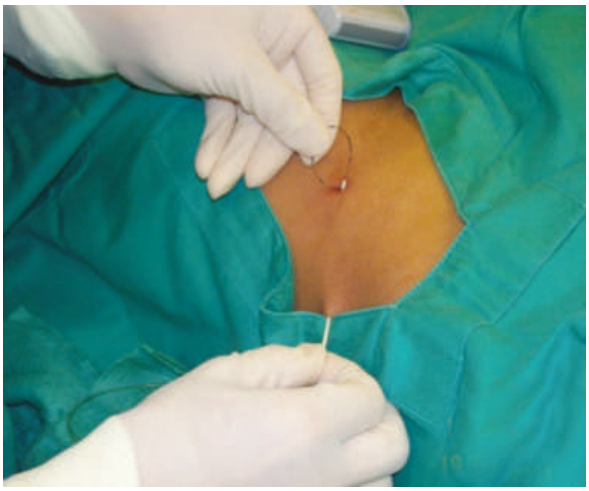
Note: LA must be titrated according to analgesic effects and maximum doses in mg/kg (refer to Table 5.12)

Catheter Placement

- Place the catheter 1-2 cm distal to the tip of the needle in the brachial plexus, sciatic and femoral nerve blocks.
- For the lumbar plexus and paravertebral block, place it 3-5 cm distal to the tip of the needle.

Tunnelling and securing catheter

Secure the catheter by tunnelling it through the subcutaneous layer.



Contraindications

- Patient refusal
- Drug allergy – allergy to local anaesthetics
- Coagulopathy – INR ≥ 1.5
- Infection at the injection site

Complications

- Systemic toxicity of the local anaesthetic, including perioral or tongue numbness, dizziness, tinnitus, blurred vision, tremors, sedation, seizures, respiratory arrest, arrhythmias, and cardiac arrest.
- Nerve injury
- Damage to other structures around the site of the injection
- Pain at the site of the injection
- Local haematoma secondary to vascular injury
- Infection
- Total spinal anaesthesia
- Quadriceps muscle weakness
- Paravertebral muscle spasm

Figure 5.2 : Cutaneous Innervation of the Upper Limbs

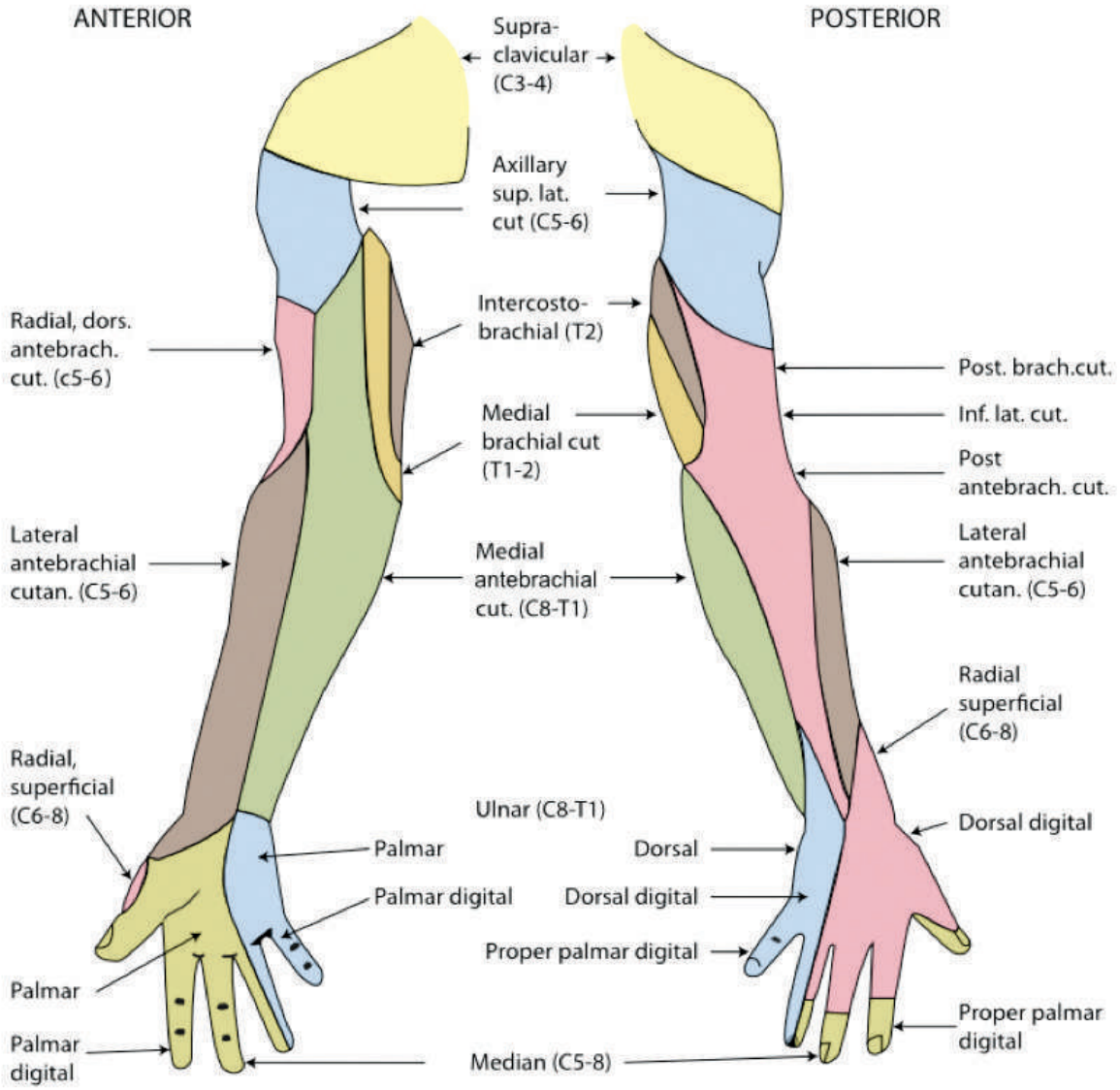
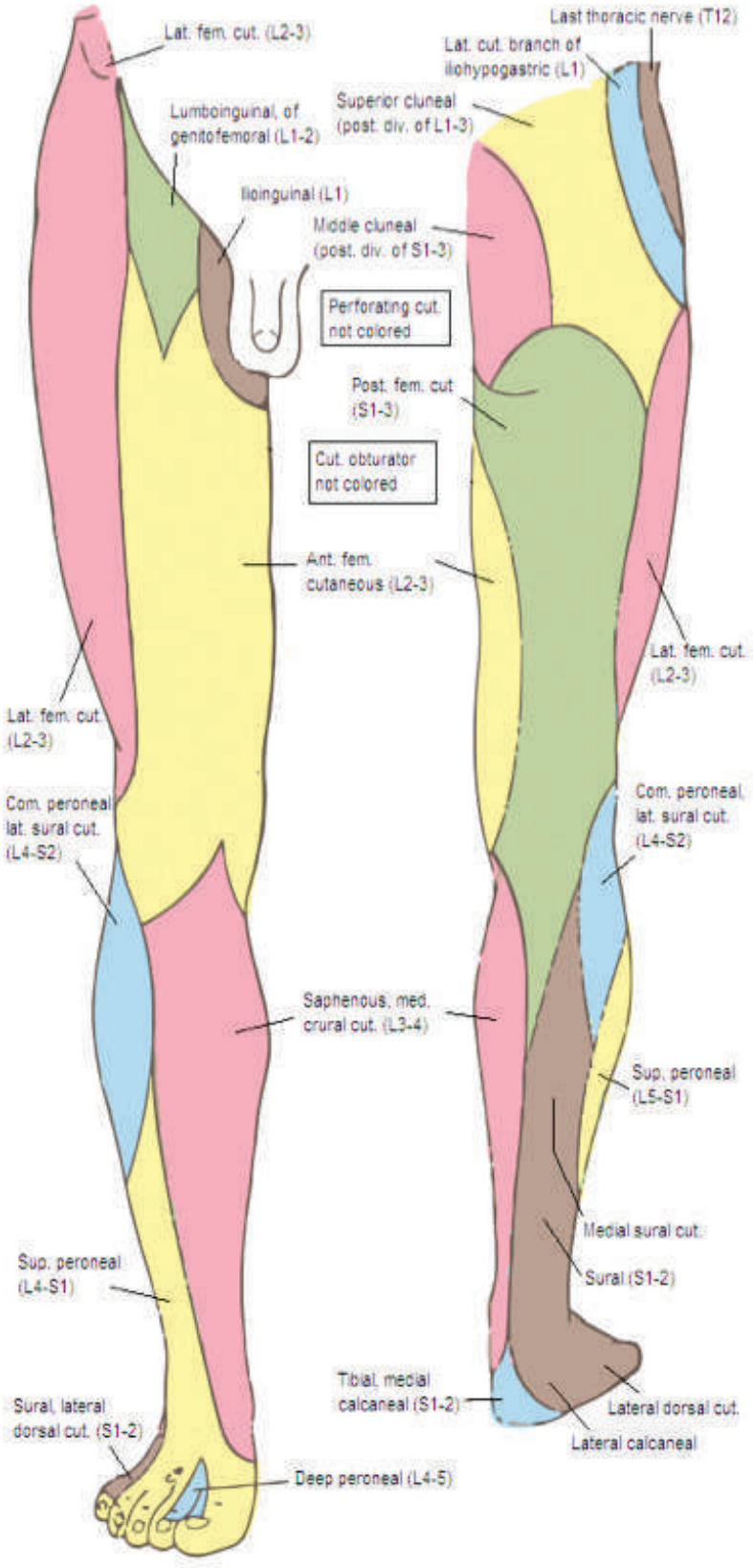


Figure 5.3 : Cutaneous Innervation of the Lower Limbs



Interfascial Plane Block

- Local Anaesthetic is injected into interfascial tissue planes and anatomical locations, which can be identified with Ultrasound guidance.
- The injectate spreads and reaches variable target nerves that innervate the chest or abdominal wall providing a multi-dermatomal sensory block.
- There is no necessity to identify specific nerves or plexuses.
- 15-20 mls of low-concentration LA are deposited on either side to a maximum of 40 mls. Maximum LA dose needs to be observed.
- This block provides effective postoperative analgesia in the first 24 hours.
- Catheter may be inserted for analgesia for up to 72 hours with an infusion of LA at 5 to 10 mls/h.

Figure 5.4 : Current Interfascial Plane Blocks for Upper Trunk
(graphics adapted from Kim Wild et al. Current Anesthesiology Report, June 2017. ESP, Erector Spinae Plane; SPB, Serratus Plane Block; PECS, Pectoralis Block; PIP, Parasternal Intercostal Plane)

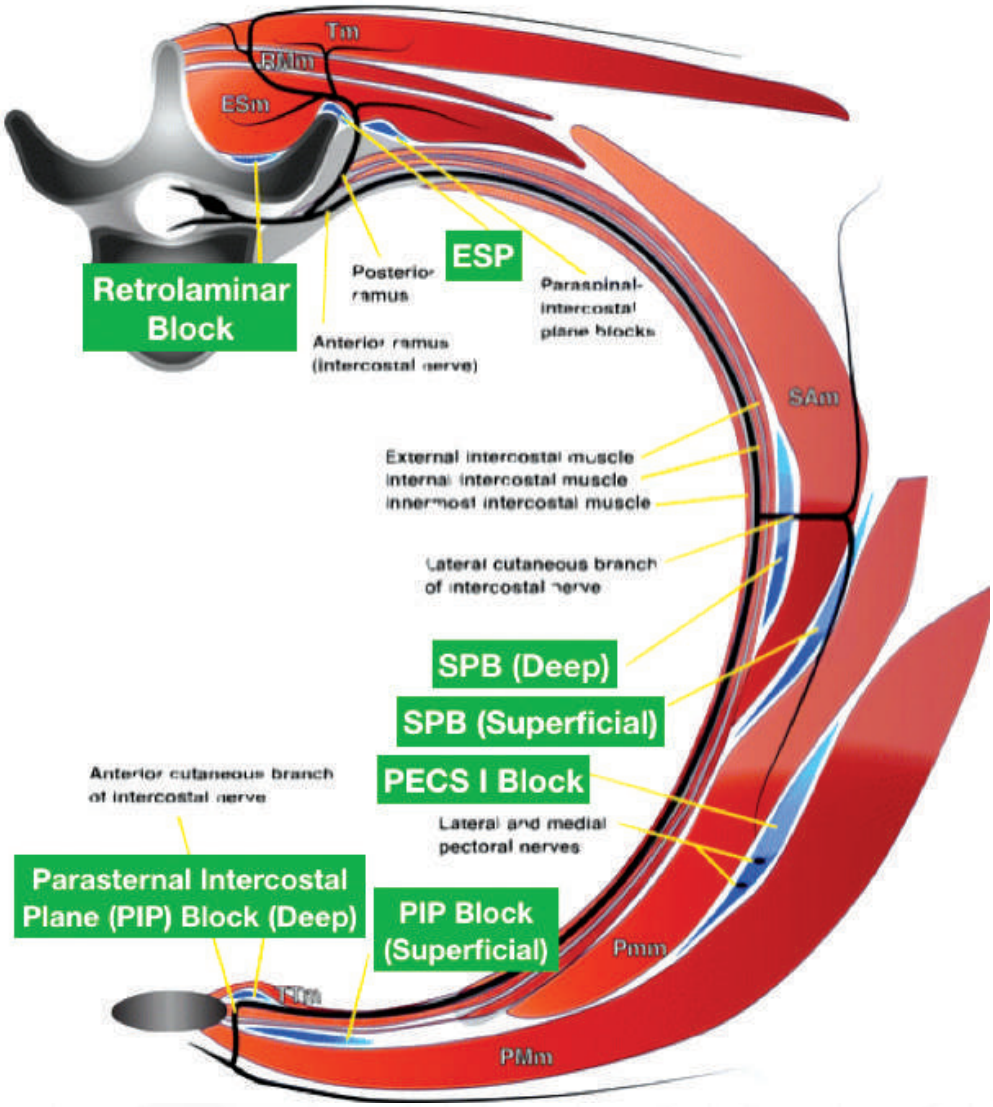


Figure 5.5 : Current Interfascial Plane Blocks for Lower Trunk
(graphics adapted from **http://www.nysora.com**. QLB, Quadratus Lumborum; TAP, Transversus Abdominis Plane; RS, Rectus Sheath)

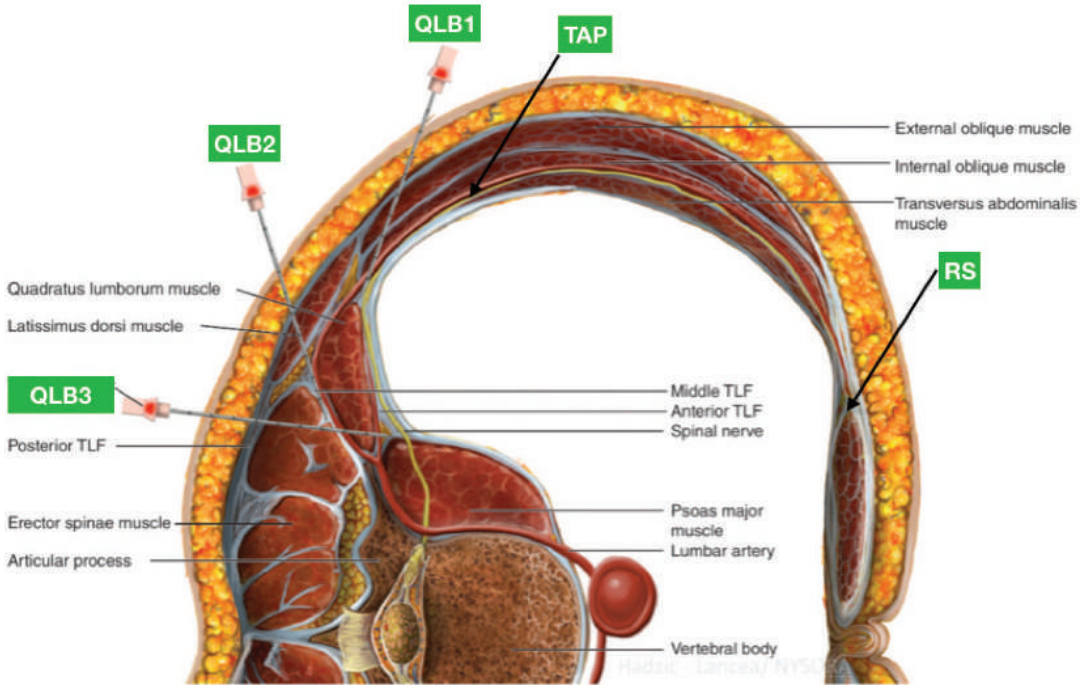


Table 5.14 : Interfascial Plane Blocks and Indications

Block	Indication
Quadratus Lumborum Block (QLB) Transversus Abdominis Plane Block (TAP)	Anterior abdominal wall surgery Appendicectomy Herniorrhaphy Caesarian Section Nephrectomy Abdominal hysterectomy Tenckhoff catheter insertion Retropubic prostatectomy Laparoscopic surgery Open Cholecystectomy
Rectus Sheath Block (RS)	Midline Laparotomy
Pectoralis Plane Block (PECS)	Simple or Radical Mastectomy
Serratus Plane Block (SPB)	Axillary Clearance Anterior Rib Fractures Thoracentesis and Chest Tube insertions Sternotomy Thoracotomy
Erector Spinae Plane Block (ESP)	Breast surgery Chest Surgery Abdominal Surgery Extensive Rib Fractures / Flail segments Nephrectomy

Conduct of Peripheral Nerve Block

- PNB should only be performed by trained personnel or under the supervision of a trained person.
- Patient monitoring, equipment, resuscitation drugs and infection controls must comply with local recommendations and policy.
- Post-procedure follow-up and audit should be performed again following local institutional policies.
- Refer to Tables 5.12 and 5.13 for LA type, concentration, and dose in a single shot, PCRA and continuous infusion.

Pain Management in Non-APS Patients

- Analgesic drugs can be administered systemically through different routes. The route of administration depends on various factors, including the severity, site and type of pain, co-morbidity, ease of use, accessibility, the onset of drugs, reliability of effect, duration of action, patient acceptability, cost, staff education and supervision available.
- Oral analgesic agents are simple, non-invasive, have good efficacy, and have high patient acceptability. It is the route of choice for most analgesic drugs (refer to Appendix 6, Analgesic Ladder for Acute Pain Management)
- Paracetamol plus tramadol or oxycodone are effective analgesics for acute pain
- IV paracetamol has a better analgesic effect after surgery with faster onset than the same dose given orally, but it is more expensive.
- NSAIDs and Coxibs can be used as sole therapy in various acute pain settings.
- Frequent pain assessment in response to treatment and monitoring for side effects is essential to achieve adequate analgesia without adverse effects.
- For those with severe pain, use IV morphine and titrate to comfort using 'Morphine Pain Protocol" (refer to Appendix 5)

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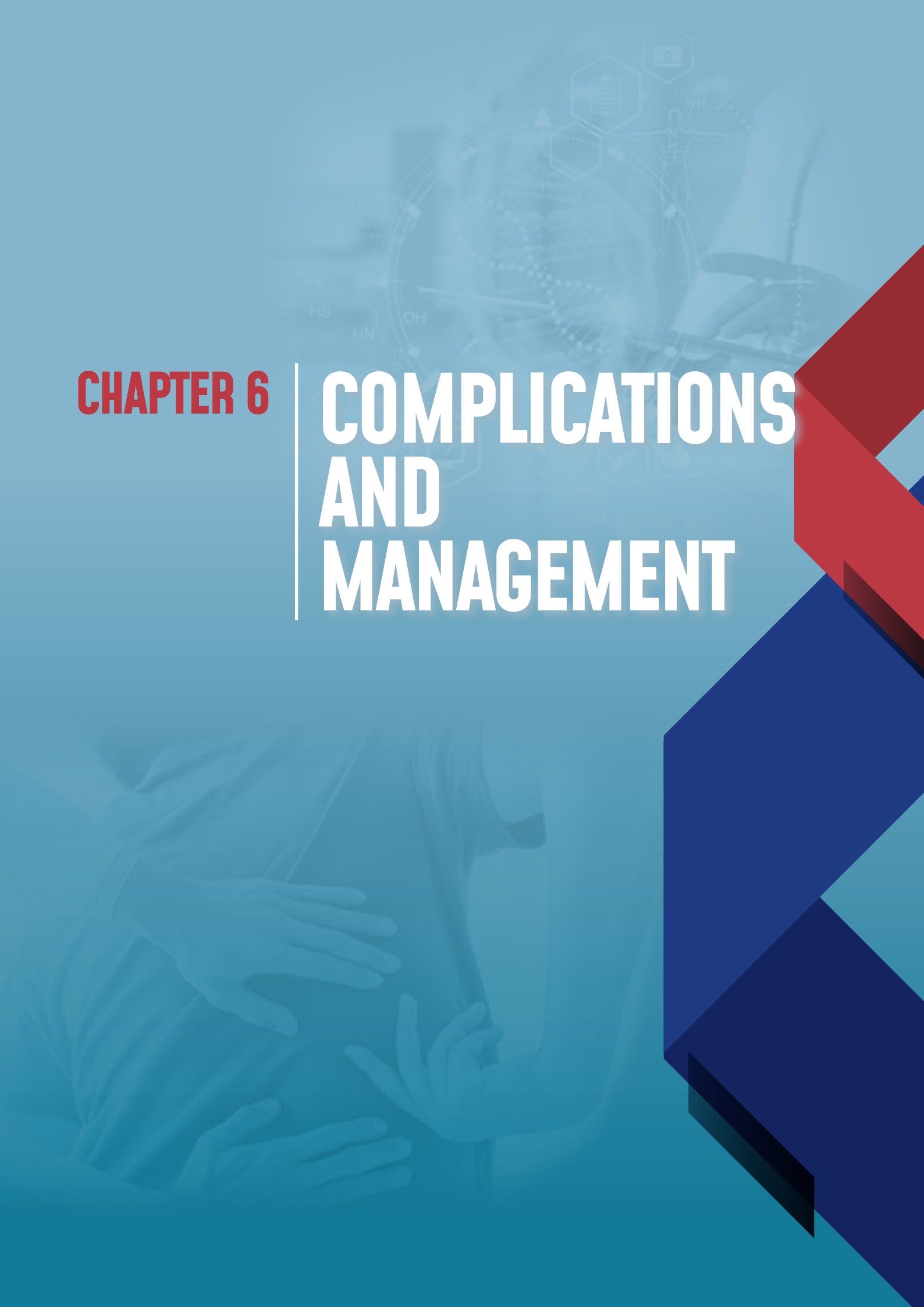


CHAPTER 6

COMPLICATIONS AND MANAGEMENT

CHAPTER 6 COMPLICATIONS AND MANAGEMENT

Complications associated with the provision of pain relief for acute pain may be related to the drugs or the techniques used.

Complications related to drugs

Opioids:

- Nausea and vomiting
- Dizziness
- Pruritus
- Ileus/constipation
- Urinary retention
- Excessive drowsiness
- Respiratory depression

Local anesthetics:

- Hypotension and bradycardia due to sympathetic block
- Systemic toxicity due to accidental intravascular injection
- Respiratory distress due to a high motor block.

Non-steroidal Anti-inflammatory Drugs:

- Gastro-intestinal (GIT) bleeding
- Renal impairment/failure
- Cardiovascular event (e.g., Myocardial ischemia/stroke / uncontrolled hypertension)
- Platelet dysfunction
- Allergic reactions

Complications related to the technique

PCA

- Superficial phlebitis at the I/V site

Subcutaneous injection

- Cellulitis at the needle site

Central neuraxial block

- Post Dural Puncture Headache (PDPH)
- Neurological Complications
  - Transient Neurological Symptoms (TNS)
  - Epidural abscess
  - Encephalitis
  - Hematoma – Epidural or Subdural
  - Meningitis – septic or aseptic
  - Cauda equina syndrome
  - Adhesive arachnoiditis
  - Traumatic / Ischaemic injury to the spinal cord and nerves roots
- Catheter problems; migration, knotting, and snapping
- Persistent back pain - PBP after spinal anesthesia is almost exclusively associated with pre-existing back pain. New onset of PBP is a rare event

Peripheral nerve block

- Complications from drug
- Local anesthetic toxicity (rare) Impaired motor and proprioception
- Neurological injury
- Transient (resolve within three months) – 0.2% (0.1 – 1.4%) Longer lasting, permanent (> 9 months) – 0.07%
- Blockade of other unintended nerves
  E.g. Phrenic nerve block with interscalene brachial plexus block
- Trauma to unintended structures
  Eg. Pneumothorax with supraclavicular/infraclavicular brachial plexus block
- Hematoma
- Catheter problems: migration, knotting, and snapping

MANAGEMENT OF COMPLICATIONS

Nausea And Vomiting

The incidence of postoperative nausea and vomiting (PONV) can be as high as 21% (National Audit, 2007).

Factors contributing to the incidence of nausea and vomiting:

Surgical

- Laparoscopic surgery
- Emergency surgery (full stomach)
- Gynaecological surgery
- Middle ear surgery
- Squint surgery
- Surgery involving the bowel, pharynx, and spermatic cord

Patient

- Female patients
- Paediatric patients
- Obese patients
- Patients with a history of motion sickness
- Patients with a previous history of PONV

Prophylaxis and treatment

- Avoid excessive movement during transport back from OT
- Add a non-opioid analgesic to reduce opioid requirements
- Reduce bolus dose of opioid
- Administer one or more IV antiemetics as required:

    i. Metoclopramide:10-20 mg TDS
    ii. Haloperidol: 1-2 mg BD
    iii. Dexamethasone:4-8 mg stat dose
    iv. Granisetron: 1-3mg stat dose

EXCESSIVE DROWSINESS

Incidence is about 1% (National APS Audit 2007). Excessive drowsiness may be a sign of opioid overdose.

RESPIRATORY DEPRESSION

Respiratory depression is an uncommon event but may be fatal. The incidence is about 0.9% (National APS Audit, 2007). It is always associated with excessive drowsiness

Clinical effects of opioids on respiration

- Decrease in respiratory rate, then decrease in the tidal volume, i.e. shallow breathing
- Decreased response to hypercarbia
- Blunted response to hypoxia

Conditions predisposing to opioid-induced respiratory depression:

- Extremes of age (elderly or neonates)
- Chronic debilitation
- Poor pulmonary function
- Patient sensitivity to opioids and other CNS depressants
- Concomitant use of central nervous system depressant drugs e.g. benzodiazepines
- Morbid obesity and obstructive sleep apnoea
- Acute intoxication with alcohol or other drugs
- Renal impairment

Avoidance of complications

- Regular monitoring of the sedation score and respiratory rate by trained personnel
- Oxygen therapy
- Availability of naloxone at the bedside.

Diagnosis

Sedation score of 2 AND respiratory rate less than 10/min Sedation score of 3 irrespective of respiratory rate

Management

1. Confirm diagnosis; check for pinpoint pupils
2. Stop the opioid
3. Call for help; ward doctor or APS team
4. Stimulate the patient to breathe.
5. Oxygen at 10L/min via face mask
6. Naloxone 0.1 mg IV every 2-3 minutes up to a total of 0.4 mg or until the patient is breathing adequately.
7. Monitor patients in high dependency area

PRURITUS

This can occur with opioids, especially morphine. The incidence is about 4% (National APS Audit, 2007).

Management:

- Apply calamine lotion
- Antihistamine e.g. chlorpheniramine
- For severe cases: Low dose IV Naxolone as infusion 0.2-2 mcg/kg/hr for 24 hours (caution: naloxone may also reverse the analgesic effect!)

ILEUS / CONSTIPATION

This may be a side effect of opioids, but other causes, including inadequate pain relief and surgical causes, must also be ruled out.

Management

- Consider surgical problems and manage them appropriately
- Use multimodal analgesia to reduce opioid requirements
- Consider changing opioids (e.g., morphine to fentanyl)

HYPOTENSION

Usually seen in patients on epidural analgesia and not in patients on PCA. It is almost always contributed by hypovolaemia.

Management

1. Ward or APS doctor to attend to the patient immediately
2. Administer oxygen via facemask
3. Rule out other causes:
   - Inadequate fluid replacement (hypovolemia)
   - Surgical problem (e.g., bleeding)
   - Cardiac event
   - Pulmonary embolus
   - Sepsis

4. Rule out causes related to the epidural:
   - Excessive sympathetic blockade
   - High block associated with bradycardia
   - Catheter migration into subarachnoid space causing a high block

5. Give fluids (200 – 500mls of Hartmann's solution)
6. Reduce the infusion rate if the cause is due to the epidural infusion.
7. Administer vasopressors if necessary, e.g. ephedrine, phenylephrine.

URINARY RETENTION

Surgery, anaesthesia and postoperative analgesia are factors that contribute to postoperative urinary retention. Urinary retention may occur with spinally administered local anaesthetics and opioids or with systemic opioids.

In patients who have not passed urine in the postoperative period, it is important to differentiate urinary retention from anuria due to other causes like acute renal failure, dehydration etc.

Management

1. Confirm full bladder by clinical examination.
2. Reassurance.
3. If the patient is still unable to void, insert an indwelling urinary catheter.

MOTOR BLOCKADE

Incidence during epidural analgesia Lumbar epidural: 7-50%
Thoracic epidural: 1-4%

Management

1. Regular neurological examination (Bromage scoring) and follow up.
2. Reduce epidural infusion rate, adjust, or remove the epidural catheter.
3. Further investigation if motor blockade persists after stopping the local anaesthetic infusion.

POST DURAL PUNCTURE HEADACHE (PDPH)

It is thought to be due to leakage of cerebrospinal fluid (CSF) from the subarachnoid space to the epidural space through the dural puncture site, resulting in traction on meningeal vessels and nerves. Incidence is lower with a smaller gauge pencil-point needles and in the elderly.

Clinical Features:

- Dural puncture and postural component
- A postural component is the hallmark of PDPH, where the headache is worse on sitting, standing, coughing, or straining and relieved by lying down
- Onset may be within a few hours but more commonly present after 24-48 hours.
- Location is bifrontal /occipital and may radiate to neck and shoulder.
- Severity ranges from mild to excruciating
- Associated symptoms are nausea, loss of appetite, photophobia, changes in hearing acuity and tinnitus, diplopia, cranial nerve dysfunction/palsies
- Differential diagnoses include: tension headache, migraine, intracranial bleed or thrombosis, meningitis, or eclampsia (postpartum female). Exclude by checking for the focal neurological deficit, neck stiffness, fever, etc

Risk factors:

1. Age <50 year
   - more frequently in young adults,
   - incidence rate of 14% compared to 7% in individuals older than 70years

2. Obstetric patients
   - Lowering intra-abdominal pressure after delivery lowers the epidural pressure
   - Hormonal changes make cerebral vasculature more reactive

3. The incidence of PDPH depends on size, type, and design of needle
   25G Quincke = 10-15 %
   27G Quincke = 8 %
   27G pencil point = 0.02 %-1.5 %

Management

Up to 90% resolves within 10 days (Candido & Stevens, 2003). Management includes:
Symptomatic:

1. Bed rest to avoid symptoms.
2. Support and reassurance
3. Adequate hydration

Pharmacotherapy:

1. Paracetamol (PCM),
2. NSAIDs
3. Weak opioid (Tramadol or DF 118)
4. Caffeine or caffeinated drinks
5. Sumatriptan

Intervention:

Epidural blood patch if conservative therapy fails. To be performed only by an experienced anaesthesiologist.

*Notes:
Bed rest delays the onset but does not prevent the occurrence of PDPH

NEUROLOGICAL COMPLICATIONS

Permanent neurological damage is the most feared complication of epidural analgesia or peripheral nerve block, but the incidence is extremely low.

Early diagnosis by monitoring patients for:

- Early signs of cord compression (eg, progressive numbness or weakness, bowel, and bladder dysfunction)
- Signs of peripheral nerve injury (Neurological examination)

Neurological injuries caused by neuraxial blockade include:

1. Transient Neurological Symptoms (TNS)
2. Epidural abscess
3. Haematoma – Epidural or Subdural
4. Meningitis – septic or aseptic
5. Cauda equina syndrome
6. Adhesive arachnoiditis
7. Traumatic / Ischaemic injury to spinal cord and nerves roots

Transient Neurological Symptoms

- Persistent pain in the back or in the lower limbs after recovery from neuraxial block
- Symptoms usually resolve spontaneously within a few days
- Etiology is unclear
- Patient should be reassured and given symptomatic treatment with analgesics and must be followed up in the Anaesthetic or Pain clinic until symptoms subside.

Epidural abscess

- Presence of severe or increasing back pain, even in the absence of a fever, may indicate epidural space infection and should be investigated promptly, including sending the patient for urgent MRI.
- If the diagnosis of epidural abscess can be made before the onset of any neurological deficit, conservative treatment (antibiotics only) may be effective.

Cauda Equina syndrome

- Characterized by the sensory deficit in the perineal area, urinary and fecal incontinence, and varying degree of motor deficit in the lower extremities which persists after regression of neuraxial block
- May be permanent or may regress slowly over weeks or months.
- Reported with the use of spinal microcatheters (<24 gauge) for postoperative infusions of local anaesthetics.

Epidural Hematoma

Incidence varies from 1:150 000 (epidural) to 1:220 000(Spinal) (Tryba 1993).

Risk factors:

1. Difficult puncture/bleeding during catheter insertion
2. Peri-operative anti-coagulation therapy or thromboembolism prophylaxis
3. Perioperative coagulation disorder

Management

- Early diagnosis, a high index of suspicion in patients with risk factors.
- Presence of severe or increasing back pain, even in the absence of local swelling may indicate epidural hematoma and should be investigated promptly, including sending the patient for urgent MRI.
- Early decompression (less than 8 hours after the onset of neurological signs) results in good neurological recovery.

Subdural Haematoma

- Intracranial subdural haematoma is a rare complication of prolonged reduction of CSF pressure resulting in high mortality and persistent neurological deficit.
- Prevention is by prompt diagnosis and treatment of Post dural puncture headache.

Spinal Cord Injury

- Traumatic injury to spinal cord and nerves roots is rare
- Anterior spinal artery syndrome giving rise to spinal cord ischemia and infarction may occur after prolonged periods of arterial hypotension and/or the use of adrenaline in the local anaesthetic solution.

Local anaesthetic systemic toxicity (LAST)

Incidence: 0.87 per 1,000 blocks

Risk factors associated with increased LAST events:

1. Paravertebral & upper limb block
2. Use of lignocaine compared with ropivacaine
3. Larger doses of local anaesthetic

Ultrasound usage was associated with a reduced incidence of LAST Toxicity risk: bupivacaine > levobupivacaine > ropivacaine

Treatment for LAST: Lipid emulsion therapy **(different from other cardiac arrest scenarios)**

Mechanism of action of the lipid emulsion:
Partitioning of local anaesthetic within the emulsion itself (acting as a “lipid sink”) Mitochondrial substrate enhancement in the myocardium
Direct inotropic effect

Management

1. Stop injecting the local anesthetic
2. Get help
   - Consider lipid emulsion therapy at the first sign of a serious LAST event
   - Call for the LAST Rescue Kit
   - Alert the nearest cardiopulmonary bypass team — resuscitation may be prolonged

3. Airway management
   - Ventilate with 100% oxygen / avoid hyperventilation / advanced airway device if necessary

4. Control seizures
   - **Benzodiazepines** preferred
   - **Avoid** large doses of **propofol**, especially in hemodynamically unstable patients

5. Treat hypotension and bradycardia — If pulseless, start CPR
   - **Reduce** individual epinephrine boluses to ≤ 1 mcg/kg (use 10-100mcg boluses)
   - **Avoid** vasopressin, calcium channel blocks, beta blockers, or other local anesthetics
   - **Amiodarone** preferred in ventricular arrhythmias (avoid lignocaine)

6. Lipid emulsion 20% (Precise volume & Flow rate not crucial)
   a. Greater than 70 kg
      Bolus 100 ml over 2-3 min, then 200-250ml over 15-20 min
   b. Less than 70 kg
      Bolus 1.5 ml/kg over 2-3 min, then 0.25 ml/kg/min or 15 ml/kg/hour (based on ideal body weight)

Notes:
If the patient is still unstable, may re-bolus 1-2x (same dose) and increase to 2x infusion rate. Dose limit of lipid emulsion: 12 ml/kg (small adult/children) or 1 L (adult)

7. Cardiopulmonary bypass (CPB) in the event of failure to respond to lipid emulsion and vasopressor therapy

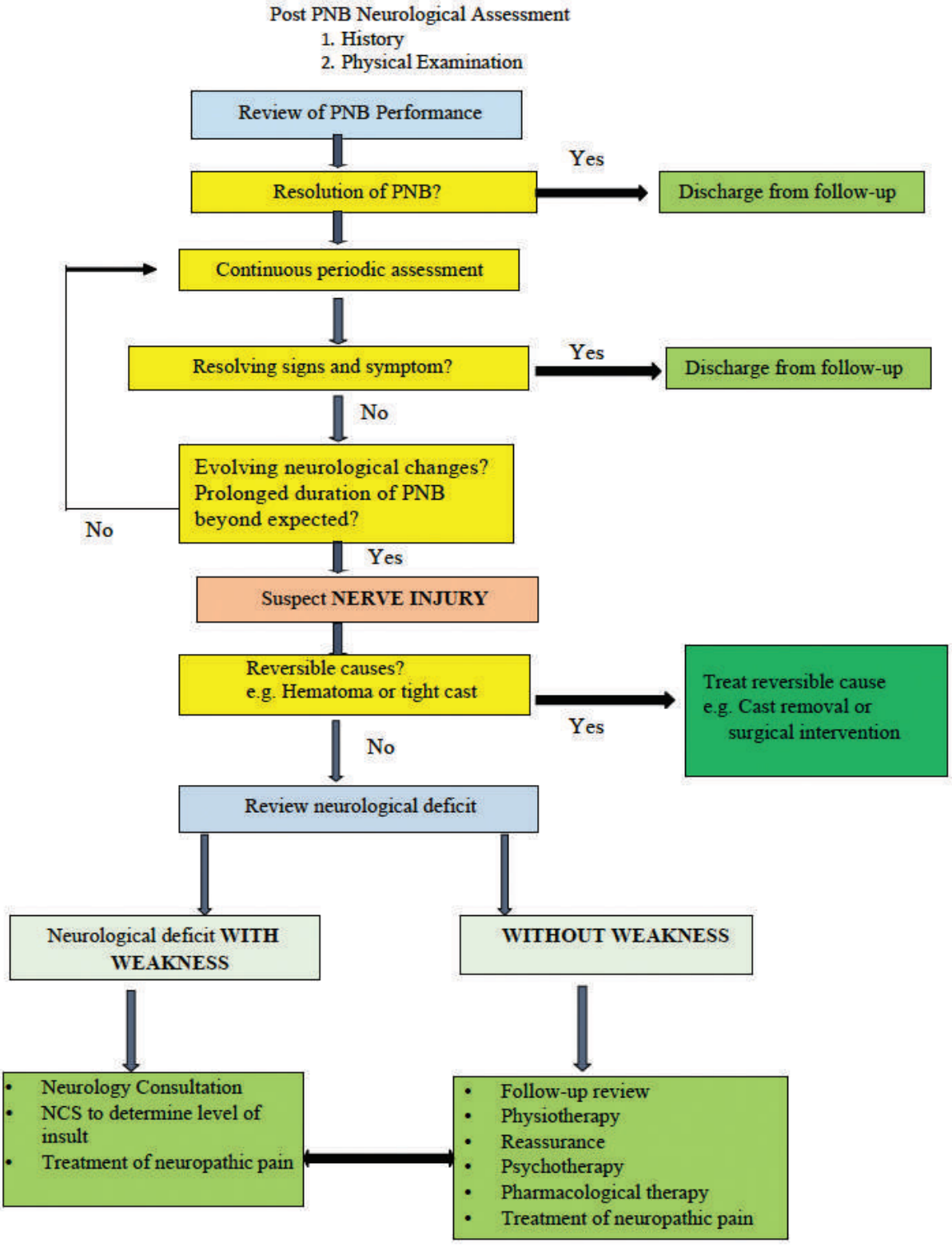
8. Continue monitoring
   - At least 4-6 hours after a CVS event or 2 hours after a limited CNS event
   - Daily amylase/lipase assay for 2 days (to exclude pancreatitis)

Peripheral nerve injury

- Transient (resolve within 3 months) – 0.2% (0.1 – 1.4%)
- Longer lasting, permanent (> 9 months) – 0.07%

Management

ALGORITHM FOR SUSPECTED POST PERIPHERAL NERVE BLOCK NEUROLOGICAL DEFICIT



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CHAPTER 7

ACUTE NEUROPATHIC PAIN

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Acute neuropathic pain (ANP) is a condition that is under-recognized, often difficult to treat, and one that may progress to persistent pain and disability. The incidence of acute neuropathic pain has been reported as 1- 3% primarily after surgery or trauma.

