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PAIN MANAGEMENT HANDBOOK

This document was developed by the Surgical and Emergency Medicine Services Unit, Medical Development Section of the Medical Development Division, Ministry of Health Malaysia and the Editorial Team for the Pain Management Handbook

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This book is based on the “Pain Management Handbook” 2004, published by the Malaysian Society of Anaesthesiologists, the College of Anaesthesiologists, Academy of Medicine Malaysia and the Malaysian Association for the Study of Pain.

Foreword

Pain management or pain medicine is a branch of medicine which employs a multidisciplinary approach for easing the suffering and improving the quality of life of those patients living with pain. The typical pain management team includes anaesthesiologists, occupational therapists, physiotherapists, clinical psychologists and pain nurses. Together the multidisciplinary team can help create a package of care suitable to the patient. While acute pain usually resolves once the underlying trauma or pathology has healed, and is treated by one practitioner, effective management of chronic pain frequently requires the coordinated efforts of the pain management team.

Medicine treats injury and pathology to support and speed healing; and treats distressing symptoms such as pain to relieve suffering during treatment and healing. When a painful injury or pathology is resistant to treatment and persists, when pain persists after the injury or pathology has healed, and when medical science cannot identify the cause of pain, the task of medicine is to relieve suffering. Treatment approaches to chronic pain include pharmacologic measures, such as analgesics, tricyclic antidepressants and anticonvulsants, interventional procedures, physical therapy and psychological measures.

In Ministry of Health hospitals, pain specialists are specially trained anaesthesiologists who have been leading pain management services. To date not less than 15 chronic pain clinics have been established while acute pain services are provided by anaesthesiologists in 84 hospitals.

The World Health Organization (WHO) estimated that approximately 80 percent of the world population has either no or insufficient access to treatment for moderate to severe pain. Every year tens of millions of people around the world suffer from such pain without treatment. Yet the medications to treat pain are cheap, safe, effective, generally straightforward to administer, and international law obliges countries to make adequate pain medications available.

In 2008, the Ministry of Health (MOH) recognised Pain as the Fifth Vital Sign through a Director General of Health's circular as a strategy to improve pain management in our hospitals. Reasons for deficiencies in pain management in MOH hospitals include cultural, societal, religious, and differences in health-seeking behaviour or attitudes, as well as lack of awareness on human rights and limited access to pain services. Moreover, the biomedical model of disease, focused on pathophysiology rather than quality of life, reinforces entrenched attitudes that marginalize pain management as a priority. Other reasons may have to do with inadequate training, personal biases or fear of prescription drug abuse.

One strategy for improvement in pain management includes guidelines and standards of practice such as this handbook. At the same time awareness programs and training need to be continually conducted for medical and allied health professionals. We envisage that this handbook will be an important resource for ongoing training and as a reference for managing pain.

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Preface

All anaesthesiologists need a working knowledge on pain management, with information about latest developments in analgesic drugs and the methods of administration in various situations. It is important that anaesthesiologists, as well as other clinicians and paramedical staff, have a basic understanding about the strategies used in pain management.

This handbook aims to provide an overall view on pain management, both acute and chronic pain and the principles upon which treatment is based. It initially started as an update of the “Handbook on Pain Management” (2004), which included a compilation of various guidelines on different aspects of pain management namely acute pain in adults and children, obstetric analgesia, pain management for day care surgery as well as cancer pain management.

In this edition, we have included practical information about pain management in our daily practice and pharmacology of analgesics. New sections include Acute Neuropathic Pain, Peripheral Nerve Blocks, Procedural Pain, Acute Pain Management in Opioid Tolerant Patients and Chronic Non Cancer Pain. The section on cancer pain has been left out as there is now a Clinical Practice Guideline (CPG) on Cancer Pain Management (2010).

We hope that anaesthesiologists – both specialists and medical officers - will find this handbook a useful source of information on the management of pain. We further hope that clinicians and paramedical staff will find it a helpful guide in managing pain in their patients.

Editorial Team

CHAPTER 1

PRINCIPLES OF PAIN MANAGEMENT

Pain is a common symptom in hospitalised patients. Acute pain is pain that is associated with tissue injury. It is usually limited in duration (less than 3 months) and diminishes as the tissues heal. Chronic pain is pain that persists beyond the healing period, after recovery from the acute injury or disease.

Pain is a complex physiological and psychological phenomena that is subjective in nature. Pain may be acute or chronic and may persist even when tissue healing has occurred. The assessment of pain and documenting the effectiveness of any intervention are the basic principles of successful pain management.

The implementation of Pain as the 5th Vital Sign in Ministry of Health (MOH) hospitals is aimed at ensuring that all medical staff are trained in the assessment and management of pain so that patients admitted to hospital will not have to suffer unrelieved pain.

Objectives of Pain Management Services

- To improve the quality of pain management in hospitalized patients, including those with postoperative pain, post-trauma pain and painful medical conditions not requiring surgery.
- To expand the range of analgesic techniques used.
- To make analgesic therapy cost effective.
- To increase the safety and efficacy of analgesia.
- To facilitate recovery in patients with acute pain.
- To avoid or effectively manage side effects of analgesic treatment.
- To increase awareness among health care providers of the importance of good pain management and the analgesic drugs and techniques available.
- To improve pain management in all patients including those in medical wards.
- To conduct audit and research in pain management.

Principles of Pain Management

- Good pain management is necessary to avoid adverse physiological and psychological effects resulting from unrelieved pain.
- Morphine is the gold standard for managing acute pain.
- Proper assessment and control of pain requires frequent assessment and reassessment of pain intensity, documentation of analgesia and patient involvement.
- Pain that is established and severe is difficult to control; therefore pain has to be treated early and continuously. The current practice is to use *preventive analgesia** rather than *pre-emptive analgesia***.

- Treatment should be individualized. Analgesia should be planned preoperatively with consideration given to the type of surgery, medical condition of the patient, peri-operative use of analgesics and regional anaesthetic techniques.
- The aim of good pain management is to reduce pain to a tolerable or comfortable level, not necessarily to eliminate pain completely.
- A multidisciplinary approach to the management of acute pain leads to improved pain relief and better patient outcomes, including the long-term benefit of reduced risk of developing chronic pain.
- Adequate monitoring of side effects is necessary to prevent morbidity and mortality of patients using pain management techniques provided by the Acute Pain Service (APS). Protocols for routine monitoring and treating of adverse effects must be implemented in all areas where APS is provided.
- Multimodal analgesia may be used to improve efficacy and reduce side effects. This means using a combination of analgesic agents such as paracetamol, NSAIDs, opioids and local anaesthetics to achieve synergistic analgesic effects with reduced doses of each component drug.
- Restoration of function e.g. early postoperative mobilization and discharge should be a clear goal of acute pain management.

**Preventive analgesia* is an analgesic intervention used pre-, intra- and post-operatively which leads to persistence of analgesic efficacy beyond the expected duration, e.g. Ketamine, epidural analgesia.

***Pre-emptive analgesia* is an analgesic intervention that is initiated before a surgical incision to reduce central and peripheral sensitization; it is a component of preventive analgesia. e.g. preoperative paracetamol and NSAIDs, pre-incisional local anaesthetic infiltration, nerve blocks and epidural analgesia.

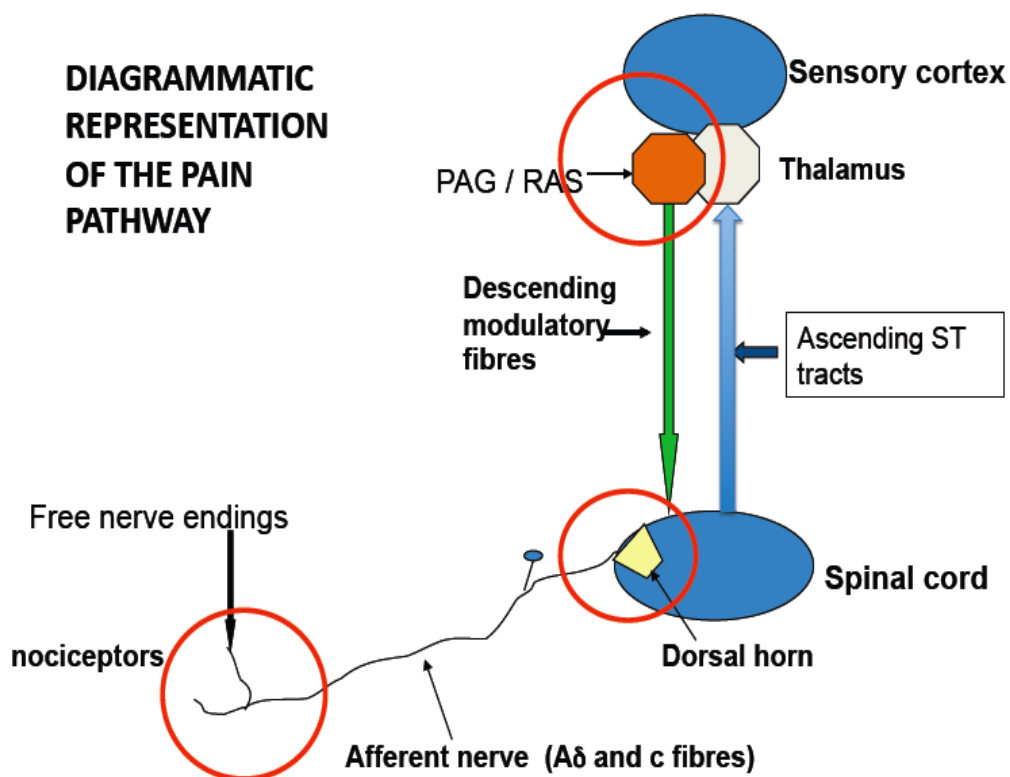
CHAPTER 2

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 actual or potential tissue damage, or described in terms of such damage”

Figure 2.1: Pain Pathway



Pain Pathway

It is convenient to describe the pain pathway in three components:
Peripheral, Spinal and Supraspinal

1. Peripheral:
 - Nociceptors (free nerve endings that respond exclusively to intense stimuli) are present at the skin, muscles, joints and viscera.
 - When triggered, the stimulus is carried through A-delta and C nerve fibers to the next level (spinal cord).