Neuropathic pain is defined as pain that arises as a direct consequence of a lesion or disease affecting the somatosensory system. Acute neuropathic pain can be one of the causes of post-surgical and post-trauma pain. Early recognition, prevention, and treatment of the patient with acute neuropathic pain is essential because it does not respond to the conventional analgesics used for the treatment of acute pain.

Characteristics of neuropathic pain

- Sharp, burning, stabbing, stinging, shooting, or electric shock-like in quality, pins and needles sensation, numbness and itching
- Allodynia and hyperalgesia.
- Dysesthesias – an unpleasant abnormal sensation, whether spontaneous or evoked
- Continuous and/or episodic paroxysmal pain
- It may be present preoperatively and may worsen after surgery.

Acute neuropathic pain can occur for the first time in the postoperative period. This is usually due to inflammation around nerve roots following surgery and may be temporary.

Acute neuropathic pain should be considered if pain persists despite high doses of strong opioids and multi-modal analgesic medications.

Severe, persistent neuropathic pain has to be investigated to exclude compression of nerve roots, e.g. by a haematoma or infection.

The intensity of acute post-surgical pain is a consistent predictor of chronic post-surgical pain.

Causes of acute neuropathic pain:

1. **Post-operative**: thoracotomy, sternotomy, cholecystectomy, mastectomy, amputation of a limb, and surgeries associated with risk of nerve injury.
2. **Post-trauma**: brachial plexus avulsion, lumbosacral plexus injury, spinal cord injury, and injury to peripheral nerves.
3. **Infection**: acute herpes zoster, Guillain-Barre syndrome, TB spine
4. **Neurological disorders**: central post-stroke pain, multiple sclerosis, trigeminal neuralgia
5. **Nerve compression**: Carpal tunnel syndrome, acute sciatica

The diagnosis of acute neuropathic pain is made by the underlying medical/surgical condition that has a risk, a detailed pain history, a thorough physical examination, and the use of neuropathic pain screening tools.

Although data is lacking, agents that have demonstrated efficacy in persistent neuropathic states should be used in acute neuropathic pain.

Recommended treatments

1. Anticonvulsants

Gabapentin

- Start at 300mg ON and titrate to a maximum dose of 3600mg/day.
- Side effects include dizziness, sedation, gastro-intestinal (GI) symptoms, and mild peripheral oedema.
- Dose adjustment is recommended in renal impairment.

Pregabalin

- Start at 75mg ON and titrate up to twice daily to a maximum dose of 600mg daily.
- Side effects similar to Gabapentin.
- Dose adjustment needed in renal impairment.

2. Tricyclic antidepressants

Amitriptyline

- Start at 12.5-25mg at bedtime. Increase by 12.5-25mg weekly up to a maximum of 75mg/day if tolerated.
- Side effects include dry mouth, headache, sedation, disturbed vision, arrhythmia, palpitation, postural hypotension, urinary retention, and constipation.
- Caution in elderly patients, cardiac disease, glaucoma, and concurrent use of SSRI, SNRI, and MAO inhibitors.

3. Duloxetine

- Commence at 30mg ON.
- May be increased to 60 mg after a week and can titrate up to 60mg BD.
- Side effects include nausea, vomiting, dry mouth, constipation, decreased appetite, insomnia, dizziness, somnolence, blurred vision, increased sweating, and fatigue.
- Advise patients to take it with food to reduce the incidence of nausea.
  *Please refer to the Drug formulary for further information.

4. Ketamine (refer Appendix 10)

- may be useful for treating neuropathic pain, which is often difficult to control.

5. Lignocaine (refer Appendix 11)

- may be useful for treating neuropathic pain and acute hyperalgesia

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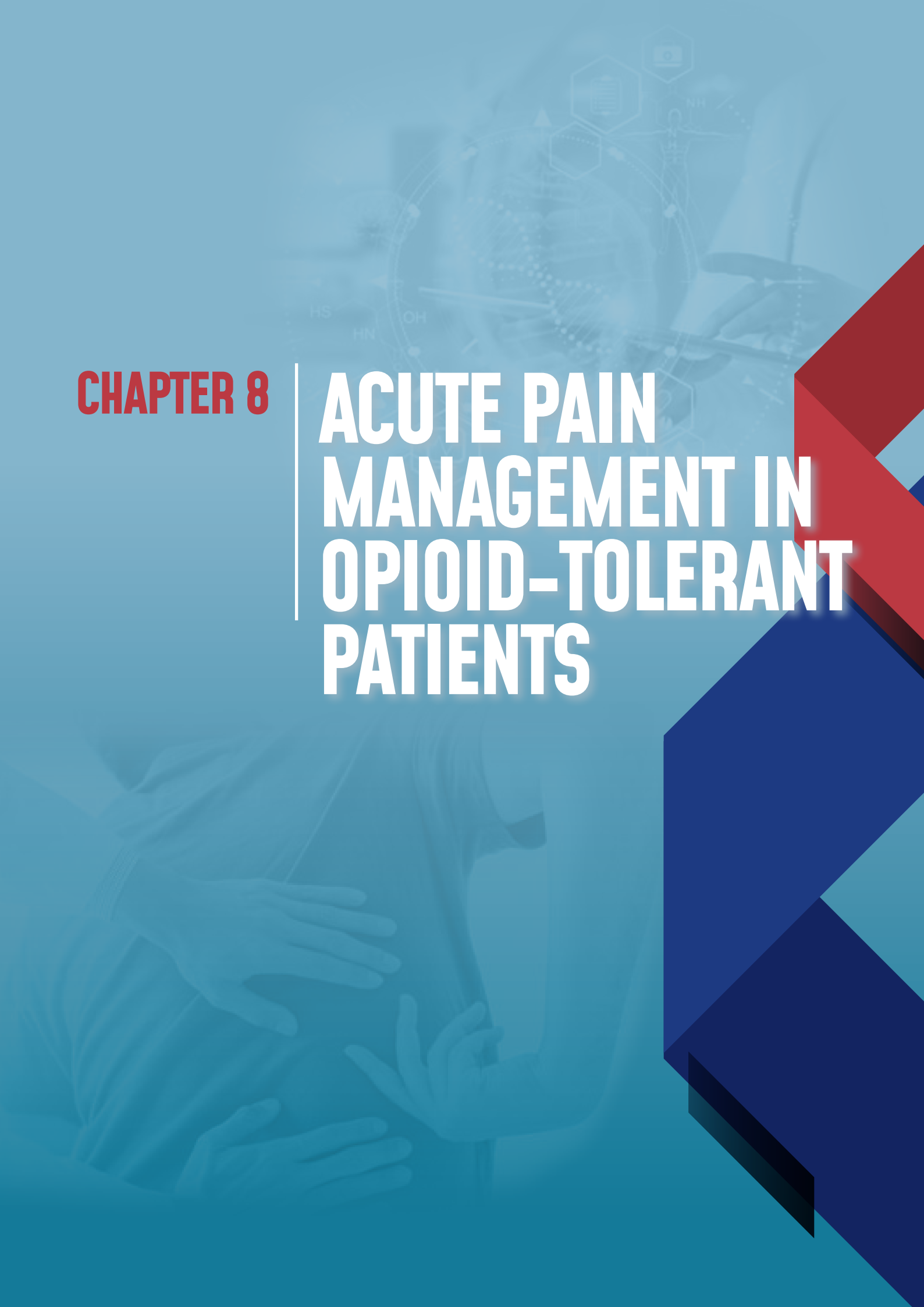

CHAPTER 8

ACUTE PAIN MANAGEMENT IN OPIOID-TOLERANT PATIENTS

CHAPTER 8 ACUTE PAIN MANAGEMENT IN OPIOID-TOLERANT PATIENTS

Opioids are commonly used for the management of pain. Prior exposure to opioids, whether recreational or therapeutic, may lead to the development of opioid tolerance.

It is crucial to recognise opioid-tolerant patients and plan their perioperative management as they would need higher opioid doses and may also require additional analgesic techniques.

Pain is often underestimated and under-treated in opioid-tolerant patients; postoperative pain scores in opioid-tolerant patients may be higher than in the opioid-naïve.

The main goals in treating acute pain in opioid-tolerant patients are effective pain relief and preventing withdrawal symptoms.

Identification of opioid-tolerant patients

There are 4 main groups of opioid-tolerant patients.

- Patients who have cancer pain treated with opioids.
- Patients who have chronic non-cancer pain treated with long-term opioids, presenting with an acute painful condition (e,g surgery, trauma)
- Patients with an opioid addiction disorder or those with a previous disorder who are on a maintenance programme (e.g. methadone).
- Patients who have developed acute or subacute opioid tolerance due to perioperative or postoperative opioid administration, particularly opioids of high potency, e.g. remifentanil or in high doses for extended periods (e.g. in an ICU)

Table 8.1 : Terminology

Tolerance	A predictable physiological decrease in the effect of a drug over time so that a progressive increase in the amount of that drug is required to achieve the same effect. Tolerance develops to desired (e.g. analgesia) and undesired (e.g. euphoria, opioid-related sedation, nausea or constipation) effects at different rates.
Physical dependence	A physiological adaptation to a drug whereby abrupt discontinuation or reversal of that drug, or a sudden reduction in its dose, leads to a withdrawal (abstinence) syndrome. Withdrawal can be terminated by the administration of the same or similar drug.
Addiction	A disease characterised by aberrant drug-seeking and maladaptive drug-taking behaviours may include cravings, compulsive drug use and loss of control over drug use, despite the risk of physical, social, and psychological harm. While psychoactive drugs have an addiction liability, psychological, social, environmental, and genetic factors play an essential role in the development of addiction. Unlike tolerance and physical dependence, addiction is not a predictable effect of a drug.
Pseudo addiction	Behaviours may seem inappropriately drug seeking but result from under-treatment of pain and resolve when pain relief is adequate.
Physical withdrawal	A syndrome occurs if an opioid is abruptly stopped, rapidly reduced, or reversed by the administration of an antagonist.
Opioid Induced Hyperalgesia (OIH)	A state of nociceptive sensitization secondary to exposure to opioids. Often more diffuse and widespread pattern.

Source: Adapted from Weissman&Haddox (1989), the Consensus statement from the American Academy of Pain Medicine, the American Pain Society and the American Society of Addiction Medicine (2001), Alford et al. (2006) and Ballantyne and LaForge (2007), GK Simpson et al. (2017)

Table 8.2 : Signs and symptoms of opioid withdrawal

Signs	Symptoms
Sweating	Restlessness
Pupillary dilatation	Irritability
Tachycardia	Nausea
Hypertension	Abdominal cramps
Vomiting	Increased sensitivity to pain
Diarrhoea	Myalgia
Yawning	Dysphoria
Fever / Chills	Insomnia
Rhinorrhoea	Anxiety
Lacrimation	Craving for opioids
Piloerection	

Acute pain management

An acute pain management plan must be made. The plan should include the following:

- Identification of opioid-tolerant patients
- Effective pain control
- Prevention of withdrawal symptoms
- Avoidance of overdose
- Multidisciplinary approach with other treating health professionals and teams to ensure continuity of long-term care.
- A step-down analgesic plan which is acceptable to the patient.
- Appropriate discharge planning to ensure continuity of long-term care.

Patient Assessment

- Differentiate new from pre-existing pain and baseline pain intensity
- Identify biological, psychological, and social triggers for pain deterioration in those with chronic pain
- Nicotine addiction, alcohol dependence and psychiatric history are relevant risk factors for drug addiction.
- Differentiate between opioid users for chronic pain and opioid abusers. Obtain details of the type of opioid, the duration of use/abuse and the timing of the last dose
- Pre-existing sleep-disordered breathing is present in 70-80% of patients taking long-term opioids. Central sleep apnea is more predominant than obstructive sleep apnea.
- Health practitioners determine the need for elective procedures or labour analgesia planning. Patients should be referred early for pain management planning and optimisation.
- Review previous records and information about the prior experience of acute pain management. Sought to avoid or optimise strategies that were ineffective and replicate those that were effective.
- Meaningful engagement of the patient and their family/caregivers is key to assessment, management, and adherence to the proposed plan through expected management, addressing concerns and education.

Table 8.3 : Clinical differentiation between opioid users for chronic pain and opioid abusers

	Opioid users for chronic pain	Opioid abusers
Use of opioids	Appropriate Declared	Out of control Often deliberately omitted
Quality of life	Improved by opioids	Impaired by opioids
Awareness of opioid-related side effects	Complete	Unconcerned
Diagnosis	Available	Unavailable
Treatment plan and medical prescription	Followed	Unavailable
Opioid medication	Available	Hidden, Illicit

Source: Adapted from Therapeutics and Clinical Risk Management 2017:13, 1163-1173

The provision of effective analgesia

A multimodal approach is recommended.

- Continuation of their usual background opioid dose to prevent withdrawal symptoms
- Additional immediate-release opioids for acute pain
- Opioid sparing techniques such as:

  - Paracetamol and NSAIDs / COX-2 inhibitors are prescribed regularly unless contraindicated.
  - Regional anaesthesia and analgesia – single-shot long-acting local anaesthetic or using catheter techniques
  - Low-dose ketamine given as a continuous intravenous infusion. (Refer to Appendix 10)
  - Adjuvants
    - Gabapentin and Pregabalin attenuate opioid tolerance, but there is not much research regarding dose, duration and effectiveness.
    - IV Dexamethasone is an effective adjunct with a dose greater than 0.1 mg/kg pre-operatively.

  - Nonpharmacological strategies

    - Physiotherapy and cognitive behavioural therapy.

Continue dose of usual opioid to prevent withdrawal

Baseline opioids must be continued in the perioperative period with additional doses for acute pain.

If the patient takes typically oral medication but has to be nil by mouth, then an equivalent parenteral replacement will be needed

Additional opioids for acute pain

- For minor procedures, immediate-release opioids can be administered as required. A starting dose of one-sixth of the patient's usual total 24-hour opioid dose, given up to 4 hourly, is recommended.
- The use of intravenous PCA is widely recommended as a treatment as it allows dose titration and minimises side effects. Patients will require increased bolus doses (compared to other patients) and may require a background infusion if unable to take their usual dose of opioids.

Example A

Mr A has Ca pancreas and is on 120mg sustained release morphine BD for pain control. He is admitted with intestinal obstruction requiring an emergency laparotomy. He is planned for PCA morphine postoperatively.

- To prevent withdrawal, the usual oral 24-hour opioid dose needs to be maintained, i.e. 240mg oral morphine.
- As he is nil by mouth this needs to be converted to an IV dose.
- Conversion ratio for oral morphine: IV morphine is 2.5 : 1 (see Table 8.3 equianalgesic doses)
- Total IV dose over 24 hours = 96mg, i.e. a background infusion of 4mg / hour.
- The bolus dose should be started at 50% of the dose of the background infusion (2mg), with a standard lock-out time of 5 mins.

A multimodal approach that includes Paracetamol and NSAIDs should be used if there are no contraindications.

Placement of an epidural catheter or other regional techniques wherever possible can be used in combination with PCA, which will help to reduce the overall consumption of opioids and improve analgesia

Note that this PCA strategy is a guideline and may not be suitable for all patients in all situations.

Opioid tolerant patients need more frequent assessments, and the initial PCA regimen will need to be altered depending on the patient's response.

Example B

Mr B who is an ex IVDU is on a methadone maintenance program of 100mg daily. He is admitted with PGU and requires a laparotomy for which he will be nil by mouth postoperatively.

He is unable to take oral methadone, so we need to convert his dose of methadone to a suitable dose of IV opioid to prevent withdrawal

- Need to convert his last 24 hours dose of methadone to oral morphine equivalents: Oral methadone: oral morphine 1:2 or 1:3
- Using 1:2 ratio, 100mg oral methadone is equivalent to 200mg oral morphine
- 200mg oral morphine is equivalent to 80mg IV morphine (2.5:1)
- As there is incomplete cross-tolerance between the different types of opioids, we reduce the equianalgesic dose of oral morphine by 50%.
- Dose of IV morphine required over 24 hours to prevent withdrawal is 40mg.
- So PCA should have morphine at 1.5mg/h background infusion and starting bolus dose at 50% of the background infusion ± 1mg bolus.

Example C

Miss C has Ca Stomach and is on Fentanyl Transdermal Patch 100mcg/hour. She is unable to take orally due to gastric outlet obstruction and has a feeding jejunostomy. She developed an obstructed umbilical hernia that requires urgent surgery.

- The fentanyl patch should be continued at the baseline dose. (100mcg/hour)
- Additional opioids to cover for acute pain using PCA Fentanyl

Placement of an epidural catheter or other regional techniques wherever possible can be used in combination with PCA which will help to reduce the overall consumption of opioids and improve analgesia. It is recommended that opioid should be omitted from the epidural infusion.

Step down analgesia plan

A reverse pain ladder approach is recommended until the baseline opioid requirement is reached. This is in contrast to the step-up approach for cancer pain.

To convert the patient from IV opioids to oral

- Calculate the patient's last 24-hour consumption of IV opioids and convert this back to the oral equivalent.
- Then administer 50% of this dose in a sustained release oral preparation prescribed regularly.
- The dose of immediate-release opioids should be 1/6 of the calculated 24-hour oral requirement prescribed on a PRN basis.

Example D

An opioid tolerant patient recovering from major surgery is now able to take orally and the plan is to convert him from his PCA morphine to oral morphine. He has used 50mg of IV morphine in the last 24 hours

- Need to convert IV morphine dose to oral morphine equivalents – 50mg IV morphine is equivalent to 125 mg oral morphine (1:2.5)
- 50% of the calculated oral equivalent (62.5mg) is given in a sustained release form e.g. 30mg of SR morphine twice daily.
- 1/6 of the calculated oral equivalent (62.5mg) dose is given in the immediate release form as required basis e.g. Syrup Morphine 10mg prn

Management of patients on buprenorphine

Buprenorphine is used as maintenance therapy in opioid addiction disorder. It is usually used in oral doses ranging from 8 – 32mg.

Buprenorphine patch is also available for chronic non-cancer pain.

Its maximum effect at the μ opioid receptor is less than that of a full agonist producing a ceiling effect for respiratory depression and analgesia. It also has a very high opioid receptor affinity, and other opioids do not easily reverse its binding to opioid receptors.

Perioperative pain management strategies for patients stabilised on buprenorphine.

Minor procedures

- Continue the current buprenorphine regimen (and consider an increase by 25%)
- Maximize non-opioid treatments.

Major procedures

- Continue the usual dose of buprenorphine + 25% increase
- Maximize non-opioid analgesia
- Consider the titration of intravenous opioids such as fentanyl or morphine. Patients should be closely observed for adverse effects of sedation or respiratory depression – HDU care is appropriate where available

Or

- Cease buprenorphine 72 hours preoperatively and commence a full opioid agonist (sustained-release morphine) 24 hours later or earlier if opioid withdrawal is noted.
- Additional doses of full agonist can be titrated to withdrawal symptoms preoperatively and analgesic requirements postoperatively

Summary

Preoperative

- Evaluation: Early recognition and high index of suspicion.
- Identification: Total opioid dose requirement, previous surgery/trauma resulting in inadequate analgesia.
- Consultation: Anaesthesiologist / addiction specialist / pain specialist for perioperative planning.
- Reassurance: Discuss concerns related to pain control and anxiety.
- Medication: Calculate opioid dose requirement and modes of administration, and provide anxiolytics and other medications as clinically indicated.

Intraoperative

- Maintain baseline opioid requirement (oral, transdermal, intravenous).
- Titrate intraoperative and postoperative opioids according to the response.
- Provide peripheral nerve or plexus blockade and consider neuraxial analgesic techniques when indicated.
- Use non-opioids as analgesic adjuncts

Postoperative

- Plan preoperatively for postoperative analgesia: Formulate a plan.
- Maintain baseline opioids.
- Use multimodal analgesic techniques.
- PCA: Use as primary therapy or as supplementation for epidural or regional techniques.
- Continue neuraxial opioids: intrathecal or epidural analgesia
- Continue continuous neural blockade

Upon discharge

- If surgery provides complete pain relief, opioids should be slowly tapered rather than abruptly discontinued.
- Establish a pain management plan before discharge. Provide adequate doses of opioid and non-opioid analgesics.
- Arrange a follow-up appointment with the patient's addiction or pain medicine specialist.

Adapted from Anaesthesiology 2004; 101:212-27: Perioperative Management of Acute Pain in the Opioid-dependent Patient; SukanyaMitra, Raymond Sinatra.

Table 8.4 : Suggested dose conversion ratio in the direction specified

From / To	Codeine mg/day	Oral morphine mg/day	SC morphine mg/day	Oxycodone mg/day	Fentanyl TD mcg/h
Oral codeine mg/day		8	20	12	24
Oral morphine mg/day	8		2.5	1.5	3
SC morphine mg/day	20	2.5		0.6	1.2
Oxycodone mg/day	12	1.5	0.6		2
Fentanyl TD mcg/h	24	3	1.2	2	

Notes: Yellow fill: Multiply
Pink fill: Divide

Additional conversion: Morphine 40mg/day PO = Tramadol 200mg/day PO

Table 8.5 : Conversion from Morphine to Buprenorphine

Oral Morphine (mg in 24 hours)	Buprenorphine patch (mcg per hour)
10	5
15	10
30	20
45	
60	35
90	52.5
120	70
180	
240	

Adapted from The British Pain Society, 2007

Table 8.6 : Recommendations and equianalgesic dose conversion ratios for perioperative pain management

Commonly used opioids	Recommendations	Conversion ratio
1. Oral Morphine	▪ Continue if allowed orally ▪ Convert to IV morphine and maintain baseline if NBM ▪ Additional morphine as indicated	Oral Morphine: IV Morphine **2.5: 1**
2. Oral Oxycodone	▪ Continue if allowed orally ▪ Convert to IV morphine and maintain baseline if NBM ▪ Additional morphine as indicated	Oral Oxycodone: IV Morphine **1: 0.6**
3. Oral Tramadol	▪ Continue if allowed orally ▪ Convert to IV morphine and maintain baseline if NBM ▪ Additional morphine as indicated	Oral Tramadol: Oral Morphine **5:1** Convert oral morphine to parenteral morphine (see above)

Commonly used opioids	Recommendations	Conversion ratio
4. Oral Codeine	▪ Continue if allowed orally ▪ Convert to IV morphine and maintain baseline if NBM ▪ Additional morphine as indicated	Oral Codeine to IV Morphine Oral Codeine ÷ 20 = IV Morphine (Oral codeine dose divided by 20 is equivalent to IV morphine equianalgesic dose)
5. Fentanyl transdermal patch	▪ Continue ▪ Additional morphine as indicated	
6. Buprenorphine transdermal patch	▪ Continue ▪ Additional morphine as indicated	

These conversions are provided only as an approximate guide to equivalences.

There is incomplete cross-tolerance between different opioids, but the exact amount will differ. Thus equianalgesic doses are only approximations.

Depending on age, and prior side effects, most experts recommend starting a new opioid at ½ -2/3 of the calculated equianalgesic dose.

Suggested safe and effective starting dose when changing oral morphine to oral methadone

Morphine dose (mg/day)	Morphine to metadone equianalgesic dose ratio	Methadone starting dose
30-90	4:1	e.g 90 mg morphine per day = 22.5 mg methadone per day
90-300	8:1	e.g 200 mg morphine per day = 25 mg methadone per day
>300	12:1	maximum = 30 mg methadone per day as outpatient

Source : www.bpac.org.nz keyword: methadone
WHO Analgesic Ladder : Step 3.
Methadone-Safe and Effective use for Chronic Pain

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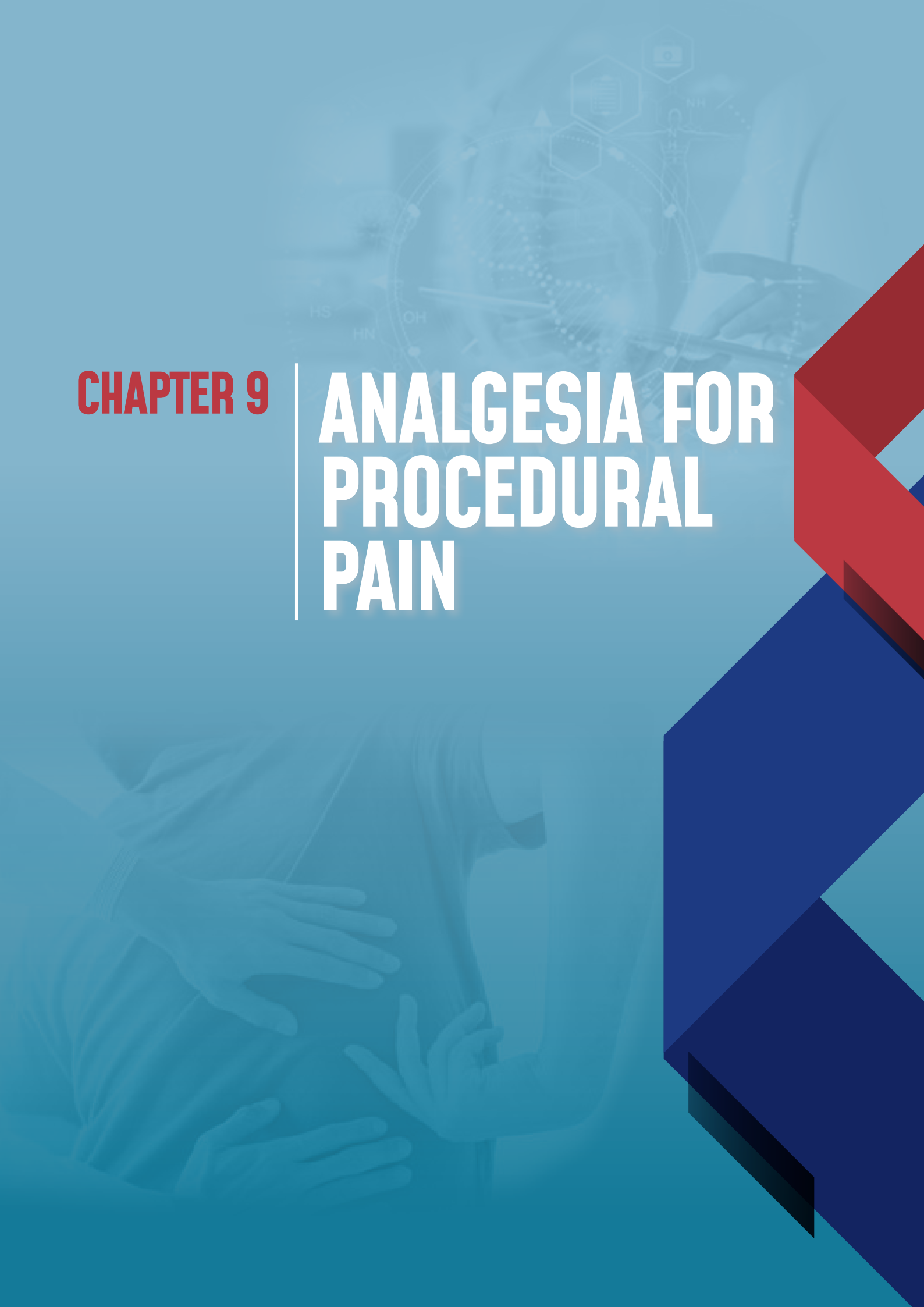
www.bpac.org.nz keyword: methadone



CHAPTER 9

ANALGESIA FOR PROCEDURAL PAIN

CHAPTER 9 | ANALGESIA FOR PROCEDURAL PAIN

Introduction

Pain is an essential aspect of all procedures. "Unresolved pain negatively affects the quality of life. Proper assessment, suitable dressing choices, skilled management, and an individualized analgesic regimen can be utilized to manage pain during procedures.

Identifying Pain

Procedural pain can be encountered in various situations:

Uncaring attitude:

- Including poor patient handling
- Disrespect of patient and disregard of patient's suffering
- Often seen during mobilisation of the patient, nursing care, during procedure, e.g. commanding, shouting etc.
- Will enhance the real pain and increase the patients' suffering of pain in terms of the psychological aspect

This attitude can be managed by taking these necessary steps:

- Assessment of personality and characters
- Awareness and evaluation
- Supervision and monitoring
- Counseling, psychotherapy
- Warning, punitive action, and reprimand

Poor bedside manners will also cause this type of pain.

Diagnostic processes that can produce pain:

- Blood taking
- X-rays, CT scan
- Ultrasound
- Maneuvering of body parts
- Mobilization and transportation of the patient

The therapeutic processes causing pain may include the following:

- IV, IM, SC injections
- Procedure – catheterisation, close manual reduction (CMR), etc.
- Lavage
- Foreign body removal
- Suturing
- Wound dressing
- Cardioversion
- Abscess incision and drainage

All these processes can produce pain and untoward events to the patients. In turn, the number of complaints towards the healthcare personnel might also increase.

Types of pain

Background pain

The pain felt at rest, when no wound manipulation is taking place.

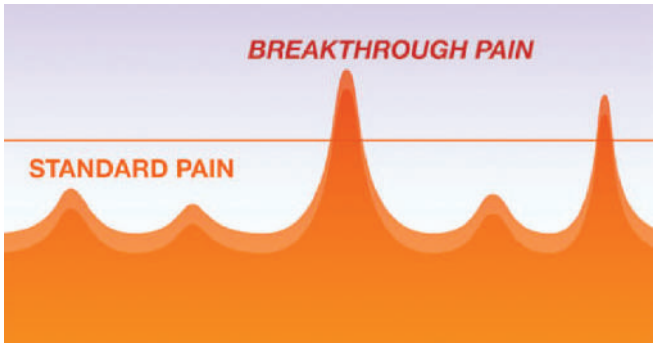
May be continuous (e.g. like a toothache) or intermittent (e.g. like a cramp or night-time pain).

Related to the underlying cause of the wound, local wound factors (e.g. ischemia, infection, and maceration) and other related pathologies (e.g. diabetic neuropathy, peripheral vascular disease, rheumatoid arthritis, and dermatological conditions).

Incident (breakthrough) pain

The pain that may occur during day-to-day activities (e.g. mobilization, physiotherapy, coughing, repositioning).

Figure 9.1 : Type of pain



Procedural pain

Results from a procedure such as dressing change and simple wound debridement

Assessment of pain

Assessment of pain is essential for its management. Refer Chapter 4.

Management:

■ BACKGROUND PAIN

- Non-pharmacological methods. Refer Chapter 16.

- Pharmacological refer chapter acute pain
- Analgesics are given according to the severity (pain score) of pain. (Refer analgesic ladder in ***Appendix 6*** and List of Drugs used as analgesics in ***Appendix 9***) for drug dosages and dosing intervals.

  - Oral Paracetamol +/- NSAIDs or COX-2 inhibitors +/- Weak opioids (Dihydrocodeine or Tramadol)
  - Adjuvant – Gabapentin / Pregabalin
  - Gabapentin prescription:
    Age 18-60 years old - to start 300mg on then titrating to 300mg TDS
    Age > 60 years old- to start 100 -150 mg BD
  - Pregabalin prescription:
    Age 18-60 years old – to start 75 mg ON then 75mg BD
    Age > 60 years old – to start 50 mg ON then TDS

*In patients who are unable to take orally, the above drugs may be replaced by any of the following:

- Subcutaneous Morphine/Oxycodone 2.5-5 mg (4-6 hourly) or Tramadol 50-100 mg (6 – 8 hourly) (maximum dose for tramadol is 400mg in a day)
- COX-2 inhibitors – IV Parecoxib 20 mg - 40 mg BD (maximum for 3 days)
- IV Paracetamol. Refer Drug Formulary.

- *For patients with severe pain refer to the Acute Pain Service (APS).

*It is important to be aware of the contraindications and potential adverse effects of these drugs and to treat them when they occur.

■ INCIDENT PAIN

All patients must be allowed to have “PRN” doses of analgesics to cover incident pain.

The actual analgesic and the dose depend on the analgesia prescribed for the background pain. However, if there are more than 2 extra doses required, it will be necessary to review the background analgesics.

For the management of incident pain, please refer to acute pain ladder.

PROCEDURAL PAIN

Non-pharmacological management:

- adequate preparation of the patient
- use of non-traumatic dressings
- to soak dressings before removal
- allowing patient control (e.g. allowing the patient to determine the time of the dressing)
- relaxation / imagery

Pharmacological management:

- All analgesics should be administered before a painful event.
- If pain persists post-procedure, background medication should be continued.
- Monitor the vital signs.

Oral medications

- **Mild to moderate pain:**

  Paracetamol and NSAIDs should be given at least 1 hour prior to the procedure. It can be given with weak opioids like Tramadol or Dihydrocodeine (Refer Appendix 9)

- **Moderate to severe pain:**

Strong opioids like immediate-release Oxycodone and Syrup Morphine may also be administered 1 hour prior to the procedure.

Subcutaneous medications

Indications:

- Unable to take orally
- If the patient has severe pain during the procedure despite oral analgesics.
- If IV line is not available

Subcutaneous Morphine or Oxycodone

- 15 -30 minutes before procedure.
- < 65years : 5mg -10mg
  > 65years : 2.5mg -5mg

Intravenous medications

1. Intravenous Opioid:

   - Titrating IV Morphine using Morphine pain protocol (appendix 5).
   - Titrating IV Oxycodone (by Anaesthetist)
   - Titrating IV Fentanyl 0.5 mcg/kg slow bolus to be given 5-10 minutes before the procedure, repeated during the procedure, if necessary, up to a maximum of 2 mcg/kg (total dose) IV Fentanyl

If the above analgesics techniques are not adequate, PCA may be used (refer Acute Pain Service Team.)

Note:

The difference between IV Morphine/Oxycodone and IV Fentanyl is in the onset and duration of action, with IV Fentanyl having a faster onset but shorter duration of action. Fentanyl is also more potent than Morphine/Oxycodone and can rapidly cause profound sedation and respiratory depression.

Assess pain and monitor vital signs.

2. Intravenous Ketamine - 0.25 - 0.5 mg/kg titrated to effect.

   - Usually used in children, but may be used in adults in selected cases.
   - Patient may have hallucinations with the use of this drug and IV Midazolam 1-2 mg may have to be used concomitantly.

   *Ketamine only to be used by Emergency Department and Anaestesiology Department

3. Intravenous Paracetamol 500 mg – 1 gm 30 minutes before the procedure.

Topical local anaesthethics

Lignocaine (2% in 5-10 mls of normal saline, plain lignocaine max dose 4mg/kg body weight; lignocaine with adrenaline max dose is 7mg/kg body weight), soaked gauze over the wound; allow to sit on the wound for 3-5 mins before the procedure.
It may provide a degree of numbness.

Inhalational

1. Methoxyflurane (Penthrox®)

- used as an inhaler 5 mins prior to the procedure
- each inhaler can be used multiple times by the same patient
- The maximum dose of methoxyflurane via the inhaler is:
  - 3mL to 6 mL for a single episode of severe pain
  - 15mL in any 7-day period (5 x 3mL bottles)
  - Can only be used once in 48 hours (alternate day administration)

Contraindications

- Severe renal impairment with reduced glomerular infiltration rate (GFR) <30 mL per minute
- Renal failure
- Hypersensitivity to fluorinated anaesthetics
- Cardiovascular instability
- A history of possible adverse reactions in either patient or relatives
- Patients unable to hold the inhaler due to impaired consciousness/cooperation
- Patients who are intoxicated with alcohol or illicit drugs
- Patients with respiratory depression, airway obstruction or airway burns
- Patients susceptible to or having a family history of Malignant Hyperthermia
- Concurrent use of tetracycline and other antibiotics of known nephrotoxic potential is not recommended as it may result in fatal renal toxicity
- Precautions in diabetic patients and liver disease

2. N2O Analgesia (Entonox®).

- administered through a facemask or mouthpiece.
- The facemask or mouthpiece is connected to an Entonox® supply through a demand valve system which allows the Entonox® to be self-regulated by the patient.
- The demand valve is operated by the act of inhalation of the patient and closes down when the patient ceases to inhale.
- In nearly all cases, Entonox® is self-administered,
- It may be administered by attendant medical personnel.