2. Spinal:
 - A delta and C fibers (first order neurons) synapse with second order neurons in the dorsal horn (substantia gelatinosa) of the spinal cord.
 - The pathway continues through the contralateral spinothalamic/spinoreticular tract to the next level (Supraspinal).
3. Supraspinal:
 - The brainstem and thalamus relay stimuli to the sensory cortex where pain is perceived.
 - 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 of Postoperative Pain

- Unpleasant to patient
- Increases surgical stress response
- Impedes nursing and physiotherapy
- Delays mobilization
- Increases postoperative complications
- Prolongs postoperative stay
- Physiological consequences, which may lead to detrimental effects

Physiological Consequences of Acute Pain

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

1. Cardiovascular system

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

2. Respiratory system

- Pain from thoraco-abdominal wounds may produce widespread pulmonary changes, an increase in abdominal muscle tone and an associated decrease in 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 increase sympathetic tone, causing an increase in smooth muscle and sphincter tone, leading to urinary retention.

5. *Musculoskeletal system*

- Pain prevents mobilization and increases muscle tone resulting in deep vein thrombosis.

6. *Endocrine system*

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

7. *CNS complications*

- Anxiety, stress and sleeplessness

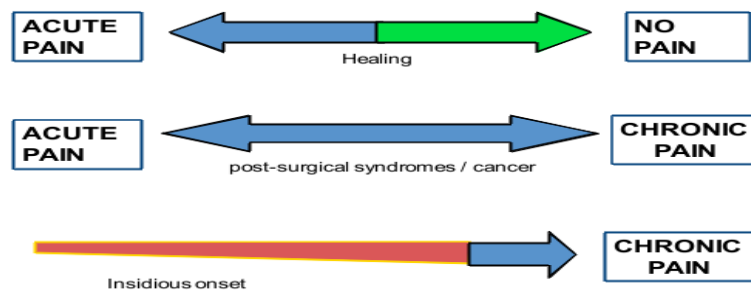
8. *Long term complications*

- Increased risk of developing of chronic pain

Spectrum of Pain

- Pain can be acute or chronic.
- Acute pain usually resolves after a short while, once the injured tissues have healed. This is what normally occurs.
- Chronic pain may begin with acute pain e.g. after an injury, accident or surgery, where the pain persists even after healing occurs. Examples are neuropathic pain after brachial plexus injury, post-thoracotomy pain, chronic abdominal pain from adhesions.
- However there are also types of chronic pain which begin insiduously, with no obvious precipitating event. Examples are chronic back pain, chronic neck pain.
- The time courses of different types of pain are illustrated in Figure 2.2

Figure 2.2: Spectrum of Pain



- The majority of patients managed by the Acute Pain Service have acute pain, mainly post-operative pain or post-trauma pain.
- However, there may be some patients referred to APS who have acute exacerbations of chronic pain, and it is important 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 pain, and the principles of management of chronic non-cancer pain see Chapter 13.

References

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CHAPTER 3

PHARMACOLOGY OF ANALGESIC DRUGS

Table 3.1: Analgesic Medications for Acute Pain Management

DRUG GROUP	DRUG CLASS	EXAMPLES
NON OPIOID MEDICATIONS	Simple analgesics	Paracetamol
	Non-selective NSAIDs	Diclofenac Sodium Mefenamic Acid Ibuprofen Naproxen Sodium Meloxicam Ketorolac
	Selective COX-2 inhibitors	Celecoxib Etoricoxib Parecoxib
OPIOIDS	Weak opioids	Dihydrocodeine Tramadol
	Strong opioids	Morphine Fentanyl Remifentanyl Oxycodone Pethidine
	Partial agonist opioids	Nalbuphine
	Opioid antagonist	Naloxone

OPIOID ANALGESICS

Introduction

The term *opiate* usually refers to drugs derived from opium e.g. morphine and codeine. Morphine is the chief analgesic component of opium, obtained from the unripe seed capsule of the poppy plant. *Opioids* refer to all drugs (natural and synthetic) that have morphine-like properties and act on the opioid receptors in the body. *Narcotic* originally referred to any psychoactive compound with sleep inducing properties; today, it is associated more with morphine and morphine-like drugs; this term has negative connotations and is used more in legal terms for enforcement purposes. The preferred term for morphine and morphine-like drugs is *opioid*.

Opioids are among the most effective known analgesics and have been a mainstay in the management of pain for centuries. Pharmacology of opioid analgesics is determined by pharmacokinetics of individual opioid analgesics and their opioid receptor properties.

Commonly available opioids are listed in Table 3.1

Mechanism of Action

- Opioids bind to opioid receptors (Table 3.2), located throughout the CNS and in some other tissues.
- Pharmacodynamic properties of specific opioids depend on which receptor is bound, the binding affinity and whether the receptor is activated.
- Opioid receptor activation inhibits the presynaptic release and postsynaptic response to excitatory neurotransmitters (e.g. acetylcholine, substance P) from nociceptive neurons.

Table 3.2: Features of Opioid Receptors

Receptors	Mu1	Mu2	Kappa	Delta
Effects	Analgesia (supraspinal, spinal) Euphoria Low abuse potential Miosis Bradycardia Hypothermia Urinary Retention Emesis	Analgesia (spinal) Depression of ventilation Physical dependence Constipation (marked) Emesis	Analgesia (supraspinal, spinal) Dysphoria Sedation Low abuse potential Miosis Diuresis	Analgesia (supraspinal, spinal) Depression of ventilation Physical dependence Constipation (minimal) Urinary Retention
Agonists	Endorphins Morphine Synthetic opioids	Endorphins Morphine Synthetic opioids	Dynorphins	Enkephalins
Antagonists	Naloxone Naltrexone	Naloxone Naltrexone	Naloxone Naltrexone	Naloxone Naltrexone

Pharmacokinetics

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

The Analgesic Corridor

This is the range of plasma concentration of opioid analgesic within which there is pain relief (Figure 3.1-3.5). When the plasma concentration of analgesic drug is below the analgesic corridor, the patient has pain. If the plasma concentration is within the analgesic corridor, the patient will have pain relief. The aim is to achieve a plasma concentration of opioid within this analgesic

corridor so as to provide comfort without serious side effects, which we expect to occur with analgesic plasma levels above the analgesic corridor.

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 required to reach an individual's analgesic corridor. The plasma concentration required for analgesia may also vary throughout the day, e.g. according to activity levels.

Variability in dose requirements has led to the concept of titration to effect (i.e. pain relief) so that each patient is given adequate analgesia, whatever drug or technique of administration chosen. Patient Controlled Analgesia (PCA) is a technique that allows self-titration of opioids to achieve safe and effective analgesia for patients with acute pain.

Figure 3.1: Plasma Concentration for Intermittent IM/SC Injections

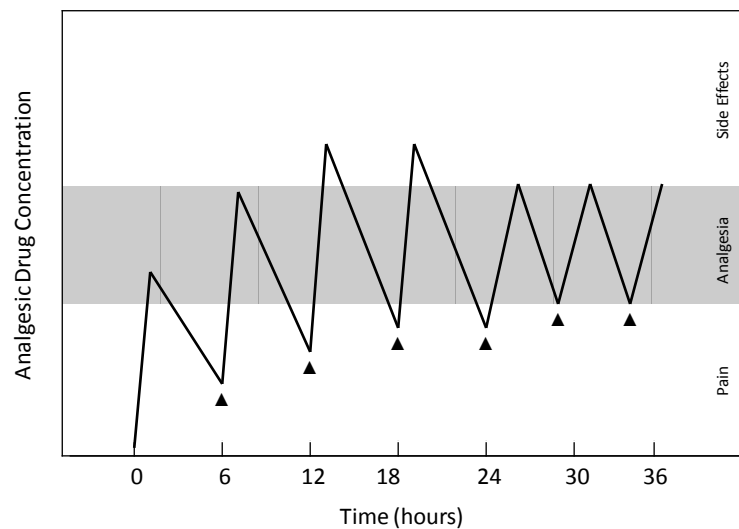


Figure 3.1 shows the plasma level of an opioid when given IM/SC 6 hourly. The pharmacokinetics of intramuscular and subcutaneous injections are the same, i.e. they have the same onset of time and duration of action. The plasma level of analgesic is frequently below the analgesic corridor, and is therefore experiencing pain. If analgesia is required to last for 6 hours, a larger dose must be given, increasing the risk of developing serious side effects like respiratory depression. It would therefore be better to give smaller doses of opioid more frequently, allowing the drug plasma levels to remain within the lower part of the analgesic corridor.

Another problem with IM / SC opioid injections is that the onset of action is about 30 minutes. Thus, there is a delay for pain relief while the drug is being absorbed.

One way to overcome this slow onset of action of IM/SC injections is to give the opioids intravenously. However, although 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 serious side effects (Fig 3.2).

Figure 3.2: Plasma Concentration for Intermittent IV Injections

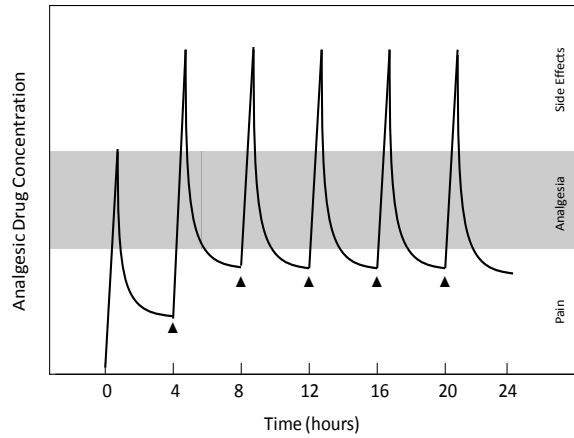
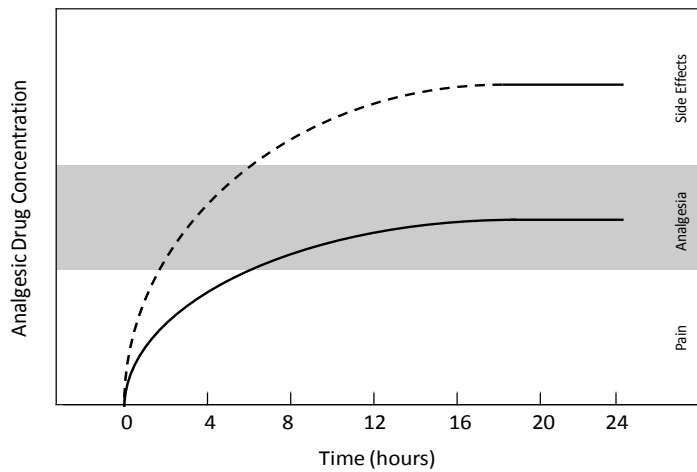


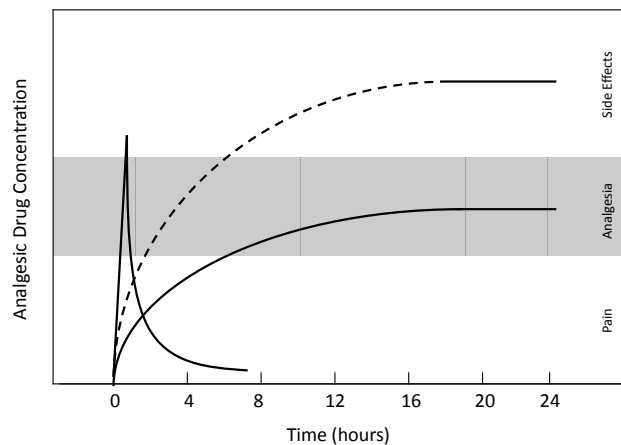
Figure 3.3 Plasma Concentration for Continuous IV Infusion



Continuous IV infusion is not a safe way to administer opioids in non-ventilated patients, because the infusion pump will continue to deliver the opioid whether the patient is oversedated (i.e. overdosed) or not.

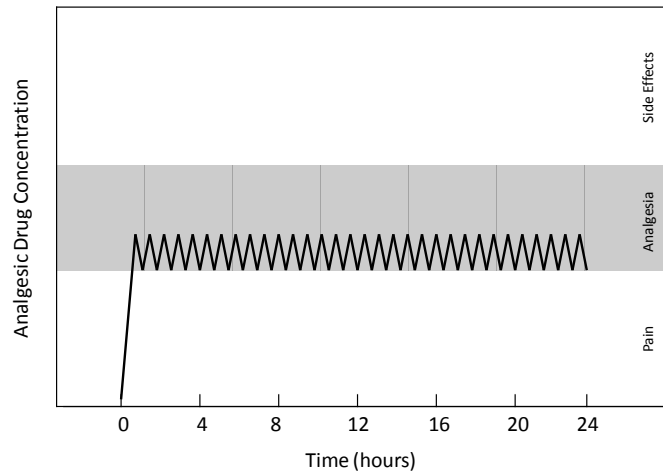
The other problem when an infusion is given at a constant rate (e.g. 2 mg/h), 4-5 half lives of the drug are required to reach a steady state plasma concentration. This means that it may take up to 20 hours to reach a steady state plateau within the “analgesic corridor”. Although a higher infusion rate (e.g. 10 mg/h) will achieve plasma concentrations within the “analgesic corridor” faster, the higher dose may result in steady state plasma levels above the analgesic corridor, i.e. in the toxic range.

Figure 3.4 Plasma Concentration 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 to the patient. Frequent small doses of analgesic e.g. 1-2mg of iv morphine every 5-10 minutes till achievement of “analgesic corridor” followed by repeated doses of the analgesic whenever necessary is the solution to proper acute pain management. This forms the concept behind Patient Controlled Analgesia (PCA). The “analgesic corridor” is said to have occurred when patient's pain is first relieved. This is illustrated in Figure 3.5.

Figure 3.5 Plasma Concentration for IV Patient Controlled Analgesia



Achieving Rapid Control of Severe Acute Pain – IV Morphine Pain Protocol (See Appendix 5)

In the immediate postoperative period, the analgesic corridor may be attained by giving small and frequent boluses of analgesic. This is achieved using the “morphine pain protocol”.

Alternatively, patient controlled analgesia (PCA), allows the patient to load him/herself by pressing the PCA demand button every 5 minutes till comfortable. Subsequently, s/he can press the button whenever feels the pain worsening (i.e. the plasma level drops below the analgesic corridor) thereby attaining the analgesic corridor again. Thus analgesia is maintained with little risk of toxicity.

Table 3.3: Pharmacokinetic & Pharmacodynamic Profile of Opioids

Drugs	Mechanism of action	Half life (hours)	Duration of action (hours)	Metabolism	Excretion	Equivalent dose to Morphine 10 mg
Morphine	Agonist : μ , delta, kappa receptors	4-5	2-4	L Active metabolites (M3G,M6G)	L,K	10
Fentanyl	Agonist : μ receptor	3-4	0.5-1	L	K	0.1
Remifentanyl	Agonist : μ receptor	0.2-0.3	-	Tissue Esterase	K	0.05
Oxycodone	Agonist : μ , delta, kappa receptors	2-4	3-4	L,K	K,Sweat	6
Pethidine	Agonist : μ , kappa receptors Anticholinergic effect Na Ion channel: LA effect	3-4	3-4	L Active metabolite (Norpethidine) has long half life; accumulation causes neuroexcitation)	K	100
Tramadol	Agonist: μ , TRPV 1 Receptor Antagonists: NMDA, Nicotinic, Ach, M1,M3 Muscarinic Receptors. Inhibit 5-HT, NA reuptake	4-6	4-6	L	K	100
Codeine/Dihydrocodeine	Agonist : μ , kappa, delta receptors	2-4	4-6	L Activated in liver to morphine	K	-
Buprenorphine	Agonist: μ receptors Antagonist: kappa, delta	10-12		L	L	-
Nalbuphine	Agonist: kappa receptors Antagonist: μ	4-6	4-6	L	K	10
Naloxone	Antagonist : μ , kappa, delta	1-1.5	0.5-1	L	K	-

TRPV-Transient Receptor Protein Vanilloid

L-Liver, K-Kidney

Pharmacodynamics of Opioids

1. Central Nervous System

- Euphoria, sedation, miosis, reduced cough reflex, nausea & vomiting
- Decreased ICP and CBF
- Overdosage: marked miosis, respiratory depression, convulsions

2. Cardiovascular System

- Decreased BP (large doses): decreased systemic vascular resistance
- Postural hypotension: peripheral venodilatation & venous pooling
- Sinus bradycardia: central vagal stimulation

3. Respiratory System

- Bronchoconstriction: histamine mediated
- Respiratory depression: decreased sensitivity of brainstem respiratory centre to PaCO₂

4. Gastrointestinal System

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

5. Genitourinary System

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

6. Skin

- Pruritus & vasodilatation : histamine mediated

Indications

- Moderate to severe acute postoperative pain
- Moderate to severe cancer pain
- Chronic pain (selected cases)

Precautions

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

Side Effects

1. Nausea and vomiting
2. Sedation
3. Respiratory depression
4. Ileus / constipation
5. Urinary retention
6. Pruritus

Dosages: Refer Drug Formulary (Appendix 9)

Important Points about Commonly Used Opioids

1. Morphine

- Naturally occurring opioid, derived from the unripe seed capsule of the poppy plant.
- Remains as the gold standard for analgesics.
- Available in oral and parenteral formulations.
 - Parenteral formulation is most commonly used for acute postoperative pain management.
 - Oral preparations may be immediate release (IR) e.g. aqueous morphine, or controlled/sustained release (SR) e.g. MS Contin.
- Metabolised in the liver to Morphine-3-Glucuronide and Morphine-6-Glucuronide
- Dose must be adjusted in hepatic and renal impairment.

2. Fentanyl

- Semi-synthetic opioid with high lipid solubility
- Faster onset of action compared to morphine
- Available as parenteral and transdermal preparations.
 - Parenteral formulation is used for acute pain, IV and intrathecal.
 - Transdermal (TD) preparation is only for use in chronic cancer pain
- TD Fentanyl is NOT suitable for management of ACUTE PAIN
- TD Fentanyl is NOT TO BE USED IN OPIOID NAÏVE PATIENTS
- Metabolised in the liver to inactive metabolite
- Safe alternative to morphine in patients with renal impairment.