Screening Tests:

All patients should be screened and monitored as follows:

- Haematologic
  Baseline Full blood picture, differential, and film. Repeat weekly

- Metabolic
  Baseline fasting homocysteine level. Repeat weekly

- Neurologic
  Baseline neurologic examination**** and lower limb "scratch test" Repeat weekly

Consider pregnancy test (BHCG) in women of childbearing age.

Prescribe The Following During Entonox Therapy

- Folinic acid 15 mg p.o. daily
- Vitamin B12 1000 mcg IM weekly

Contraindications:

- Confined airspace disease: eg pneumothorax, intracranial gas/air, bowel obstruction, middle ear or sinus obstruction, gas embolism.
- Severe respiratory disease
- Bone marrow failure eg. leukaemia, chemotherapy
- Folic acid deficiency
- Vitamin B12 deficiency (pernicious anaemia)
- Chronic neurological disease eg multiple sclerosis
- Known hyperhomocysteinaemia
- Pregnancy

Prescribing Entonox® Therapy
Entonox® 50:50 N2O and O2 for .....minute; ..... times per day
for ..... days (**maximum 7 days before review**)

Entonox® therapy should be kept to a minimum and ceased as soon as possible Cease Entonox® therapy and review if any of the following develop:

1. Significant decrease in blood cell counts and/ or macrocytosis, megaloblastosis develops on haematological screening
2. Abnormal neurological signs and symptoms develop, particularly in the lower limbs.
3. Change in homocysteine levels of greater than 30 % from baseline.

**** Neurological examination Hankey and Edis J Neuro 1989; 395-398.

Baseline neurological examination of lower limbs including power, reflexes, proprioception, and vibration is necessary. This should be repeated weekly.

The "scratch test" developed by Hankey and Edis in 1989 for assessment of posterior column pathology, is a standardized, repeatable objective test of posterior column neurological function.

Equipment: a tongue depressor is split in half in the long axis and the "sharp-end" is used as the instrument.

Method:

A 2 cm long vertical "scratch" is performed over the anterior shin halfway between the medial malleolus and the tibial tuberosity.

10 scratches are performed in a vertical direction.

The direction of scratch should be randomised.

The number of correct directional assessments is recorded.

Significant impairment is denoted if greater than 2/10 errors are made.

If significant impairment, stop N20 and consult neurologist.

The test should be performed and recorded weekly.

UNCONTROLLED PAIN

Patients whose pain is not controlled despite all the above methods should be referred to the Acute Pain team (APS). There are other methods including the use of regional blocks (e.g. epidural, peripheral nerve block) which can be used in selected cases but this can only be done with the appropriate expertise and monitoring.

PATIENT EDUCATION

It is necessary to educate patients on their analgesics and how to take them.
They must understand that for the first 3-7 days, they will need to take their analgesics on a regular basis, and then as the wound heals, it can be on a PRN basis.

It should be emphasized that prior to any painful procedure, they will need to take their analgesics 1 hour before the procedure as ordered.

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CHAPTER 10

PAEDIATRIC ACUTE PAIN MANAGEMENT

CHAPTER 10 | PAEDIATRIC ACUTE PAIN MANAGEMENT

INTRODUCTION

Significant advances have been made in the field of pain management in recent years. The essential question is no longer whether children feel pain but how best to treat and prevent it.

Acute pain is one of the most adverse stimuli experienced by children, occurring because of injury, illness and necessary medical procedures. It is associated with increased anxiety, avoidance, somatic symptoms, and increased parent distress. Despite the magnitude of effects that acute pain can have on children, it is often inadequately assessed and treated.

Numerous myths and misconceptions, personal biases about pain, insufficient and inadequate application of knowledge among caregivers contribute to the lack of effective management. Misconceptions about pain and its management in children include the fear of side effects like respiratory depression, cardiovascular collapse, addiction, and the notion that children especially infants and neonates have an immature nervous system and do not feel or react to pain, and therefore do not require analgesic like adults.

It is now quite clear that the development of the physiologic mechanism and pathways for pain perception takes place during the late fetal and neonatal life. Children of all ages including newborns feel and react to pain. There is mounting evidence that adequate pain relief after surgery reduces the period of recovery, lowers morbidity, and improves outcome.

It is now widely accepted that for moral, ethical, humanitarian, and physiological reasons, pain should be anticipated and safely and effectively controlled in all children, whatever their age, maturity, or severity of illness.

This document has been prepared to give guidance to professionals involved in the acute care of children undergoing pain management after surgery or for painful medical procedures. This guidance is relevant to the management of children 0-12 years undergoing surgery or painful procedures in hospital settings. The procedures can be divided into two categories, painful diagnostic and therapeutic (medical procedures) and surgical procedures (postoperative pain)

PRINCIPLES OF PAIN MANAGEMENT IN CHILDREN

There are some major differences between paediatric and adult pain relief.

1. For children, analgesics are calculated on **mg/kg body weight** basis.
2. Infants < 6 months of age require lower initial opioid dosing, approximately 25-50% of the calculated opioid doses provided
3. The World Health Organization (WHO) recommends analgesic treatment in two steps according to the child's level of pain severity:

    - Choose the drug based on the degree of pain (mild, moderate, or severe)

    Step 1 – Mild Pain

    - Non-opioid +/- adjuvant agent
    - Paracetamol and Ibuprofen are the medicines of choice

        - For children less than three months of age, paracetamol is the only option

    Step 2 – Moderate to Severe Pain OR Pain Uncontrolled after Step 1

    - Opioid +/- non-opioid +/- adjuvant agent
    - Morphine is the medicine of choice

Choose the least invasive route – oral and sublingual (SL) preferred when possible

4. Children **do not like** intramuscular (IM) injection. IM injection is unpredictable, largely ineffective and children will deny having the pain to avoid injection. Intravenous, oral, and rectal are the preferred methods of administration.
5. Pain is **best prevented** rather than treated. Requirements for analgesics are lower if children are allowed to wake up comfortable and pain-free following surgery or are pretreated before painful procedures.
6. Severe pain is best treated with **continuous methods** of analgesic administration (e.g. infusion, PCA).
7. Neonates and some ex-premature infants (up to 52 weeks post-conceptual age) may be sensitive to opioids. After administration of opioids, they must be closely monitored in a high dependency unit or ICU.
8. Post-operative pain relief should be planned before the surgery. Preparing the child and the family in advance with clear and simple information will help to reduce fear and anxiety and correct misconceptions. Further, some analgesic techniques require preoperative explanation in order for the technique to be optimally used e.g. PCA.
9. 'Around-the-clock' (ATC) administration of pain medication is superior to 'as needed (PRN) after Day-care surgery. Hence it is important to advise parents and children to take their medication regularly as prescribed for at least the first 24 hours.

PAIN ASSESSMENT IN CHILDREN

Assessment and management of pain are interdependent, for, without adequate assessment of pain, treatment is likely to be ineffective. Good pain assessment contributes to early recognition, prevention as well as effective management of pain.

It is a challenging task to obtain an objective, quantitative and accurate measurement of pain in children, especially in young, pre-verbal children.

There are three fundamental approaches to pain assessment in children:

1. Self-report: measuring expressed the experience of pain
2. Observational/behavioral: measuring behavioral distress associated with pain, or measuring the perceived experience of pain by parent 's or caregiver's report
3. Physiological: measuring physiological arousal consequent to pain

Because pain is a subjective experience, a self-assessment scale may be preferable and is considered the 'gold standard' of measurement compared to an observer's objective assessment and should be used wherever possible. Self-report tools are appropriate for most children aged 4 years and older and provide the most accurate measure of the child's pain.

For older children and adolescents, self-report using the visual analogue scale, the numerical rating scale is suitable while for younger children, facial expression, colour analogue scales, pieces of the hurt tool may be useful. By contrast, preverbal children and infants must be assessed by an objective observer using objective scales such as FLACC, modified Objective Pain Score and Objective Pain Score which relies on physiological and behavioral observations.

In the Ministry of Health hospitals, the selection of pain measuring tools has been standardized to allow a consistent approach towards pain management throughout the country. FLACC scale is used for pain measurement in paediatric patients from age 1 month to 4 years. IASP Faces Pain Scale-Revised is used for paediatric patients from above 4 years to 7 years. For older children, the Visual Analogue / Numerical Rating Scale is used.

METHODS OF PAIN MANAGEMENT IN CHILDREN

Preventive treatment is most effective in controlling postoperative pain. This approach helps to minimize the emotional problems of fear and anxiety, prevents wind-up phenomenon of CNS sensitization to noxious stimuli, ameliorates stress response and reduces intra and post-operative analgesic requirement.

Multimodal therapy is the mainstay of acute pain management. This technique uses drugs or methods that modify nociceptive transmission at different points in the pain pathway. By approaching the pain pathway at different points, analgesia can be produced using minimal doses of drugs, thereby reducing side effects.

NON-PHARMACOLOGICAL METHODS

There is increasing interest in the use of non-pharmacological techniques in the management of acute pain. Most non-pharmacological techniques will not reduce the intensity of pain but will help the child and family to cope better and give a sense of being more in control. They should not be used solely but in combination with appropriate pharmacological methods.

These techniques include **distraction** such as playing with their favourite toys, watching videos, video games, TV, music by headphones. Other techniques include **breathing techniques** i.e. **deep breathing** (rhythmically with slow deep breathes) and **blowing** (imaginary candles or take a deep breath and 'blow away the pain'), **hypnosis*, guided superhero imagery**, massage, heat, cold, warm baths, physical and occupational therapy, meditation, Reiki, storytelling, art therapy, aromatherapy, weighted blankets and vibratory stimulation in children .

For infants and younger children, physical comfort measures such as cuddling, rocking, swaddling, auditory and tactile stimulation, and suckling i.e. breast feeding and nonnutritive sucking and/or the use of sucrose or other sweet solutions **(only for procedural acute pain)** may reduce behavioral and physiological responses to acute pain.

The environment should be made as child-friendly as possible and parental involvement should be encouraged where possible. Preparation of the parent and child, anticipation and planning for each individual child's expected distress, and training of staff in coping with the child and parent are methods to reduce pain and distress. Management of acute pain in children should be individualized and tailored according to the child.

- In this context, hypnosis is defined as a state of highly focused attention with a relative diminution of peripheral awareness. In this state, it is possible to enhance control over unwanted sensations, such as pain.

PHARMACOLOGICAL METHODS

1. Paracetamol
2. Non-steroidal anti-inflammatory drugs e.g. diclofenac
3. Ibuprofen
4. Weak Opioids i.e. Oxycodone, Oxycontin
5. Intravenous opioid infusion
6. Patient Controlled Analgesia (PCA)
7. Regional Analgesia
   - Topical eg. EMLA Cream, Lignocaine Gel
   - Local anaesthetic instillation
   - Wound infiltration
   - Peripheral nerve block
   - Epidural infusion of local anaesthetic with opioid

MANAGEMENT OF PROCEDURAL PAIN

Several factors should be considered when selecting appropriate pharmacologic agents for patients undergoing procedures, including the type and length of the procedure, how much pain is associated with the procedure, the setting in which the procedure will be performed, age of the patient, accessibility to pharmacologic agents and techniques, and availability of skilled personnel to administer and monitor the effects of the selected pharmacologic intervention(s)

Common pharmacologic methods include

1. **Local anaesthetics**
2. **Simple analgesic**
3. **Nonsteroidal anti-inflammatory drugs (NSAIDs)**
4. **Nitrous oxide (Entonox)**
5. **Ketamine**
6. **Opioids**
7. **Anxiolytics**
8. **Sedatives**

Some particularly invasive and painful procedures may benefit from the use of regional (e.g., peripheral nerve block) or general anesthesia.

1. Local Anaesthetics

- Commonly used for dermal procedures e.g. venipuncture, suture
- Injected subcutaneously or intradermal
- Applied topically to the skin e.g. EMLA cream, Lignocaine gel

2. Infiltration of Local Anaesthetics

Infiltration of local anesthetic e.g lignocaine, bupivacaine or levobupivacaine into the subcutaneous area is effective for procedures like lumbar puncture, bone marrow aspiration.

Safe maximum dose of LA (mg/kg)	
Lignocaine	7.0 (with adrenaline)
Bupivacaine	2
Ropivacaine	3
Levobupivacaine	2 – 2.5

3. EMLA Cream

EMLA cream consists of a eutectic mixture of 2.5% lignocaine base and 2.5% prilocaine base in an emulsifier. A blob of cream is placed over the chosen site and an occlusive dressing (e.g. Opsite, Tegaderm) is applied to ensure skin contact and to speed up absorption. It is effective in relieving pain associated with needling procedures such as venepuncture, venous cannulation, arterial cannulation, vaccination, and lumbar puncture.

The minimum effective application time is one hour. There is an initial phase of vasoconstriction followed by vasodilatation. This initial vasoconstriction at the site of application sometimes makes venepuncture difficult.

EMLA is not advisable for use in infants less than 3 months of age because of the possibility of methaemoglobinaemia from the prilocaine component.

Other choices (not available in Malaysia) are Ametop (Amethocaine)/ AnGEL and Lignocaine -Adrenaline -Tetracaine (LAT). There are other topical gels such as ELA-max (4% lignocaine) which is also unavailable. Vapo-coolant sprays, ethyl chloride and fluoromethane, are available for intravenous cannulations and venepunctures but may not be tolerated well by young children.

4. Nitrous oxide (N2O) Analgesia (ENTONOX)

Nitrous oxide (N2O) can provide analgesia to facilitate diagnostic and therapeutic procedures. It may be used in painful procedures. It is an anaesthetic agent with significant analgesia and some amnesic and anxiolytic properties. It has a rapid onset and predictable onset and offset and can safely be titrated to produce a state of 'conscious sedation'.

Contraindications

- Closed head injury/raised ICP
- Respiratory distress
- Impending airway obstruction
- Pneumothorax
- Bowel obstruction
- Intoxicated/ drug overdose
- Impaired level of consciousness
- Known cobalamin-dependent inborn errors of metabolism
- Area without resuscitation and monitoring

Relative contraindications

- Infants*
- Facial/ airway burns
- Difficult airway

* Requires an anaesthetist to be present

Fasting

- No food/ milk/ fluid or intragastric feeds for two hours prior to the procedure.
- If an oral or IV premedication is to be given, the child must fast for 4-6 hours.

Pre-requisites for safe administration

- Parental consent for sedation and procedure
- Fasting
- N_2O prescribed documented indicating % concentration administered
- No contraindications present
- Healthcare worker administering N_2O and observing the child is allocated to this task only
- Inability to provide N_2O without oxygen
- Appropriate resuscitation equipment present
- Scavenging available

Delivery system and Administration

Premixed cylinders with 50% N2O in oxygen are available, but it is also occasionally administered at inspired concentrations of up to 70% with oxygen.

Nitrous oxide inhalation is self-administered with a face mask or mouthpiece and the 'demand valve' system is widely used for analgesia. It is also used in dentistry. The system is suitable for children able to understand and operate the valve, generally those above 5 years of age. Healthcare workers must be specifically trained in the safe and correct technique of administration of N_2O.

The self-administration demand flow system is operated by the child unaided such that sedation leads to the cessation of inhalation. Analgesia is usually achieved after 3 or 4 breaths. There must be an **anti-viral, anti-bacterial filter** attached to the system with **scavenging** of exhaled gases. The child must have a pulse oximeter attached. Suction equipment and a resuscitation trolley must also be available. Recovery is rapid once the gas is discontinued. 100% oxygen should be applied for 3 minutes, to prevent diffusion hypoxia. Ensure that the child is returned safely to bed.

Continuous flow techniques of administration, where the face mask is held by a healthcare worker rather than the child, can produce deep sedation and unconsciousness and therefore this method is not included in this document.

Safe delivery of N_2O

- Provide 100% oxygen for 2-3 minutes before the procedure
- Monitor HR, RR, O_2saturation, conscious state
- Administer N_2O in oxygen
- Maintain verbal contact with the child at all times
- Provide 100% O_2 for 3 minutes after the procedure
- Provide 100% O_2 if child experiences adverse effects (desaturation, deeply sedated)

* Requires an anaesthetist to be present

Recovery

- Conscious level appropriate to the age
- Stable vital signs
- Cough /gag reflex normal
- Absence of respiratory distress
- Absence of nausea/ vomiting
- Ambulation consistent with a developmental age

Adverse effects of N_2O

- Over sedation
- Airway obstruction
- Diffusion hypoxia
- Rapid expansion of air-filled spaces
- Bone marrow suppression with chronic use
- Nausea
- Vomiting
- Dizziness

Repeated Exposure to NO

This may occur for children who require sedation to facilitate procedures such as repeated dressing changes, especially in burns. N_2O is known to interfere with Vitamin B12 and folate metabolism. Megaloblastic bone marrow changes can be detected following exposures for several hours. Leucopenia, megaloblastic anaemia and subacute combined degeneration of the cord are well-recognized complications of prolonged exposure to nitrous oxide.

The risks of repeated brief exposure to nitrous oxide are unknown.

- For all children requiring daily or second daily N_2O for longer than two weeks
- For all children requiring N_2O three times a week or more for a period of two weeks or more:
  - Add Folate 250mcg / kg (max 10mg) oral daily
  - Add Vitamin B_{12} 5mg / day oral daily

5. Ketamine

Ketamine is an N-methyl D-aspartate receptor antagonist that has a long history of use to induce anaesthesia, analgesia, and sedation. It can be administered orally, via the intramuscular route or intravenously.

At low doses, it produces analgesia and in higher doses, it produces a state of dissociative anaesthesia. It somewhat preserves the pharyngeal/ laryngeal reflexes, cardiovascular stability, and less respiratory depression. However, it increases secretions. When used as a sole anaesthetic agent, it can cause hallucinations and emergence phenomena.

Used in subanaesthetic doses (< 1mg/kg per dose IV or 1-2mg/kg per dose IM), it is an analgesic and amnesic agent. Ketamine has been used effectively for sedation and analgesia for brief painful procedures and in combination with midazolam and fentanyl. Ketamine has an additive analgesic effect when used in combination with opioids, with improved analgesia, often providing an opioid-sparing effect seen as a reduction in morphine requirement and the development of escalating opioid requirement over time (tolerance).

When used for the management of moderate to severe pain, Ketamine is most often used as a low dose infusion in conjunction with morphine or fentanyl infusions/PCA on the ward, to provide improved analgesia where opioids alone may be insufficient or produce unacceptable side effects.

Indications

1. Burns
2. Repeated wound dressing

Contraindications

1. raised intracranial pressure
2. known allergy to the drug
3. patient/parental preference

Recommended Dosage

Oral: 2-10mg/kg (parenteral preparation can be given orally). Usually at 5mg/kg. Intramuscular: 1-2mg/kg
Intravenous: 0.2-0.5mg/kg
Continuous infusion: as below

Continuous Ketamine infusion

Indication

a. Children aged 6 months and over
b. Underwent surgery that is likely to result in moderate or severe pain that would require opioids (Ketamine infusion is added in to run in combination with opioid analgesia when pain is not well controlled or there are problems with opioid side effects)

Preparation of solution for continuous ketamine infusion

Add 5 mg/kg of **Ketamine (maximum 250mg) and make up to 50 mls with normal saline**
1 ml of solution = **0.1 mg/kg** of ketamine
Range: 0.2-2 ml/hour

A loading dose is usually not required. Bolus doses are not routinely given and must not be given in the ward. Ketamine infusion must be run in an independent line.

Table 10.1 : Suggested Ketamine Infusion

Safe Dose (mg/kg/hr)	Infusion rate (ml/hr)	Max infusion rate (ml/hr)
0.02-0.2 mg/kg/hr **(20-200mcg/kg/hr)**	0.2 -2ml/hr (20-200mcg/kg/hr)	2ml/hr

STANDARD ORDERS FOR KETAMINE INFUSION (FOR WARD NURSES AND DOCTORS)

1. Patient must be **observed in the Acute Bay with pulse oximetry**.
2. No **opioid** is to be given except on the order of the anaesthetist.
3. IV line for ketamine infusion is to be used **only** for infusion of ketamine (dedicated line).
4. Blood pressure, pulse rate, respiratory rate, pain score, sedation score, nausea and vomiting score **hourly for first 4 hours and then 4 hourly** until the infusion is stopped. Observe for dysphoria and hallucinations.
5. The infusion rate must not be altered except on the order of the APS team. **Bolus administration can only be done by the APS team**.
6. Patients being considered for a Ketamine infusion require their analgesia regime to be discussed and agreed upon with a consultant anaesthetist or intensivist prior to commencing.

Common side effects

- At low doses infusions used for acute pain management (0.1 – 0.2 mg/kg/hr) adverse effects are minimal apart from dysphoria and vivid dreams.
- If some of the side effects are too unpleasant, they can be attenuated by low dose benzodiazepine use.
- Other less common side effects include increased salivation, tachycardia, sweating, increased blood pressure, increased intracranial pressure, and intraocular pressure.

POSTOPERATIVE INSTRUCTIONS (FOR WARD NURSES)

Ketamine is an anaesthetic agent and therefore in high doses could potentially cause respiratory depression or over sedation.

NOTIFY APS DOCTOR IMMEDIATELY

1. RR < 10/min (> 5 year) or < 15/min (1-5 year) or < 20/min (< 1yr)
2. Sedation score of 2 (drowsy, arouses with shaking)
3. Inadequate analgesia (pain score >4)
4. Hallucinations or bad dreams

MANAGEMENT OF MAJOR COMPLICATIONS

APS doctor should be notified immediately

- **STOP the ketamine infusion.**
- STOP all other infusions that could be contributing to sedation
- APS doctor should be notified immediately.
- Attempt to rouse the patient
- Administer naloxone if opioid toxicity is suspected and the patient is receiving a concurrent PCA/ NCA or opioid infusion

Hypoventilation or Unarousable

1. Stop infusion
2. Oxygen 12L/min.via Hudson mask

NB: Hypoventilation if *Respiratory rate < 10 / min. for > 5 years old*
Respiratory rate < 15 / min. for 1 – 5 years old
Respiratory rate < 20 / min. for < 1 year old.

Apnoea

1. Stop infusion
2. Ventilate with bag and mask (100% oxygen)
3. Check pulse, if absent start CPR

6. SUCROSE 24% / Glucose 25%

Sucrose/glucose solutions reduce physiological and behavioural indicators of stress and pain in neonates. It may be used in painful procedures such as venipuncture, intravenous cannulation, immunization, intramuscular injections, and heel lancing. The effects of sucrose/glucose appear to be directly related to the sweet taste of the solution with very low volumes (0.05- 2ml), being effective within 2 minutes of administration and duration of action of 5 to 10 minutes. The analgesic effect appears to diminish with age; however, the evidence does now exist to support the use of sucrose in infants up to 12 months of age. More research is needed into the effect of repeated doses of sucrose, especially for very low birth weight or ventilated babies. It is not an effective analgesic if administered into the stomach via a nasogastric tube.

Indications

Analgesia in neonates and infants >27 weeks and under 3 months of age, undergoing short-lived but acutely painful procedures, for example:

- lumbar puncture
- urinary catheter insertion
- difficult intravenous access
- immunization
- infrequent venipuncture
- infrequent heel prick

Also consider

- similar short-lived painful procedures such as dressing changes or eye examinations.
- pain and discomfort associated with neonatal transport

Contra-indications

- Avoid in infants unable to suck or swallow.
- Avoid in fructose, glucose, or sucrose intolerance.

Precautions

- Sucrose has a high osmolarity and should be used with caution in infants who have not established feeding and possibly those recovering from gut problems, e.g. gastroschisis. Similarly, use with caution in patients at risk of developing necrotising enterocolitis. (However, these problems are theoretical and are limited by the lingual administration of small volumes for procedural pain only).
- Use with caution in intubated infants. Give slowly to avoid gagging or choking.
- May not be effective in infants born to mothers taking methadone.
- Sucrose pain reduction may be less when given with concomitant opioid analgesics.

Dosage and administration

- Sucrose/glucose should be administered orally as a 24% or 25% solution, 1-2 minutes before a painful stimulus, and may be repeated during a painful procedure if necessary.
- It can be given using a pacifier or directly dripped (one drop at a time) on to the tongue using a syringe, the number of applications is decided according to the child's response.

  Upper volume limit per procedure according to gestational age:

  27-31 weeks 0.5 ml maximum
  32-36 weeks 1 ml maximum
  > 37 weeks 2 ml maximum
  Each 'dip' of the pacifier is estimated to be 0.2 ml

Adverse Effects

Limited published data exist on the adverse effects of oral sucrose in neonates and infants. There are rare reports of transient choking and oxygen desaturation with the administration of oral sweeteners (directly into the mouth and when given on a pacifier). Theoretical adverse effects include hyperglycaemia and necrotising enterocolitis.

GUIDELINES FOR PAIN MANAGEMENT IN CHILDREN WITH BURNS

1. Pain management due to burn injury is complex. Other factors such as emotional distress, traumatic memories, anticipatory fears about treatment, confinement in a new and potentially frightening environment and discomfort may contribute to it.
2. It is better to prevent pain before it starts, because once it has begun, relief of pain is much more difficult, and the associated anxiety response complicates pain management.
3. Optimal pain management involves treatment of the 2 main components of burn pain: background pain and procedural pain.

- **Background Pain**

  Pain experienced by the patients while at rest, which is usually dull, continuous and of low intensity.

- **Procedural Pain**

  Pain experienced during or after procedures like change of dressing, physiotherapy, is usually acute and short-lasting, but of great intensity.

4. A multimodal approach is the mainstay in the pain management of burn patients.
5. Frequent assessment of pain using a reliable pain assessment tool should be done and analgesia adjusted to individual needs.

Management of Pain in Non-Ventilated Paediatric Patients with Burns

Initial stage (Resuscitation Phase)

During this phase, there is haemodynamic instability, the pharmacokinetics of drugs is unpredictable and their absorption through non-intravenous routes is uncertain. Therefore, intravenous administration is preferred, and drugs should be given with great care. **Use of small but frequent intravenous boluses of opioids is preferred.**

- IV morphine 0.05 - 0.1 mg/kg bolus every 5 minutes till patient is comfortable.
- Pain should be evaluated before each bolus using an appropriate pain assessment scale
- Heart rate, blood pressure, respiratory rate and oxygen saturation should be monitored.

A.BACKGROUND PAIN

Major Burns (> 15%)

Options:

1. **Intravenous Morphine Infusion**
2. **Patient Controlled Analgesia** –for any child > 6 years old who is able to use his/her hand

Minor Burns

Options:

1. **Oral Opioids**

   i. Morphine sulphate: 0.05-0.2 mg/kg 4 hourly (Max dose 5mg)

   - 3 – 6 months: 0.05 mg/kg (cautious in infants)
   - 6 months – 2 years: 0.1 mg/kg
   - 2 – 18 years: 0.1-0.2mg/kg

   ii. Codeine: 0.5 - 1.0 mg/kg/dose 4-6 hourly
   iii. Oxycodone: 0.2 - 0.3 mg/kg/dose 4-6 hourly (Max 5mg)

2. **Paracetamol**

   Oral Route

   Loading dose – 20 mg/kg, then 15 mg/kg 4 hourly, maximum of 90 mg/kg/day

   - 1 month- 3 months: 10 – 15mg/kg 4-6 hourly, maximum of 60 mg/kg/day
   - 3 months -18 years: 15 mg/kg 4-6 hourly, maximum of 90 mg/kg/day (not to exceed 4g/day)

   Rectal Route

   Loading dose – 40 mg/kg, then 20 mg/kg 8 hourly, maximum of 90 mg/kg/day.

   NB: Paracetamol can be used as an adjunct to opioids if necessary; cautious with jaundice patients

B.PROCEDURAL PAIN

Experienced during dressing changes, wound debridement, physiotherapy, lines insertion can be very intense and often associated with anticipatory anxiety when previous procedures have been painful.

General Anaesthesia

Indicated in patients:

1. with extensive dressings changes and wound debridement
2. with severe pain which cannot be adequately and safely controlled

Sedation

a. IV Morphine + IV Midazolam

Morphine

Initial bolus	0.1 mg/kg
Subsequent	0.05 mg/kg
Maximum	0.25 mg/kg in any 2-hour period

Wait 5 to 10 minutes between doses

Midazolam

Initial bolus	0.1 mg/kg
Subsequent	0.05 mg/kg
Maximum	0.3 mg/kg in any 2-hour period

Wait 2 to 5 minutes between doses

b. IV Ketamine + IV Midazolam

Midazolam

Initial bolus	0.1 mg/kg
Subsequent	0.05 mg/kg
Maximum	0.3 mg/kg in any 2-hour period

Wait 2 to 5 minutes between doses

Ketamine

Give Glycopyrrolate 5 mcg/kg IV or atropine 0.02 mg/kg IV before initial dose of Ketamine

Initial dose: 0.5-1 mg/kg over 30-60 sec
Subsequent: 0.5 mg/kg every 5 min

Table 10.2 : Suggested Ketamine Infusion

Dose mg/kg/hour	Infusion rate ml/hour	Max infusion rate ml/hour
0.02-0.4 mg/kg/hour (20-400mcg/kg/hour)	0.2 -2ml/hour 4ml/hour (20-200mcg/kg/hour)	4ml/hour

c. IV Fentanyl + IV Midazolam

Midazolam
Initial bolus: 0.1 mg/kg
Subsequent 0.05 mg/kg
Maximum 0.3 mg/kg in any 2-hour period
Wait 2 to 5 minutes between doses

Fentanyl
Initial bolus 0.5 mcg/kg over 30-60 sec
Subsequent 0.5 mcg/kg
Maximum 2 mcg/kg or total of 100 mcg

d. Oral morphine + oral midazolam

Morphine sulphate 0.3 mg/kg 1 hour before procedure supplemented by oral midazolam 0.5 mg/kg 30 min. before procedure

At end of the procedure, no further opioids are to be given by any route for the next 4 hours. Further analgesia can be provided by paracetamol.

i. For patients on IV morphine infusion:

- Give midazolam (for sedation)
  Oral – 0.5 mg/kg 30 minutes before procedure
  or
  IV – 0.1 mg/kg bolus and then 0.05 mg/kg boluses

- Give a bolus of 2 ml (20 mcg/kg) of morphine infusion every 5 min till desired effect.

ii. For patients on IV morphine infusion:

- Give midazolam (for sedation)
  Oral – 0.5 mg/kg 30 minutes before procedure
  or
  IV – 0.1 mg/kg bolus and then 0.05 mg/kg boluses

- Ask the patient to press the button of the PCA machine for bolus doses of morphine (10 mcg/kg) every 5 min until the desired effect.

MANAGEMENT OF POST-OPERATIVE PAIN

METHODS

1. Paracetamol
2. Non-steroidal anti-inflammatory drugs e.g. diclofenac
3. Weak opioids i.e. Tramadol, Oxycodone
4. Intravenous opioid infusion
5. Patient Controlled Analgesia (PCA)
6. Regional Analgesia:
   - Topical e.g. EMLA cream, lignocaine gel
   - Local anaesthetic instillation
   - Wound infiltration
   - Peripheral nerve block
   - Epidural infusion of local anaesthetic with opioid

PARACETAMOL

Paracetamol is a simple analgesic and antipyretic drug which is useful for all types of mild to moderate pain. It is available for oral administration in syrup, tablet, and dispersible form. Oral administration can be used in children from 6 months of age onwards. Following oral administration, maximum serum concentration is reached in 30-60 minutes.

For infants and children who do not tolerate oral medication, who are kept strictly “nil by mouth” or who are nauseated and vomiting, paracetamol may be administered as a rectal suppository. However, there is a wide variation of bioavailability following rectal administration. To achieve an adequate plasma concentration, a loading dose of 40 mg/kg rectally is recommended to achieve target plasma levels of 10-20mg/l, followed by repetition doses every 6 hours is recommended. Because of the slow onset of action, rectal paracetamol suppository should be given after induction of anaesthesia for postoperative pain relief. Rectal suppositories are available in doses of 125mg, 250mg and 500mg. These suppositories should not be cut.

Table 10.3 : Guidelines for Paracetamol dosing for analgesia in healthy children (Morton & Arana)

Age Group	Oral initial dose (mg/kg)	Rectal initial dose (mg/kg)	Maintenance dose oral / rectal (mg/kg)	Dosing interval (hour) oral/ rectal	Max. daily dose (mg/kg/day)	Duration of max dose (hour)
28-32 weeks PCA	20	20	Oral 10-15/ Rectal 15	Oral 8-12/ Rectal 12	30	48
32-52 weeks PCA	20	30	Oral 10-15/ Rectal 20	Oral 6-8/ Rectal 8	60	48
> 3 months	20	40	Oral 15/ Rectal 20	Oral 4/ Rectal 6	90	72

PCA – post-conceptual age

Rectal administration should be avoided in neutropenic patients and in paediatric patients undergoing anorectal surgeries.
It is contraindicated in patients with severe liver disease.
Caution should be exercised when prescribing paracetamol to children who are malnourished or dehydrated.

INTRAVENOUS PARACETAMOL

Intravenous Paracetamol provides a higher effect-site concentration with higher analgesic potency. It should be given as an infusion over 15 minutes. It is approved for the relief of mild to moderate pain when an intravenous route is considered clinically necessary. Dosage guidelines are based on ideal body weight (IBW). For obese children, this is less than their measured weight.

Formulation of IV

Aqueous solution: 10mg/ml paracetamol, 50 and 100ml vials.
Additive to this solution include: sodium phosphate dibasic dehydrate, hydrochloric acid, sodium hydroxide, cysteine hydrochloride and mannitol.

Indications for IV Paracetamol

1. Older children who are fasting or NBM post-operatively and in whom PR administration is contraindicated or too distressing for the paediatric patient. Typically, children undergo laparotomy/ bowel surgery.
2. Intra-operative loading of paracetamol for children undergoing long surgical procedures e.g. Neurosurgical, spinal surgery, craniofacial surgery, multiple trauma orthopaedic surgery, children with mucositis where oral intake may be likely be delayed.

- Short cases will be managed using oral paracetamol premedication or rectal peri-operative (under GA) rectal suppositories.
- Intravenous paracetamol should not be used where the alternative routes of administration (oral/ rectal) is available.
- Current recommendations for intravenous paracetamol use are limited to
  - Children over 1 year of age and weight > 10 kg.
  - Only in anticipated short duration of therapy (72 hours)

Table 10.4 : Guidelines for Intravenous Paracetamol dosing

Weight (kg)	Dose	Interval (hour)	Maximum daily dose
5 - <10	7.5mg/kg	4-6	30 mg/kg
10-50	15mg/kg	4-6	60 mg/kg
>50	1 gram	4-6	4 grams

Risk Management Strategies

With the advent of a liquid product for infusion, there is potential for other (oral) liquid Paracetamol formulations to inadvertently be injected into a drip. Individual hospital policy documents should clearly identify safe prescribing and administration for IV Paracetamol. The following are suggested:

- 100 ml vials should be stored in the pharmacy and the operating suites only.
- IV Paracetamol should not be stored in general paediatric wards.
- IV Paracetamol should be prescribed by anaesthetists, pain team and intensivists. In general, IV Paracetamol may be prescribed on a regular basis (q 6 hourly) and must be reviewed by the pain team.
- Prescriptions should clearly state the trade name of the drug and the generic name (Paracetamol), the route (IV), a fixed-dose in mg and may also state volume in ml. it should also state a maximum daily dose in mg.
- IV Paracetamol should be infused over 15 minutes using a paediatric chamber/infusion burette.
- Oral or rectal paracetamol should not be prescribed simultaneously with IV Paracetamol

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAID)

NSAIDs are effective for mild or moderate pain. They have anti-inflammatory and antipyretic effects. They inhibit peripheral cyclo-oxygenase and decrease prostaglandin production, leading to possible side effects such as gastric ulcer, platelet, and renal dysfunction. NSAIDs may exacerbate asthma in a predisposed subset of asthmatics. Use with caution in children with a history of eczema, multiple allergies, and nasal polyps. Avoid in children with liver failure.

Diclofenac (Voltaren)

It may be given via oral or rectal route.

- Oral: 1mg/kg
- Rectal: 1mg/kg
- Interval 8 -12 hourly

  - Licensed from age of 6 months
  - Suppositories should not be used in neutropenic paediatric patients or who are severely immunocompromised
  - Particular attention should be paid to maintain hydration during the perioperative period

Contraindications

- bleeding tendencies
- renal impairment
- gastritis, ulcerative colitis, Crohn's disease
- liver failure
- history of allergy
- orthopaedic procedures where bone healing may be compromised

Table 10.5 : NSAIDS preparations, dosages and routes

NSAID	Dose mg/kg	Route	Interval hours	Maximum daily dose mg/ kg/day	Licensed from age
Ibuprofen	5-10	Oral	6-8	30 mg/kg/day Single-dose max 400mg	3 months
Naproxen	5-7.5	Oral/ rectal	12	15mg/kg/day	2 years
Diclofenac	1	Oral/ rectal	8	up to 150mg/24 hours for only a maximum of 2 days	6 months
	0.3 -1	IV	12	Maximum of 2 days	> 2 years

TRAMADOL

Tramadol hydrochloride is a weak opioid analgesic with noradrenergic and serotonergic properties that may contribute to its analgesic activity. Tramadol can have a useful role as part of a multimodal analgesic regimen for managing acute pain in children.

An important metabolic pathway for tramadol is that provided by CYP2D6 to form O-desmethyltramadol; the active M1 metabolite. This active M1 metabolite has a μ-receptor affinity approximately 200 times greater than tramadol. There is concern that this metabolite can cause respiratory depression in those children who are ultra-rapid metabolizers.

It does not produce gastritis, gastric ulcers, or effect platelet aggregation. Tramadol can be given by oral route, as a rectal suppository or intravenously.
Tramadol has been shown to be effective against mild to moderate pain and may be used in children more than **12years of age**.

It may produce fewer typical opioid adverse effects such as respiratory depression, sedation, and constipation though demonstrates a relatively high rate of nausea and vomiting. Initial slow titration of tramadol may minimize side effects such as nausea and vomiting.

Care should be taken when prescribing tramadol if the child has uncontrolled epilepsy/seizures or is on tricyclic antidepressants, selective serotonin reuptake inhibitors, major tranquillizers, fentanyl, and pethidine. Tramadol is contraindicated in children who have taken MAO inhibitors within the previous two weeks.