3. Oxycodone

- Semi-synthetic opioid
- Available in oral and parenteral formulations.
 - Parenteral formulation may be used for acute postoperative pain management (only recently registered in Malaysia)
 - Oral preparations may be immediate release (IR) e.g. Oxynorm, or controlled release (CR) e.g. Oxycontin
- Metabolised in liver to active metabolites

- Dose must be adjusted in hepatic and renal impairment

4. Pethidine

- Synthetic opioid with low oral bioavailability
- Available in parenteral formulation only
 - IM pethidine demonstrates variable absorption and is associated with widely fluctuating plasma concentrations with variable levels of analgesia.
- Metabolised in liver to active metabolite (Norpethidine) which has a long half life and is neurotoxic (tremors and convulsions)
- It is believed that long term pethidine usage may have a higher risk of addiction compared to morphine.
- There is no evidence that pethidine is better than morphine in the management of renal colic or obstetric pain.
- NOT RECOMMENDED FOR USE IN ACUTE OR CHRONIC PAIN

NONSTEROIDAL ANTI-INFLAMMATORY DRUGS & CYCLO-OXYGENASE-2 SELECTIVE INHIBITORS

Introduction

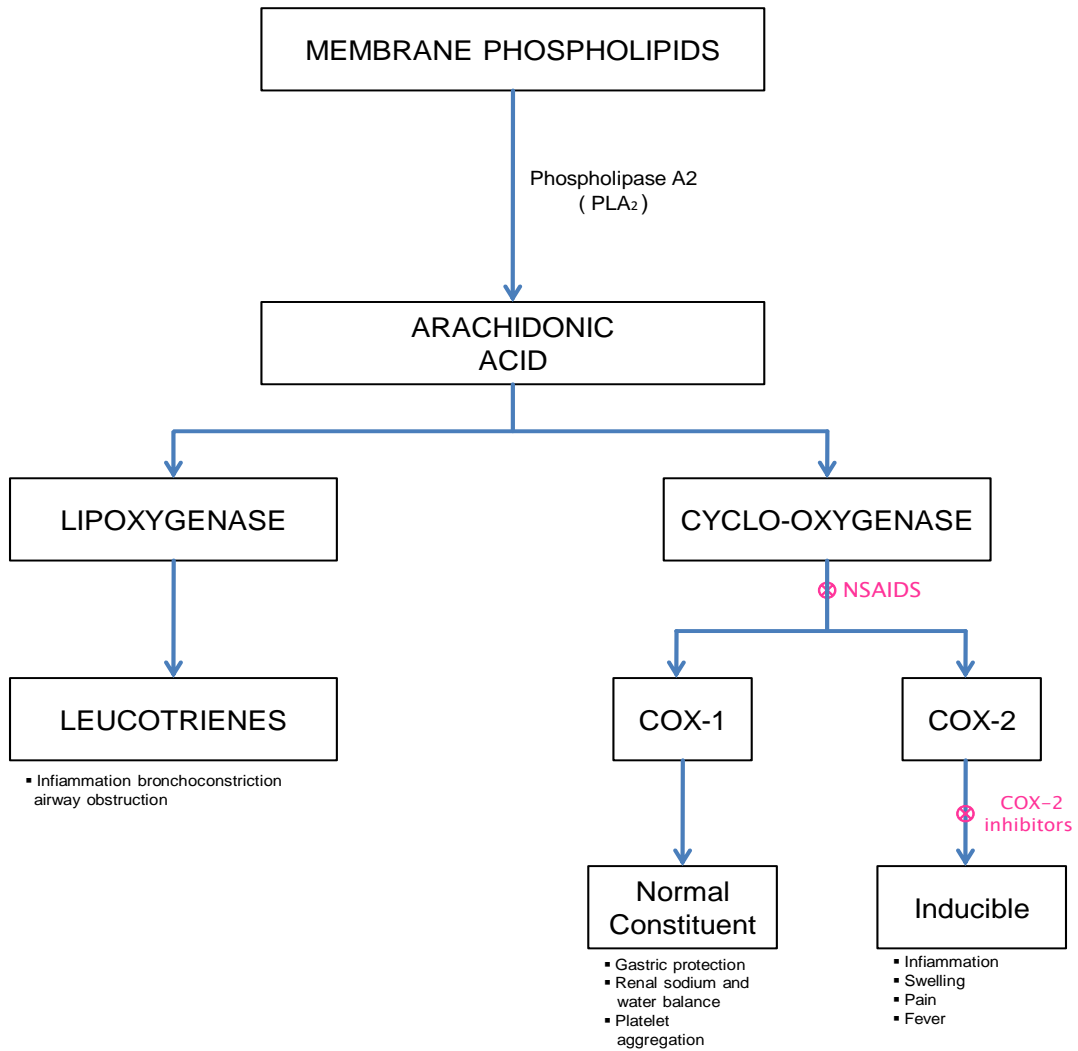
Non-steroidal anti-inflammatory drugs (NSAIDs) act by inhibiting the enzyme cyclo-oxygenase (COX), involved in the metabolism of arachidonic acid, thereby inhibiting the synthesis of prostaglandins, which play a part in the transmission of pain.

Commonly available NSAIDs and COX2 inhibitors are listed in Table 3.1

Mechanism of action

- The cyclo-oxygenase (COX) enzyme is present in two forms:
 - COX-1 (Constitutive) – physiological function of maintaining the normal prostaglandin functions of the kidney and gastric mucosa. Inhibition of this enzyme is responsible for the renal and gastric toxicity of NSAIDs.
 - COX-2 (Inducible) – expressed in response to tissue injury and inflammation, which releases the inflammatory mediators of pain.
- NSAIDs vary in the selectivity of inhibition of the COX enzymes. Traditional NSAIDs inhibit both COX-1 and COX-2 enzymes while selective COX2 inhibitors (Coxibs) inhibit mainly the COX-2 enzyme.
- All NSAIDs and Coxibs are used for their analgesic and anti-inflammatory effects.
- Some NSAIDs, e.g. low-dose aspirin, are also used for their anti-platelet effect.

Figure: 3.6: Cyclo-oxygenase Pathways



Indications

1. Parenteral, as a supplement to epidural analgesia or PCA, as a component of multimodal analgesia.
Example: Parecoxib 40 mg stat followed by 20-40 mg BD for 24 H may be given to a postoperative patient on PCA morphine or epidural cocktail.
2. Oral analgesics, ordered when the patient starts taking orally and the PCA or epidural has been stopped.
 - Coxibs provide better overall safety than traditional NSAIDs in terms of GI side effects and effects on platelet function but ***do not prevent renal impairment***.
 - Coxibs have the ***same analgesic efficacy*** compared to traditional NSAIDs and are mainly used in patients who are unable to tolerate the side effects of NSAIDs.

Contraindications

1. History of coagulopathy or bleeding tendencies Histor
2. History of peptic ulcer disease (may use Coxibs instead) Histor
3. Concomitant use with renal impairment Patient
4. History of Coronary Artery Bypass Graft (immediate post-op period) Post-
5. History of hypersensitivity to NSAIDS Histor

Side effects

All NSAIDs have similar side effects, which are independent of the route of administration.

Gastrointestinal (less with COX2 inhibitors):

- Nausea, anorexia, abdominal pain, gastritis, ulcers, gastrointestinal hemorrhage, perforation, diarrhoea

Hematological (less with COX2 inhibitors)

- Inhibition of **Platelet function**

Cardiovascular

- Increased risk of stroke and myocardial infarction.
- Hypertension: decreased effectiveness of anti-hypertensive medication.

Renal

- Reduced renal blood flow, deterioration of kidney function, salt and water retention, oedema
- Analgesic nephropathy with long term use

Hypersensitivity reactions including Anaphylactic shock.

- Cross allergy is common between different NSAIDs / COX2 inhibitors
1. Main difference between NSAIDs and COX2 inhibitors is that COX2 inhibitors have a lower incidence of peptic ulceration and upper GI bleed.
 2. COX2 inhibitors can also lead to renal impairment and adverse cardiovascular effects, particularly with long term use.

Dosages: Refer Drug Formulary (Appendix 9)

LOCAL ANAESTHETICS

Introduction

The local anaesthetics (LA) commonly used in our hospitals are Lignocaine, Bupivacaine, Levobupivacaine and Ropivacaine. These are metabolised in the liver and rarely cause allergic reactions.

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 conduction of action potentials and therefore neural conduction.

Pharmacokinetics

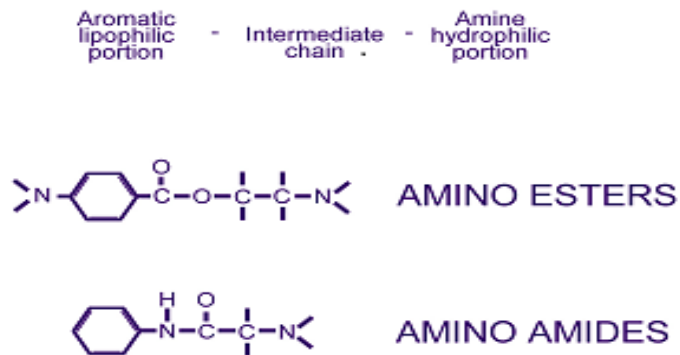
Structural Classification

LA consists of 3 structural components:

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

Figure 3.7: Chemical Structure of LAs

Chemical structure of local anesthetics



2

Examples of esters: cocaine and procaine

Examples of amides: lignocaine, bupivacaine, levobupivacaine and ropivacaine

Table 3.4: Commonly Available LAs

AGENT	ONSET	DURATION OF ACTION	PROTEIN BINDING	POTENCY	MAXIMUM DOSE (mg/kg)	ADVERSE EFFECTS
Cocaine	rapid	medium	91%	Medium	1	CVS
Lignocaine	rapid	medium	60-80%	Medium	4 (plain) 7 (with adrenaline)	CVS and CNS
Bupivacaine	slow	long	90-97%	High	2 (plain) 2.5 (with adrenaline)	More cardiotoxic than lignocaine
Levo-bupivacaine	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 and dose – peak plasma concentrations are influenced by the site of injection. Subarachnoid and subcutaneous routes are associated with a more rapid onset, whereas epidural and brachial plexus blocks are associated with a slower onset of action.
2. Addition of vasoconstrictor –eg adrenaline, prolongs duration of action and decreases systemic absorption.
3. Tissue pH – infection produces acidic tissue and decreases 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. Hyperkalaemia leads to a increased resting membrane potential and an increased local anaesthetic affect while hypercalcaemia has the opposite effect.