Dose oral, rectal, or intravenous:

1 mg/kg 4-6 hourly

(Tramadol dose should be limited for acute pain after tonsillectomy (e.g., maximum dose 1 mg/kg 6-8 h, max 400 mg/day). The suggestion is to start with a lower dose of 2 mg/kg daily in divided doses (e.g., 0.5 mg/kg 6-8 h). Tramadol overdose is a greater danger than CYP variants. Children with obstructive sleep apnoea who have undergone tonsillectomy should continue to be monitored in hospital overnight to assess both response and sensitivity to opioids before discharge. While the evidence is lacking, it may be prudent to observe any child given opioids during a period of sleep before discharge.

OXYCODONE

Oxycodone is a synthetic opioid agonist in oral preparation. It comes in five forms: immediate-release tablet, extended-release tablet, immediate-release capsule, extended-release capsule, and solution. Oxycodone extended-release tablets are available as the brand name drug Oxycontin and immediate-release tablet Oxynorm. Oxycodone has FDA approval to be used in 11 years old and above patients. Some institutions use oxycodone for younger patients (as off-label) to treat post-operative pain.

Table 10.6 : Indication and Doses of Oxycodone

Oxycodone is used to treat moderate to severe pain in cancer or post-operative patients.

Analgesic	Analgesic	Loading dose	Maintenance	Maximum dose
Oxycodone	10-30 30-40 20-30 15-40	0.1-0.2mg /kg (max5 mg) >12 years: adult dose	0.1-0.2 mg/kg (max 5 mg) 4 -6 hourly >12 years: adult dose	Usual max of 5 mg 4 hourly higher and/or more frequent doses may be used. Adult dose: Oxynorm: 5 mg 4-6 hourly, increased as required. Oxycontin 10 mg bd, increased as required.

Side Effect

1. Drowsiness
2. Nausea and vomiting
3. Constipation
4. Headache
5. Fever
6. Respiratory depression
7. Physical dependence, addiction

When oxycodone is used with certain drugs, it may not work as well to treat pain. The two drugs that are commonly used are rifampicin and anticonvulsants i.e. carbamazepine and phenytoin.

INTRAVENOUS OPIOID INFUSION

Introduction

Intravenous opioid infusion provides continuous analgesia that is consistent with rapidly adjustable serum concentrations of opioids. They are suitable for children of all ages when regional analgesia is contraindicated and PCA is unsuitable. However, intravenous opioid infusions need **close observation** as it is a continuous infusions and accumulation may occur. The aim of this technique is to have the child comfortable with minimal pain and stable vital sign observations.

In general, morphine is the preferred drug for children. If morphine causes unacceptable side effects, fentanyl or oxycodone will usually provide an acceptable alternative. The use of pethidine is not recommended in children because of its metabolic product norpethidine which can accumulate and cause central nervous system side-effects like restlessness and convulsions.

Indications

1. Post-operative pain
2. Burns
3. Oncology
4. Other painful conditions e.g. acute pancreatitis

Contraindications

1. History of allergy and hypersensitivity
2. History of apnoea
3. Airway obstruction
4. Head injury, raised intracranial pressure

    - *Only infants who have reached 12 weeks of age (or 52 weeks post-gestational age for pre-term neonates born at less than 36 weeks) may be nursed on the wards. Any infants below 12 weeks corrected must be nursed in a high-dependency area or NICU.*

HOW TO PRESCRIBE AN INTRAVENOUS OPIOID INFUSION:

I. Morphine

1. Prior to commencing morphine infusion, the child should be **titrated to comfort** with intravenous boluses of morphine. **This should be administered and titrated every 5 minutes until analgesia is achieved.** The child must be continuously monitored.

Table 10.7 : Titration of morphine (100 mcg/ml i.e. 0.1mg diluted to 1ml in a 1ml syringe):

- **< 12 months:** 20 mcg/kg increments every 5 min x 5 (max) over 25 min (40-100 mcg/kg)
- **12 months and under 50 kg:** 50 mcg/kg increments every 5 min x 4 (max) over 20 min (100- 200mcg/kg)

2. Preparation of solution for infusion:

   Dilute 0.5 mg/kg of morphine in 50 mls normal saline
   1 ml of solution = **10 mcg/kg** of morphine

3. Infusion rates will depend on the age of the patients:

Table 10.8 : Suggested Morphine Infusion

Safe Dose (mg/kg/hr)	Infusion rate	Maximum infusion rate
Neonates	0.5-0.7 ml/hour	1 ml/ hour
1-3 months	0.5-1ml/ hour	2 ml/ hour
Children > 3 months	1-2 ml/ hour	4 ml/ hour

Bolus doses of 0.5 ml – 1 ml of the infusion can be given in 2 situations :

1. If **pain relief is inadequate**, then a prescribed bolus dose should be administered followed by increasing the infusion rate by 0.5 – 1 ml/hour. Never leave the patient unattended during the bolus administration.
2. To cover **"incident pain"** (e.g. pulling out drains, physiotherapy, dressing etc.) A bolus dose should be given 10 – 15 minutes prior to the anticipated painful procedure. It is extremely important to ensure that the original rate is resumed once the bolus has been administered. Never leave the patient unattended during the bolus administration.

Before bolus doses are given,

1. Alternative causes such as urinary retention, hunger etc. should be excluded.
2. The patient should be awake and coherent with the appropriate respiratory rate for age.

2. Fentanyl

Fentanyl should only be used in the intensive care unit under close monitoring. There is no age limitation, but observation must be in the intensive care unit.

1. Prior to commencing fentanyl infusion, the patient should be titrated to comfort with an intravenous bolus of fentanyl. This should be administered and titrated every 5 - 10 minutes until analgesia is achieved. Fentanyl loading doses should only be given by the Anaesthetic Team.

2. Preparation of solution:

FENTANYL (Standard Strength)

Dilute 20 mcg/kg **of fentanyl in 50 mls normal saline (Max 1000 mcg in 50ml)**

1 ml of solution = **0.4 mcg/kg** of fentanyl i.e. 1 ml/hour = 0.4 mcg/kg/hour
Maximum 1000 micrograms Fentanyl.

1 ml of solution = **0.4 mcg/kg** of fentanyl i.e. 1 ml/hour = 0.4 mcg/kg/hour

Loading Dose:
Initial bolus dose 0.4 mcg/kg (1ml)

Infusion rate:
0.5 – 2 mls/hour (0.2 – 0.8 mcg/kg/hour)

STANDARD ORDERS FOR OPIOID INFUSION (FOR WARD NURSES AND DOCTORS)

1. Patient must be **observed in the Acute Bay with pulse oximetry.**
2. No other **opioid** is to be given except on the order of the anaesthetist.
3. Naloxone (Narcan) must be always available at the bedside.
4. IV line for opioid infusion is to be used **only** for infusion of opioids unless anti-reflux valve is used.
5. Monitoring:
   Blood pressure, pulse rate, respiratory rate, pain score and sedation score **hourly for first 4 hours and then 4 hourly** until the infusion is stopped.

6. The infusion rate **must not** be altered except on the order of the APS team.
7. **Bolus administration can only be done by the APS team**.

POSTOPERATIVE INSTRUCTIONS (FOR WARD NURSES)

Notify Aps Doctor Immediately:

- RR < 10/min (> 5 yrs.) or < 15/min (1-5 yrs.) or < 20/min (< 1yr)
- Systolic BP < 80mmHg (> 1yr) or <60mmHg(<1yr)
- Sedation score of 2 (drowsy, arouses with shaking)
- Inadequate analgesia (pain score ≥ 4)
- Persistent vomiting
- Severe pruritus

MANAGEMENT OF MAJOR COMPLICATIONS

APS doctor should be notified immediately.

Hypoventilation or Unarousable

1. Stop infusion
2. Oxygen 12 L/min. via Hudson mask
3. Naloxone (Narcan) 0.01mg/kg

NB: Hypoventilation if

Respiratory rate < 10 / min. for > 5 years old
Respiratory rate < 15 / min. for 1 – 5 years old
Respiratory rate < 20 / min. for < 1 year old.

Apnoea

1. Stop infusion
2. Ventilate with bag and mask (100%oxygen)
3. Check pulse, if absent start CPR
4. Naloxone (Narcan) 0.01mg/kg

Persistent Vomiting

1. Before any antiemetic, ensure always that patient is adequately hydrated, has good analgesia, and that hypoglycemia and hypotension are not causative factors.
2. Reduce or stop infusion if necessary.

   Give ondansetron 0.15-0.20 mg/kg (max 4 mg) IV or granisetron 0.02- 0.05mg/kg (max 1 mg) IV over 10 min.

Recommendations for PONV Prophylaxis:

Children at increased risk of PONV

- IV ondansetron (Zofran) 0.15-0.20 mg/kg (max 4 mg) or IV granisetron (Kytril) 0.02-0.05mg/kg (1 mg) over 10 min

For all children undergoing Adenotonsillectomy, Strabismus and Laparoscopic surgery

- IV dexamethasone 0.1-0.2 mg/kg (max: 4 mg) and
- IV ondansetron (Zofran) 0.15-0.20 mg/kg (max 4 mg) or IV granisetron (Kytril) 0.02- 0.05mg/kg (max 1 mg) over 10 min

PATIENT CONTROLLED ANALGESIA (PCA)

Introduction

PCA is a technique of managing acute pain which uses a programmable pump to allow the patient to **self-administer** their own intravenous opioid analgesia. It allows small amounts of the opioid to be given intravenously at frequent intervals, keeping the blood levels of opioids within an effective range. This avoids having either excessive or inadequate blood levels of opioids and reduces the likelihood of ineffective analgesia or side effects such as excessive sedation, respiratory depression and nausea and vomiting.

Child suitability:

Not all children are appropriate candidates for a PCA. A general recommendation based on chronological age is 5 years and above. The child must have the cognitive ability to associate pressing the PCA button with receiving pain relief and be physically able and willing to press the button to control their pain.

Morphine is the preferred drug for PCA

Indications

1. Post-operative pain
2. Burn
3. Oncology
4. Other painful conditions e.g. acute pancreatitis

Contraindications

1. Inability to understand PCA e.g. preschool children, intellectually impaired.
2. Head injury

HOW TO PRESCRIBE PCA

1. PCA is a specialised technique and must be commenced and supervised by anaesthetic staff. All prescription and programming of the PCA machine are to be done by the APS team.
2. Request for post-operative PCA should be made pre-operatively to allow for the patient to be familiar with the technique.
3. Patient starting on PCA should be titrated to comfort with intravenous boluses before starting PCA

Preparation of solution for PCA Infusion

Indications

i. Morphine

1. **0.5 mg/kg** of morphine make up to 50 mls with normal saline to a maximum of 50mg of morphine

1ml of solution = **10 mcg/kg**

2. The PCA machine is programmed in mls.

Bolus dose	: 1 ml (10 mcg/kg)
Lockout interval	: 5 mins
Basal rate	: 1 ml/hr (10 mcg/kg/hour) – only for first 24 hours
1 hour limit	: 13 mls

ii. Fentanyl

Caution: an alternative to morphine if morphine causes undesirable side effects or is contraindicated. It must be prescribed by an anaesthestist and monitored in intensive care or a high dependency unit.

20 mcg/kg of fentanyl make up to 50 mls with normal saline. Maximum 1000 micrograms fentanyl.

1. **20mcg/kg** of fentanyl make up to 50 mls with normal saline

1ml of solution = **0.4 mcg/kg**

2. The PCA machine is programmed in mls.

Bolus dose	: 1 ml (0.4 mcg/kg/ml))
Lockout interval	: 5 mins
Basal rate	: 0.5 ml/hr (0.2 mcg/kg/hr)
1 hour limit	: 13 mls (5 microgram/kg in any hour)

A background infusion (basal rate) is recommended when fentanyl is used because of the short duration of a single bolus dose.

STANDARD ORDERS (FOR WARD NURSES AND DOCTORS)

1. No other **opioid** is to be given except on the order of the anaesthetist / APS doctor.
2. Naloxone (Narcan) is to be kept at the bedside at all times.
3. IV line for PCA is to be used for **PCA only** unless an anti-reflux valve is used.
4. Monitoring:
   Record blood pressure, pulse rate, respiratory rate, pain score, sedation score, vomiting score **hourly for 4 hours, and then 4 hourly** until the PCA is stopped.

5. Any change of PCA settings can only be made by the anaesthetic staff / APS team.
6. APS doctors to be notified if there are any problems with the PCA machine.

MANAGEMENT OF MAJOR COMPLICATIONS

APS doctor should be notified immediately.

Hypoventilation or Unarousable

1. Stop infusion
2. Oxygen 12L/min. via Hudson mask
3. Naloxone (Narcan) 0.01mg/kg

NB: Hypoventilation if *Respiratory rate < 10 / min. for > 5 years old*
Respiratory rate < 15 / min. for 1 – 5 years old
Respiratory rate < 20 / min. for < 1 year old.

Apnoea

1. Stop infusion
2. Ventilate with bag and mask (100%oxygen)
3. Check pulse, if absent start CPR
4. Naloxone (Narcan) 0.01mg/kg

Persistent Vomiting

1. Before any antiemetic, ensure always that patient is adequately hydrated, has good analgesia, and that hypoglycemia and hypotension are not causative factors.
2. Reduce or stop infusion if necessary.
3. Give ondansetron 0.15-0.20 mg/kg (max 4 mg) IV or granisetron 0.02- 0.05mg/kg (max 1 mg) IV over 10 min.

Recommendations for PONV prophylaxis

Children at increased risk of PONV

IV ondansetron (Zofran) 0.15-0.20 mg/kg (max 4 mg) OR IV granisetron (Kytril) 0.02-0.05mg/kg (1 mg) over 10 min

For all children undergoing Adenotonsillectomy, Strabismus and Laparoscopic surgery

IV dexamethasone 0.1-0.2 mg/kg (max: 4mg)
and
IV ondansetron (Zofran) 0.15-0.20 mg/kg (max 4 mg) or IV granisetron (Kytril) 0.02- 0.05 mg/kg (max 1mg) over 10 min

LOCAL AND REGIONAL ANALGESIA

Instillation of LA

Local anaesthetics can be instilled onto small open wounds either by dropping the solution onto the wound or applying a soaked dressing to the wound. Irrigation of herniotomy wound for 30 seconds has been shown to be as effective as a nerve block.

Instillation of dilute local anaesthetics onto dressings is a useful simple method of providing analgesia for split skin graft donor sites. Bupivacaine 0.125-0.25% with adrenaline (1:400,000) up to a maximum of 2 mg/kg of bupivacaine is placed on a foam pad which is applied to the donor site once the graft has been taken. This provides prolonged analgesia for this very painful site.

Pain relief can be prolonged by an infusion of the local anaesthetic solution at a rate of 1-3 ml/hour. using an epidural catheter placed on the surface of the foam dressing. Care must be taken not to exceed 0.5 mg/kg/hour of bupivacaine.

Wound Infiltration

Infiltration techniques are widely used in children for providing analgesia for surface wounds. Infiltration of the wound after inguinal herniotomy is as effective as caudal analgesia or ilioinguinal nerve block. However, analgesia is limited to the skin and superficial tissues. The maximum dose of bupivacaine, ropivacaine and levobupivacaine is 2, 3 and 2.5 mg/kg respectively.

Peripheral Nerve Blocks

Some of the common peripheral nerve blocks performed in children include:

- Dorsal nerve block for circumcision
- Ilioinguinal/ iliohypogastric nerve block for inguinal herniotomy
- Femoral nerve, lateral cutaneous nerve blocks or fascia iliaca block can be useful in children for muscle biopsies in the thigh, skin harvesting from anterior and lateral sides of the thigh. It also provides analgesia for femoral shaft fracture and relieves muscle spasm.
- Sciatic nerve block for surgery of the foot.
- Brachial plexus block for surgery of shoulder, arm, and hand.

EPIDURAL INFUSION

Introduction

Epidural infusion is the introduction of analgesic drug into the epidural space to provide pain relief. Mixtures of local anaesthetic and opioids can be infused into the epidural space via an indwelling catheter to provide post-operative pain relief for urological, abdominal, or thoracic surgery. The epidural catheter can be placed either in the **caudal, lumbar, or thoracic** areas at the time of surgery.

Contraindications

1. Head injury or raised intracranial pressure
2. Coagulopathy
3. Local or systemic infection
4. Progressive neurological deficit

HOW TO PRESCRIBE AN EPIDURAL INFUSION

1. The epidural catheter is placed at the time of surgery, usually after induction before surgery starts.
2. Once the epidural catheter is inserted, a bolus dose is given.
   - Bupivacaine 0.25% or Levobupivacaine 0.25% or Ropivacine 0.2% 0.5ml-0.75ml/kg titrated up to maximum, not exceeding 2 mg/kg.
   - fentanyl 1 mcg/kg may be given via the epidural catheter.
3. Infusion can be started 30 min after the bolus dose.

PREPARATION OF INFUSION SOLUTION:

- Levobupivacaine / Bupivacaine 0.1%
  - dilute 10 ml of Levobupivacaine/ Bupivacaine 0.5% (i.e. 50 mg) in 50 ml normal saline

- Levobupivacaine 0.125%
  - dilute 10 ml of Levobupivacaine 0.5% (i.e. 50mg) in 40 ml normal saline

- Ropivacaine 0.1%
  - dilute 25 ml of 0.2% Ropivacaine in 50 ml normal saline
    or
  - dilute 6.7ml of Ropivacaine 0.75% (i.e 50 mg) in 50 ml normal saline

- Additive
  - Babies < 6 months: Nil
  - Infants 6 months – 1 year: Fentanyl 1 mcg/ml (1ml of Fentanyl added in 50 ml dilution)
  - Children > 1year: Fentanyl 2 mcg/ml (2ml of Fentanyl added in 50 ml dilution)

DOSAGE FOR INFUSION

- Neonates (< 5kg):

  - Bupivacaine/ Levobupivacaine 0.1%
    - rate: 0.1-0.2 ml/kg/hour

- Infants (< 1 year old / 5-10 kg):
  - Bupivacaine 0.1% + Fentanyl 1 mcg/ ml
    - rate : 0.2-0.4 ml/kg/hour
  - Ropivacaine 0.1% + Fentanyl 1 mcg/ ml
    - rate : 0.2-0.4 ml/kg/hour
  - Levobupivacaine 0.1% + Fentanyl 1 mcg/ ml
    - rate : 0.2-0.4 ml/kg/hour

- Children (> 1year old / > 10kg)
  - Bupivacaine 0.1% + Fentanyl 2 mcg/ ml
    - rate: 0.2-0.4ml/kg/hour
  - Ropivacaine 0.1% + Fentanyl 2 mcg/ ml
    - rate: 0.2-0.4ml/kg/hour
  - Levobupivacaine 0.1% + Fentanyl 2 mcg/ ml
    - rate: 0.2-0.4ml/kg/hour

4. If analgesia is inadequate, a bolus dose of 0.5 ml/kg should be given followed by increasing the rate of infusion by 0.05 – 0.1 ml / kg / hr. Do not exceed an infusion rate of 0.4 ml/kg/hr. Following a bolus, observe the blood pressure, pulse, and respiratory rate every 15minutes for 1 hour. Pain score and motor tone should also be observed every 15 minutes for 1 hour.
5. The catheter is usually kept for an average 48 – 72 hours post-operatively i.e. until the patient can tolerate oral feeding and oral medication. The removal of the catheter is to be done by the APS team.

Table 10.9 : Suggested Maximum Doses of Bupivacaine, Levobupivacaine and Ropivacaine

Single bolus dose	Maximum Dosage
Neonates	2mg/kg
Children	2.5mg/kg
Continuous Postoperative Infusion	**Maximum infusion rate**
Neonates	0.2mg/kg/hr
Children	0.4mg/kg/hr

STANDARD ORDERS (FOR WARD NURSES AND DOCTORS)

1. No other opioid is to be given except on the order of the anaesthetist / APS doctor.
2. Naloxone (Narcan) must be available at all times by the bedside.
3. Monitoring:

   - Record the blood pressure, pulse rate, respiratory rate, pain score, sedation score and vomiting score **hourly for the first 4 hours and 4 hourly** until the epidural infusion is stopped.
   - **Motor function** of lower limb should be assessed 4 hourly using Bromage score (See Appendix 3). This is important to detect the onset of complications e.g. epidural haematoma or abscess.
     - To assess the motor function, ask the patient to flex their knees and ankles.
     - For younger or children who are unable to follow commands, try to elicit movement by tickling the toes, or gentle knee or hip flexion.
     - With thoracic epidural, upper limb motor function should be assessed by testing bilateral hand and finger extension and flexion.
     - The degree of motor block on both the left and right side should be assessed.

   - To inform APS doctor if **Bromage score is 2 - 3 or reduced hand or finger motor** function with a thoracic epidural

4. The infusion rate must not be altered except on the order of the anaesthetist / APS doctor.
5. APS doctors are to be notified when the syringe finishes, or there are any problems with the infusion.

POSTOPERATIVE INSTRUCTIONS (FOR WARD NURSES)

Notify Aps Doctor Immediately:

i. RR < 10/min (> 5 yr) or < 15/min (1-5 yrs) or < 20/min (< 1yr)
ii. Systolic BP< 80 mmHg(>1yr)or< 60 mmHg(<1yr)
iii. Sedation score of 3 (unarousable)
iv. Inadequate analgesia >4
v. Severe vomiting or pruritus
vi. Profound weakness of lower limb (Bromage Score 2 – 3)

MANAGEMENT OF MAJOR COMPLICATIONS

Notify Aps Doctors Immediately

Hypoventilation or Unarousable

1. Stop infusion
2. Oxygen 12L/min. via Hudson mask
3. Naloxone (Narcan) 0.01mg/kg

NB: Hypoventilation if *Respiratory rate < 10 / min. for > 5 years old*
Respiratory rate < 15 / min. for 1 – 5 years old
Respiratory rate < 20 / min. for < 1 year old.

Apnoea

1. Stop infusion
2. Ventilate with bag and mask (100%oxygen)
3. Check pulse, if absent start CPR
4. Naloxone (Narcan) 0.01mg/kg

Convulsion

1. Stop infusion
2. Maintain airway and give 100 % oxygen
3. Ventilate if apnoeic
4. Check pulse, if absent commence CPR

High Epidural Block

(as evidence by decreased sensation and/or motor block in the arms or respiratory difficulty)

1. 1. Stop infusion
2. 2. Oxygen 12 L/min
3. 3. Check ventilation and assist if required
4. 4. Check pulse, if absent commence CPR

CAUTION

Compartment Syndrome

Limb fractures and long hours in lithotomy position can sometimes be complicated by compartment syndrome.

Cardinal Signs

- Increasing pain at the site of surgery and injury (disproportionate pain)
- Pain remote to surgical site
- Increasing analgesia requirements
- Paraesthesia not attributable to analgesia
- Reduced perfusion of painful site
- Swelling
- Pain on passive movement of painful site

While it is important that analgesia does not mask these signs, analgesia should not be withheld from children.

Unexpected increases in analgesia requirements should trigger clinical review. APS team must be called.

ANALGESIA FOR DAY-CARE SURGERY

Elective paediatric day-care surgery offers several benefits to children and their families over inpatient surgery. These include reduced psychological distress, less disruption to family routine, a decreased risk of hospital-acquired infections and reduced health care cost. However, post-operative pain assessment and management is one of the challenging issues beside post-operative nausea and vomiting.

Optimal post-operative pain control for day-dare surgery should be safe and effective, with minimal side effects, facilitate recovery and permit `normal' activities and easily managed at home. Management of pain control shall start from preoperative period whereby parents are informed about the likely degree and duration of pain and types of analgesia available with a multimodal approach being the most effective.

Analgesia in OT and Recovery Ward

Analgesia is usually started intraoperatively with a multimodal approach such as a combination of two or more drugs and/or two or more methods of delivery (rectal, intravenous, regional) to improve analgesia and minimize side-effect. Morphine is deemed to be more effective than fentanyl in long term pain management. However there is a reluctance to use morphine due to its lengthy duration, delay discharge and an increase in the incidence of post-operative nausea and vomiting. Fentanyl is a more commonly used opioid in day-care patients. Apart from opioids, NSAIDs or acetaminophen may be given. Regional block in accordance to the surgery can be performed and plays an important component in post-operative pain management (opioids ± NSAIDs, acetaminophen ± regional).

Pain score of 4 or more (FLACC or VAS) in recovery demands intervention. Short acting opioids i.e. fentanyl (0.5-1ug/kg per bolus) is the commonest drug used because of rapid acting property and easily titrated to desired effect.

Analgesia at Home

The time taken for recovery varies and there is no set time interval that should elapse before discharge. As soon as a child has met the discharge criteria, they may be discharged. Oral analgesics are the mainstay of continuing pain control at home, and it is important to encourage parents and child to take analgesics regularly for the first 24 hour, starting before the effect of the local anaesthetic has worn off. Dispensing appropriate analgesics with clear instructions to the parents is crucial. Giving parents/children pre-packed analgesics for anticipated mild, moderate or severe pain, with clear directions has the potential for improving children`s comfort at home.

Children with obstructive sleep apnoea who have undergone tonsillectomy should continue to be monitored in hospital overnight to assess both response and sensitivity to opioids before discharge. While evidence is lacking, it may be prudent to observe any child given opioids during a period of sleep before discharge. The use of any opioid in children after day-stay surgery should be done so with caution.

Moderate to Severe Pain

Pain management after day-care surgery needs to be tailored to the type of surgery. Several studies indicate a high incidence of moderate to severe pain following surgeries such as tonsillectomy, adenotonsillectomy, orchidopexy and certain orthopedic procedures and in patients requiring more than 2 doses of opioids in the recovery.

Oral acetaminophen and NSAIDs (e.g. Ibuprofen, naproxen etc.) are highly recommended to be taken regularly for the first 24 hours (refer to the dosing guideline **NSAIDS preparations, dose and route).** Subsequently the prescribed analgesics are taken `as needed` (PRN) when the pain score is above 3.

Mild Pain

Minor surgeries examples herniotomy or excision of small lumps are associated with mild pain. Regular around the clock dosing of oral or rectal acetaminophen is adequate.

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Table 10.10 : Appendix 1 – PAIN SCORE

r-FLACC Scale for 1 month-3 years (Revised FLACC Observational Pain Score)

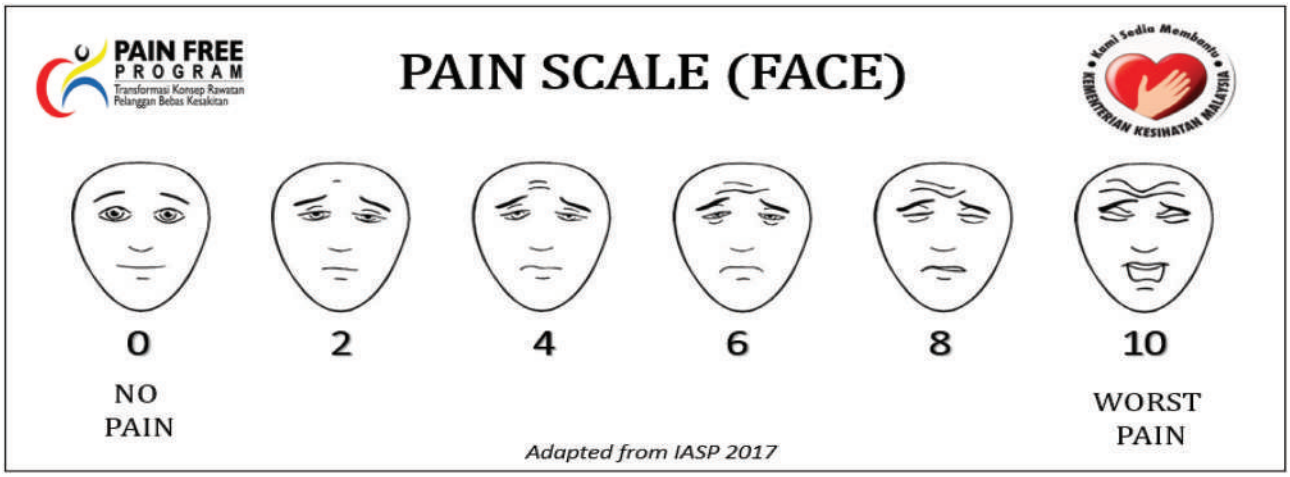
Category	Scoring		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to distractible	Difficult to console

Each of the five categories (F)face, (L)legs, (A)activity, (C)cry and (C)consolability is scored from 0-2, resulting in total range of 0-10.
0 for no pain to 10 for the most severe pain.
r-FLACC (revised FLACC)
0 relaxed
1-3 = Mild discomfort
4-6= Moderate discomfort
7-10= Severe pain or Discomfort or both

FACES PAIN SCALE- REVISED for 4-7 years

It is a self-reporting measure of pain intensity developed for children. It is adapted from the Faces Pain Scale to make it possible to score pain sensation on the widely accepted 0-10 metric. Score the chosen face 0,2,4,6,8,10, counting left to right. Hence the left –most face equals "0", therefore no pain and point from the left most face and point to each from left to right. Basically ask the child which face shows his/her pain. Do not use word like "happy" and "sad". Ask the child to point to which face that describes the pain best.

This scale is intended to measure how the child feels inside and not how the face looks



NUMERICAL SCALE for > 7 years

Refer to Chapter 4 (Monitoring)

Explain to the child that he/she can rate the pain he/she is feeling on a scale from 0 to 10 by sliding the small bead, '0' being no pain and '10' being the worst pain that the child can imagine. It is recorded in cm or by the faces.

Grading Severity for all three Pain Scores

Total Score	Severity of Pain
0-3	Mild pain
4-6	Moderate Pain
7-10	Severe Pain

Table 10.11 : Appendix 2 - Sedation score and Vomiting score

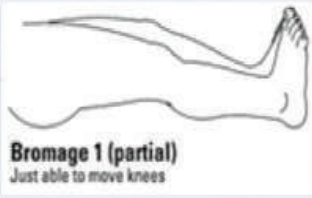
Sedation Score

0	awake alert
1	mild, wakes instantly to call
2	drowsy, arouses with shaking
3	very drowsy, difficult to arouse
S	sleeping

Vomiting Score

0	Nil
1	Mild / infrequent (<2x)
2	Moderate / frequent
3	Severe

Table 10.12 : Appendix 3 - BROMAGE SCORE (ASSESSMENT OF MOTOR BLOCKADE)

Bromage Score		
 Bromage 0 (none) Full flexion of knees and feet	No Residual Motor Block; Full flexion of knee and feet	0
 Bromage 1 (partial) Just able to move knees	Partial Block Remains; just able to flex knees with free movement of feet	1
 Bromage 2 (almost complete) Able to move feet only	Almost complete block; only able to move feet; Unable to flex knee	2
 Bromage 3 (complete) Unable to move feet or knees	Complete Motor Block; Unable to move feet or knees	3
	Total Score	

CHAPTER 11

OBSTETRIC ANALGESIA SERVICE (OAS)

CHAPTER 11 | OBSTETRIC ANALGESIA SERVICE (OAS)

Contents:

I. Introduction

Labour and delivery cause moderate to severe pain in the most parturient. The alleviation of pain and suffering is one of the fundamental principles guiding medical practice, yet ameliorating pain during childbirth has historically attached much controversy. In our country, the provision of effective labour pain relief has been delayed by superstitions, religious and cultural believes, and even opposition from members of the medical profession.

The pathophysiological changes in response to poorly controlled pain may result in harm to both the mother and fetus. The provision of optimal obstetric anaesthetic care to the parturient requires an appreciation of the multidimensional nature of childbirth. It is essential for the anaesthetist to understand the mechanisms of pain transmission during labour and delivery, as well as other factors that may influence the intensity, duration and quality of pain. Rational pain management will involve proper application of pharmacological and non-pharmacological interventions that can disrupt these mechanisms.

The three essentials of obstetric pain relief are simplicity, safety and preservation of maternal and fetal homeostasis. With regards to the fetus, the most important factor to consider is the transfer of oxygen across the placenta from the maternal to the fetal circulation (This is dependent on the concentration of inhaled oxygen, uterine blood flow, the oxygen gradient across the placenta, and the umbilical blood flow).

II. Principles of Pain Relief in the Obstetric Patient

Pain relief in labour presents several unique problems. These may be best appreciated by comparing several important differences between obstetrical and surgical analgesia and anaesthesia.

1. Fetus – Infant

In surgical procedures, there is only one patient to consider, whereas during labour there are two patients: mother and fetus. The respiratory center of the fetus is highly vulnerable to sedatives and anaesthetic drugs. Hence, when these agents are given to the mother, they rapidly transverse the placenta and may cause neonatal respiratory depression.

2. Analgesia

Analgesia is essential for safe, satisfactory and humane performance of surgical and abnormal deliveries. Although analgesia is not mandatory for spontaneous deliveries, it may relieve unnecessary suffering.

There are several potential sources of pain during labour and delivery that must be managed appropriately to promote postpartum recovery. Unrelieved pain can negatively impact a woman's ability to care for herself and her infant, to breastfeed, and may contribute to postpartum depression.

When considering postpartum analgesia, the clinician should consider methods that provide adequate pain relief with the least maternal side effects that will not impact a woman's ability to care for her newborn.

3. Duration

In most surgical procedure, analgesia is only required for a few hours. Obstetric analgesia maybe required for 12 hours or even longer.

4. Effects on Labour

Analgesic techniques used should exert little or no deleterious effect on uterine contractions and voluntary expulsive efforts.

5. Timing

Elective surgical patients can be fasted properly prior to anaesthesia. In obstetric patients, labour can begins without warning and anaesthesia maybe required within a few hours to immediately after a full meal. During labour, aspiration of gastric contents is a constant threat and often a major cause of serious maternal morbidity and mortality.

III. Introduction

An understanding of the mechanisms of pain transmission during labour and various factors that may influence the intensity, duration, distribution and quality of pain is essential if optimal labour analgesia is to be provided.

Most of these factors vary as labour progresses; thus the stages of labour are considered separately.

Figure 11.1 shows the peripheral nociceptive pathways involved in the pain of childbirth.

Figure 11.1 : Pain pathways in a parturient

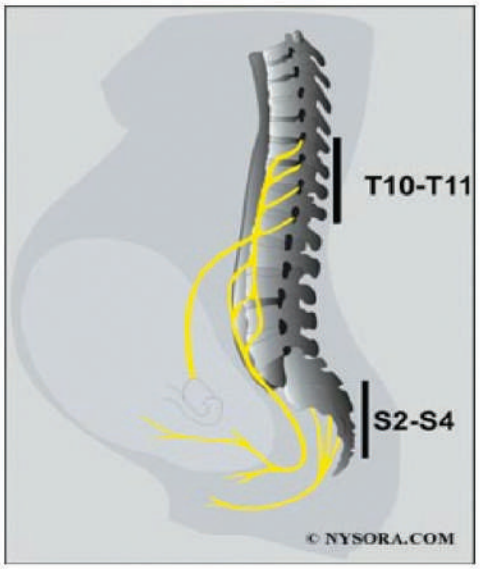
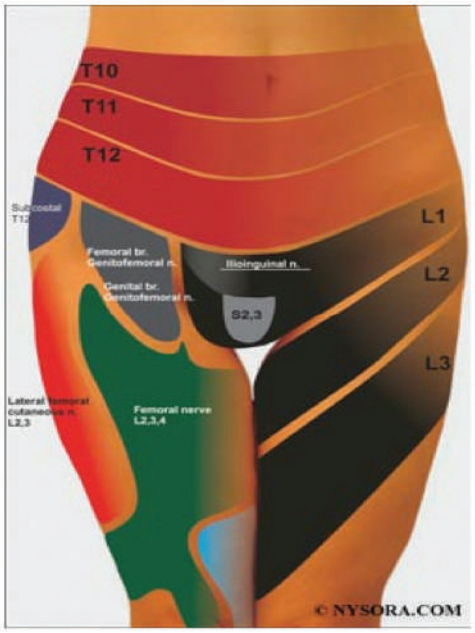


Figure 11.2 : Dermatomes of the lower abdomen, perineal area, hip, and thighs



Labour pain can be divided into the three stages of labour.

First stage of labour

1. Pain during the first stage of labour arises from the uterus and adnexae during contractions.

    - Pain results from dilatation of the cervix and lower uterine segment and their subsequent mechanical distension, stretching and tearing during contractions.
    - Pain intensity is related to the strength of the contractions and the pressure generated. The minimal pressure required to initiate dilatation of the cervix and lower uterine segment is 15 mmHg. Typically, intrauterine pressure must exceed 25 mmHg before pain is experienced.
    - Several chemical nociceptive mediators contribute to pain including bradykinins, leukotrienes, prostaglandins, serotonins, lactic acids and substance P.

2. Pain is visceral in nature and it is poorly localized, diffuse, dull and vague. It is usually referred as periodic and builds to a peak.
3. The pain fibers are transmitted via T10, T11, T12 and L1 spinal nerves.

Second Stage of Labour

1. Pain during second stage occurs when the cervix is fully dilated, and continues from the uterine body contractions and distension of the lower uterine segment.
2. The progressively increasing pressure of the fetal presenting part on pelvic structure gives rise to pain, with stretching and tearing of fascia and subcutaneous tissue of the lower birth canal, distension of the perineum and pressure on skeletal muscle.
3. The pain is transmitted via the pudendal nerve, a somatic derivative from the S2, S3 and S4 sacral nerve roots.
4. The pain is somatic in nature and is well localized, sharp definite, and intense. The 2nd stage of labour occurs in addition to the ongoing visceral pain of uterine contractions.

Third Stage of Labour

1. The pain is associated with the expulsion of the placenta and is often not consciously registered by the mother if placenta expulsion follows soon after delivery. However if placenta expulsion is delayed or manually removed, pain relief is required.

IV. Factors That May Influence the Pain of Childbirth

Table 11.1 : Factors That May Influence the Pain of Childbirth

Physical	Psychological and Ethnocultural	Proposed Neuro-Humoral Mechanism
1. Age and parity 2. Physical condition 3. Size of infant/ birth canal 4. Abnormal fetal presentation 5. Stages of labour 6. Speed and degree of cervical dilatation 7. Frequency of contraction 8. Maternal position in labour 9. Menstrual history	1. Attitude towards labour 2. Fear and anxiety 3. Expectation of pain 4. Prior experience of pain 5. Knowledge of childbirth 6. Support and environment 7. Confidence to cope with labour 8. Education and social class 9. Culture and beliefs	1. Endogenous opioids 2. Hormones 3. Placenta with or without amniotic fluid substances 4. Substance P 5. Nociceptin/ ORL-1 receptor system 6. Spinal cord noradrenergic-cholinergic system

V. Physiological Changes in Labour

Labour is a physically demanding event that stresses the mother physiologically and forces her to call on her cardiac, respiratory, renal, hepatic and other reserves. The mother in whom these reserves are already compromised whether, by congenital abnormalities, disease or drug therapy may be stressed to the point that organ failure becomes a reality.