7. Pregnancy increases CNS sensitivity to local anaesthetics and increases cardiotoxicity.
8. Overall circulatory state affects systemic absorption.
9. Some drugs can interfere with the action of local anaesthetics e.g. Metoprolol, Cimetidine, Dextran.

Indications:

1. Central neuraxial block (Subarachnoid block, epidural block)
2. Peripheral Nerve or plexus block
3. Infiltration anaesthesia & Field block
4. Surface anaesthesia : bronchoscopy, cystoscopy
5. Local anaesthesia of body cavities : interpleural anaesthesia, intraarticular anaesthesia
6. Transincision or transwound catheter anaesthesia
7. Topical application (EMLA, Cocaine)
8. Transdermal : Lignocaine 5% patch
9. Intravenous regional anaesthesia (Bier's Block)
10. IV lignocaine infusion for neuropathic pain (refer Chapter 7)
11. IV Lignocaine for ventricular arrhythmias (Anti-arrhythmic, Class 1B)

Contraindications:

1. Porphyria: Only Lignocaine is known to be porphyrogenic; other LA agents are safe.
2. True allergy to local anaesthetics

Toxicity of Local Anaesthetic

- Occurs with an overdose of local anaesthetic, or with an accidental intravascular injection. Increasing blood concentrations of local anaesthetic will result in progressive signs of local anaesthetic toxicity (Figure 3.8)

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 pramod methylparaben, a preservative in multi-dose vials of lignocaine.
- The amide class of local anaesthetics is far less likely to produce allergic reaction.

Systemic

1. Immune system

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

2. Hematologic

- Methemoglobinemia – caused by lignocaine and more notably, prilocaine

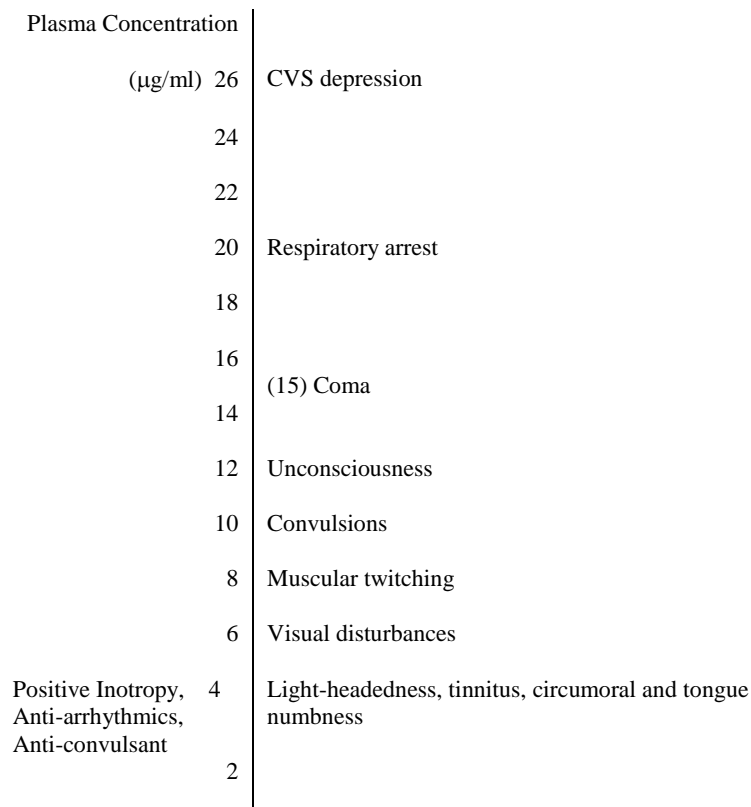
3. Central Nervous System

- CNS symptoms are progressive as the level of the LA in the blood rises.
- Initial symptoms suggest CNS excitation: ringing in the ears (tinnitus), 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.

4. Cardiovascular

- Myocardial depression, bradycardia and cardiac arrhythmias
- Cardiovascular collapse

Figure 3.8: Relationship between Lignocaine Plasma Concentration and Pharmacological Effects



OTHER ANALGESIC DRUGS

PARACETAMOL

Introduction

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

Mechanism of Action

- Not completely understood.
- Main mechanism is the inhibition of cyclooxygenase (COX). Selectively blocks a variant of the COX enzyme that is different from COX-1 and COX-2. This enzyme is now referred to as COX-3.
- Antipyretic properties - reduced amount of PG E2 in the CNS, lowers the hypothalamic set-point in the thermoregulatory centre, resulting in peripheral vasodilation, sweating and hence heat dissipation

Pharmacodynamics

IV Perfalgan®

- Provides rapid, higher and more predictable plasma drug level with greater bioavailability than oral dosing.

Indications

- Management of mild to moderate pain where oral and rectal paracetamol is not appropriate
- For its opioid sparing effect in the perioperative management of moderate to severe pain

Contraindications

- Hypersensitivity to paracetamol or to propacetamol hydrochloride (prodrug of paracetamol) or to any of the excipients (sodium phosphate dibasic dehydrate, hydrochloric acid, sodium hydroxide, cysteine hydrochloride and mannitol).
- Patients with hepatic failure or severe hepatocellular insufficiency
- Concomitant administration of other medications which contain paracetamol

Side Effects

- Injection site pain
- Injection site reaction
- Nausea / Vomiting

Precautions

- Hepatic insufficiency.
- Severe renal insufficiency (Creatinine clearance \leq 30 mL/min).
- G6PD deficiency (may lead to haemolytic anaemia).
- Chronic alcoholism or excessive alcohol intake.
- Anorexia, bulimia or cachexia, chronic malnutrition (low reserves of hepatic glutathione).
- Dehydration and hypovolemia.

Dosages: refer to Drug Formulary (Appendix 9)

KETAMINE

Introduction

- Ketamine is a drug with anaesthetic and analgesic properties depending on the dosage administered.
- When used in subanaesthetic doses, it assists in controlling acute and chronic pain, particularly severe forms with evidence of central sensitization not well controlled with other agents.
- When used for acute pain, it is usually combined with an opioid.

Mechanism of action

- NMDA –receptor antagonists (main mechanism)
Persistent nociceptive (e.g. tissue damage) and neuropathic pain states can activate N-methyl-D-aspartate (NMDA)-receptors in the spinal dorsal horn, producing the phenomenon of “wind-up” with spinal hyperexcitability, allodynia and hyperalgesia (central sensitisation).
- Mild opioid agonist- mu (μ) and kappa (κ)
- Inhibits calcium and sodium channel at high doses
- Inhibits serotonin and noradrenalin reuptake
- Inhibits muscarinic and nicotinic receptors
- Acts on β_2 receptor causing bronchodilatation
- Inhibits nitric oxide (NO) synthase, inhibiting production of NO

Pharmacokinetics

- May be given oral and parenteral (most common is 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, increase cardiac output, myocardial depression in absence of autonomic control
- GIT: nausea and vomiting
- GUT: bladder dysfunction on long term use

Indications (refer to Table 3.5)

- Adjuvant to opioids in postoperative pain especially in opioid tolerant patients
- Rescue analgesia in difficult- to- control pain (acute and chronic)

- Chronic neuropathic pain conditions such as central pain syndromes, Complex Regional Pain Syndrome (CRPS), fibromyalgia and ischaemic pain.
- Treatment of opioid-resistant cancer pain
- Analgesia for painful procedures (usually in children)
- Midazolam may be added to ketamine to minimize the dysphoric effects

Contraindications

Ketamine should be avoided in patients with:

- 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.

Precautions

- Elderly patients.
- Cardiac arrhythmia and hypertension

Dosage and Administration

- Starting doses of Ketamine are usually 10 to 25mg IV for intermittent dosing, or 50 to 100mg per 24 hours by IV infusion. Lower dose ranges should be used in the elderly.
- Adverse effects of hallucinations and delirium may be reduced by the co-administration of a benzodiazepine (e.g. oral Midazolam 7.5mg ON, Midazolam 5-10mg in syringe driver over 24 hrs) or Haloperidol (1.5mg – 3mg in syringe driver over 24hrs).
- Studies show that adverse effects of short term systemic administration of low dose Ketamine to be low.
- **Ketamine should only be used in consultation with a specialist in pain medicine, anaesthesia or palliative care.**

Table 3.5: Use of IV Ketamine as an Analgesic Adjuvant to GA and PCA

Procedure	Before incision	During surgery	After surgery
Very painful, e.g. major visceral surgery	0.5mg/kg	Infusion 0.5mg/kg/h or bolus 0.25mg/kg, repeated at 30 min intervals. If procedure is ≥ 2 h, stop use 60min before end of surgery.	Background infusion: 0.12mg/kg/h for 24h, then 0.06mg/kg/h for 48h (or longer if necessary) and opioid based PCA
Less painful e.g. hip surgery	0.25mg/kg	Infusion: 0.25mg/kg/h or bolus; 0.125mg/kg, repeated at 30min intervals	PCA, bolus 1mg Ketamine and 1mg Morphine

(Adapted from Himmelseher S and Duriex ME, 2005: Ketamine for Peri-operative Pain Management, Anaesthesiology; 102:211-20)

METHOXYFLURANE

Introduction

- Methoxyflurane (MOF) is a highly lipophilic inhalational anaesthetic agent which is no longer used in routine anaesthetic practice.
- Very low concentrations of methoxyflurane produce analgesia. It is now available via a disposable inhalational device (Penthrox™ inhaler) for analgesia in various clinical settings.
- MOF is metabolised in the liver by the enzyme CYP2A6 into free fluoride, dichloro-acetic acid, oxalic acid and difluoromethoxyacetic acid. No toxic effects have been recorded if MOF is used for less than 2.5 MAC hours.