It is essential for the anaesthetists to understand these physiological changes experienced by the laboring women when providing pain relief to them.

Table 11.2 : Physiological Changes in Pregnancy

Respiratory System

- As pain becomes severe, minute ventilation of the unmedicated parturient increases by 75% to 150% to 300% during the first and second stages of labour respectively.
- Maternal hyperventilation can potentially cause fetal hypoxaemia by causing:
  - Uteroplacental and fetoplacental vasoconstriction.
  - A left shift of maternal oxyhemoglobin dissociation curve which causes O_2 to be bound tightly to maternal hemoglobin and compromises the transplacental transfer of O_2 to the fetus.
- The resulting maternal hypocarbia (e.g. $PaCO_2$ of 20 mmHg or less) and alkalemia (pH greater than 7.55) may also cause hypoventilation between contractions, which may result in maternal and fetal hypoxia and loss of maternal consciousness.

Cardiovascular System

- Labour result in a progressive increase in maternal cardiac output. Each uterine contraction increases cardiac output by 10% – 25% and this is associated with a 5% to 20% increase in blood pressure.
- The greatest increase in cardiac output occurs immediately after delivery due to increase in venous return associated with relief of vena cava compression and autotransfusion that results from uterine involution. Studies suggest that severe cardiovascular system stress may result in adverse conditions for the fetus.

Maternal Endorphins

- Maternal concentration of beta-endorphins is increased during pregnancy, which is proportionate to the frequency and duration of uterine contractions, reflecting the stress of labour.
- Caesarean section under general anaesthesia is also associated with marked increase in beta- endorphins.
- Lumbar epidural analgesia causes minimal change in beta- endorphin concentration during labour, vaginal delivery and caesarean section.

Adrenergic Response

- Pain, stress and anxiety increase maternal plasma concentration of catecholamines during labour. High maternal concentration of catecholamines may be harmful for the mother and the fetus.
- Shnider et al. demonstrated that pain causes marked increase in circulating concentration of catecholamines with up to 50% decrease in uterine blood flow of the gravid uterus. After administration of epidural analgesia Shnider et.al. observed that there was a 55% decrease in plasma concentration of epinephrine and a 25% decrease in plasma concentration of norepinephrine.

Acid Base Balance

- Pain, anxiety and increase skeletal muscle activity (eg. Hyperventilation) during labour may result in both maternal and fetal metabolic acidosis.
- Rooth et.al.noted that woman who received effective analgesia had less metabolic acidosis as did their fetuses than woman who delivered without analgesia.

Effect of Maternal Fear on the Fetus

Maternal fear during labour is a complex response, which may be influenced by many factors including mother's expectations, her level of education, severity of pain, presence of a support person and the labour room environment. The actions and words of the physician and nurses may promote or dispel fears during labour. Many studies have shown that maternal fear results in a deterioration of fetal condition. Hence, effective labour analgesia provided in a supportive and comforting environment can be one of the most effective means of facilitating childbirth without fear.

VI. Guidelines for Regional Techniques In Obstetrics

A. Prior To Performance Of Regional Techniques:

1. Detailed pre-anaesthetic evaluation is performed, which includes an assessment of patient's medical, surgical and anaesthetic history.
2. Only a full blood count (FBC) is required if there are no other concurrent diseases in the parturient.
3. Consent from patient and risks of regional analgesia discussed.
4. Minimum monitoring standards should be instituted prior to procedure as per College Of Anaesthesiologists Malaysia Guidelines 2014. (ECG, NIBP, SpO_2). Additional monitoring may be required depending on the clinical situation.
5. Establish intravenous access, minimum 18G cannula.
6. Appropriate equipment including equipment for emergency conversion to GA and supplies for resuscitation should be checked and made immediately available during administration of regional analgesia.

    - Oxygen supply.
    - Suction apparatus.
    - Self-inflating bag and for positive-pressure ventilation.
    - Mask
    - Laryngoscope with different blades.
    - ETT tube sizes 6-7mm.
    - Oropharyngeal airways.
    - Drugs:

    Thiopentone, Propofol, Suxamethonium, Adrenaline, Atropine, Ephedrine, Phenylephrine, Calcium chloride, Sodium bicarbonate, Naloxone, 20% lipid emulsion (Intralipid)

B. Criteria For Initiation Of Epidural Analgesia

- No fetal distress (an assessment of fetal well being is performed in consultation with the obstetrician).
- Established labour (The patient is in labour and the obstetrician is committed in delivering her).
- Obese parturients should be counseled to have an early epidural as they are at higher risks of instrumental/surgical delivery (50% risk)

Lumbar epidural analgesia is generally administered only when labour is well established. It may however be advantageous to place an epidural catheter early when the patient is comfortable and can be positioned easily. Patient request alone is a good indication to provide epidural

C. Monitoring (refer to nursing observation /pink chart)

- All patients should have CTG and non-invasive BP monitoring prior to performance of the block.
- After the block has been performed, BP should be taken every 5 mins for the first 30 mins, then every 15 mins for the next 30 mins, after which hourly BP monitoring should be instituted.
- Pain score – should be documented before and 15 minutes after the initiation of epidural. After which hourly charting should be instituted
- Document lower limb weakness using Bromage score and sensory block level (dermatomes)
- CTG should be continuous after performance of the block for continuous
- Fetal heart rate monitoring.
- Continual verbal communication.

D. Technique

This is a sterile procedure and full sterile precautions such as scrubbing, gown, gloves and facemask are essential. The patient's skin should be appropriately prepared and draped. A trained assistant is a prerequisite. Ensure that patient's hair is well kept by using the OT cap.

- The patient is placed in a lateral decubitus or sitting position.
- The epidural space is identified under aseptic technique with a loss of resistance technique.
- Epidural catheter is threaded 3-4 cm into the epidural space.
- Drug administration according to protocol.
- The patient is cared for in any position comfortable to the patient. If in the supine position, ensure left uterine displacement (LUD) to avoid aortocaval compression.
- The maternal blood pressure is measured and the fetal heart rate is monitored continuously.
- The level of analgesia and intensity of sensory/ motor block is assessed initially after establishing the block.
- The pain score is monitored hourly or more frequently as indicated.

VII. Protocols For Management of Labour Pain

Options:

A. Lumbar Epidural
   - Patient Controlled Epidural Analgesia With Continuous Epidural Infusion (PCEA + CEI)
   - Patient Controlled Epidural Analgesia With Programmed Intermittent Bolus (PCEA + PIB)
   - Continuous Epidural Infusion (CEI)

B. Combined Spinal-Epidural (CSE)
C. PCA Fentanyl
D. PCA Remifentanil

A. Lumbar Epidural

1. Patient Controlled Epidural Analgesia (With Continuous Infusion or Programmed Intermittent Bolus)

   - Insert epidural catheter
   - Administer test dose (see Table 11.2)
   - 5 mins after the test dose, if no complications occur, PCEA is started, using either PCEA Regime 1,2,3 or 4 (see Table 11.2)
   - The patient is cared for in any position comfortable to the patient. If in the supine position, ensure left uterine displacement (LUD) to avoid aortocaval compression.
   - The patient is told that when she is nearing towards 2nd stage she will experience perineum pain, she has to sit-up and bolus herself using the PCEA pump.

2. Continuous Epidural Infusion Technique

   - Insert epidural catheter
   - Administer test dose (see Table 11.2)
   - 5 mins after the test dose, if no complications occur, administer a bolus dose followed by the infusion (see Table 11.2)
   - The patient is told that when she is nearing towards 2nd stage she will experience perineum pain, she has to sit-up and bolus herself using the PCEA pump.
   - The patient is cared for in any position comfortable to the patient. If in the supine position, ensure left uterine displacement (LUD) to avoid aortocaval compression.
   - If patient experiences pain during 2nd stage, sit patient up and top-up with 5 ml of 0.2% Ropivacaine OR 0.125% Levobupivacaine with Fentanyl 50 mcg as rescue analgesia.

B. Combined Spinal-Epidural

The advantage of this technique is that pain relief is rapid. Patients who are having frequent strong contractions will benefit from this technique.

- Once the epidural space is identified, the spinal needle is introduced through the Tuohy needle and CSF backflow is confirmed.
  - 15-25 mcg of undiluted Fentanyl +/- 0.5 mls of 0.5% Plain Bupivacaine is injected intrathecally, after which the spinal needle is removed. The effect may last about an hour.

- The epidural catheter is inserted and connected to the PCEA pump or infusion pump
- No loading bolus/ initial clinician dose is needed through the epidural
- The patient is cared for in any position comfortable to the patient. If in the supine position, ensure left uterine displacement (LUD) to avoid aorto-caval compression.
- The following regimes can be run through the epidural catheter (see Table 11.2):
  - PCEA + CEI may be used following the Regime 1 or 2
  - PCEA + PIB may be used following Regime 3 or 4 or
  - CEI alone

Ambulation (Walking Epidural)

Theoretical Advantages of Walking Epidural:

- Increased maternal satisfaction
- Retention of the urge to bear down and the ability to push during the 2nd stage
- Retention of bladder sensation/avoidance of urinary retention
- Obstetric outcome may be improved – a trend towards reduced assisted delivery

Criteria for Walking Epidural:

- Only to be considered 45 minutes after initiation of block and if ≥ 15 minutes have elapsed since the last top-up and maternal and fetal observations are satisfactory.
- Assessment for risk of falling.
- A full assessment should be performed to rule out the following:
  - Mobility impairment (including epidural/spinal analgesia)
  - Postpartum haemorrhage 1000mls and/or symptomatic anaemic <90g/L
  - Significant medical co-morbidities (Significant cardiac or respiratory dysfuntion)
  - Hypotension, drowsiness, giddiness, extreme fatigue etc.
  - Altered cognitive status
  - Visual impairment
  - Continence issues- incontinence, frequency, nocturia

- Assessment of sympathetic block and postural hypotension:
  - BP to be taken both lying and sitting on edge of bed.
  - Patient not to ambulate if:
    - Reports any feelings of light-headedness or giddiness or nausea.
  - Systolic BP whilst sitting is less than 100 mmHg or there is postural drop in systolic BP of 20 mmHg or more.

- Assessment of motor block:
  - Patient able to sustain straight leg raise for ≥ 5 sec. on each side.
  - Patient able to weight bear - this must be tested with the help of two staff members.
  - Patient should only ambulate within the Labour room and must be accompanied by a nurse at all times.

Table 11.3 : Labour Epidural Infusion Regimes

	PCEA + CEI (Regime 1)	PCEA + CEI (Regime 2)	PCEA + PIB (Regime 3)	PCEA + PIB (Regime 4)	Continuous Infusion (CEI)
Drug	0.05% Ropivacaine + Fentanyl 2 mcg /ml	0.05% Levo-bupivacaine + Fentanyl 2 mcg /ml	0.05% Ropivacaine + Fentanyl 2 mcg /ml	0.05% Levo-bupivacaine + Fentanyl 2 mcg /ml	0.1% Ropivacaine or 0.1% Levo-bupivacaine + Fentanyl 2 mcg/ml
Test dose	2ml Lignocaine 2% or 2ml Levobupivacaine 0.5% or 4ml Ropivacaine 0.2%				
Initial dose or loading dose	Loading dose 15 mls	Loading dose 15 mls	Initial clinician dose 10 mls	Initial clinician dose 10 mls	10-15 mls 0.1% Ropivacaine OR 0.1% Levo-bupivacaine + Fentanyl 50-100 mcg
PCEA settings or infusion rate	PCEA Bolus 10 mls Lockout interval 10 mins Basal infusion 10 mls/hr One hour limit not set	PCEA Bolus 10 mls Lockout interval 10 mins Basal infusion 10 mls/hr One hour limit not set	PCEA Bolus 10 mls Lockout interval 10 mins PIB Bolus 10 mls PIB interval 1 hour One hour limit not set	PCEA Bolus 10 mls Lockout interval 10 mins PIB Bolus 10 mls PIB interval 1 hour One hour limit not set	Infusion rate 10 -15 ml/hr
2nd Stage of Labour	Patient to sit up and bolus herself using PCEA if perineal pain experienced				Sit patient up and top-up with 5 ml 0.2% Ropivacaine OR 0.125% Levo-bupivacaine + Fentanyl 50 mcg

C. PCA Fentanyl

- This technique is suitable for patients with IUD, mid-trimester termination of pregnancy or when there are absolute or relative contraindications to neuraxial block such as, platelet dysfunction (ITP), coagulation disorders, anticoagulant therapy, sepsis, spinal anomaly/ history of spinal trauma/injury, high intracranial pressure (ICP).
- Fentanyl PCA is not as effective as, but is a useful substitute for regional analgesia.
- No difference in APGAR scores and the need for naloxone in newborn when compared with epidural technique. Nevertheless, paediatricians should be informed and have Naloxone ready if needed.

PCA Fentanyl regime:

Loading dose : 1 mcg/kg
PCA bolus : 10 – 20 mcg

Lock out interval : 5 min
Basal infusion : none

D. PCA Remifentanil

- Similar indication as PCA fentanyl
- Ultra short acting opiods, rapidly hydrolysed by plasma and tissues esterases with no accumulation
- Significant placental transfer but clear evidence for extensive fetal metabolism and redistribution
- Parturients should be advised to bolus as soon as they sense the contractions starting.
- One-to-one nursing is required
- Oxygen supplement either via nasal prong or simple mask
- Close monitoring (half-hourly) of sedation score, RR, SpO2
- Presence of an in-house anaesthetist is mandatory

  - PCA Remifentanil Regime:
    - Prepare remifentanil as 20 ug/ml concentration (add 1 mg of remifentanil into 50 mls of normal saline)
    - PCA bolus : 20 ug at a rate not faster than 30s (to avoid chest rigidity)
    - Lockout interval : 2 minutes
    - Background infusion : to start at 80 ug/hr (4 ml/hr) and may be titrated to achieve VAS of < 4(titrate the background, not the bolus to reduce side effects)

VIII. Management of Complications of Regional Analgesia in Labour

1. Hypotension

Hypotension is defined as a 20-30% decrease in baseline systolic BP or if systolic BP is less than 100mmHg. Maternal hypotension and its complication can be minimized or avoided with proper assessment of the parturient's fluid and cardiovascular status and timely treatment of hypotension.

Management:

- Administering only the required amount of local anaesthetic to relieve maternal pain without causing sympathetic blockade to reduce the risk of hypotension. Dose should be titrated to achieve sensory analgesia so that only the minimum dose is used.
- Place patient in Left Uterine Displacement (LUD).
- Intravenous fluids (volume expansion) and supplement oxygen.
- Intravenous Phenylephrine 50-100 mcg or Ephedrine (6-30mg) should be administered if above measures do not result in prompt correction of hypotension.
- If maternal bradycardia is observed, atropine (0.4 - 1 mg) given intravenously will block any untoward vagal overactivity that may be contributing to the hypotension.
- If there is profound hypotension, further investigation should be made to determine whether an accidental intrathecal injection has occurred.

2. Unintentional Dural Puncture

- If recognized, thread the catheter about 4 cm into the intrathecal space. The catheter will now be managed as an intrathecal catheter.
- Administer 15 -25 mcg of Fentanyl +/- 0.5 mls of 0.5% plain Bupivacaine.
- Label the catheter clearly as "SPINAL CATHETER - DO NOT INJECT". Cover the filter and the injection port with transparent dressing. All subsequent top-ups via the catheter must be given by the anaesthetic medical officer only.
- Inform the staff-midwife to let the anaesthetic medical officer know when the pain score is 4 and above. Similar top-up with fentanyl+/- plain Bupivacaine should be administered.
- Both anesthesiologist and obstetrician should be informed of the incident and consideration given to an instrumental delivery to avoid straining. The catheter should be left in-situ for at least 24 hours and to be removed only by the OAS team.
- The patient should be told about the complication so as to be aware of the possible post-dural puncture headache later. The patient should be followed-up for 3 days.

3. Post Dural Puncture Headache (PDPH)

- Definition
  Severe postural headache is thought to be due to an acute reduction in CSF volume and pressure consequent to leakage of CSF via a dural tear. Possibly contributed to by reflex cerebral vasodilatation.

Table 11.4 : International Headache Society Definition of PDPH

- Onset within 5 days after dural puncture
- Worsening within 15 minutes after sitting or standing
- Improves within 15 minutes after lying down
- With at least 1 of the following:
  - Neck stiffness
  - Tinnitus
  - Hypoacusia
  - Photophobia
  - Nausea

- Significance
  Headache may be debilitating. The obstetric population is especially at risk of developing PDPH. Rarely intra-, extra- or subdural haematoma can occur. Hence severe PDPH must be treated as more than just an inconvenience to the patient.

- Recognition
  Suspect whenever subarachnoid or epidural block has been performed. Expect in up to 80% following inadvertent dural puncture with 18G Tuohy needle. Of those patients with headache:
  - 50% will be mild and need no treatment
  - 35% will be moderate and may require treatment
  - 15% will be severe, incapacitating and always require treatment

  Severe, typical occipital and bifrontal headache occurring when patient sits or stands. Relieve by lying flat. Onset is usually 24 to 48 hours following the dural puncture. Associated symptoms include visual and auditory disturbance, nausea and vomiting.

- Differential Diagnosis for PDPH
  - Migraines
  - Pre-eclampsia
  - Sinusitis
  - Meningitis
  - Cerebral haemorrhage
  - Cerebral vein thrombosis
  - Cerebral infarction/ ischemia
  - Pseudo tumour cerebri
  - Intracranial tumour
  - Metabolic (hypoglycaemia, electrolyte imbalances)

- Management of PDPH
  - Explanation and reassurance to the patient.
  - Daily (at least) review, by anaesthesiology medical officer and patient alerted to the specialist/consultant in-charge of obstetrics of the day. Fill up the PDPH follow-up form on each visit. (Refer appendix)
  - Trial of conservative management.
  - Bed rest for symptomatic relief. Patient must be informed not to care for her newborn. This responsibility has to be taken over by the ward nurse.
  - Adequate (not over) hydration, oral or intravenous. At least 2.5L for 24 hours
  - Analgesia. Use regular paracetamol and a NSAID, providing the latter is not contraindicated. Supplemental parenteral opioids are frequently required.
  - Suggested regime:
    - T. PCM 1g qid
    - T. Diclofenac 50 mg tds
    - Oral caffeine 300mg to start. Repeat 12 hourly prn. (if available)
      A cup of instant coffee contains approx 70 mg caffeine, fresh coffee 100 - 150 mg, and a can of coke 40 mg. Note this may be a cause of irritability in breastfed babies.
    - Consider laxatives
    - Patient should be primed for the possibility of an epidural blood patch if the headache persists.
  - Other drugs:
    - Sumatriptan (Controversial value according to studies)
    - Adrenocorticotrophic hormone (Not recommended as first line therapy but may be considered for persistent cases not amenable to blood patch)
    - Gabapentin, methylergonovine, hydrocortisone (reports of use but further studies needed)
  - Offer epidural blood patch from Day 2 for unrelenting or disabling headache causing inability to care for infant and delay in discharge. Epidural blood patch is the definitive treatment of PDPH, but if performed within 24 hours of dural puncture, it has a much higher failure rate than after 24 hours.
  - Prophylactic blood patching not widely accepted, carries potential risk for patients who may not develop headache
  - Ensure the patient does not have local or systemic sepsis (examination, white cell count, temperature).

Epidural Blood Patch Procedure

- Explain procedure and obtain consent.
- IV access and infusion of crystalloid.
- 2 operators are recommended to improve sterility and efficacy. Epidural should be performed a skilled operator.
- Appropriate location and skilled assistant. The ideal location is usually the operation theatre.
- Position the patient and identify vertebral level one below that of the dural puncture.
- Under aseptic technique, identify epidural space in usual manner.
- Withdraw 20ml of venous blood from non-drip arm under aseptic conditions.
- Slowly inject blood via Tuohy needle. Stop once 15-20 mls has been given or sooner if back pain occurs or cessation of headache.
- Send remaining blood for culture.
- Bed rest for 1-2 hours + routine observations.
- Inform obstetrician that patient will need to rest in ward for at least 24 hours before discharge.
- Avoid straining or lifting for 4 days.
- Repeat blood patching may be required in 25% of patients

Contraindications to Epidural Blood Patch

- Patient refusal e.g. Jehovah Witness
- Systemic or local sepsis.
- Blood dyscrasias.
- Anticoagulation.
- Active central axis neurological disease.

Follow-up

- All patients must be given a phone call follow-up on the day after discharge
- An appointment to the anaesthetic clinic must be given at 2 weeks after discharge together with a discharge note.

4. Unintentional Intravascular Injection of Local Anaesthetic

Intravenous injection of large doses of local anaesthetic causes CNS symptoms (eg. restlessness, dizziness, tinnitus, confusion, seizures and loss of consciousness). Convulsions result in serious damage to mother and fetus. It also causes serious CVS effects (eg. bradycardia, arrhythmia, depressed ventricular function, ventricular tachycardia and fibrillation and cardiac arrest). Bupivacaine cardiotoxicity maybe fatal in pregnant women.

Management:

- Stop convulsions with a barbiturate or benzodiazepine
- Maintain Airway and Breathing by administrating 100% oxygen to maintain maternal oxygenation. Use positive pressure ventilation if necessary. Tracheal intubation will facilitate ventilation and help protect airway.
- Maintain Circulation by intravenous fluid and vasopressors (Ephedrine 6-30 mg).
- Monitor maternal blood pressure, ECG and oxygenation and fetal heart rate.
- Provide cardiopulmonary resuscitation (CPR) if necessary with uterine displacement. Delivery of fetus may facilitate successful resuscitation of mother.
- Provide Advanced Life Support as necessary.
- Intralipid 20% according to AAGBI guideline
- Lipid Rescue Kit must be made available at in Labour Room and all Operating Theatres.
- Prevent maternal respiratory and metabolic acidosis.

5. Unexpected High Block

Etiology

- A high or total spinal block results after unintentional placement of either the subarachnoid or subdural space, followed by injection of an epidural dose of local anaesthetic through the catheter.
- The epidural catheter may migrate into the subarachnoid or subdural space during the course of labor and delivery.

Precautions

- Aspiration alone is an inadequate method of excluding subarachnoid placement of the catheter.
- Administration of an appropriate Test Dose and careful assessment of the patient's response to the Test Dose should minimize the chance of a large dose of local anaesthetic into the subarachnoid space.

Symptoms

- Hypotension, dyspnoea, inability to speak and loss of consciousness.

Management

- High spinal anaesthesia may occur several minutes after an epidural injection of local anaesthetic.
- Communicate with the patient. Agitation, dyspnoea, and difficulty talking may herald the onset of total spinal anaesthesia.
- Avoid aorto-caval compression.
- Maintain Airway and Breathing by administrating 100% oxygen to maintain maternal oxygenation. Use positive pressure ventilation if necessary. Tracheal intubation will facilitate ventilation and help protect the airway.
- Maintain Circulation by intravenous fluid and vasopressors (Phenylephrine 50-100mcg or Ephedrine 6-30mg) as needed. Do not hesitate to give Adrenaline if needed.
- Monitor maternal blood pressure, ECG, oxygenation and fetal heart rate.

7. Unintentional Intravascular Injection of Local Anaesthetic

Failure rate of epidural analgesia ranges from 1.5 to 5.0%. Successful location of epidural space is not always possible and satisfactory analgesia does not always occur even when the epidural space has been identified correctly. Patient factors (eg. obesity, abnormal lumbar spine anatomy, depth of epidural space, longitudinal connective tissue band between the dura) increase the likelihood of an unsatisfactory result.

Management:

a. Perform an honest evaluation of the anaesthetic. Is the catheter really in the epidural space? If in doubt, replace the catheter.
b. If catheter is in the epidural space but block is asymmetric:

- Withdraw the catheter 0.5 to 1.0cm, place the less-blocked side in the dependent position and administer 10 mls of local anaesthetic cocktail
- Additional 50-100mcg of Fentanyl may be given
- If these maneuvers are unsuccessful, replace the catheter.

c. If the patient feels a change in the nature of her pain;

- Ask the obstetrician to evaluate the progress of labor
- Check for bladder distention
- Increase the volume and/or concentration of local anaesthetic, or add an opioid to the local anaesthetic

8. Pruritus

- Pruritus is the most common side effect of intrathecal opioid administration. Commonly affected areas are face, nose and upper extremeties
- May be related to disturbance of sensory input, which results from rostral spread of the opioid within the CSF to the level of the trigeminal nucleus or subnucleus caudalis. It is not due to histamine release.
- Possible mechanism: μ receptor mediated, stimulation of trigeminal nerve, oestrogen, itch centre in the brain

Management

- Reassurance as effects are normally transient and self limiting
- Ondansetron 4-8 mg IV may reduce the incidence, severity and need for rescue treatment
- In severe cases, titration of intravenous Naloxone 40mcg every 5 minutes up to 400 mcg or intravenous Nalbuphine 2.5 – 5mg IV
- Avoid antihistamines as it may cause more sedation and increase the risk of respiratory depression

IX. Post LSCS Analgesia

Objectives :

1. To provide an appropriate management plan for analgesia following a routine caesarean section using a multimodal approach.
2. To provide safe and effective post-operative analgesia that is safe for both mother and baby
3. Allow maximal postoperative mobility in mothers in order to facilitate optimal neonatal care

Options:

A. Intrathecal Morphine
B. Epidural Morphine
C. Epidural infusion
D. Patient Controlled Analgesia (PCA) using Fentanyl
E. Regional blocks: Transversus abdominis plane (TAP) block, Quadratus lumborum block.
F. Supplemental Analgesia: Paracetamol, NSAIDS (Should be given to all the techniques mentioned above)

A. Intrathecal Morphine

Introduction

- Onset of action is slow, up to 45 minutes and has a prolonged duration of action after a single bolus dose (up to 24 hours of analgesic benefit) following administration.

Indication

- Analgesia following caesarean section in a woman having spinal anaesthesia for caesarean section

Anaesthetic Problems (dose-dependant side-effects)*

- Pruritus: Incidence of 60%; 1/6 need specific treatment
- Nausea and vomiting: incidence of 40-50%; severe cyclical form for 10-12 hours in 2-3%
- Herpes simplex reactivation - clear association after intrathecal Morphine has not been established but avoid Morphine if there is strong history of herpes
- Late respiratory depression (up to 24 hours after administration) - clinically significant depression or arrest has not been reported in this population within the usual clinical dose range of up to 0.25 mg when intrathecal Morphine is used in isolation, i.e. with no other parenteral or intrathecal opioids
- Potential for significant opioid side-effects when other parenteral opioids or sedatives administered within the first 24 hours after administration.
- There is increased risk of sedation or respiratory depression for up to 24 hours in the presence of morbid obesity or when additional sedative drugs are used.

Contraindications

- Allergy to Morphine
- Sensitivity to opioids, e.g. previous severe nausea/vomiting
- Morbid obesity
- Previous herpes labialis infection

Preparation

- Given intraoperatively with spinal anaesthesia for LSCS itself
- Dose 0.1 mg (100 mcg)
- Example: To prepare 0.1mg :
  - Take 1 mg (0.1ml) of Morphine in 1 ml syringe. Add 0.9ml 0.5% Heavy Bupivacaine and discard 0.9 ml. Administer the remaining 0.1ml (0.1mg) morphine with the desired amount of 0.5% heavy Bupivacaine +/- Fentanyl

- A typical patient may be given 2.0 ml heavy Bupivacaine + 15 mcg Fentanyl (0.3ml) + 0.1mg (0.1ml) = total volume 2.4 mls. (Assuming average adult female height = 156cm).

  Please adjust the dose at your discretion.

Post-operative Management

- Routine post-caesarean section observations - hourly pulse, respiratory rate and blood pressure for four hours and then 4-hourly thereafter
- No other sedative or parenteral opioids in the first 24 hours

Management of Side Effects

- Pruritus (Refer Management of Complications of Regional Anaesthesia in Labour)
- Nausea and vomiting
  - Antiemetic prophylaxis to be given to all patients in OT after clamping of the umbilical cord
  - IV Dexamethasone 8 mg + IV Ondansetron 4mg or Granisetron 1 mg
  - For treatment of PONV, chose a drug with a different mechanism of action than was used for prophylaxis
  - Treatment options: Ondansetron 4-8mg IV or Granisetron 1mg IV, Metoclopramide 10mg IV, Propofol 10-20mg IV, Promethazine 6.25 – 12.5 mg IV

- Inadequate analgesia
  - This is extremely uncommon, particularly if combined with NSAIDs.Parturients are encouraged to take oral analgesics as soon as tolerated
  - IV patient-controlled analgesia (PCA) is appropriate if there is complete failure of therapy. Hourly RR observation is mandatory if initiated within the first 24 hours following intrathecal morphine

- Respiratory depression (RR < 8)
  - Call OAS team / anaesthetist.
  - Administer high-flow oxygen via face-mask
  - Administer Naloxone 0.1mg IV or subcutaneous and titrate to effect up to 0.4mg

B. Epidural Morphine

Introduction

- Its onset of action is slow, up to 45 minutes and has a prolonged duration of action after a single bolus dose (up to 24 hours of analgesic benefit) following administration.

Indication

- Analgesia following caesarean section in a woman who has an epidural catheter in situ

Contraindications

- Allergy to Morphine
- Sensitivity to opioids, e.g. previous severe nausea/vomiting
- Morbid obesity
- Previous Herpes Labialis infection

Technique

- Administered at the end of surgery
- Dose: 3 mg
- To prepare: Take 10mg (1 ml) of Morphine in 10 ml syringe. Add 9 ml N/S and discard 7 ml. Administer the remaining 3 ml (3 mg) Morphine and flush the catheter with 2 ml N/S.
- Epidural catheter to be removed in OR before discharge to the ward. Document complete removal of catheter in GA notes

Post-operative Management

- Routine post-caesarean section observations - hourly pulse, respiratory rate and blood pressure for four hours and then 4-hourly thereafter
- No other sedative or parenteral opioids in the first 24 hours

Management of Side Effects

Refer to "management of side effects of intrathecal morphine"

N.B. Alert stickers attached to the patient's medication chart can remind the ward doctors not to prescribe additional opioids.

SPINAL / EPIDURAL MORPHINE ADMINISTERED

DATE: TIME:

No opioids/sedatives to be given within first 24 hours.

If pain relief is inadequate, please inform the APS team.

If RR < 8, give oxygen via high-flow mask @ 15L/m.

Give naloxone IV 0.1mg stat and titrate to effect up

to a maximum of 0.4mg. Call APS team or ICU MO

N.B. When neuraxial opioids are contraindicated, epidural cocktail of 0.1% Ropivacaine + Fentanyl 2mcg/ml can be administered during the postoperative period as part of a CSE technique.

C. Epidural Infusion

- Epidural infusion of low dose local anaesthetic solution (without opioids) can be used for post LSCS analgesia in patients who are morbidly obese or has obstructive sleep apnea.

D. Patient Controlled Analgesia using Fentanyl

- Following GA LSCS or when regional technique is contraindicated
- Fentanyl commonly used.
- If allergic to Fentanyl, Oxynorm would be the alternative
- No opioids/ sedatives should be given while PCA is in progress. If pain relief is inadequate, please inform the OAS team.

E. Regional Blocks (Tranversus Abdominis Plane (TAP) Block / Quadratus Lumborum (QL) Block)

- In patients who undergo general anesthesia or spinal anesthesia without intrathecal or epidural morphine, TAP/QL blocks can significantly improve postoperative pain and reduce opioid consumption.
- These blocks should be performed under ultrasound guidance. With the landmark technique, the spread of LA drugs are in the correct plane in only 23.6% of the injections.
- The duration of sensory blockade for a single-shot TAP block is limited to 6 to 12 hours, with a mean analgesic effect of 9.5 hours (8.5–11.9 hours).
- TAP blocks have been used effectively for rescue analgesia in the postanesthesia care unit for patients with severe postoperative incisional pain who are not responding to routine analgesics and rescue opioids.
- TAP blocks are effective primarily for somatic incisional pain rather than visceral or cramping pain
- There is no significant analgesic and opioid-sparing benefit of routine TAP block after cesarean delivery in patients who receive intrathecal morphine.

F. Supplemental Analgesia

To be given to all patients unless contraindicated

Paracetamol (PCM)

- 1 gram suppository at the end of surgery
- Tab PCM 1 gram 6 hourly strictly for 3 days to be written in patient medication chart
- Contraindication:
  - Allergy to paracetamol
  - Liver disease (use with caution or in reduced dose)
  - Suppositories are contraindicated in proctitis

Diclofenac Acid

- 100 mg suppository at the end of surgery
- To be started 18 hours after initial 100mg suppository: Tab Diclofenac 50 mg 8 hourly (with food) strictly for 3 days to be written in patient medication chart
- Contraindication
  - Allergy to aspirin or other NSAIDs
  - History of gastric or duodenal ulcer or gastrointestinal bleeding
  - NSAID induced asthma
  - Pre-eclampsia/HELLP Syndrome
  - Coagulation disorder
  - Major haemorrhage (until review the following day)
  - Hypovolaemia
  - Renal impairment
  - Suppositories are contraindicated in proctitis

Note:

Paracetamol and Diclofenac may be regarded as a mild-moderate analgesic agent. However, it is still useful as part of the multimodal approach of pain management.

Oxynorm

- Cap Oxycodone (Oxynorm) 5 qid for 3 days can be used as an alternative if there are contraindications for the use of Diclofenac or Paracetamol.

Other Issues:

- Please do not keep the bladder catheter (CBD) and IV drip in-situ merely because OAS techniques are being used. The bladder catheter and IV drip may be discontinued once the obstetric team is satisfied, regardless of OAS techniques. Please leave the IV cannula in-situ and use a stopper.
- Our aim is to have a pain-free, ambulatory patient. The OAS infusion pumps may be attached to a drip stand, and the patient may walk around, pushing the drip stand. Once the patient is able to tolerate fluids orally, oral analgesia (Paracetamol, NSAIDs) should be given strictly as ordered.
- Epidural Catheter
  - If catheter is disconnected from filter, the catheter is to be removed by OAS doctor/ nurse immediately.
  - The OAS nurse and doctor are the only personnel allowed to inject drugs or other solutions through the epidural catheter.

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APPENDIX

APS HTAR

PDPH follow-up form

Patient Name : IC: RN:

Address:

Tel (Hse): Tel (H/P):

Date of procedure:

Inadvertent dural punture? Y / N

Needle type/size	Tuohy	16 / 18
	sprotte	23 / 25 / 27
	whitacre	23 / 25 / 27
	quincke	23 / 25 / 27

Number of attempt: once / multiple

Difficulty: none / difficult Comments:

	Day	1	2	3	4
	Date:				
	seen by:				
headache not relief from lying flat		Y / N	Y / N	Y / N	Y / N
nausea/vomiting		Y / N	Y / N	Y / N	Y / N
unable to care for infant		Y / N	Y / N	Y / N	Y / N
possible early discharge or loss to follow up		Y / N	Y / N	Y / N	Y / N

If 2 or more Yes after one day of conservative therapy, Epidural Blood Patch should be performed

Epidural blood patch performed? Y / N

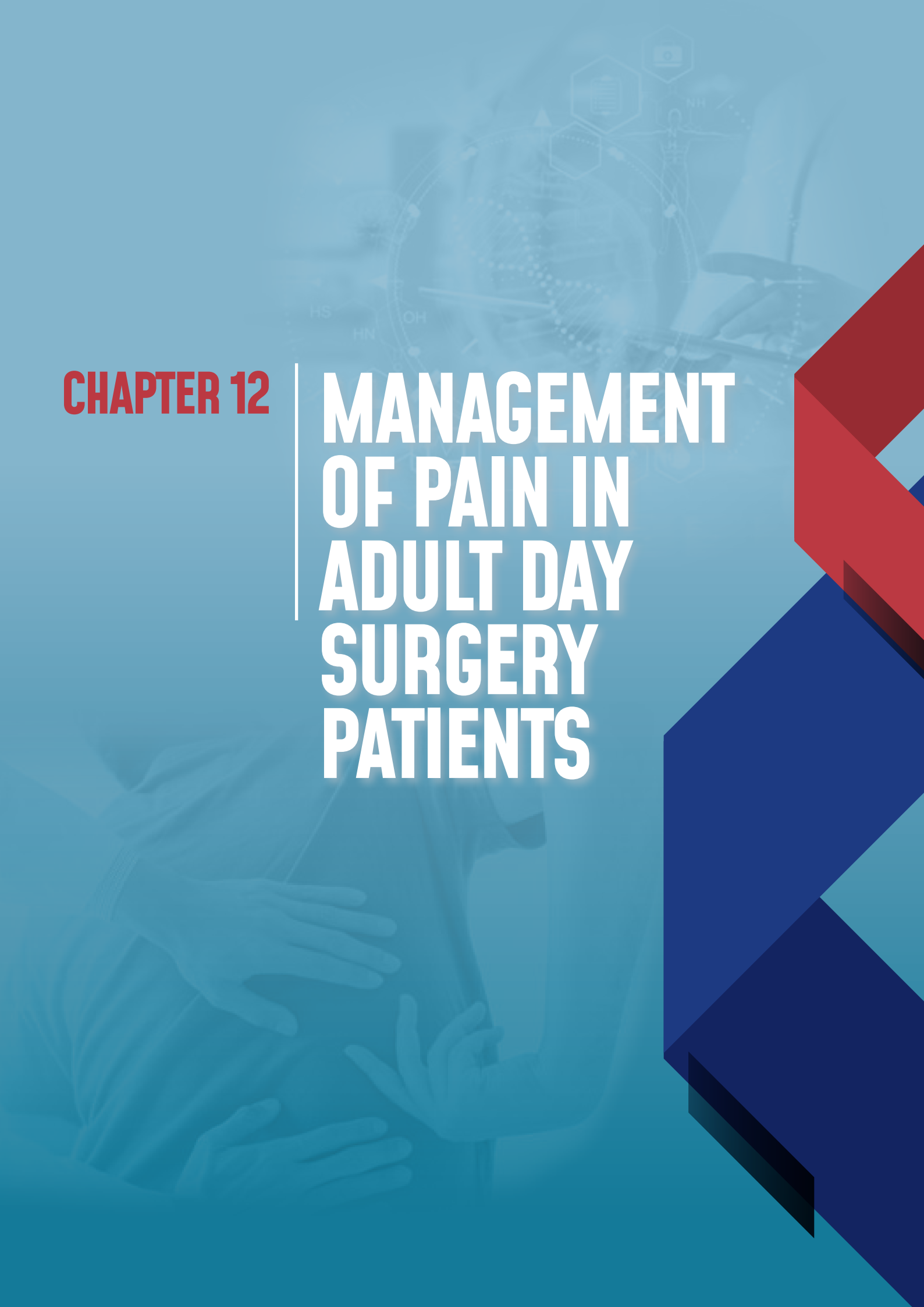
if Yes; date and time performed:

On discharge, please make a 2 weeks appointment to the anaesthetic clinic with an accompanying letter.