Advantages of Methoxyflurane

- 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 A&E department
- Minor surgical procedures
- Incident pain 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 that they should not drive for 24 hours after using methoxyflurane.

Side effects

- Drowsiness
- Headache
- Dizziness

Dosage: Refer to Chapter 9, Analgesia for Procedural Pain

NITROUS OXIDE

Introduction

Nitrous oxide (N₂O) is a potent, short-acting inhaled analgesic gas with rapid and predictable onset and offset. In general anesthesia, it is used in high concentrations (e.g. 70% N₂O with 30% oxygen). A 50:50 mixture of N₂O with oxygen, Entonox®, is used for its analgesic properties to provide short term analgesia for minor surgical procedures, labour pain or incident pain. Nitrous oxide possesses synergistic effect if given with other analgesics and sedatives.

Indications for Entonox®

- Labour pain
- Paediatric inpatient and outpatient settings: removing sutures, redressing wounds, lumbar puncture and venepuncture
- During outpatient treatments: laser for diabetic retinopathy, biopsies, sigmoidoscopies, 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 there may be air trapping.
- Decompression sickness or those 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 inactivation of methionine synthetase leading to megaloblastic anaemia and neuropathy from subacute combined degeneration of the spinal cord.

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 on a regular basis

As nitrous oxide may obtund conscious levels,

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

ADJUVANTS

Adjuvants are medications which are not typically used for pain but may have analgesic effects in specific conditions.

Commonly used adjuvants are as below:

Table 3.6: Commonly Available Adjuvants

Drug classes	Examples	Used in the following conditions
Antidepressants	Tricyclic Antidepressants (TCA): Amitriptyline, Nortriptyline Serotonin Norepinephrine Reuptake Inhibitors (SNRI): Duloxetine, Venlafaxine	Neuropathic pain
Anticonvulsants	Carbamazepine Gabapentin Pregabalin Sodium Valproate Topiramate Phenytoin	Neuropathic pain

PHARMACOLOGY OF ANALGESICS IN SPECIAL GROUPS

Renal diseases

Two groups of patients to be considered

- Renal dysfunction
- Haemodialysis

Table 3.7: Recommended Use of Selected Opioids in Patients with Renal Dysfunction & Dialysis Patients

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

(Adapted from Aronoff 1999 & Dean 2004)

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.

**Table 3.8: Recommended Dosage Adjustments in Renal Impairment
- Selected Opioids**

GFR (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

Important considerations:

1. Pethidine

- metabolized to toxic metabolite norpethidine
- accumulated especially with repeated dosing can cause tremors, myoclonus and seizures
- DO NOT USE IN RENAL FAILURE PATIENTS

2. Morphine

- The elimination half –life of morphine and the duration of analgesic effect may be prolonged
- The metabolites are morphine-3-glucuronide (M3G) and morphine-6-glucuronide (M6G) which tend to accumulate in renal dysfunction
- M6G is a potent analgesic and contributes to the analgesic effect when morphine is given for long term
- M3G has no analgesic activity itself , on the other hand it may antagonize the analgesic activity of morphine and may be responsible for neurotoxic symptoms:
 - Hyperalgesia
 - Allodynia
 - Myoclonus & seizures
- Patients should be commenced on a lower dose and/or with extended dosage intervals. Doses should be slowly titrated upwards depending on response towards any side effects
- In renal impairment, fentanyl is a suitable alternative to morphine.

3. NSAIDs

- NSAIDs cause sodium and water retention and decreases glomerular filtration rate
- The use of NSAIDs (including COX-2 Inhibitors) may lead to impairment of renal function, especially in the elderly, those with heart failure or volume depletion, or those on ACE Inhibitors, ARBs or concurrent nephrotoxic drugs. **NSAIDs can induce acute renal failure in these vulnerable groups even with a single dose.**
- They may worsen renal function in those with established renal disease. **NSAIDs should be avoided even in mild renal impairment. They may be used in dialysis patients with complete anuria.**
- Patients with end stage renal failure (ESRF) are more prone to develop ureamic gastritis. Regular use of heparin during haemodialysis predisposes them to gastrointestinal bleed.

Liver Disease

1. Opioids

Table 3.9: Recommended Use of Opioids in Hepatic Dysfunction

Opioid	Recommended usage	Comment	Dosing recommendations
Morphine	Use cautiously and monitor patient for sedation	In severe hepatic impairment, the parent drug may not be readily converted to metabolites	Increase the dosing interval by twice the usual time period
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	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.	-
Fentanyl	Appears safe, generally no dose adjustment necessary	Decreased hepatic blood flow affects metabolism more than hepatic failure	Dose adjustment usually not needed

2. Paracetamol

- Prudent to restrict its use in these patients as regular paracetamol can lead to possible hepato-toxicity, especially if the patient:
 - Is fasting or dehydrated (poor oral intake for more than 24 hours)
 - Has a concurrent acute illness causing dehydration (e.g. fever, vomiting, diarrhea)
 - Has chronically poor nutrition or has chronic or heavy (binge) alcohol intake
 - Is concurrently taking liver enzyme-inducing drugs (e.g. phenobarbitone, phenytoin).

Elderly Patients

Elderly people are more likely to experience pain than general population, in many cases they are undertreated.

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 and post operative 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 of cognitive function.
5. Consider handling adverse effects by changing treatment, using a lower dose or by treating symptoms such as constipation or nausea.
6. Cease the medication if proven ineffective after an adequate trial.

Points to note when prescribing analgesics for the elderly patient:

Non-opioid Analgesics

- Paracetamol is the preferred non-opioid analgesic, unless contraindicated (e.g. in liver disease).
- The use of NSAIDs and COX-2 inhibitors in elderly people requires extreme caution, and should be generally avoided unless there are no other alternatives available.

Opioid analgesics

- When using opioids, dose adjustment is necessary as there are age-related decreases in opioid requirements and significant inter-patient variability.
- Oral weak opioids that may be used include
 - Tramadol 50 mg once daily to TDS

- Dihydrocodeine 30-60 mg once daily to TDS
- There are also mixtures of weak opioids and paracetamol which may be useful
 - Ultracet® (Paracetamol 325 mg + Tramadol 37.5 mg) 1-2 tablets once daily to QID
 - Panadeine® (Paracetamol 500mg and Codeine 8mg) 1-2 tablets once daily to QID
- Oral strong opioids available include
 - Aqueous morphine 2.5 - 5 mg 4-6 hourly
 - Oxynorm® 5 mg 6-8 hourly
 - Oxycontin® 5-10 mg once to twice daily.

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CHAPTER 4

ASSESSMENT AND MONITORING

ASSESSMENT OF PAIN

Taking a Brief Pain History

P: Place or site of pain - " <i>Where does it hurt?</i> "
A: Aggravating factors - " <i>What makes the pain worse?</i> "
I: Intensity - " <i>What is your pain score at rest and on movement?</i> "
N: Nature and neutralizing factors - " <i>What does it feel like, e.g. aching, throbbing, burning, electric shock, shooting, stabbing, sharp, dull, deep, pressure....</i> " " <i>What makes the pain better?</i> "

Other questions to ask on pain:

- **Pattern of pain:** *intermittent or continuous/constant?*
- **Associated symptoms:** *numbness, tingling, allodynia, hyperalgesia, dysaesthesia*
- **Impact of pain:** *pain affect sleep, appetite, mood, daily activities, relationships and work?*
- **Other important information:** *medical / surgical / psychosocial / drug / allergic history*

In summary, history is important 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
5. Psychosocial conditions contributing to the pain

Pain assessment tools

Why measure pain?

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

As pain is very subjective and varies greatly from patient to patient, we need to ask the patient themselves about their pain. There are various ways of doing this.

- Self reporting by the patient (best method)
- Observer assessment
- Observation of behaviour and vital signs
- Functional assessment

Pain measurement

Unidimensional scales

- Numerical Rating Scale (NRS)
- Verbal Analogue Score (VAS)
- Categorical Scale or Verbal rating scale

Multidimensional scales

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

Scales used in children / infants and in cognitively impaired patients

- Wong Baker Faces Scale
- FLACC scale

Numerical Rating Scale (NRS)

“If ‘0’ = no pain, and ‘10’= the worst pain you can imagine, what number is your pain now?”

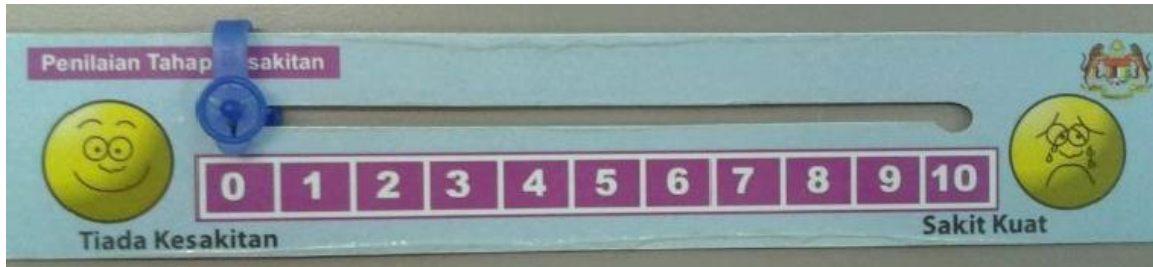
Visual Analogue Score

Patient is asked to slide a small bead along a scale to indicate the severity of pain

Total length of scale is 100 mm (10 cm)

**Combination Rating Scale (NRS & VAS), *Recommended for Ministry of Health*
MOH Pain Scale**

a. Side that faces the patient



b. Side that faces the nurse/paramedic/doctor



“On a scale of ‘0’ – ‘10’ (show the pain scale), if ‘0’ = no pain and ‘10’ = worst pain you can imagine, what is your pain score now?”

The patient is asked to slide the indicator along the scale to show the severity of his/her pain. The nurse records the number on the scale (zero 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, but not preferred method (not sensitive, difficult to record)

The Visual Analogue Score and the Verbal Analogue Score (zero to ten) are the most commonly used pain scoring systems.

PAIN AS THE 5TH VITAL SIGN

In 2008, the MOH implemented “Pain as the 5th Vital Sign” in MOH hospitals which mandates measuring and documenting pain score for all patients whenever other vitals are measured. Pain 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 nursing 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 effective analgesia for patients
- To detect serious 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 8 or sedation score of 3 irrespective of RR
- Shallow respiration may occur without a large decrease in respiratory rate
- Actual decrease in respiratory rate may occur later

SEDATION SCORE

- Respiratory depression due to opioid overdose is ALWAYS accompanied by depression in conscious level

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 effectiveness of analgesia
- Determines when to give the next dose of analgesic drug in techniques that use intermittent bolus doses
 - High Pain Score (≥ 4) → inform APS doctor
 - Low 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, 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 is relieved after anti-emetic is given
- If no relief, call APS doctor

When to call the APS doctor?

The APS doctor or anaesthesiologist on call should be informed if

- Sedation score = 2, respiratory rate < 8
- Sedation score = 3, does not matter what respiratory rate is
- Pain score is > 4 in 2 observations
- Vomiting is persistent despite anti-emetics
- Hypotension (systolic < 90 mmHg)

What to do if patient has respiratory depression?

- Call ward doctor and APS doctor
- Give oxygen to patient
- Try to wake patient up and remind patient to breathe
- Stop epidural or PCA
- Get resuscitation trolley
- Give iv Naloxone 0.1 mg stat; repeat up to 0.4 mg at 2-3 minute intervals

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CHAPTER 5 MANAGEMENT OF ACUTE PAIN

ACUTE PAIN SERVICE

Anaesthesiology-based Acute Pain Services (APS) were introduced in the mid-1980s in the USA, and in 1993 the first APS in the Ministry of Health (MOH) was set up in Hospital Kuala Lumpur, followed rapidly by similar services in other MOH hospitals and by 2006 all MOH hospitals with anaesthesiology specialists had APS. In 2007, a multicenter audit of postoperative pain relief carried out in 21 MOH hospitals still showed that 64% of post-laparotomy patients under the care of APS still reported experiencing moderate to severe pain in the first 24 hours; worse still, 76% of patients not under the care of the APS had moderate to severe pain. Reports from western countries showed similar results, with little change in the proportion of patients experiencing moderate to severe pain in 1999 compared to 1993.

Overall, the problem of inadequate postoperative analgesia is multi-factorial, attributable to staff attitude, inexperience or overwork, fears of addiction to opioids and of serious side effects like respiratory depression as well as failure of the patient to ask for pain relief.

The introduction of better techniques of pain relief by the anaesthesiologist like epidural analgesia, patient-controlled analgesia (PCA) and ambulatory analgesia using a multi-modal approach has resulted in an improvement in the management of acute pain. The setting up of pain clinics to evaluate and manage patients with persistent pain using a multidisciplinary approach has also proven to be beneficial in improving the management of chronic pain.

The Role of the Acute Pain Service is summarised as follows:

1. To improve the management of acute, particularly postoperative pain by introducing new methods and improving old methods of pain relief. This will result in more comfortable patients, less postoperative complications and shortened hospital stay.
2. To train hospital staff in the management of acute pain - this includes ward nurses, surgeons, anaesthesiologist, medical officers and house officers from anaesthesiology and surgical-based disciplines.
3. To provide standardized protocols in various techniques of acute pain management - including the early detection and management of complications and the standard monitoring necessary for patients. This will minimize the adverse effects associated with the provision of good pain relief.
4. To develop awareness towards the role of pain management clinics in managing chronic pain using a multidisciplinary approach.
5. To conduct audit and clinical research in pain management.

Setting Up an Acute Pain Service

Acute Pain Services are usually run by the Department of Anaesthesiology and Intensive Care, and in Malaysia the model that has been found to work well is a nurse-based APS where we have a full time nurse responsible for the APS. In large hospitals where the patient load is high, there may be more than one APS nurse and they may work two shifts. At the same time, the APS is usually overseen by a Specialist Anaesthesiologist and Anaesthetic Medical Officers do daily ward rounds with the APS nurse. The Anaesthetic Medical Officer on call also attends to problems and starts new patients on APS techniques after office hours.

At the daily morning ward rounds, the doctor and nurse will review the adequacy of analgesia, treat side effects and solve any problems that the patient or ward staff may have which are related to the provision of analgesia. In the afternoon and evening, another ward round is done to review any problems and all new patients started on APS techniques that day. Ideally, patients on APS should be seen within an hour of having returned from post-anaesthetic care unit to ensure that pain scores remain minimal i.e. less than 4.

The Acute Pain Service has Standard Orders for all patients under the care of the APS, which includes the orders for pain relief, monitoring and management of complications. At the same time, there are standard orders NOT to administer other opioids or sedatives by other routes in patients already on PCA or epidural. This is an important practice and needs to be strictly enforced to ensure the safety of patients under the care of the APS.

In order to have an effective APS, there must be regular in-service training courses for ward nurses and lectures on acute pain management for surgical doctors and new anaesthetic medical officers. This is to ensure that everyone involved understands the principles of APS techniques used and the rationale behind the management of patients with acute pain, so as to ensure the effectiveness of the analgesia as well as the safety of patients using the techniques. Keeping an audit of your practice is also important for continuous quality improvement.

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)

2. Surgical factors
 - site of surgery
 - severity of postoperative pain
 - When can the patient take orally?

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

Methods

Treat pain early and effectively.

Methods include non- pharmacological and pharmacological approaches.

Non-pharmacological approaches

Techniques proven to be useful in acute pain management:

1. Psychological approaches: including music, preoperative information, distraction, cognitive methods, relaxation training, hypnosis, guided imagery
 - Music- reduction in postoperative pain and opioid consumption.
 - Pre-operative information- effective in reducing procedure-related pain.
 - Distraction- effective in procedure-related pain in children
 - Cognitive methods-training in coping methods or behavioural instruction prior to surgery, reduces pain and analgesic use.
 - Hypnosis and relaxation-inconsistent evidence of benefit in the management of acute pain

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

Pharmacological approaches

- Oral analgesics- NSAIDs / COX2 Inhibitors / Opioids
- Intravenous injection – NSAIDs / COX2 Inhibitors / Opioids
- Patient-controlled analgesia (PCA) - Morphine / Fentanyl
- Epidural analgesia – Intermittent / infusion/ PCEA
 - Mixtures of local anaesthetics and opioids (“cocktail”)
 - Opioids
- Intrathecal analgesia
 - Opioids
- Subcutaneous morphine
- Peripheral nerve blocks

Multi-modal Analgesia

Also known as “Balanced Analgesia”, involves the use of two or more analgesic agents or techniques of controlling pain. Drugs with different mechanisms of actions potentiate the analgesia by additive or synergistic effects and may reduce severity of side effects due to the lower doses of the individual drugs used.

Examples are:

- Epidural with NSAIDs and Paracetamol
- PCA morphine with Paracetamol, NSAIDs and local wound infiltration
- Peripheral nerve block with PCA morphine

PATIENT CONTROLLED ANALGESIA (PCA)

- One of the most common methods for postoperative pain control.
- A method of opioid delivery where 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. Hence the patient titrates the required dose of the analgesic according to individual needs.
- Analgesics can be given by the following routes – Intravenous, subcutaneous, epidural and through peripheral nerve catheters.
 - e. g. subcutaneous PCA opioids as effective as intravenous PCA in controlling pain, very suitable and practical in patient with difficult IV access
- PCA has several modes of administration. The two most common are demand dosing and continuous infusion + demand dosing.
- Morphine is by far the most commonly used opioid for PCA. The alternative is fentanyl, which is used in patients with renal failure.
- One opioid may be better tolerated than the others. Therefore, changing from one opioid to another opioid may be beneficial if the patient is suffering from severe intolerable side effects.
- The routine use for pethidine is strongly discouraged because pethidine has a neurotoxic metabolite, *norpethidine*, which can lead to CNS excitation e.g anxiety, tremors and grand mal seizures. Drug interaction with MAOI can also occur, causing Malignant Hyperpyrexia Syndrome.

Indications

- Post –operative pain
- Severe acute pain e.g. burn, trauma, invasive procedures
- Severe cancer pain
- Patients unable to take oral medications

Contraindications

- Untrained staff
- Patient preference
- Patient inability to safely comprehend the technique (language barrier, confusion)
- Patient who are not able to use the PCA (severe deformity or weakness of both hands, bilateral fracture of upper limbs)

Advantages

- Effective for severe pain regardless of the site of surgery.
- Patient controls the amount of opioid used and therefore the analgesic dose matches the patient's requirement.
- May reduce opioid consumption and side-effects.

- Patients are actively involved with their own recovery and feel better.(high rating for patient satisfaction)
- Nursing made easy as patient is comfortable, and nurses do not have to administer medication for pain relief.
- 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 the safe and effective use of PCA.
- High cost of PCA machine and disposables.
- Human and pump errors

Features of PCA and Programming Modes

PCA pump

- microcomputer for programming
- syringe pump
- device for activation by 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: in milligrams per milliliters (e.g. morphine 1mg/ml, fentanyl 10mcg/ml)

Loading dose: initial dose delivered on commencing PCA

Bolus dose: dose delivered by the PCA machine when the demand button is pressed.