Follow-up phone call; (24 hrs after discharge)

Date and time:

Remarks:



CHAPTER 12

MANAGEMENT OF PAIN IN ADULT DAY SURGERY PATIENTS

CHAPTER 11 MANAGEMENT OF PAIN IN ADULT DAY SURGERY PATIENTS

Introduction

Pain is the most common problem after discharge of day surgery patients. A survey of more than 5000 patients published in 2004 found that 30% of patient had moderate to severe pain after ambulatory surgery. Uncontrolled pain can lead to prolonged stay in the day surgery unit and is a major cause of nausea and vomiting, which further delays discharge. Pain also limits early mobilization and early return to normal function, is the most common reason for unanticipated hospital admission and leads to patient dissatisfaction and increased healthcare costs.

Effective management of acute postoperative pain in day surgery should include the following:

- Education and training of all staff
- Education of patients and their caregivers regarding analgesic options that are available (pharmacological and non-pharmacological)
- Identification of at risk groups
- Having an established formal protocol and guidelines covering acute pain management which are relevant to each institution
- Having a formal quality assurance program to regularly evaluate the effectiveness of acute pain management

General Principles

- Optimal postoperative pain control for day surgery should be effective and safe, produce minimal side-effects, facilitate recovery and be easily managed by patients at home.
- Analgesics should be prescribed on a regular schedule, not on a “PRN” basis.
- Analgesics should provide a general background level of analgesia sufficient to permit normal activities.
- Additional analgesic supplements (rescue) should be provided to cover any painful activity.
- The use of pre-packaged take-home analgesics specific to the type of surgery and breakthrough medication can lead to improved pain control and sleep.
- Regular monitoring and recording of each patient’s pain intensity and treatment efficacy should be done. (refer to Chapter 4)
- To improve the effectiveness of acute pain management in day surgery, multimodal or balanced analgesia is strongly recommended.
- To ensure that patients are comfortable and relatively pain-free after the operation, postoperative pain control must be started pre-emptively.
- Cases done under regional anaesthesia alone should be started on supplemental analgesics (NSAIDs, / COX-2 inhibitors and/or opioids) before the block wears off.
- Prior planning of analgesic therapy is necessary and can be done according to the anticipated level of pain from the surgery.

Techniques for Intraoperative analgesia

A. Regional Analgesia

1. **Wound infiltration** with local anaesthetics (LA) has been shown to be a simple and effective method for immediate postoperative pain relief and is highly recommended. Bupivacaine or Levo-bupivacaine 0.25% or Ropivacaine 0.375% are preferable as they have a longer effect than lignocaine 2.0%.
2. **Peripheral nerve blocks** are useful in day surgery because they provide site specific anaesthesia and analgesia with little systemic and haemodynamic effects.

    - The type of blocks varies according to the surgery. Although many peripheral nerve blocks are feasible, only a few are regularly practiced in day surgery, as listed below. With the increasing use of ultrasound-guided nerve blocks as well as the availability of peripheral nerve catheters, the trend is to use more blocks in day surgery patients.
    - **Continuous peripheral nerve block** (CPNB) with perineural catheters and continuous infusions of local anaesthetics result in sustained postoperative analgesia, earlier discharge, less sleep disturbance and improved rehabilitation of patients at home. In addition, they also have an opioid sparing effect. CPNB have increased the scope of ambulatory surgery cases, as patients may be sent home with infusions of LA for 24-48 hours by continuous infusion or by patient-controlled devices which allow intermittent bolus doses of LA.
    - If patients are sent home with CPNB, we need to provide ***extensive*** oral and written instructions to the patients as well as relatives and 24-hour telephone access to the anaesthesiologist during the period of block. In Malaysia, this has not been practiced yet but is expected to catch on in the near future.
    - Ropivacaine and levo-bupivacaine are usually the agents of choice due to their improved safety profile, particularly with respect to cardiovascular toxicity.
    - Blocks should only be performed by experienced anaesthesiologists or under the direct supervision of an expert.
    - Examples of commonly used peripheral nerve blocks:

        - **Brachial Plexus Blocks**
            - Interscalene approach for proximal humerus and shoulder surgery. This may be done with a catheter technique and patients can be sent home with LA infusions through disposable infusion devices.
            - Infraclavicular approach for surgery to the elbow, forearm and hand.
            - Axillary approach for procedures on the forearm and hand. This is preferred to supraclavicular block because of the risk of pneumothorax with the latter block.

        - **Ankle block** for foot surgery.
        - **Ilioinguinal, iliohypogastric and genitofemoral nerve block** for inguinal hernia surgery.
        - **Sciatic and femoral nerve block or popliteal nerve block** for knee surgery.

3. Central Neural Blockade (CNB)

- CNB is not frequently done in day surgery patients unless it is done for the first patient on the list. This is because the patients cannot be discharged until the block has regressed which may take time.
- Intrathecal (spinal) anaesthesia may be performed for operations such as knee arthroscopy, and other lower limb surgery.
- Intrathecal low dose local anaesthetic with the addition of a short acting opioid (fentanyl) gives good postoperative analgesia and a smooth transition to oral analgesia.
- As with all regional blocks, supplementation with other forms of analgesia should be started before the block effect wears off.
- Epidural or combined spinal-epidural (CSE) anaesthesia are not commonly done for day surgery cases, as the operations done here are relatively short in duration.

B. Oral and Parenteral Analgesics

Paracetamol (PCM)

- May be used orally, rectally or intravenously (IV).
  - Oral: premedication or for postoperative analgesia
  - Rectal: administered intraoperatively, after induction of anaesthesia. *Note that patients and/or parents should be informed of the intention to use rectal administration of drugs.*
  - IV: intraoperatively.

- It is often used in combination with other drugs, such as weak opioids and NSAIDs, as multimodal analgesia.
- Paracetamol may be given in doses limited to 4 g/day in adults. It should be used with caution in patients with liver disease.

1. Non-steroidal anti-inflammatory drugs (NSAIDs) and COX-2 inhibitors

- In patients with no contraindications to them, NSAIDs or COX-2 inhibitors are the drugs of choice and form the basis of most day surgery analgesic regimes. They may be used orally, rectally or intravenously.
  - Oral: premedication or for postoperative analgesia.
  - Rectal: administered intraoperatively, after induction of anaesthesia. Note that patients and/or parents should be informed of the intention to use rectal administration of drugs.
  - IV: intraoperatively, usually towards the end of surgery.
  - Note: Intramuscular NSAIDs should be avoided as it could lead to haematoma and abscess formation.

(For doses of the different NSAIDs and COX-2 inhibitors, please refer to the Drug Formulary, Appendix 9)

2. Morphine

The routine use of morphine is not common in day surgery patients as it causes significant nausea and vomiting and excessive sedation.

3. Fentanyl

1. Fentanyl is more useful for day surgery analgesia as it is highly potent, has a rapid onset and a short initial half-life.
2. It may be used:
   - for intra-operative analgesia at doses of 1-2 ug/kg
   - as a rescue analgesic for the treatment of severe pain in the Post-Anaesthesia Care Unit (PACU) titrated to effect

4. Oxycodone

- IV Oxycodone – intra and post-operative analgesia; as a rescue analgesic for the treatment of severe pain in the Post-Anaesthesia Care Unit (PACU) titrated to effect
- Oral Oxycodone - postoperative analgesia.

5. Remifentanil

- Remifentanil has limited use in day surgery because of its extremely short duration of action.

6. Tramadol

- Tramadol may be used for postoperative analgesia in patients with moderate to severe pain.
- High incidence of nausea and vomiting
- Ultracet®, a combination of Tramadol 37.5 mg and Paracetamol 325 mg, may also be used for postoperative analgesia (*not available in KKM formulary at present*).

7. Dihydrocodeine / Codeine

- Dihydrocodeine -postoperative analgesia in patients with moderate to severe pain.
- Panadeine®, a combination of Codeine 8 mg and Paracetamol 500 mg - may also be used for postoperative analgesia (*not available in KKM formulary at present*).

Pain management in the Day Surgery Unit before discharge

Pharmacological

1. Commence oral analgesics as soon as possible
2. Mild to moderate pain: Paracetamol, NSAIDs or COX-2 inhibitors
3. Moderate to severe pain: IV Tramadol 0.5-1mg/kg or IV Oxycodone 2-5 mg in titrated doses may be used. Oral Tramadol 50 mg or IR Oxycodone 5-10 mg may be used.

Non-pharmacological

1. Physical methods (RICE - Rest, Ice, Compression, Elevation)
2. Transcutaneous electric nerve stimulation (TENS)
3. Reassurance, relaxation, deep breathing, distraction, hypnotherapy, aromatherapy, acupressure, music therapy.

Discharge analgesia

1. Review patient, assess the efficacy of pain relief and provide specific drugs and discharge instructions.
2. Patients must be provided an adequate supply of analgesics.
3. Written information on analgesic dosing must be given to the patient and care giver.
4. Important to encourage patients to take analgesics regularly as prescribed.
5. An emergency telephone number must be given.
6. Patient follow-up phone call is encouraged on the first postoperative day.

Analgesia according to anticipated postoperative pain

The degree of postoperative pain can be anticipated by the type of surgery and managed accordingly.

Table 12.1 : Anticipated Postoperative Pain by Surgery and Selection of Perioperative Analgesia

Severity of Pain	Mild Pain	Moderate Pain	Severe Pain
Type of Surgery	Myringotomy Submucous resection Excision of nasal or aural polyps Biopsy of oral lesions Excision of tongue tie Dilatation and currettage Hysteroscopy 0ther minor gynaecological surgery Excision of breast lump Removal of other lumps and bumps Orchidopexy Circumcision Lymph node biopsy Toenail surgery Cataract surgery	Reduction of nasal fracture Tonsillectomy Adenoidectomy Removal of dental bone plates and wires Surgical removal of wisdom tooth Cone biopsy of cervix Termination of pregnancy Laparoscopic tubal ligation Marsupialisation Cystoscopy Herniotomy Ligation of Varicose veins Ligation of Hydrocoele Vasectomy Excision of thyroid nodule Bunion surgery Dupuytren's contracture surgery Carpel tunnel surgery Excision of ganglion Excision of chalazion Correction of squint	Wisdom teeth extraction Wide excision of breast lump with axillary clearance Open hernia repair Laparoscopic hernia repair Laparoscopic cholecystectomy Haemorrhoidectomy Varicose vein surgery Anal fissure dilatation or excision Arthroscopic surgery Removal of orthopaedic implants
Preop analgesia	Oral NSAIDs / COX-2 inhibitors + Paracetamol	Oral NSAIDs / COX-2 inhibitors + Paracetamol	Oral NSAIDs / COX-2 inhibitors + Paracetamol
Intraop analgesia	Wound infiltration with LA +/- IV fentanyl*	Wound infiltration with LA and/or Peripheral Nerve/plexus block or Single shot spinal +/- IV fentanyl*	Wound infiltration with LA and/or Peripheral Nerve/plexus block or Single shot spinal +/- IV fentanyl*
Postop analgesia In Recovery Room	Oral NSAIDs / COX-2 inhibitors + Paracetamol (if not given preop)	Oral NSAIDs / COX-2 inhibitors (if not given preop) Oral or IV Tramadol Oral Oxynorm IV fentanyl (titrated to effect)	Oral NSAIDs / COX-2 inhibitors (if not given preop) Oral or IV Tramadol Oral Oxynorm IV fentanyl (titrated to effect)

*For cases done by anaesthesiologist.

Table 12.2 : Suggested Regime for Home Analgesia in Adult Day Surgery Patients according to Pain Severity **

<table>
<tr><th>Mild Pain</th><th>Moderate Pain</th><th>Severe Pain</th></tr>
<tr><td>Non-drug techniques
RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.</td><td>Non-drug techniques
RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.</td><td>Non-drug techniques
RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.</td></tr>
<tr><td rowspan="2">Regular Oral Paracetamol
OR / AND
Regular / PRN Oral NSAIDs
or
Oral COX-2 inhibitors</td><td>Regular Oral Paracetamol
OR / AND
Regular / PRN Oral NSAIDs or
Oral COX-2 inhibitors</td><td>Regular Oral Paracetamol
OR / AND
Regular / PRN Oral NSAIDs or
Oral COX-2 inhibitors</td></tr>
<tr><td>PRN
Oral Tramadol
or
Oral Oxycodone</td><td>Regular and PRN
Oral Tramadol
or
Oral Oxycodone</td></tr>
</table>

**Patients with contraindications to NSAIDs / PCM are excluded from this regime.

Special considerations

Groups of patients requiring special considerations include the following:

1. **Elderly patients**

   a. May develop over-sedation and dosages should be reduced.
   b. Dementia, deafness and visual disturbances may make pain assessment difficult.
   c. Renal toxicity and gastric irritation may occur with the use of NSAIDs.

2. **Opioid tolerant patients** require higher opioid doses perioperatively (refer Chapter 8).

Conclusion

- Multimodal pain management is pivotal to the success and popularity of day surgery. As more extensive and painful procedures are being performed as day cases, there will be a pressing need to introduce better drug combinations and newer pain relief methods to alleviate pain.
- Pain management guidelines can standardize and simplify a safe and effective analgesic regime. Nevertheless, each patient should be further individualized and his or her pain treatment tailored to produce excellent pain relief after day surgery.

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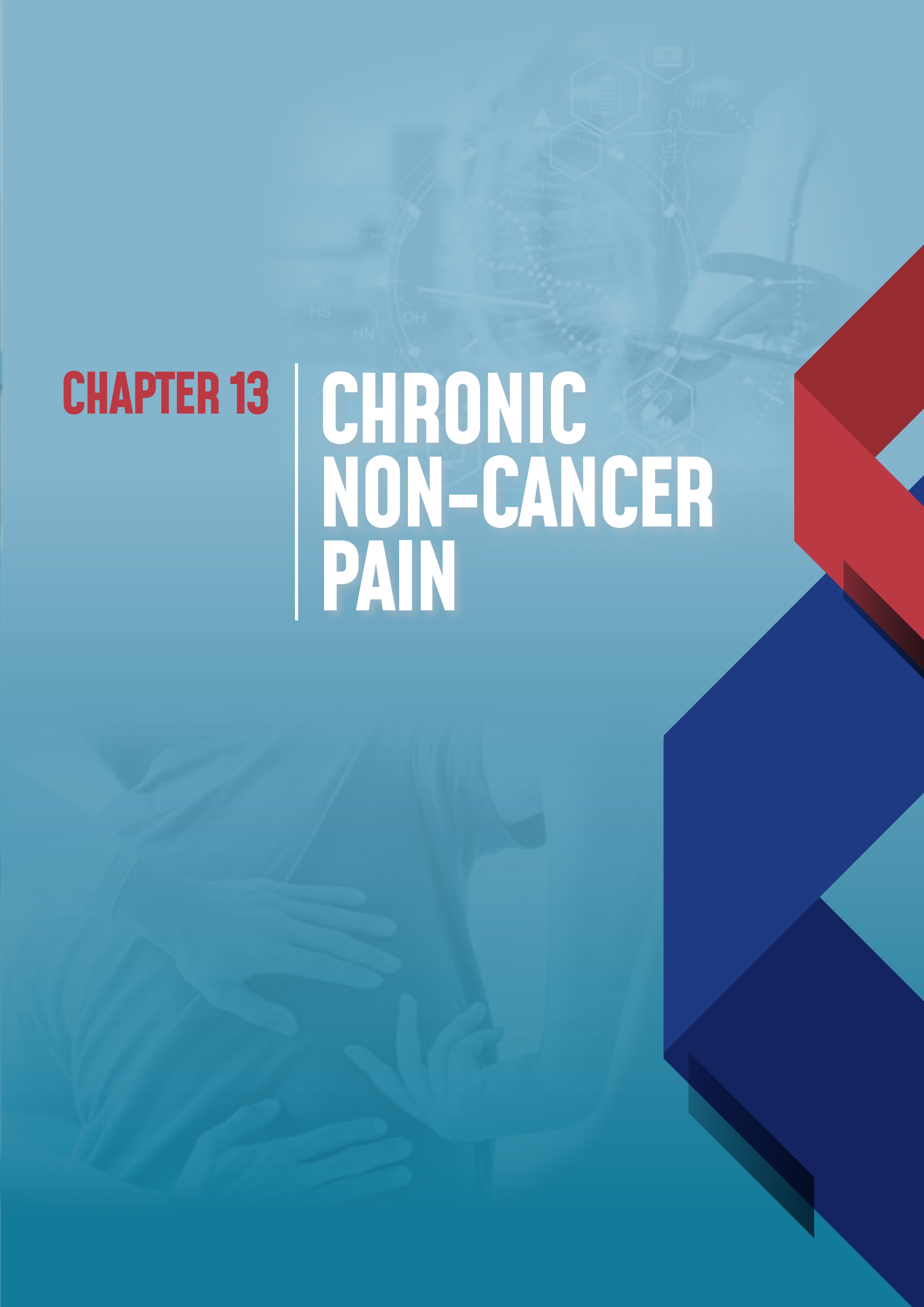
CHAPTER 13

CHRONIC NON-CANCER PAIN



CHAPTER 13 | CHRONIC NON-CANCER PAIN

Introduction

- It is estimated that about 20% of individuals worldwide have some degree of chronic pain.
- Chronic non-cancer pain is typically defined as pain lasting longer than 3 months or beyond the expected period of healing of tissue pathology2. It is a pain of any aetiology associated with a chronic medical condition or extending in duration beyond the expected temporal boundary of tissue injury and normal healing, and adversely affecting the function and well-being of the individual.3
- Mechanisms underlying chronic pain include a complex interaction of physiological, emotional, cognitive, social, and environmental factors.

Principles of management of chronic non-cancer pain

- Make the diagnosis
  - differentiate between acute and chronic pain.
  - establish if it is neuropathic or nociceptive pain

- The patient may already be known to have chronic pain e.g. in the emergency department where he / she is a patient or in the surgical or orthopaedic ward where the patient gets admitted every few weeks or months. You need to re-investigate the patient ONLY if the pain is in a different site or if the patient has new symptoms e.g. vomiting, loss of weight.
- Individualise management
- Emphasis is on Quality of Life of patient
- Education of patient on techniques to adapt to chronic pain using non pharmacological methods like relaxation, pacing, focusing, establishing short term and long term goals and stress management.
- All patients with chronic pain who are coming for repeated admissions or treatment because of pain should be referred to a Pain Clinic.

Table 13.1 : Differences between Acute and Chronic

Mild Pain	Acute Pain	Chronic Pain
General	A symptom of underlying damage or disease	A chronic disease of the nervous system
Onset	Acute pain begins suddenly, usually due to tissue injury from infection, trauma or after surgery	Chronic pain might have originated with an initial trauma/ injury or infection, or there might be an ongoing cause of pain. However, onset may be insidious, and many people suffer chronic pain in the absence of any past injury or evidence of body damage.
Types of pain	Usually nociceptive (somatic or visceral) Acute neuropathic pain may occur but is much less common	May be nociceptive (somatic or visceral) or neuropathic. Nociceptive somatic pain is that arising from skin, soft tissue and bones while visceral pain is that arising from viscera e.g. liver, pancreas, intestines. Neuropathic pain is pain caused by a lesion or disease of the somatosensory nervous system.
Characteristics of pain	Somatic pain is sharp in quality and well localized, and is worse on movement, while visceral pain is dull, aching and poorly localized. Psychological effect, if present is usually anxiety.	Nociceptive pain may be sharp or dull, throbbing or aching. Neuropathic pain is usually burning, shooting or stabbing. Neuropathic pain may be associated with the following sensory symptoms: ▪ Numbness or Paraesthesia ▪ Allodynia: pain in response to a non-painful stimulus,e.g. touch ▪ Hyperalgesia: pain out of proportion to a painful stimulus ▪ Dysasthaesia: unpleasant abnormal sensations Often has negative psychosocial impact e.g. depression/ anxiety, anger, fear, family and relationship stresses, sleep disturbances.
Meaning of pain	Acute pain serves as a warning sign of damage e.g. injury, disease or a threat to the body.	Chronic pain does not signify damage. The nature of the disease is that the pain level may be worse on some days and better on others so that patients have 'bad days' and 'good days'. Often associated with fear of re-injury resulting in 'fear avoidance'
Pain Duration	Acute pain resolves when the injury heals and/or when the underlying cause of pain has been treated. **Unrelieved severe acute pain, however, might lead to chronic pain.**	Chronic pain persists despite tissue healing. Duration of pain is usually more than 3 months. Patients may also present to hospital with 'acute' episodes which are actually 'flare-ups' of pain.
Common Causes	Acute pain might be caused by many events or circumstances, including: Surgery Fracture Burns or cuts Labour and childbirth Myocardial infarction Inflammation e.g. abscess, appendicitis	Common chronic pain conditions include: Headache Low back pain Cancer pain Arthritis pain Chronic pancreatitis Chronic abdominal pain from 'adhesion colic' Neuropathic pain e.g. a. Post-herpetic neuralgia b. Painful Diabetic peripheral neuropathy c. Post spinal cord injury pain d. Central post-stroke pain e. Trigeminal neuralgia

Multimodal analgesic management of patients with chronic non-cancer pain in the ward

- Give regular oral analgesics e.g. Tramadol 100 mg QID + Paracetamol 1 gram QID
- Avoid Inj. Pethidine and other injections (e.g. IM Diclofenac). Pethidine is not recommended in chronic pain conditions because of its high addiction potential.
- If you suspect neuropathic pain, add antineuropathic agents like gabapentinoids, amitriptyline (refer appendix 8, drug formulary).
- Do not use NSAIDs / COX2 inhibitors longer than 1-2 weeks. You may use them for a few days to get control of a flare up of chronic pain, but they should never be given for long term as the patient will have a risk of developing renal failure and have a higher risk of cardiovascular events.

Multidisciplinary Management of the patients with chronic non-cancer pain in the ward

- Refer to a physiotherapist and /or occupational therapist for an exercise program (tailored to the patient's current physical abilities) that he/she can do at home.
- Discharge the patient on a regime of regular analgesics.
- Refer to a pain clinic for assessment and follow-up. If a pain clinic is not accessible, you may have to follow up the patient in your clinic.

Management of chronic pain patients at the Pain Clinic

- **Multidisciplinary assessment** of the patient, which includes
  - Medical assessment, which includes making a diagnosis and deciding whether any further investigations are indicated, as well as reviewing current treatment. This is done by the doctor.
  - A review of available records, investigations, previous treatments and current medications
  - Physical assessment to look for primary and secondary musculoskeletal effects of chronic pain. This is done by a doctor and a physiotherapist.
  - Psychological assessment which includes looking at the psychological impact of the pain, level of anxiety and depression, how the patient copes with the pain, effect on family and work, etc. This is usually done by a clinical psychologist or psychiatrist.

- **Multidisciplinary multimodal management,** which includes
  - Review of current treatment
  - Making a pain management plan (short term and long-term). This usually includes
    - Non pharmacological
      - Cognitive behavioral strategies
      - Active physiotherapy, including exercises and activities that patients can do at home
      - Psychological therapy including relaxation training
      - Rehabilitation, Occupational Therapy and Biofeedback
      - Transcutaneous electrical nerve stimulation

Non pharmacologic strategies may be useful in easing pain and improving function, especially if used together with pharmacologic therapies.

- Pharmacological
  - » Pharmacotherapy, using appropriate drugs
  - » Classes of agents with efficacy demonstrated in multiple, randomized, controlled trials for neuropathic pain
  - » topical analgesics (capsaicin, lidocaine patch 5%)
  - » anticonvulsants (gabapentin, carbamazepine, pregabalin)
  - » antidepressants (nortriptyline, amitriptyline, duloxetine)
  - » opioids (morphine, oxycodone, tramadol)

.

- Consider safety and tolerability when initiating treatment

In the management of chronic pain, emphasis is on **self-management** (what the patient can do for him/herself) and achieving long-term changes (e.g. from exercise) rather than short-term gains (e.g. from short acting analgesic medications).

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CHAPTER 14

ENHANCED RECOVERY AFTER SURGERY (ERAS)

CHAPTER 14 ENHANCED RECOVERY AFTER SURGERY (ERAS)

The concept of Fast Track surgery or Enhanced Recovery After Surgery (ERAS) necessitates reformed management of 3 key factors - modulating surgical stress response, managing perioperative fluids and postoperative pain control for recovery and rehabilitation. The concept commands perioperative interventions from a multidisciplinary team.

Historically, the concept was envisioned and introduced by a collaborative group of surgeons for perioperative care. More evidence-based approaches have been added to accommodate a growing number of surgical specialties, such as hepatobiliary, urology, gynae-oncology and arthroplasty. Current practices are updated regularly at the ERAS Society website.

The primary aims of the ERAS protocol are to reduce hospital stays, decrease complication rates and reduce readmissions. There are 4 to 12 essential elements targeting perioperative care, with acute pain management being one. However, provision of good analgesia alone may not provide maximal impact on speed and quality of recovery. Hence, implementation of all elements of perioperative care remains the mainstay of management in ERAS.

Table 14.1 : Perioperative Elements Of ERAS

Preadmission	Preoperative	Intraoperative	Postoperative
Cessation of smoking and alcohol	Preadmission counselling and engagement of the patient and caretakers	Minimal invasive surgical techniques	Early mobilization (day of surgery)
Preoperative nutritional screening and support	Preoperative carbohydrate treatment	Standardized anesthesia, avoiding long-acting opioids	Early oral fluids and solids (day of surgery) Early removal of urinary catheters and intravenous fluids (morning after surgery)
Medical optimization of chronic disease	No prolonged fasting	Maintain fluid balance, avoid over/under- hydration, use vasopressors for blood pressure control	Use chewing gums and laxatives and peripheral opioid-blocking agents (when using opioids)
	No or selective bowel preparation	Epidural Analgesia for Open Surgery	Intake of protein and energy-rich nutritional supplements
	Antibiotic prophylaxis	Restrict surgical drains	Multimodal approach to opioid-sparing analgesia
	Thromboprophylaxis	Removal of NG tubes before reversal	Multimodal approach to control of nausea and vomiting
	Prophylaxis against nausea and vomiting	Control temperature using warm air flow blankets and warmed intravenous infusions	Prepare for early discharge
Audit of outcomes and process in a multiprofessional, multidisciplinary team on a regular basis			

(adapted from Olie Ljungqvist et al 2017)

The following is a summary of recommendations for perioperative multimodal opioid-sparing analgesia which can be considered in ERAS driven perioperative care.

1. Thoracic Epidural Analgesia (TEA)
   - T6-T11 - superior analgesic effects and earlier return of bowel function. It can be continued up to 72 hours.

2. Intrathecal Morphine Analgesia (ITM)
   - Useful for early postoperative pain and may assist recovery.
   - Plays a role in postoperative analgesia of low risk, laparoscopic surgery in the first 24 hours.
   - Dosage ranges from 200-250mcg in <75 years old and <150mcg in >75 years old. It is usually used in conjunction with isobaric or hyperbaric bupivacaine at a dose of 10-12.5mg.

3. Intravenous Lignocaine Infusion (IVLI)
   - Anti-nociceptive and anti-inflammatory properties
   - Helps in reducing postoperative opioid requirement
   - A loading dose of 1.5mg/kg (IBW) is given at induction followed by 2mg/kg/hr infusion of Lignocaine. The infusion is discontinued at the end of surgery or in recovery area.

4. Continuous Wound Infusion of Local Anaesthetics (CWI)
   - Efficacy remains inconclusive
   - Subfascial or preperitoneal catheter with amide LA infusion 0.2% 10ml/hr for 48-72 hours.
   - Clinical studies indicated subfascial placement may offer more benefit.
   - Systemic opioid is still required for visceral pain.

5. Abdominal Truncal Blocks - Transversus Abdominis Plane (TAP) and Rectus Sheath Block (RS)
   - Reduces pain and opioid consumption in the initial 24 hours following surgery.
   - Continuous infusion extends postoperative analgesia up to 72 hours.

6. Multimodal Analgesia (MMA)
   - Paracetamol and NSAID or COX-2 Inhibitor should be ordered.
   - IV Paracetamol has preventive role for PONV.
   - With the use of NSAID or COX-2 inhibitor, studies on incidence of complications such as anastomosis leak, delayed bone healing and cardiovascular risks are inconclusive.
   - Ketamine and Gabapentinoids have opioid sparing effects.

Early postoperative DREAM (DRinking, Eating, Ambulation and Mobilization, summarizes the desired outcome of ERAS implementation. Therefore, analgesic techniques in ERAS protocols must permit early mobilisation, early enteral feeding and preferably be opioid-sparing.

Table 14.2 : Summary of Recommendations for Procedure Specific Pain Management within ERAS protocol (Level of Evidence and Recommendations were derived from studies conducted within an ERAS programme)

	Gastrointestinal Surgery (Feldheiser et al)	**Pancreatico-duodenectomy** (Kristoffer Lassen et al)	**Bariatric Surgery** (A Thorell et al)	**Bladder Cancer Surgery** (Y Cerantola et al)	**Rectal Surgery** (J Nygren et al)	**Gynae-oncology Surgery** (G Nelson et al)	**Breast Reconstruction** (Temple-Oberle et al)
MMA Multimodal Analgesia (PCM, NSAID/ COXib, Opioid, Gabapentinoids)	Strong Recommendation	Strong Recommendation	Strong Recommendation	Strong Recommendation	Strong Recommendation (Gabapentin, Combined PCM/ NSAID) *Rectal pain can be neuropathic	Strong Recommendation (Gabapentin, Combined PCM/NSAID)	Strong Recommendation (Gabapentin, Combined PCM/ NSAID)
TEA (Thoracic Epidural Analgesia)	*Open Surgery:* Strong *Laparoscopic Surgery:* Weak Recommendation	Weak Recommendation (Midthoracic Epidural)	*Laparoscopic Surgery:* Weak Recommendation (Consider in Open Surgery)	Strong Recommendation	*Open Surgery:* Strong *Laparoscopic Surgery:* Weak Recommendation	*Open Gynae Surgery*: Strong *Major Onco Surgery*: Weak Recommendation	Not graded
ITM (Intrathecal Morphine)	*Laparoscopic Surgery:* Moderate Recommendation	Not graded	Not graded	Not graded	Not graded	*Vaginal Hysterectomy:* Weak Open Gynae Surgery: Strong *Major Onco Surgery:* Weak Recommendation	Not graded
IVLI (Intravenous Lignocaine Infusion)	*Open Surgery:* Moderate *Laparoscopic Surgery:* Moderate Recommendation	Weak Recommendation	Not graded	Not graded	Weak Recommendation	*Laparoscopic Surgery:* Weak Recommendation	Not graded
CWI (Continuous Wound Infiltration)	*Open Surgery:* Weak Recommendation	Weak Recommendation	Strong Recommendation	Not graded	Weak Recommendation	*Vaginal Hysterectomy:* Weak Recommendation *Open Gynae Surgery:* Strong	**Part of MMA*
Plane Block (Abdominal/ Truncal)	*Open Surgery:* Moderate *Laparoscopic Surgery*: Moderate Recommendation	Weak Recommendation	Not graded	Not graded	Weak Recommendation	*Open Gynae Surgery*: Strong *Laparoscopic Surgery*: Weak *Vaginal Hysterectomy -Paracervical Block*: Weak Recommendation	**Part of MMA – Regional Blocks*

Opioid Free Anaesthesia (OFA)

The term refers to the use of multimodal agents to manage perioperative pain, while avoiding opioids. Aggressive opioid-based postoperative pain control is being blamed as a major contributor to opioid addiction epidemics and prolonged hospital stay due to opioid adverse effects.

In the context of ERAS, OFA has not been adequately studied to establish level of evidence and recommendations. However, its practice is gaining momentum in patients at risk for perioperative opioid use, for example:

- Patients with obstructive sleep apnea
- Patients with high risk of postoperative pulmonary complications
- Morbidly obese
- Chronic opioid users
- Chronic pain patients

The OFA uses a multitude of techniques and agents at different sites and mechanisms of action. Main agents used perioperatively are:

- IV Ketamine (Bolus and/or infusion)
- IV Lignocaine (Bolus and/or infusion)
- IV Dexmedetomidine (Infusion)
- IV Magnesium Sulphate (Infusion)
- Peripheral Nerve Blocks (Single Shot or Catheter techniques)
- Paracetamol and NSAID or COX-2 Inhibitor

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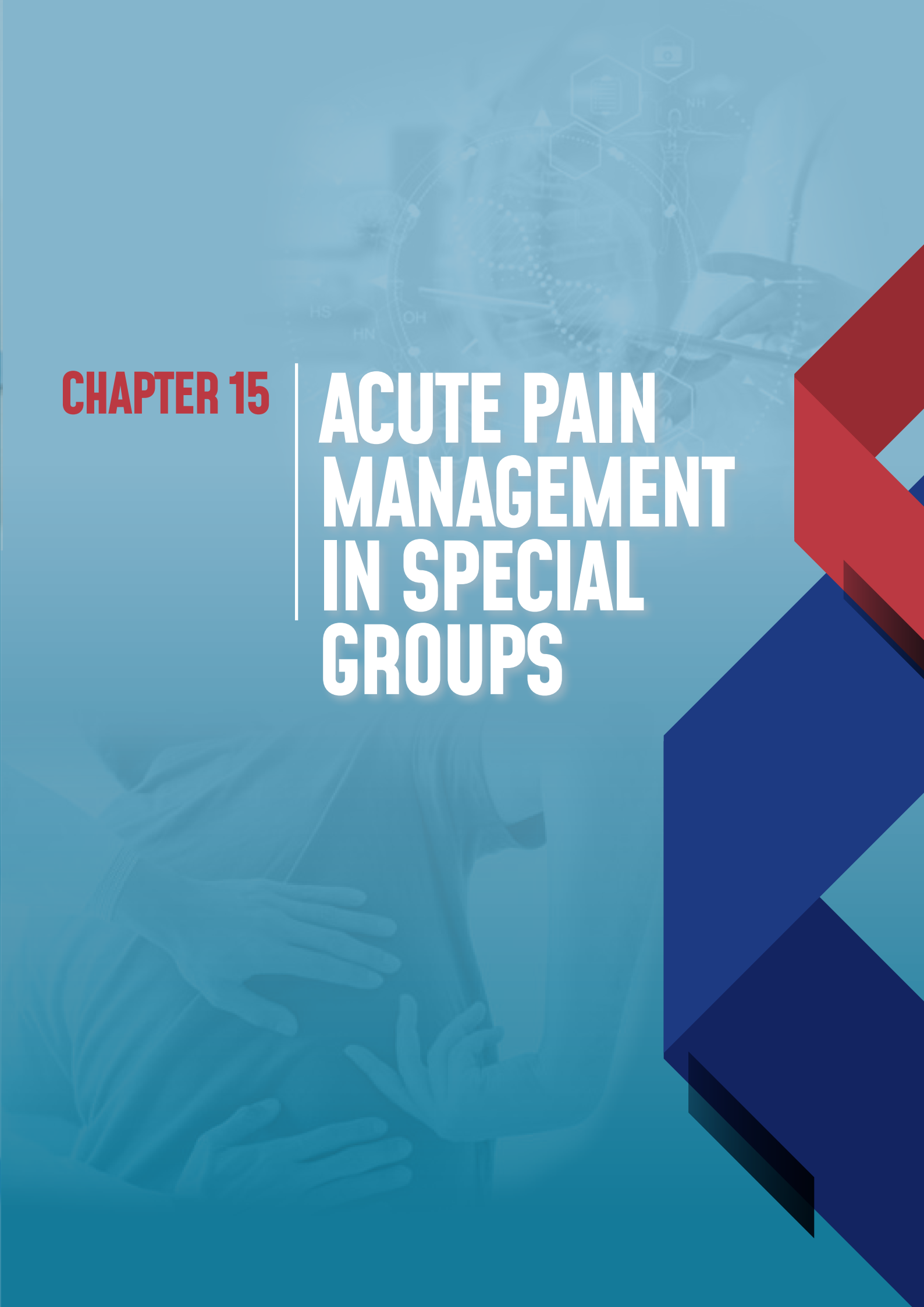

CHAPTER 15

ACUTE PAIN MANAGEMENT IN SPECIAL GROUPS

CHAPTER 15 | ACUTE PAIN MANAGEMENT IN SPECIAL GROUPS

The pharmacology of analgesics is altered in patients with renal and liver impairment due to altered clearance and metabolism respectively. In elderly patients, due to presence of comorbidities, concurrent medications and age-related physiological changes, requirement for analgesia can be altered.

Renal Diseases

In patients known to have renal impairment, renal function should be checked before prescribing any analgesics as the drug may require dose modification because plasma levels of analgesics and their active metabolites will increase and duration of action of analgesics are prolonged.
Formula used to estimate GFR (eGFR)

Cockcroft–Gault (CG)

$$\text{eGFR (ml/min)} = \frac{1.2 \times \{140 - \text{age (yr)}\} \times \text{weight (kg)}}{\text{Cr (µmol/L)}}$$

Multiply x 0.85 in ♀ to correct for reduced creatinine production

CKD is defined as abnormalities of kidney structure or function, present for > 3 months, with implications for health

Table 15.1 : Classification of chronic kidney disease (CKD) stages

CKD Stage	Terms	eGFR (ml/min/1.73m²)
1	High or Normal renal function	≥90
2	Mildly decreased*	60-89
3a 3b	Mild to Moderate Moderate to Severe	45-59 30-44
4	Severe	15-29
5	End stage renal disease (ESRF)	< 15

relative to young adult

Table 15.2 : Principles of pain management in CKD
(Sara N Davison, www.uptodate.com, 2021)

General Principle	Specific consideration in CKD
'By mouth'	▪ Oral or transdermal routes are preferred.
'By the clock'	▪ Some patients with mild pain may achieve adequate pain relief with analgesic dosing post-hemodialysis only. E.g. neuropathic pain dosed with gabapentin post dialysis.
'By the ladder'	▪ Careful selection of analgesics for each step of the ladder, taking into account the degree of kidney failure, is critical. ▪ Sustained-release preparations are generally not recommended in patients with advanced CKD.
'For the individual'	▪ Close attention to other issues (physical, psychosocial, spiritual and end-of-life) must not be forgotten as part of the pain management strategy.
'Attention to detail'	▪ Regular reassessment.

Table 15.3 : Pharmacokinetic data on analgesic medications in the normal state and in the context of chronic kidney disease (Sara N Davison, www.uptodate.com, 2021)

Medication	% excreted in the urine	t ½ (normal)	t ½ (Dialysis	Hemodialysis	Peritoneal dialysis	Comments/ recommendation
Paracetamol	<5	1-4	Unchanged	Dialyzed	Not dialyzed	· Accumulation of inactive metabolites · *Analgesia of choice for mild to moderate pain* · No dose reduction required
Codeine	0-16	2.5-4	13-18.9	Not dialyzed	Unlikely to be dialyzed	· Metabolized to morphine derivatives · Known to cause profound hypotension, CNS and respiratory depression · *Not recommended in* CKD
Tramadol	90 (30% unchanged, 60% as metabolites)	6	11	Dialyzed	Unknown	· eGFR 10-30ml/min: 50- 100mg BD · eGFR <10ml/min: 50mg BD · To give after dialysis
Morphine	10	2-3	Unchanged	Parent and active metabolites dialyzed	Not dialyzed	· Rapid accumulation of active metabolites in CKD resulting in opioid toxicity · · *Not recommended* in CKD
Fentanyl	<7	2-7	Possibly increased	Not dialyzed	Not dialyzed	· Inactive metabolites · *Safe for use in CKD if monitored carefully*
Oxycodone	<10	2-4	3-5	Dialyzed	Unknown	· Case reports of toxicity with CKD · Overall consensus from literature : *Reasonably safe in CKD if monitored carefully*
Buprenorphine	Minimal	30	Unchanged	Dialyzed	Dialyzed	· May be given in standard doses in CKD · *Safe for use in CKD if monitored carefully*
Methadone	15-60	13-47	Unknown	Not dialyzed	Not dialyzed	· Primarily excreted in feces · *Safe for use in CKD if monitored carefully*
Gabapentin	100	5-7	52-132	Dialyzed	Possibly dialyzed	· GFR 50-79: 600mg tds 30-49: 300mg tds 15-29: 300mg bd <15 :300mg OD · *Dose post dialysis*
Pregabalin	92-99	5-6.5	Increased	Dialyzed (50% dialyzed in 4Hours)	Dialyzed	· eGFR>30-60:150mg bd 15-30: 150mg/day <15 :75mg od · Can dose supplementary dose post dialysis (75mg)
Duloxetine	<1	8-17	Unchanged	Not dialyzed	Not dialyzed	· In CKD, start at 30mg, maximum 60mg/day · If eGFR<30 : *Avoid or maximum 30mg OD*
Ketamine	2-4	2-4	Unchanged	Not dialyzed	Unlikely to be dialyzed	· *Dose as per normal renal function*
Amitryptiline	<2	9-25	Unchanged	Not dialyzed	Not dialyzed	· *Low starting dose recommended due to anticholinergic adverse effects*

Management of chronic pain in chronic kidney disease. Sara N Davison, 2017. Dec 2017 (**www.uptodate.com**, retrieved Oct 2018)

Table 15.4 : Preferred analgesic medications for chronic pain management in CKD stages 4 and 5 (Sara N Davison, www.uptodate.com, 2021)

WHO step	Recommended	Use with caution	Do not use
1	Paracetamol		NSAIDs
2		Tramadol	Codeine
3	Fentanyl, alfentanil Methadone Buprenorphine Hydromorphone	Oxycodone	Morphine Pethidine
Adjuvant	Gabapentin Pregabalin	TCAs	

WHO: World Health Organization, NSAIDs: nonsteroidal anti-inflammatory drug, TCA: tricyclic antidepressant

Liver Diseases

Cirrhosis can be categorized clinically into:

i. Early and well-compensated cirrhosis (manifest as anorexia, weight loss, weakness, fatigue, osteoporosis)
ii. Decompensated cirrhosis (manifest as ascites, spontaneous bacterial peritonitis, hepatic encephalopathy, variceal bleeding from portal hypertension)

Hepatocellular function with impaired hepatic enzyme synthesis can occur in patients with cirrhosis. This can cause alteration in drug metabolism. Heightened sensitivity and medication toxicity may occur when analgesics are prescribed in this group of patients.

1. Opioids

Table 15.5 : Recommended Use of Opioids in Hepatic Dysfunction (James P Hamilton 2021)

Opioid	Recommended usage	Comment	Dosing recommendations*
Morphine	*Use cautiously and monitor patient for sedation* *Avoid use* in patients with cirrhosis AND renal failure	· In severe hepatic impairment, the parent drug may not be readily converted to metabolites · Oral bioavailability in advanced CLD or cirrhosis increased up to 100% relative to healthy individuals due to diminished first-pass extraction · Half-life can be increased by up to twofold	· Reduce dose and frequency by approximately 50% in advanced CLD or cirrhosis. · Titrate dose gradually to avoid accumulation of active drug.
Oxycodone	*Use cautiously* and *monitor patient carefully* for symptoms of opioid overdose	· In severe hepatic impairment, the parent drug may not be readily converted to metabolites · Risk of accumulation in patients with advanced chronic liver disease (CLD) or cirrhosis.*	· Decrease initial dose by 1/2 to 1/3 of the usual amount & prolong the dosing interval
Naloxone-containing opioid combination* (Oxycodone/ Naloxone)	*Reduce dose in mild hepatic impairment* *Avoid use in advanced CLD or cirrhosis*	· Orally administered naloxone is systemically absorbed in patients with moderate to severe hepatic impairment. · Systemic absorption of naloxone will reverse analgesic efficacy and can precipitate opioid withdrawal	· E.g. Oxycodone-naloxone: Reduce starting dose by one-half to two-thirds in mild hepatic impairment
Codeine	*Avoid use*	· In severe hepatic impairment, codeine may not be converted to the active metabolite, morphine.	

Opioid	Recommended usage	Comment	Dosing recommendations*
Fentanyl	Appears safe, generally no dose adjustment necessary	Decreased hepatic blood flow affects metabolism more than hepatic failure	Dose adjustment usually not needed
Methadone	Appears to be safe in patients with advanced CLD or cirrhosis, at least for short-term administration	· Half life can be mildly prolonged in severe cirrhosis · Drug disposition not significantly altered	
Tramadol*	Avoid use in patients with decompensated cirrhosis. Avoid use in patients at risk for seizures.	· Hepatically metabolized to active metabolite by CYP3A4, 2D6 & glucuronidation. · Unpredictable onset, variable analgesic efficacy, and risk of accumulation in patients with cirrhosis.	Based upon limited experience, a reduced dose of 25 mg every eight hours may be considered for treatment of pain in patients with advanced CLD or well-compensated cirrhosis.
Pethidine*	Avoid use	· Risk of accumulation of toxic metabolite (norpethidine). · Unpredictable analgesic efficacy and increased risk of toxicity in patients with advanced CLD or cirrhosis	

2. Non-opioid analgesics

Table 15.6 : Recommendations for Non-Opioid analgesics (James P Hamilton 2021)

Medication	Recommended usage	Comment	Dosing Recommendations
Paracetamol (PCM)	· *Generally well tolerated at reduced dose* in patients with chronic liver disease (CLD) or cirrhosis who do not consume alcohol ·	· Glutathione tissue stores needed to block formation of PCM's toxic metabolite (NAPQI) are reduced in individuals with cirrhosis or malnutrition, thereby lowering the dose threshold of PCM that can be safely administered each day · Active alcohol consumption further reduces available glutathione stores. · Half-life of PCM may be prolonged by up to twofold compared with healthy patients.	· 2g/day · 4g/day (for short term or once only) in patients with CLD/early compensated cirrhosis who does not take alcohol · Avoid use in patients with advanced CLD or cirrhosis who are 1. actively consuming alcohol 2. malnourished/ dehydrated 3. fasting/has poor oral intake >24 hours 4. having severe alcoholic hepatitis and acute liver injury 5. receiving multiple medications that undergo hepatic biotransformation, or any co-administered medication that is a potent inducer of hepatic enzymes (eg. phenobarbitone, phenytoin)
NSAIDs including aspirin	· *NSAIDs and aspirin should be avoided* in patients with advanced chronic liver disease (CLD) or cirrhosis.	· An increased risk of GI mucosal bleeding, variceal hemorrhage, impaired renal function (↓GFR), and development of · diuretic-resistant ascites is seen with use of NSAIDs in patients with cirrhosis with portal hypertension. · Individual NSAIDs (eg, diclofenac) have been associated with hepatotoxicity in general population.	· Low-dose PCM should be used instead of NSAIDs
COX-2 inhibitors	· *Avoid use of COX- 2 inhibitors* pending additional safety data	· Available data are inadequate to establish the safety of selective COX-2 inhibitors in patients with advanced CLD	· If used, celecoxib product information suggests a 50% dose reduction for Child- Pugh class B cirrhosis

3. Anti neuropathics Agents

Table 15.7 : Recommendations for Anti neuropathic Agents (James P Hamilton 2021)

Medication	Altered response and pharmacokinetics	Management suggestions
Carbamazepine	· Potent inducer of hepatic enzymes · Has been associated with hepatotoxicity and severe allergic reactions · May precipitate rapid · decompensation in patients with cirrhosis	Avoid as there are safer options
Gabapentin	· Not hepatically metabolized or bound to plasma proteins · Highly dependent on renal function for clearance of unchanged drugs · Sedation, ataxia, dizziness & nausea may limit usefulness in patients with advanced CLD or cirrhosis	· Initiate at 300mg OD and titrate if needed over weeks due to delayed onset and to improve tolerability · Maintenance dose dependent on renal function · Do not stop abruptly
Pregabalin	· Not hepatically metabolized or bound to plasma proteins · Highly dependent on renal function for clearance of unchanged drugs · Sedation & may limit usefulness in patients with advanced CLD or cirrhosis	· Initiate at 50mg BD and titrate over weeks due to delayed onset · Maintenance dose-dependent on renal function · Do not stop abruptly
Lignocaine topical patch	· Low (3-5%) systemic absorption through intact skin	· Good choice of local relief in area of intact skin · No adjustment needed in liver impairment
Nortriptyline	· Not hepatically metabolized or bound to plasma proteins · Accumulation of metabolites in hepatic impairment less likely with nortriptyline than amitriptyline · Dose related anticholinergic and cardiovascular side effects may be poorly tolerated in medically ill patients with advanced CLD or cirrhosis	· Initiate at 10mg ON and titrate over weeks due to delayed onset and to improve tolerability · Low maintenance dose (25- 50mg daily)

Management of pain in patients with advanced chronic liver disease or cirrhosis. James P Hamilton, 2021 (www.uptodate.com, retrieved January 2022)

Elderly Patients

As a convention, a person aged 65 years or more is often referred to as 'elderly'

Elderly people are more likely to experience pain than the general population, and in many cases they are undertreated. Although the incidence of side effects with drug therapy is higher in elderly people, analgesics can still be safe and effective when comorbidities and other concomitantly prescribed medicines are carefully considered.

Problems with elderly patient

1. Co-morbidities
2. Concurrent medications: higher risk of drug interactions
3. Age related physiological, pharmacokinetic and pharmacodynamic changes
4. Difficulties with pain assessment e.g. dementia, post-operative delirium.
5. Under-reporting of frequency and intensity of acute pain in the elderly patient

Principles of management:

1. Co-morbidity and other concurrent medications must be considered to minimize the chance of drug–disease and drug–drug interactions.
2. Consider non-pharmacological options to reduce reliance on medication.
3. Select each medication based on a balance of its risks and benefits.
4. Initiate one drug at a time
5. Start with low doses and titrate upwards slowly
6. Allow sufficiently long intervals between introducing drugs to assess effects
7. Monitor for pain relief, functional improvement and adverse effects including worsening of cognitive function.
8. Multimodal analgesia may provide synergistic effects with fewer side effects than higher doses of a single drug
9. Consider handling adverse effects by changing treatment, using a lower dose or by treating symptoms such as constipation or nausea.
10. Cease the medication if proven ineffective after an adequate trial

Points to note when prescribing analgesics:

Non-opioid Analgesics

- Paracetamol is the preferred non-opioid analgesic
- The use of NSAIDs and COX-2 inhibitors in elderly people requires extreme caution.

Opioid Analgesics

- Dose adjustment is necessary as there are age-related decreases in opioid requirements and significant inter-patient variability.
- Oral weak opioids:
  - o Tramadol 50 mg once daily to TDS
  - o Dihydrocodeine 30-60mg once daily to TDS
- Mixtures of weak opioids and paracetamol:
  - o Ultracet® (Paracetamol 325mg + Tramadol 37.5mg) 1-2 tablets once daily to QID
  - o Panadeine ® (Paracetamol 500mg + Codeine 8mg) 1-2 tablets once daily to QID
- Transdermal buprenorphine 5mcg/H and titrate to effect
- Oral strong opioids:
  - o Aqueous morphine 2.5 – 5mg 6-8 Hourly
  - o Oxycodone 2.5 – 5mg 6-8 Hourly

Depending on the dose of immediate-release dose required, (Oxycodone/Naloxone) OR, Slow Release Oxycodone OR, Slow Release Morphine

Table 15.8 : Recommended Drugs for Persistent Pain in Elderly (adapted from Journal of American Geriatric Society JAGS, August 2009-Vol 57, No 8)

No.	Drug	Recommended dose	Comments
1	Nonopioid analgesic Paracetamol	325-500 mg every 4 h or 500-1000 mg every 6 h	Maximum dose usually 4 g daily Reduce maximum dose 50%-70% in patients with hepatic impairment or history of alcohol abuse
	Celecoxib	100 mg daily (Available dose in Malaysia: 200mg)	Higher doses associated with higher incidence of GIT,CVS side effects Patients with indications for cardio protection require aspirin supplement; therefore, older individuals will still require concurrent gastroprotection
	Naproxen sodium	220 mg 2 x daily (Available dose in Malaysia: 250mg, 275mg,500mg,550mg)	Several studies implicate this agent as possessing less CV toxicity
	Ibuprofen	200 mg 3x a day	Concurrent use with aspirin inhibits aspirin's antiplatelet effect.
	Diclofenac sodium	50 mg 2x daily or 75 mg extended release daily	Owing to its relative cyclooxygenase-2 inhibitor selectivity, may be associated with higher CV risk compared to other NSAIDs

No.	Drug	Recommended dose	Comments
2	Opioid Oxycodone (immediate release formulations)	2.5-5 mg every 4-6 h	Useful for acute recurrent, episodic or breakthrough pain; daily dose limited by fixed-dose combinations with acetaminophen or NSAIDs (We do not have these combinations in Malaysia)
	Controlled release Oxycodone	10 mg every 12 h	Usually started after initial dose determined by effects of immediate- release opioid or as an alternative to a different long-acting opioid because of indications for opioid rotation
	Morphine Immediate release	2.5-10 mg every 4 h	Available in oral solution for episodic or breakthrough pain
3	*Adjuvant drugs* Tricyclic antidepressant		
	Amitriptyline Anticonvulsant	10 mg at bedtime	Significant risk of adverse effects for the elderly
	Carbamazepine	100 mg daily	Monitor hepatic transaminases, blood count, creatinine, blood urea, electrolytes
	Gabapentin	100 mg daily	Monitor sedation, ataxia, edema
	Pregabalin	50 mg at bedtime	Monitor sedation, ataxia, edema
4	*Other drugs* Corticosteroids		
	Prednisolone	5 mg daily and taper as soon as feasible	Use lowest possible dose to prevent side effects. Anticipate fluid retention and glycemic effects in short-term use and CV and bone demineralization with long-term use
	Lignocaine 5% patch	1-3 patches for 12 hours per day	Monitor for rash or skin irritation
	Muscle relaxant Baclofen	5 mg up to 3x daily	Monitor muscle weakness, urinary function, cognitive effects, sedation. Avoid abrupt discontinuation because of CNS irritability

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CHAPTER 16

NON-PHARMACOLOGICAL MANAGEMENT OF ACUTE PAIN

CHAPTER 16 NON-PHARMACOLOGICAL MANAGEMENT OF ACUTE PAIN

It is recommended that acute pain should be managed using both pharmacological and non pharmacological methods. This is an important aspect and one of the requirements to be certified as a "Pain Free" hospital.

Table 16.1 : Non-pharmacological modalities can be classified as follows

Physical	Psychological
RICE (Rest, Ice, Compression, Elevation)	Explanation
Positioning	Counselling
Acupuncture	Reassurance
Massage	Education and support
Physiotherapy such as hot pack, cold pack, Ultrasound, Interferential therapy, traction	Relaxation therapies
Transcutaneous electrical nerve stimulation (TENS)	Distraction
Surgery	Guided imagery Music therapy Hypnotherapy

Physical therapies

- **Ice** helps decrease swelling and pain and it may also prevent tissue damage. A cold pack is placed on the painful area for 15-20 minutes every hour or as directed.
- **Heat** reduces pain by vasodilatation effect.
- **Massage therapy** may help to relax tight muscles and decrease pain.
- **Acupuncture** uses very thin needles to balance energy channels in the body. This is thought to reduce pain and other symptoms.
- **TENS** is an electro- analgesia method. It works by applying electrical stimulation to or around the painful area to stop or reduce pain transmission in the management of acute, chronic and post-operative pain.

Psychological approaches

- **Relaxation techniques** can help to relax, relieve stress and decrease pain. Common relaxation techniques are:
  - Aromatherapy: this is a way of using scent to relax and relieve stress
  - Deep breathing
  - Progressive muscle relaxation
  - Meditation and yoga

- **Guided imagery** teaches patients to imagine a picture and focus on that picture instead of his pain. It may help to change the way the body senses and responds to pain.
- **Music therapy** increases energy level and improves mood. It may help to reduce pain by the release of endorphins.
- **Self-hypnosis** is a way to direct attention to something other than pain.

Pain should be managed with a combination of pharmacological and non-pharmacological therapies for optimum pain control with minimal side effects.

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APPENDICES

Appendix 1

ACUTE PAIN SERVICE

Instructions for Medical Officers and APS nurse

Acute Pain Service (APS)
Department of Anaesthesiology & Intensive Care, Kementerian Kesihatan Malaysia

I. Selection of patients for APS

- Technique selected should be explained to the patient prior to surgery during the pre-operative assessment.
- Patient should be well informed and educated regarding mode, benefits of analgesia and possible complications.(via flipchart or brochure if available)
- If you are unsure about what analgesic technique to use please discuss it with your specialist before informing the patient.
- The choice of analgesia explained to the patient should be documented in the pre-operative assessment form (GA form).

II. Responsibility of Medical Officers in the Operating Theatre

- To fill up the APS Audit Form, inform APS nurse and place it in the APS file.
- To fill up the APS Nursing Observation Chart and place it in patient's BHT.
- To inform the surgeon on the choice of analgesia prescribed to avoid duplication of orders.
  ****Surgeon should not order any opioids or sedative medications if patient is under the APS team.**
  ****Oral analgesics without opioids are allowed e.g: Paracetamol, NSAIDs or COX-2 inhibitors.**
- To ensure medications prescribed are available.
- To fill up the prescription slip in patient's BHT.
- To start PCA or epidural in the recovery bay and re-educate patients on how to use the PCA machine.
  ****Please make sure pain score < 4/10 before discharging patient to the ward.**

III. Preparation of Epidural Infusion Cocktail Solutions

Levobupivacaine 0.1% / plain Bupivacaine 0.1% + Fentanyl 2 mcg/ml

10 mls Levobupivacaine 0.5% OR plain Bupivacaine 0.5%
+ 100 mcg Fentanyl (2 mls)
+ 38 mls normal saline
(Total volume = 50 mls)

Levobupivacaine 0.125% / plain Bupivacaine 0.125% + Fentanyl 2 mcg/ml

10 mls Levobupivacaine 0.5% OR plain Bupivacaine 0.5%
+ 100 mcg Fentanyl (2 mls)
+ 28 mls normal saline
(Total volume = 40 mls)

Ropivacaine 0.2% + Fentanyl 2 mcg/ml

48 mls 0.2% Ropivacaine
+ 100 mcg Fentanyl (2 mls)
(Total volume = 50 mls)
Note: Ropivacaine concentration is slightly less than 0.2%

Drug Used and Dosages

1. Patients on epidural cocktail

Levobupivacaine 0.1% + Fentanyl 2 mcg/ml
OR
Plain bupivacaine 0.1% + Fentanyl 2 mcg/ml
OR
Ropivacaine 0.2% + Fentanyl 2 mcg/ml

Lumbar epidural: Run at 6-12 ml/h
Thoracic epidural: Run at 4-10 ml/h

2. Patients on PCA

PCA Morphine/Oxycodone
Concentration = 1mg/ml,
Bolus (Demand) dose : <60 years = 1 mg; >60 years = 0.5 mg
Lockout interval = 5 min
If patient has severe pain before started on PCA, give a loading dose of 2-3mg

PCA Tramadol
Concentration = 10 mg/ml,
Bolus (Demand) dose = 10 mg
Lockout interval = 5 min

PCA Fentanyl
Concentration = 10 mcg/ml,
Bolus (Demand) dose = 10-20 mcg
Lockout interval = 5 min

3 Patients on Subcutaneous morphine/oxycodone
<60 years: 5 - 10mg 4-6 hourly
>60 years: 2.5 - 5mg 4-6 hourly

IV.Responsibility of the APS team

1. Ward rounds

1.1. All APS patients should be reviewed 2-3 times a day and when pain score is ≥ 4/10 or complications/side effects arise.
1.2. All patients started on APS should be reviewed as following:

A. Assess the patient

- Ensure patient is comfortable. Assess the pain score. Aim for pain score at rest and on movement < 4/10.
- Ensure patient knows how to use the PCA machine.
- Look for and treat side effects from the APS technique.

B. Check the pump

- Ensure the tubing is connected correctly (Epidural or PCA)
- Ensure there is enough morphine / epidural solution in the syringe / cassette to last till the next morning.
- Record the drug used and dose delivered to the patient.

C. Check the nursing observation form

- Ensure that the ward nurse in charge of the patient understands the technique and the observations that are required (*Pain Score, Sedation Score, Respiratory Rate and Bromage score*)
- **Point out** to the ward nurse and/or sister if observations are not done.
- Note **pain score, sedation score and respiratory rate** and take appropriate action if values are abnormal.

D. Check the Medication Chart

- Make sure no opioids or sedative medications are given except tramadol during weaning off the PCA
- Inform the ward doctor or your specialist if these drugs were given to the patient.
- Make sure the following sticker is attached to the patient's medication chart.

PATIENT ON APS **DATE:** **TIME:**
No opioids/sedatives to be given within first 24 hours.
If pain relief is inadequate, please inform the APS team.
If RR < 8, give oxygen via high-flow mask @ 15L/m.
Give naloxone IV 0.1mg stat and titrate to effect up to a maximum of 0.4mg. Call APS team or ICU MO

E. Documentation

- Record your findings in the patient's file and APS form.
- Record your decision on whether to continue or to stop the APS technique.
- Record your step down analgesia plan after ruling out contraindications.

1.3. All problems should be discussed. Consult your specialist and pass over to the on-call team.

2. Other Responsibilities

2.1. Education: To motivate and educate the ward staff and junior doctors and help in conducting APS course.

2.2. Medication and the pump
- Prepare the medication as documented in APS audit form.
- Make sure all drugs prepared are clearly labeled, including name of drug and patient's particulars.
- Check the function of the pump and send for repair if necessary.

2.3. This APS protocol should be available in the APS file at all times.

2.4. Audit- daily/monthly census to be done.

2.5. Research

V. Monitoring in the ward

- All patients should be monitored hourly for the first 4 hours then 4 hourly (Blood Pressure, Pulse, RR, Sedation Score, Pain Score at rest and movement, Bromage Score)
- Ward staff to notify the APS team according to Standard Orders in Nursing Observation Chart
- Make sure the primary team does not order any opioids or sedative medication.

VI. Taking a patient off the APS

We can stop the analgesic technique when

- The patient is tolerating orally
- The patient require low dose opioid and pain score< 4
- The epidural has been in situ for 3-5 days; remove the epidural catheter as risk of infection increases.

When you stop the analgesic technique, please make sure that the patient has oral analgesia ordered (usually Paracetamol +/- NSAID/COX-2 inhibitor or a weak opioid)

Oral analgesics available and standard doses for adult are in the drug formulary (Appendix 9)

VII. Trouble shooting

1. **Inadequate analgesia**, e.g.: Pain score at rest and on movement is ≥ 4/10.

See the patient immediately and check for the following:

i. Patients on Epidural

- Check that the epidural catheter is still in place and the marking is as noted in the anaesthetic notes.
- Give a bolus dose (either 3-5mls of the solution that is running, or 3-5 mls of 0.5- 1% lignocaine) through the epidural catheter.
- If patient still complains of pain after the bolus dose of lignocaine, check the level of the block and give an additional bolus if the level is not high enough to cover the incision.
- Rule out neuropathic pain (spontaneous burning, shooting).
- If patient is comfortable after the bolus dose, increase infusion rate by 2-3 mls/hour. Review the patient in an hour to ensure patient is still comfortable.
- If there is a unilateral block, pull out catheter by 1-2 cm and give a bolus of 0.5-1% lignocaine. Make sure at least 2-3cm of catheter is left in epidural space.
- Please **recheck BP** after each epidural bolus dose.

ii. Patients on PCA

- Check patency of IV line and tubing.
- Check that the **patient knows how to use the PCA pump**.
- Check the number of demands, successful and unsuccessful.
- If the patient understands how to use the PCA pump, and the number of unsuccessful demands is high, **you may want to increase the bolus dose by 50%**. You may add a background infusion dose if patient is in ICU/HDW.
- If the patient does not understand how to use the PCA pump, you may need to **re-educate** the patient and stay with the patient until she is comfortable or at least until there is a downward trend in the pain scores.
- Make sure the **tubing is connected correctly** and there is **no leakage** at all connecting points

2. Hypotension for patient on epidural cocktail infusion (BP 20% lower than baseline)

- Run 250ml crystalloid
- Rule out other causes e.g. surgical bleed or cardiac event
- Assess adequacy of analgesia and level of block
- If it is due to the epidural technique, give IV Ephedrine 6mg stat/PRN and IV fluids till BP is stable, and then reduce the epidural infusion by 2ml/hr. Review 1 hour after changing the infusion rate.
- Withhold epidural and change to another modality of pain control if hypotension persists.
- If due to surgical bleed or cardiac event, call the surgeon or physician, stop the epidural cocktail temporarily and restart the cocktail at a reduced dose when BP is stable. Give a bolus dose if patient is in pain.
- Epidural opioids alone DO NOT cause hypotension but be careful of respiratory depression.

3. Nausea/vomiting

- IV/PO Metoclopromide 10-20mg tds
- IV/PO Ondansteron 4 mg tds
- IV Granisteron 1-3 mg od/bd
- IV dexamethasone 4mg single dose

4. Pruritus

- Reassurance
- Calamine Lotion
- Naloxone 0.04mg titrating to a max of 0.4 mg
- Ondansetron 4-8mg IV or Granisetron 3mg IV
- T. Chlorpheniramine 4mg tds/prn. Sedative properties of antihistamines may be helpful in interrupting the itch-scratch cycle. However caution is necessary because the sedative effect of antihistamine may worsen opioid-induced sedation.

5. Respiratory Depression

Diagnosis

- Sedation Score =2 and Respiratory Rate < 8/min
- Sedation Score =3 regardless of Respiratory Rate
- pin point pupils

Management

- Confirm diagnosis; check for pin–point pupils
- Stop APS technique-opioid/epidural
- Call for HELP-ward doctor and APS doctor
- Check Airway, Breathing and Circulation (ABC)
- Give oxygen to patient-3L/min via nasal prong/10L via face mask where necessary
- Try to wake patient up and remind patient to breathe
- Get resuscitation trolley
- Establishing monitoring eg ECG,BP,SpO_2
- IV Naloxone 0.1mg boluses every 2-3 mins up to a total of 0.4 mg or until patient wakes up or RR >10
- Monitor SpO_2, RR, BP,PR, Pain Score hourly
- If respiratory depression recurs:
  - Give another dose of Naloxone.
  - Consider airway protection if indicated
  - Admit patient to ICU / HDU for close monitoring. May require Naloxone infusion.

6. Numbness and muscle weakness

- Check and document the level of numbness and muscle weakness (Bromage score) to exclude nerve injury

Bromage 1

- Reassure the patient

Bromage 2-3

- Reduce the infusion rate by 50%
- Add multimodal analgesic or **Change** to PCA morphine.
- Inform specialist
- Reassess muscle power (Bromage score) after 1 hour
- If muscle power improves, continue with current infusion, increase infusion by 1-2ml/hr if PS≥4
- Needs further investigations eg MRI if motor blockade persists after reducing or stopping the local anesthetic infusion
- **absolutely essential to rule out** other causes such as epidural haematomas and CNS infections

Bromage Score		
 Bromage 0 (none) Full flexion of knees and feet	No Residual Motor Block; Full flexion of knee and feet	0
 Bromage 1 (partial) Just able to move knees	Partial Block Remains; just able to flex knees with free movement of feet	1
 Bromage 2 (almost complete) Able to move feet only	Almost complete block; only able to move feet; Unable to flex knee	2
 Bromage 3 (complete) Unable to move feet or knees	Complete Motor Block; Unable to move feet or knees	3

VIII: Recommendations on Neural Blockade and Anticoagulant Refer to Appendix 7

Appendix 2

NURSING OBSERVATION CHART

PCA	EPIDURAL	PCEA	NERVE BLOCK	OTHERS
MORPHINE ☐	**COCKTAIL**	**COCKTAIL**	*** UPPER LIMB**	**INTRATHECAL OPIOID**
FENTANYL ☐	-Bupivacaine ☐	-Bupivacaine ☐	**BRACHIAL PLEXUS**	- fentanyl .....mcg ☐
OXYCODONE ☐	-Ropivacaine ☐	-Ropivacaine ☐	**BLOCK**	- morphine..... mg ☐
OTHERS ☐	-Levo- bupivacaine ☐	-Levo- bupivacaine ☐	- interscalene ☐	- others..... ☐
.....	**PETHIDINE** ☐	**OTHERS** ☐	- supraclavicular ☐	**INTRAVENOUS OPIOID**
Conc.....mg/ml	**OTHERS** ☐	Conc... + Fentanyl	- infraclavicular ☐	**INFUSION** ☐
Bolus Dose	.....	..... mcg/ml	- axillary ☐	Drug.....
.....mg	Conc.....+ Fentanyl .....mcg/ml	Bolus dose.....ml	*** LOWER LIMB**	Bolus Dose.....mg
Lockout.....mins	Infusion Rate.....ml/hr	Lockout.....mins	**FEMORAL BLOCK** ☐	Conc..... mg/ml
Background	Epidural inserted by.....	Background.....ml/hr	**SCIATIC NERVE BLOCK** ☐	Infusion Rate.....ml/hr
.....ml/hr	Level:	Loading Dose	**3 in 1-BLOCK** ☐	**SUBCUTANEOUS MORPHINE** ☐
Loading Dose	Anchored at skin.....cm	..... ml at.....hr	**OTHERS** ☐	.....
.....mg at		Epidural inserted	.....	**OTHER TECHNIQUES**
.....hr		By.....	Drug.....	Oral analgesia ☐
		Level:	infusion.....ml/hr	PCM / NSAIDs / Coxibs
		Anchored at skin.....cm	Catheter anchored at skin.....cm	Tramadol / Oxycodone

STANDARD ORDERS

1. **No Opioids or sedatives** to be given other than that ordered by Acute Pain Service (APS).
2. **Naloxone (Narcan) 0.4mg** to be available in the ward.
3. **Oxygen at 2L/min** via nasal cannula /face mask where necessary
4. **Monitor** HR,BP,RR,Pain score,sedation and Bromage score **hourly for the first 4 hours, then 4 hourly.**
5. **Management of Complications**

i. **Respiratory Depression**
Sedation Score = 2 and Respiratory Rate less than 8 per minute OR
Sedation Score = 3 regardless of Respiratory Rate
Give Naloxone (Narcan) 0.1mg IV stat and repeat up to total of 0.4mg
Call APS Team/ ICU doctor immediately.

ii. **Hypotension**
If systolic BP drops to less than 90mmHg, stop epidural infusion (if any).Call the ward doctor
Run in 250mls Normal Saline or Hartmann's solution
Call the APS Team/Anaesthesia MO for additional assistance if required

iii.**Nausea and vomiting**
Call the ward doctor, give IV Metoclopramide (Maxolon) 10mg 8hrly PRN, if still no relief, call APS Team

iv. **Any persistent numbness / weakness / paralysis (Bromage score>2) / Sudden onset of back pain / Snapped or dislodged epidural catheter**
Call APS Team/ICU doctor immediately

v. **Other Problems**
For inadequate analgesia (Pain Score≥4), call the APS Team / ICU doctor immediately.
For mild pruritus, treat with calamine lotion. For severe pruritus, inform APS Team.
For other problems like urinary retention, call the ward doctor.

NURSING OBSERVATION CHART

TECHNIQUE: PCA ☐ EPIDURAL ☐ PCEA ☐ OTHERS ☐

SEDATION SCORE

0 = Patient is awake

1 = Mild (occasionally drow

2 = Moderate (frequently drowsy, easily rousable)

3 = Severe (difficult to rouse)

S = Sleeping (easy to rouse)

Bromage Score		
	No Residual Motor Block; Full flexion of knee and feet	0
	Partial Block Remains; just able to flex knees with free movement of feet	1
	Almost complete block; only able to move feet; Unable to flex knee	2
	Complete Motor Block; Unable to move feet or knees	3

DATE	TIME	DRUG	DOSE	PAIN SCORE	SED SCORE	BROMAGE SCORE	RR	BP	HR	NAUSEA/ VOMITING	COMMENTS

Name: _____ RN : _____

Appendix 3

ACUTE PAIN AUDIT FORM

APS No.

Name: ….....R/N: ……

Age: …… Sex: Male/Female Unit/Ward: …… Weight: ……kg BMI……...

Medical problems: …… ASA: ……

Diagnosis & Operation (Elective/Emergency): ……

Technique 1) …… Ordered by: …… Date started/end: ……

2) …… Ordered by: …… Date started/end: ….....

PCA	EPIDURAL	PCEA	NERVE BLOCK	OTHERS
MORPHINE ☐	**COCKTAIL**	**COCKTAIL**	*** UPPER LIMB**	**INTRATHECAL OPIOID**
FENTANYL ☐	-Bupivacaine ☐	-Bupivacaine ☐	**BRACHIAL**	- fentanyl ……mcg ☐
OXYCODONE ☐	-Ropivacaine ☐	-Ropivacaine ☐	**PLEXUS**	- morphine ……mg ☐
OTHERS ☐	-Levo- bupivacaine ☐	-Levo- bupivacaine ☐	**BLOCK**	- others ☐
Conc…….mg/ml	**MORPHINE** ☐	**OTHERS** ☐	-interscalene ☐	Dose……mg
Bolus Dose…….mg	**PETHIDINE** ☐	Conc……+ Fentany…mcg/ml	-supraclavicular ☐	**INTRAVENOUS OPIOID**
Lockout……mins	**OTHERS** ☐	Loading Dose	-infraclavicular ☐	**INFUSION** ☐
Background…….ml/hr	Conc…+	…… ml at…….hr	-axillary ☐	Drug……
Loading Dose	Fentanyl ……mcg/ml	Bolus dose……ml	*** LOWER LIMB**	Bolus Dose……..mg
……mg at……hr	Infusion Rate…ml/hr	Lockout……..mins	**FEMORAL BLOCK** ☐	Conc…… mg/ml
	Epidural inserted by……	Background…..ml/hr	**SCIATIC NERVE BLOCK** ☐	Infusion Rate…ml/hr
	Level: …….	Epidural inserted	**3 in 1-BLOCK** ☐	**SUBCUT. MORPHINE** ☐
	Skin to space ……cm	By……	**OTHERS** ☐	Dose……..
	Anchored at skin ……cm	Level: ……	……	**OTHER TECHNIQUES**
	Length of catheter in space	Skin to space ……cm	Drug……	Oral Analgesia…… ☐
	……cm	Anchored at skin……cm	Bolus…… mls	PCM / NSAIDs / Coxibs
		Length of catheter in space……cm	given at ……(time)	Tramadol / Oxycodone
			Infusion…...ml/hr	

PCA ☐ EPIDURAL ☐ PCEA ☐ NERVE BLOCK ☐ OTHERS ☐

Drug Used: .... **Anticoagulant:** .....

DATE								
TIME								
Seen by								
Dose used								
Pain score at rest /activities								
Heart Rate (HR)								
Blood Pressure (BP)								
Sedation score								
Respiratory Rate (RR)								
Nausea / vomiting								
Pruritus								
Numbness (dermatome)								
Motor weakness (Bromage Score)								
Urinary retention (Y /N), CBD present?								
Able to sleep? (Y/N)								
Ambulation (Y/N)								
Epidural site								
Plan & medications								

Level of Satisfaction: Excellent ☐ Good ☐ Satisfactory ☐ Poor ☐

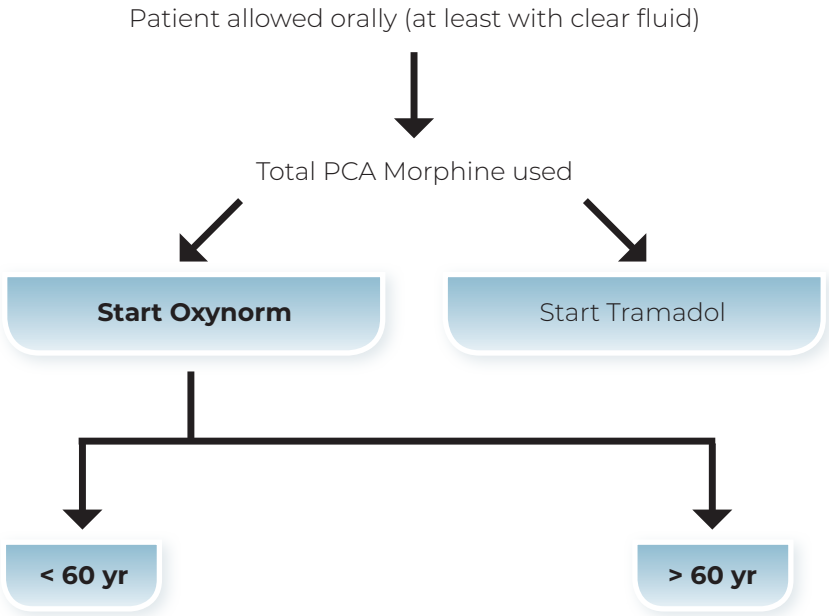
Bromage Score

 Bromage 0 (none)	No Residual Motor Block; Full flexion of knee and feet	0
 Bromage 1 (partial)	Partial Block Remains; just able to flex knees with free movement of feet	1
 Bromage 2 (almost complete)	Almost complete block; only able to move feet; Unable to flex knee	2
 Bromage 3 (complete)	Complete Motor Block; Unable to move feet or knees	3

Appendix 4

GUIDELINE FOR USE OF OXYNORM®

USE OF OXYNORM® IN PATIENTS WEANED OFF **PCA MORPHINE**



Give Oxynorm 5mg stat & stop PCAM PCAM

Prescribe Oxynorm in ward:

Regular dose for 2 days
C. Oxynorm 5mg **4 hourly &**
C. Oxynorm 5mg **PRN**
(to give 1hr after regular dose)

Give Oxynorm 5mg stat & stop PCAM

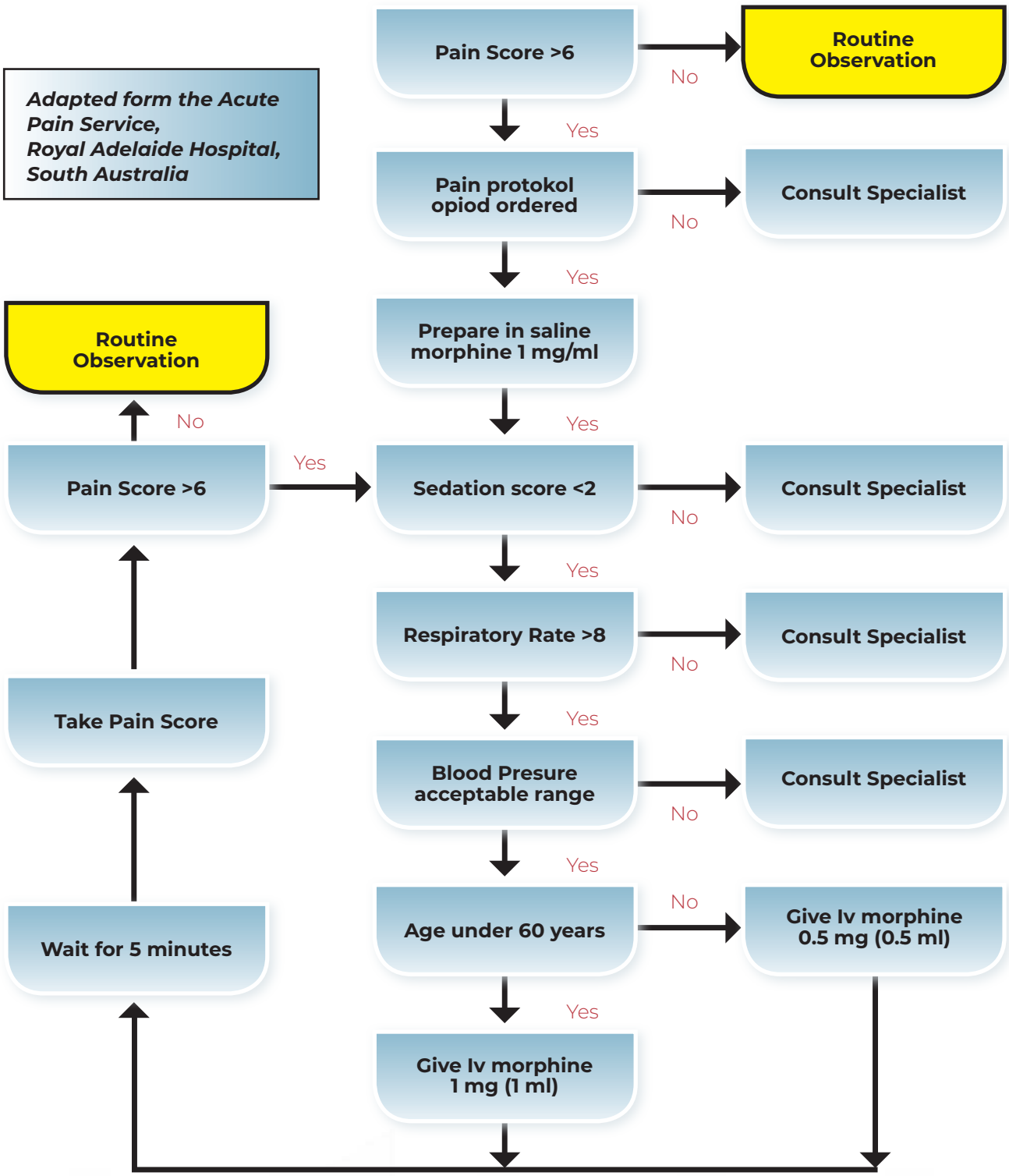
Prescribe Oxynorm in ward:

Regular dose for 2 days
C. Oxynorm 5mg **6 hourly &**
C. Oxynorm 5mg **PRN**
(to give 1hr after regular dose)

- Combine with regular Paracetamol ± NSAID/COX-2 inhibitors unless contraindicated
- May consider Oxynorm for those who cannot tolerate Tramadol
- ALL post-operative patients on Oxynorm will be followed-up by the APS Team.
- Please fill up the APS form for these patients

Appendix 5

MORPHINE PROTOCOL



Appendix 6

ANALGESIC LADDER OF ACUTE PAIN MANAGEMENT

Analgesic Ladder for Acute Pain Management

MILD		MODERATE		SEVERE		UNCONTROLLED
1-3		4-6		7-10		To refer to APS for: PCA or Epidural or other form of analgesia
Regular No medication or PCM 1gm 6hrly	PRN PCM &/or NSAID / COX2 inhibitor	Regular Tramadol 50mg tds/qid ± PCM 1gm QID oral ± NSAID / COX2 inhibitor	PRN Additional tramadol 50-100mg (max 400mg/day) OR DF118 30-60mg 6-8 hrly	Regular IV/SC Morphine 5-10mg 4 hrly OR Aqueous morphine 10-20 mg ± PCM 1gm QID oral / rectal ± NSAID / COX2 inhibitor	PRN IV/SC Morphine 5-10mg OR Aqueous morphine *Oral Oxynorm 5-10mg 4-6 hrly	

Notes:

1. Dihydrocodeine (DF118) may be used as an alternative to Tramadol
2. In NBM patients oral drugs may be replaced by
   a. Tramadol SC or IV
   b. PCM rectal
   c. Diclofenac rectal or Parecoxib IV
3. NSAIDs should be used with caution in patients with asthma, thrombocytopenia, coagulopathies, and renal, hepatic or cardiac impairment.
4. NSAIDs are contraindicated in patients with hypovolemia, active peptic ulceration and those with a history of hypersensitivity, e.g. wheezing to aspirin or any other NSAIDs.
5. In the elderly (over 65 years), avoid or consider using a lower dose of NSAID
6. Those at risk of GI problems or with symptoms (epigastric pain) may be “buffered” with Proton Pump Inhibitors.
7. For those with severe pain, use SC or IV morphine and titrate to comfort (see appendix 5 Morphine Pain Protocol)
8. Used of Oxynorm only for APS team
9. Refer to APS team for uncontrollable severe pain

Appendix 7

YLC2022

Anticoagulation Guidelines for Regional Anaesthesia American Society of Regional Anaesthesia and Pain Medicine (Evidence-Based Guidelines (Fourth Edition))			
Anticoagulant (Half-life)	**MINIMUM delay between last dose of anticoagulant and performance neuraxial technique**	**MINIMUM delay between neuraxial technique or catheter removal and next anticoagulant dose**	**Other precautions/ Remarks**
UNFRACTIONATED HEPARIN (UFH)			
Heparin (unfractionated)* Intravenous (1.5H)**	4-6H (with assessment of coagulation status)	– **No contraindication of maintaining neuroaxial catheter in the presence of low dose UFH.** – ***Removal of catheter: 4-6H after last dose** – ***First dose after catheter removal: 1H** ***With assessment of coagulation status**	– Heparin-induced thrombocytopenia in cases of Heparin administration > 4 days – Avoid in patients with coagulopathy
Heparin (unfractionated)* (5000u BID / QID)**	4-6H (with assessment of coagulation status)		
Heparin (unfractionated)* (< 20 000u / day; or 7 500u – 10 000u BD)**	12H (with assessment of coagulation status)		
Heparin (unfractionated)* (>20 000u / day; or >10 000u BD)**	24H (with assessment of coagulation status)		
LOW MOLECULAR WEIGHT HEPARIN (LMWH)			
Enoxaparin (3-6H; with normal renal function) prophylaxis 40mg QD or 30mg BID	12H	– First dose after catheter placement: 12H – Removal of catheter: 12H after last dose – First dose after catheter removal: 4H	**Other precautions/ Remarks**
Enoxaparin (3-6H) therapeutic 1mg/kg BID or 1.5mg/kg OD, Tinzaparin therapeutic 175u/kg OD	24H	– First dose after catheter placement: 24H – Removal of catheter: 24H after last dose **Presence of blood during needle/ catheter placement: Initiation of LMWH therapy should be delayed for 24H First dose after catheter removal: – 24H: after non-bleeding-risk surgery – 48H-72H: after high-bleeding-risk surgery	Dose reduction for: – Old age – CrCl <50mL/min Consider checking factor Xa in elderly patients and patients with renal insufficiency

Anticoagulant (Half-life)	MINIMUM delay between last dose of anticoagulant and performance neuraxial technique	MINIMUM delay between neuraxial technique or catheter removal and next anticoagulant dose	Other precautions/ Remarks
ANTI-FACTOR Xa AGENTS			
Fondaparinux (Arixtra) (17-21H)	48H (longer if higher doses used)	– Removal of catheter: 36H after last dose – First dose after catheter *removal*: 6H	Neuroaxial blockade may not be feasible in clinical practice If needed; – Single needle pass – Atraumatic needle placement – Avoidance of indwelling catheter
Rivaroxaban (Xarelto) (5-9H in healthy patients, 11-13H in elderly) **Renal impairment:** **Mild: 1.4 fold** **Moderate: 1.5 fold** **Severe: 1.6 fold** **Prophylaxis: 20mg OD** **Treatment: 15mg OD x 3/52 then 20mg OD**	72H	Removal of catheter: – 22-26H after last dose – 44-65H in cases of CrCl < 50mL/min or dose >10mg/day First dose after catheter removal: 6H	Should be avoided in CrCl < 30mL/min; however may reduce dose 15mg OD (CrCl 15-30mL/min)
Apixaban (Eliquis) (10-15H in healthy patients; up to 17.5H in moderate to severe renal insufficiency) **Dose:** **Prophylaxis: 2.5mg BD** **Treatment: 10mg BD x 1/52 then 5mg BD** **Dose modification in special group:** – **Age > 80** – **Serum Cr > 1.5mg/dL** – **BW < 60kg**	72H	– Removal of catheter: 26-30H after last dose – First dose after catheter *removal*: 6H	Should not be used in patients with: – CrCl < 15mL/min – Child-Pugh class B and C
Edoxaban (10-14H) **Dose modification in special group:** – **CrCl 15-49mL/min** – **BW < 60kg**	72H	– Removal of catheter: 20-28H after last dose – First dose after catheter removal: 6H	
Betrixaban	Minimum of 3 days	– Removal of catheter: 72H after last dose – First dose after catheter *removal*: 5H	Contraindication: – CrCl < 30mL/min

Anticoagulant (Half-life)	MINIMUM delay between last dose of anticoagulant and performance neuraxial technique	MINIMUM delay between neuraxial technique or catheter removal and next anticoagulant dose	Other precautions/ Remarks
VITAMIN K ANTAGONIST			
Warfarin (Coumadin) (60H)	5 days, with normalized INR	– Removal of catheter: INR < 1.5 (no guaranteed timeframe) – Neurological examination should be continued for at least 24H following catheter removal	Contraindicated with existence of concurrent use of NSAIDs, Thienopyridines, UFH and LMWH Patients receiving dose Warfarin: – Daily INR – Neurological examination
ANTIPLATELET AGENT – **NSAIDs** – **Thienopyridine Derivatives/Platelet ADP Antagonist (Clopidogrel, Ticlopidine and Prasurgel)** – **Platelet P2Y12 Receptor Antagonist (Ticagrelor)** – **Platelet Glycoprotein (GP) IIb/IIIa Receptor Antagonist (Abciximab,Eptifibatide, Tirofiban)** – **Platelet Phosphodiesterase (PDE) IIIA Inhibitor (Cilostazol)**			
Aspirin/NSAIDs (>72H)	Not applicable	– Not applicable	Caution: – Concurrent use of other anticoagulant or antiplatelet agents COX-2 inhibitors have minimal effect on platelet function
Clopidogrel (Plavix) (6-8H)	5-7 days	Catheter can be maintained for 1-2 days, provided a loading dose of the antiplatelet agent is not administered First dose after catheter removal: – *Without* loading dose: immediately – *With* loading dose: 6H Post-operative: – Therapy may be reinstated 24H postoperatively	
Ticlopidine (Ticlid) (4-5 days with repeated doses)	10 days	Catheter can be maintained for 1-2 days, provided a loading dose of the antiplatelet agent is not administered First dose after catheter removal: – *Without* loading dose: immediately – *With* loading dose: 6H Post-operative: – Therapy may be reinstated 24H postoperatively	

Anticoagulant (Half-life)	MINIMUM delay between last dose of anticoagulant and performance neuraxial technique	MINIMUM delay between neuraxial technique or catheter removal and next anticoagulant dose	Other precautions/ Remarks
ANTIPLATELET AGENT – **NSAIDs** – **Thienopyridine Derivatives/Platelet ADP Antagonist (Clopidogrel, Ticlopidine and Prasurgel)** – **Platelet P2Y12 Receptor Antagonist (Ticagrelor)** – **Platelet Glycoprotein (GP) IIb/IIIa Receptor Antagonist (Abciximab,Eptifibatide, Tirofiban)** – **Platelet Phosphodiesterase (PDE) IIIA Inhibitor (Cilostazol)**			
Prasugrel (Effient) (7H)	7-10 days	Catheter should not be maintained Post-operative: – Therapy may be reinstated 24H postoperatively	
Ticagrelor (Brilinta) (7-12H)	5-7 days	Catheter should not be maintained First dose after needle placement/ catheter removal: – *Without* loading dose: immediately – *With* loading dose: 6H Post-operative: – Therapy may be reinstated 24H postoperatively	
Abciximab (Reopro) (30minutes)	Should be avoided until platelet function has recovered	Post-operative: – Contraindicated within 4 weeks of surgery	
Eptifibatide (Integrilin) (2.5H)	Should be avoided until platelet function has recovered		
– **Tirofiban (Aggrastat) (2H)**	Should be avoided until platelet function has recovered		
Cilostazol	No data, however based on half-life; 2 days	– Catheter be removed prior to reinstitution of Cilostazol therapy postoperatively – First dose after catheter *removal*: 6H	

Anticoagulant (Half-life)	MINIMUM delay between last dose of anticoagulant and performance neuraxial technique	MINIMUM delay between neuraxial technique or catheter removal and next anticoagulant dose	Other precautions/ Remarks
THROMBIN INHIBITOR			
Bivalrudin (Angiomax) **Desirudin (Iprivask)** **Argatroban (Acova)**	CONTRAINDICATED		
Dabigatran (Pradaxa) (12-17H) (Prolonged with CRI)	120H CrCl (mL/min) > 80: 72H 50-79: 96H 30-49: 120H < 30: Contraindicated	– Removal of catheter: 34-36H after last dose – First dose after catheter *removal*: 6H	
OTHERS			
Dipyridamole	24H	– Catheter should be removed prior to reinstitution of Dipyridamole therapy postoperatively – First dose after catheter *removal*: 6H	
Cangelor	No data however based on half-life; 3H	– Catheter should be removed prior to reinstitution of Cangelor therapy postoperatively – First dose after catheter *removal*: 8H	
Herbal Medications	– The use of herbal medications does not create a level of risk that will interfere with the performance of neuroaxial block – No role of discontinuation or avoidance of regional anaesthetic techniques in patients in whom these medications have been administered		

Appendix 8

MANAGEMENT OF SEVERE LOCAL ANAESTHESTIC TOXICITY

1 Recognition

Signs of severe toxicity:

- Sudden alternation in metal status, severe agiation or loss of consciousness, with or without tonic-clonic convulsions
- Cardiovascular collapse: sinus bradycardia, conduction on block, asystole and ventricular tachyarrhythmias may all occur
- Local anaesthetiac (LA) toxicity may occur some time after initial injection

2 Immediate management

- Stop injecting the LA
- Call for help
- Maintain the airway and, if necessary, secure it with a tracheal tube
- Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH int the presence of metabolic acidosis)
- Confirm of establish intravenous access
- Control seizure: give a benzodiazepine, thiopental or protofol in small incremental doses
- Assess cardiovascular status throughout
- Consider drawing blood for analysism but do not delay definitive tratment to do this

3 Treatment

In circulatory arrest

- Start cardiopulmonary resuscitation (CPR) using standard protocols
- Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment
- Consider the use of cardiopulmonary by pass if available

Give intravenous lipid emulsion
(following the regimen overleaf)

- Continue CPR throughout treatment with lipid emulsion
- Recovery from LA-induced cardiac arrest may take >1 h
- Propofol is not suitable substitute for lipid emulsion
- Lignocaine should not be used as an anti-arrhythmic therapy

Without circulatory arrest

- Use conventional therapies to treat:
- hypotension
- bradycardia,
- tachyarrhytmia

Consider intravenous lipid emulsion
(following the regimen overleaf)

- Propofol is not suitable substitute for lipid emulsion
- Lignocaine should not be used as an anti-arrhythmic therapy

4 Follow-up

- Arreange safe transfer to a clinical ara with approciate equipment and suitable staff until sustained rcovery is achieved
- Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days

IMMEDIATELY

Give an initial intravenous bolus injection on of 20% lipid emulsion 1.5ml/lg ovr 1 min	**AND**	Start an intravenous infusion of 20% lipid emulsion at 15 ml/kg/h

AFTER 5 MIN

Give a maximum of two repeat boluses (same dose) if: ▪ cardiovascular stability has not been restored or ▪ an adequate circulation deteriorates Leave 5 min between boluses A maximum of three boluses can be given (including the initial bolus)	**AND**	Continue infusion at same rate, but: Double the rate to 30 ml/kg/h at anytime after 5 min, if: ▪ cardiovascular stability has not been restored of ▪ an adequate circulation deteriorates Continue infusion until stable and adequate circulation restored of maximun dose od lipid emulsin given

Do not exceed a maximum cumulative does of 12 ml/kg

Adapted from The Association in Anaesthestic of Great Britian & Ireland 2010

Appendix 9

DRUG FORMULARY

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Simple analgesic	Paracetamol	0.5 - 1gm, 6 - 8 hourly Max: 4g/day Reduce maximum dose 50%-70% in patients with hepatic impairment	Rare	Hepatic impairment Severe renal insufficiency (creatinine clearance ≤ 30 mL/min), Glucose 6 Phosphate Dehydrogenase (G6PD) deficiency Chronic alcoholism Anorexia, cachexia, chronic malnutrition (low reserves of hepatic glutathione) dehydration and hypovolemia	Preferred drug in elderly. Liver damage following overdosage. Maximum dose 4 g daily
	IV Paracetamol	<10kg 7.5mg/kg/ dose 10-50 kg, 15 mg/kg/ dose >50 kg, 1 g 6 hourly up to max 4g/day max 60mg/kg in 4 divided doses Administration: Infusion over 15 minutes. Renal & hepatic impairement: minimum interval between doses should not be less than 6 hours.		Hepatic impairment	Important to consider the total dosage of paracetamol used i.e. to include dosage of. suppositories and oral preparations

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Non-Selective NSAIDs	Diclofenac Sodium	50 - 150 mg daily, 8 - 12 hourly Max: 200 mg/day	Peptic ulcer, GI bleed, Platelet dysfunction, Renal failure, Hypertension Allergic reaction in susceptible individuals, Increase in CVS events	Gastroduodenal ulcer Asthma Bleeding disorder Renal dysfunction Ischaemic heart disease Cerebrovascular disease Inflammatory bowel disease	Current data suggest that increased CVS risk may be an effect of the NSAIDs/Coxib class. Physicians and patients should weigh the benefits and risks of NSAIDs/ COX-2 inhibitors therapy. Concurrent use with aspirin inhibits aspirin's antiplatelet effect (mechanism unclear)
	Mefenemic Acid	250-500 mg 8 hourly			
	Ibuprofen	200-400 mg, 8 hourly Max: 2400 mg/day Elderly patients: 200 mg 3 x a day			
	Naproxen	500-550mg BD Elderly patients; 220 mg BD			
	Ketoprofen	Patch: 30 -60 mg BD Topical; PRN			
	Ketolorac	IV: 10-20 mg BD (max 3days)			
	Meloxicam	7.5-15 mg daily Max: 15 mg /day			

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Selective COX-2 Inhibitors	Celecoxib	400mg BD in acute pain (48 hours only) 200-400 mg daily (for longer term use) <18 years : not recommended Elderly patients: 100 mg daily	Renal impairment Allergy reaction in susceptible individuals Increase in CVS events Hypertension	Ischaemic heart disease Cerebrovascular disease Hypersensitivity to sulfonamides Higher doses associated with higher incidence of GIT, CVS side effects Patients with indications for cardioprotection require aspirin supplement Uncontrolled Hypertension	Associated with lower risk of serious upper gastrointestinal side effects compared to traditional NSAIDs Use the lowest effective dose for the shortest duration necessary
	Etoricoxib	120 mg daily in acute pain (48 hours only) 60 - 90 mg daily (for longer term use) Elderly patients 30-60 mg daily			
	Parecoxib	20-40mg 6-12 hourly (max 80mg/day for max duration of 72 hours) Elderly (>65 years & <50kg) reduce to half the dose with a maximum daily dose of 40mg. Renal & hepatic impairment : *Do not use*			

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Weak opioids	Tramadol	50 - 100 mg, 6 - 8 hourly Max: 400 mg/day	Dizziness Nausea Vomitting Constipation Drowsiness	Risk of seizures in patients with history of seizures and with high doses In elderly, start at lowest dose (50 mg) and maximum 300 mg daily	Interaction with TCA, SSRI and SNRI
	Dihydrocodeine tartrate (DF118)	30 - 60 mg, 6 - 8 hourly Max: 240 mg/day Renal dysfunction &:dialysis patient: do not use Hepatic dysfunction: *do not use*	Nausea Vomiting Constipation Drowsiness	Respiratory depression Acute alcoholism Paralytic ileus Raised intracranial pressure	Metabolites can accumulate causing adverse effects In severe hepatic impairment, codeine may not be converted to the active metabolite-morphine.
Combinations of opioids and paracetamol	Paracetamol 500 mg + Codeine 8 mg	1 - 2 tablets, 6 - 8 hourly Max: 8 tablets/day	Constipation	Hepatic impairment,	Decrease in side effect profile of tramadol and paracetamol while maintaining efficacy
	Paracetamol 325 mg + Tramadol 37.5 mg (Ultracet®)	1 - 2 tablets, 6 - 8 hourly Max: 8 tablets/day	Nausea Vomiting Drowsiness	Hepatic impairment, risk of seizures in patients with history of seizures and with high doses	

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Strong opioids	Morphine	SC (Adults): <65 yrs: 5mg-10 mg 4 hrly >65 yrs: 2.5 mg-5mg 4hrly IV: Follow morphine pain protocol (Appendix5) Oral: Starting dose 5- 10 mg, 4 hourly of IR Elderly: 2.5 - 5 mg, 4 - 6 hourly of IR	Nausea Vomiting Pruritus Sedation Constipation Respiratory depression Myoclonus	Acute bronchial asthma Respiratory depression Head injuries,Renal and *hepatic dysfunction: needs* dose adjustment (refer Chapter 3)	Metabolites can accumulate causing increased therapeutic and adverse effects. Both parent drug and metabolites can be removed with dialysis, watch for "rebound" pain effect
	IV Fentanyl	Renal dysfunction : appears safe, however, a dose reduction is necessary Dialysis patients : appears safe Hepatic dysfunction : appears safe, generally no dose adjustment necessary	Nausea Vomiting Sedation Constipation Respiratory depression		No active metabolites and appears to have no added risk of adverse effects; monitor with high long term user Metabolites are inactive, but use caution because fentanyl is poorly dialysable Decrease hepatic blood flow affects metabolism more than hepatic failure.

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Strong opioids	Oxycodone IR (oxynorm)	Starting dose (oral): 5 -10 mg 4 - 6 hourly Renal dysfunction : Use cautiously with careful monitoring, adjust dose if necessary Dialysis patients: do not use Hepatic dysfunction: Use cautiously and monitor patient carefully for symptoms of opioid overdose Decrease initial dose by 1/2 to	Nausea Vomiting Sedation Constipation Respiratory depression	Acute bronchial asthma Respiratory depression Concomitant used of sedative drugs Head injuries,Renal and *hepatic dysfunction: needs* dose adjustment (refer Chapter 3)	Metabolites and parent drug can accumulate causing toxic and CNS-depressant effects In severe hepatic impairment, the parent drug may not be readily converted to metabolites
	TD Buprenorphine	initiation : 5mcg/H patch supplement with immediate acting opioid & non opioid for breakthrough pain upward titration : with a minimum interval of 72H Renal dysfunction: no dose adjustment required Hepatic dysfunction : careful monitoring required Elderly patients: no dosage adjustment required	Nausea Vomiting Constipation headache dizziness somnolence confusion Opioid Induced Ventilator Impairement (OIVI) depression insomnia nervousness anxiety	hypersensitivity to active substance or any excipients treatment of opioid dependence & narcotic withdrawal respiratory centre & function impairement receiving MAO inhibitors within the last 2 weeks myasthenia gravis delirium tremens pregnancy	do not increase > 20mcg/H (risk of QT prologation) Not suitable for the treatment of acute pain

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Antidepressant	Amitriptyline	Start with 10 - 25 mg nocte. Increase weekly by 25 mg/day to a max of 150 mg/day Elderly patients: 10 mg ON	Anticholinergic effects e.g. dry mouth, drowsiness, urinary retention, arrhythmias	Not recommended in elderly patients with cardiac disease, glaucoma, renal disease	Nortriptyline may be a suitable alternative and better tolerated in elderly at similar doses Interaction with Tramadol Significant risk of adverse effects for the elderly
	Duloxetine	30 - 60 mg/day Max: 120 mg/day	Gastrointestinal disorder Excessive sweating CNS disorder	Narrow-angle glaucoma Potent CYP1A2 inhibitors Concomitant use of MAOIs Hypertension	Interaction with Tramadol
Anticonvulsants	Carbamazepine	100 - 1600 mg/day Elderly patients: 100 mg daily	Dizziness Ataxia Fatigue Leucopenia Nausea Vomiting Drowsiness	Increased ocular pressure Latent psychosis Confusion Agitation	Well tolerated. Serious adverse events are rare
	Gabapentin	Day 1: start at 300mg ON Day 2: 300 mg 12 hourly Day 3: 300 mg 8 hourly Thereafter, increase by 300 mg/day every 1- 7 days Max: 3600 mg/day Elderly patients : 100mg daily	Drowsiness dizziness GI symptoms Mild peripheral oedema	Dose adjustment needed in renal impairment	However, need to monitor sedation, ataxia, oedema, hepatic trans-aminases, blood count , serum creatinine, blood urea and electrolytes

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Anticonvulsants	Pregabalin	Start with 150 mg/ day (in 2 divided doses). If needed, increase to 300 mg/ day after 3 - 7 days intervals, then if needed, increase to 600 mg/ day after 7 days interval Max: 600 mg/day Elderly patients : 50 mg at bedtime	Drowsiness dizziness GI symptoms Mild peripheral oedema	Dose adjustment needed in renal impairment	However, need to monitor sedation, ataxia, oedema, hepatic trans-aminases, blood count , serum creatinine, blood urea and electrolytes
	Sodium Valproate	Initially 400 mg/day in 2 divided doses. Maybe increase by 200 mg at 3 day intervals Max: 1600 mg/day	Fatigue Loss of appetite Vomiting Dizziness	Avoid concomitant use of salicylates in children < 3 year old due to risk of liver toxicity. Monitor prothrombin time when used with Warfarin	Swallow whole,do not chew / crush

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Bisphosphonates	Pamidronate	60 - 90 mg as a single infusion over 2 - 4 hrs every 4 weeks	Asymptomatic hypocalcemia, hypophosphataemia, hypomagnaesemia Flu-like symptoms Mild fever Local injection -site reactions Malaise Rigor	Hypersensitivity to biphosphonates. Hyperparathyroidism In renal impairment, reduce dose and increase infusion duration required In patients with poor dental hygiene, there is higher risk of ONJ. Dental referral is advised.	Nortriptyline may be a suitable alternative and better tolerated in elderly at similar doses Interaction with Tramadol Significant risk of adverse effects for the elderly
	Zoledronate Acid	4 mg as 15 min IV infusion every 3 - 4 weeks	Rise in body temperature Flu-like symptoms Headache Hypersensitivity reactions Osteonecrosis of the jaw		Interaction with Tramadol
	Clodronate	800-3200 mg daily (oral) Max: 3200 mg/day	Gatrointestinal irritation	Renal dysfunction	Should not be taken within 1 hour before or 2 hours after meals

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Corticosteroid	Dexamethasone	Oral/ IV/SC: 8 - 16 mg daily or divided doses (initial dose), then to reduce to lowest possible dose (usually 2 mg/day) Elderly patients :5 mg daily and taper as soon as feasible	Increased or decreased appetite Insomnia Indigestion Nervousness Myopathy Oral candidiasis Adrenal suppression	Peptic ulcer disease Concomitant NSAIDs use Liver or cardiac impairment	Should be given before 6 pm to reduce risk of insomnia Efficacy may reduce over 2 - 4 weeks Use lowest possible dose to prevent side effects. Anticipate fluid retention and glycemic effects in short-term use and CV and bone demineralization with long-term use Monitor for rash or skin irritation
Lignocaine (topical)	Lignocaine 5%	1-3 patches for 12 hours per day			Monitor muscle weakness, urinary function, cognitive effects, sedation
Muscle relaxant	Baclofen	5 mg -15 mg daily			Avoid abrupt discontinuation because of CNS irritability

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Laxatives	Lactulose	15 - 45 ml orally 6 - 8 hourly	Bloating Epigastric pain Flatulence Nausea Vomiting Cramping	Hypersensitivity to lactulose products Galactosemia Patients requiring a galactose free diet	May be mixed with fruit juice, water or milk Reasonable fluid intake is required for efficacy
	Bisacodyl	5 - 10 mg orally, 1 - 2 times daily Max: 30 mg/day	Atony of colon	Intestinal obstruction	
	Senna	2 - 4 tablets daily in divided dose	Diarrhoea Nausea Vomiting Rectal irritation Stomach cramps Bloating	Allergies especially to Tartrazine	
	Macrogols	1 - 2 sachets/day	Abdominal distension Nausea Diarrhoea	Severe inflammatory bowel disease, Fructose intolerance,	

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Antiemetic	Metoclopramid	10 - 20 mg 6 - 8 hourly	Extrapyramidal reactions Dizziness Drowsiness	Epileptic patients Gastrointestinal hemorrhage	
	Haloperidol	0.5-3 mg ON	Extrapyramidal Syndromes Dystonia Prolonged QT interval Neuroleptic Malignant Syndrome	Concomitant use with other psychotropic drugs may increase Extra- pyramidal Syndromes	
	Granisetron	1 mg 12 hourly	Constipation	Progressive ileus and/ or gastric distension may be masked	Should not be used as first line. Not for long term use.
	Ondansetron	8 mg 12 hourly	Headache Sensation of flushing or warmth in the head and epigastrium Constipation	Pregnancy and lactation Hepatic impairment	
	Prochlorperazine	10 - 30 mg daily in divided doses Severe nausea and vomiting: 20 mg stat followed by 10 mg after 2 hours For prevention: 5 - 10 mg 8 - 12 hourly	Extrapyramidal symptoms Dry mouth	May increased risk of seizure with Tramadol	

Appendix 10

RECOMMENDED GUIDELINES FOR USE OF KETAMINE IN PERIOPERATIVE PAIN MANAGEMENT

* Adapted from Pain Management Services Hospital Selayang

As an adjunct anaesthesia (GA or RA)

1. Loading dose of 0.5mg/kg before surgical incision
2. Follow by infusion 0.25mg/kg/hr up to 0.5mg/kg/hr. the rate of infusion depends on the nature of pain and the expected duration of the surgery
3. Recommended for procedures lasting longer than 2 hours. Infusion should be stopped at least 60 minutes before the end of surgery to prevent prolonged recovery

As an adjunct To Acute or Post Op Pain Management

1. Useful adjuvant to PCA opioids when tolerance, neuropathic pain or poorly controlled pain is an issue. For example in

    - high risk surgery e.g : pelvic exenteration, oesophagectomy
    - rapid tolerance to opioids
    - sedation with opioids but pesistent pain or excessive opioid side effects
    - moderate to high doses of opioids

2. Continuous intravenous or subcutaneous infusion at doses of 0.1 – 0.2 mg/kg/hr are commonly used in combination with an opioid for the management of post operative and post injury pain
3. Continuous intravenous or subcutaneous infusion at (2-4mg/h), 2 mg/h for elderly and then titrate accordingly. The recommended infusion rate is usually 2-8mg/hour.

DILUTION REGIME FOR KETAMINE

1. Dilute Ketamine to a final concentration of 4mg/ml using 0.9% Normal Saline as diluent.

For Example:

Dilute 200mg Ketamine with 0.9% Normal saline to a final volume 0f 50mls.

i.e 200mg/50mls = 4mg/ml

2. Ideally, the Ketamine should be run in a locked syringe driver.

Appendix 11

LIGNOCAINE INFUSION PROTOCOL

* Adapted from Pain Management Services Hospital Selayang

Lignocaine infusion is recommended for neuropathic pain that originates from the peripheral and the central nervous system. Although there are reports to show the effectiveness for Complex Regional Pain Syndrome (CRPS) and fibromyalgia, more research/evidence is needed.
Conditions that are suitable for lignocaine infusion:

- Trigeminal Neuralgia
- Post herpetic Neuralgia
- Painful diabetic peripheral neuropathy
- Complex Regional Pain Syndrome
- Phantom limb pain/ Stump pain
- Peripheral nerve injury/lesion with neuropathic pain
- Chronic daily headache
- Central Pain Syndrome
- Post Spinal Cord Injury

Aim of lignocaine infusion:

- to reduce the pain score so that patient will be more functional
- for medication reduction especially when there is unacceptable side-effects of the current medication (like opioids)

In pain management clinic:

- choose the patient accordingly
- explain to the patient regarding the process: day case, nil by mouth, and it may reduce the current pain score
- do a screening 12-lead ECG for baseline rhythm

During the day of lignocaine infusion:

- patient is nil by mouth for at least 6 hours
- take the patient's weight
- reassess the pain score and the medication taken
- take consent
- set a cannula and start a drip
- establish monitoring : ECG, HR, SpO2, BP
- fill up the DN4 Questionnaire prior to infusion
- infusion should be given in the presence of an anaesthetist

For the lignocaine infusion:

- bolus: 1mg/kg over 5 minutes
- infusion: 5mg/kg over the next 2 hours
- continuous monitoring of vital signs and sedation score at 5 minutes interval
- ask patient to report if there is any dizziness, light-headedness, fingers and toes tingling sensation, circumoral numbness, metallic taste, tinnitus (early symptoms of toxicity)

Post infusion:

- continuous monitoring of vital signs and sedation score for an hour
- check list for discharge to be filled
- patient will be contacted after 1 week
- pain clinic follow up in one month.
- inpatients will be reviewed in the ward

OBSERVATION FOR LIGNOCAINE INFUSION

TIME	NIBP	SpO2	HR	PAIN SCORE	SEDATION SCORE	COMMENT

DN4 – QUESTIONNAIRE

To estimate the probability of neuropathic pain, please answer yes or no for each item of the following four questions.

INTERVIEW OF THE PATIENT		
QUESTION 1:		
Does the pain have one or more of the following characteristics?	**YES**	**NO**
Burning	❑	❑
Painful cold	❑	❑
Electric shocks	❑	❑
QUESTION 2:		
Is the pain associated with one or more of the following symptoms in the same area?	**YES**	**NO**
Tingling	❑	❑
Pins and needles	❑	❑
Numbness	❑	❑
Itching	❑	❑

EXAMINATION OF THE PATIENT		
QUESTION 3:		
Is the pain located in an area where the physical examination may reveal one or more of the following characteristics?	**YES**	**NO**
Hypoesthesia to touch	❑	❑
Hypoesthesia to pinprick	❑	❑
QUESTION 4:		
In the painful area, can the pain be caused or increased by:	**YES**	**NO**
Brushing?	❑	❑

YES = 1 point
NO = 0 points

Patient's Score: /10

Post IV Lignocaine infusion check lists prior to discharge:

1. Monitoring of BP, HR, RR, SpO2, Sedation Score and Pain Score (pre, during and post infusion)
2. Assess for post procedure complications:
   - NS : agitation, dizziness, blurred vision, confusion, drowsiness, lightheadedness, muscle twitching, circumoral numbness, seizure
   - CVS : hypotension, hypertension, bradycardia, cardiac arrest
   - GIT : nausea, vomiting
   - Allergic reaction

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