Continuous infusion /background infusion that can be used with or without the patient demand facility.

Lock-out interval: period during which the patient cannot initiate another dose, a safety feature to prevent overdose.

4 Hourly Limit: Maximum drug doses which can be delivered within the 4 hour period

PCA with Background/Continuous Infusion

- Not routinely used. The additional use of a background infusion during PCA may increase opioid consumption by up to 50% and increases the risk of respiratory depression about 5 fold.

- There is also increased incidence of sedation, nausea, vomiting and hypoxaemia, does not improve pain relief or sleep or reduce the number of PCA demand.
- Therefore background infusion is not recommended for routine postoperative analgesia in the ward especially in patients with risk of respiratory depression.
- The background infusion rate should be less than the bolus dose.

Indications

1. In opioid tolerant patients. (Refer to Chapter 8)
2. In patients who complain of repeatedly waking in severe pain (night time analgesia).
3. In patients with severe acute pain in ICU/HDU e.g. chest injury
4. After major surgery e.g. laparotomy, coronary by-pass surgery etc

General Guidelines

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 the use of 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 which has a one way “*anti-reflux valve*” to prevent accidental opioid overdose. If an anti-reflux valve is not available, use a *dedicated line* for the PCA.
- Patient monitoring which include 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.
- Recommended settings: Age affects opioid dosing but not gender and body weight.
- Drug concentration should be standardised to reduce the chance of programming errors.

Drug concentration:

- Morphine 1 mg/ml OR
- Fentanyl 10 mcg/ml

Mode:

- PCA mode

Loading dose:

- Usually not set for patients who are receiving postoperative PCA as they will usually already have received opioid intraoperatively.
- For those patients who have not received any opioid prior to start in the PCA, a loading dose of 2-3 mg morphine may be administered.
- PCA is essentially a maintenance therapy; therefore a patient’s pain should be controlled before starting PCA.

Bolus dose:

- < 60 years: morphine 1 mg
- > 60 years: morphine 0.5 mg

Lock-out interval:

- 5 minutes

4 hour limit:

- Usually not set

Common problems with PCA and what to do

1. Patient is not comfortable:
 - Repeat patient education
 - Look at the number of times the patient has pressed the demand button each hour. On the whole, most patients will not continue to press if they are getting 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 50-100%.
2. Machine alarms
 - Check cause - ?syringe empty ? occlusion
 - Inform APS or ICU doctor on call if ward nurses are unable to correct the cause.

When to stop PCA?

- Patient requests.
- Low opioid requirements for analgesia, e.g. patient using less than 10 mg morphine/day
- Patient is tolerating fluid intake and able to take oral analgesics.

Analgesia after PCA is stopped

- Oral paracetamol 1 gm 6 hourly
- Oral tramadol 50 mg 6-8 hourly
- Oral dihydrocodeine (DF118) 30-60mg (1 to 2 tabs) 6-8 hourly
- NSAIDs or COX2 inhibitors (dose as appropriate)
- Oral Oxynorm (See Appendix 4)

Adverse effects of PCA opioids

1. Respiratory Depression

Possible causes:

- drug interaction – especially if patient is on another drug with sedative effect
- continuous (background) infusion
- inappropriate use of PCA by relatives
- human error

- programming error
 - equipment error
2. Nausea & vomiting
 3. Pruritus
 4. Sedation

Complications related to PCA

- Factors related to Health care providers - human factor is the main cause
 - programming errors (setting of a continuous infusion)
 - error in clinical judgment
 - improper dose
 - unauthorized drug
 - prescribing error
 - wrong administration technique
 - wrong drug preparation
 - wrong patient
 - wrong route
 - inexperienced staff
 - omission of 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 the responsibility of managing and assessing the patient frequently. It is extremely important for nurses/doctors to monitor **medication use** and **accuracy of the prescription** that is programmed into the PCA pump.

In order to use PCA safely, the “**just push the button**” concept should be discouraged. Rather focus should be on **proper patient selection, patient education** and consistent **assessment and monitoring** of the patient

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 multimodal regime, together with PCA, to improve analgesia and reduce opioid requirements.

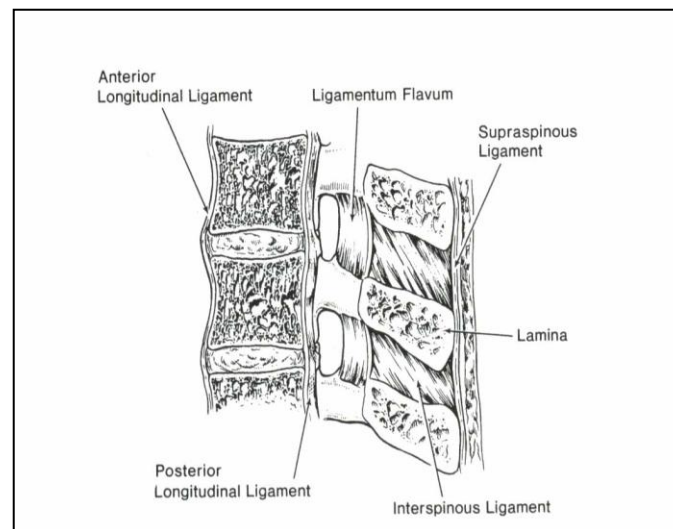
CENTRAL NEURAXIAL BLOCK

Anatomy relevant to epidural analgesia

The spinal cord and brain are covered by 3 membranes -- the *meninges*.

- Outer layer - **duramater**
- Middle layer - **arachnoid mater** (lies beneath the dura)
- Inner layer - **pia mater** (adheres to surface of spinal cord and brain)

Figure 5.1: Anatomy of the Vertebral Column



- Outside the dura lies the *epidural space*. This is a potential space containing 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).

Definitions

Epidural analgesia

This is the introduction of analgesic drugs into 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
- Central neurological disorders e.g. stroke, head injury, brain tumour
- Coagulation disorders / patient on anticoagulants
- Hypovolemia
- Severe fixed cardiac output states

Advantages

- Compared to parenteral opioids, neuraxial block provides:
 - Good quality of analgesia at rest and at movement (incident/dynamic pain), early mobilization and resume normal activities unlimited by pain.
 - Less sedation.
 - Less nausea and vomiting
- Faster return to normal lung function, decreased incidence of pulmonary infection especially patients with lung disease, chest injury, thoracotomy and upper abdominal surgery.
- Reduced duration of ileus in colorectal surgery
- Reduced rate of arrhythmias, earlier extubation, reduced intensive care unit (ICU) stay, reduced stress hormone cortisol and glucose concentrations as well as reduced incidence of renal failure.

Disadvantages

- Technical difficulty
- High cost of equipment
- Weakness and numbness with local anaesthetics

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 5.1: 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 high block
RESPIRATORY	Early respiratory depression from systemic absorption Late resp. 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 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 gray (PAG) area of the brain
- Affect the modulation of nociceptive input but do not cause motor or sympathetic blockade

Local Anaesthetics:

- Block the conduction of impulses along nerves and spinal cord

Epidural analgesia using mixtures of LA and opioids (“cocktail”)

- Local anaesthetic (LA) drugs introduced into the epidural space reach the CSF via dural cuffs surrounding each spinal nerve root, and also gain access to spinal cord.
- Epidural infusion of LA alone or combined with opioids are better than opioids 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.
- To obtain good analgesia with minimum side effects, mixtures of low concentrations of local anaesthetic and opioids i.e. ‘cocktail’ are used.
- Once the epidural catheter is inserted, a bolus dose is given.
- **“Every dose is a test dose”**

Table 5.2: 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 key factor in the height of the block
2. The guideline for dosing and epidural in adults is 0.5-0.7 mls (thoracic) and 1-2 mls (lumbar) per segment to be blocked
3. Adjust the guideline for shorter patients (less than 155 cm) or taller patients (more than 185 cm)
4. Beware of intravascular and intrathecal injection 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 of the lower limbs but patients are allowed to sit up and out of bed with assistance.

Patient Controlled Epidural Analgesia (PCEA)

- PCEA decreases the requirement for epidural top-ups, lowers consumption of LA and decreases 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 background 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).

Epidural analgesia using opioids alone

- Epidural opioids alone have limited benefit and are not commonly used.
- Risk of delayed respiratory depression is greater with morphine when compared to fentanyl.
- Concurrent opioids and sedatives must not be given by other routes.
- Opioid solutions used must be preservative-free (as preservative may be neurotoxic).
- Patients receiving epidural opioids alone may ambulate, as there is no motor blockade.
- 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 any significant benefit. (refer Table 5.3)

Table 5.3: 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
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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 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 5.4: 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 5.5 Optimal Intrathecal Opioid Dose for Specific Surgical Procedures

(Adapted from Rathmell JP et al. Intrathecal Drugs for Acute Pain. Anesthesia Analgesia

Procedure	Optimal IT opioid & dose	Comments
Caesarean Delivery	Fentanyl 25 µg + Morphine 100 µg	Fentanyl improves intraoperative analgesia, faster onset of block but does not produce significant postoperative analgesia.
Day Care Surgery under spinal anesthesia (e.g. knee arthroscopy)	Fentanyl 10-25 µg	Intrathecal lipophilic opioids speed onset of block, short duration of action and improve both intraoperative and immediate postoperative analgesia without prolonging motor block. Minimal cephalad spread, 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 orthopedic 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 provided more intense analgesia than IV patient-controlled analgesia with morphine. Its role in major abdominal surgery is less clear due to fact that the analgesic effects wear off after first 24 hr 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. Can be injected under direct vision at the end of surgery.

2005; 101: S30-43)

Note: Intrathecal morphine doses of 300 mcg or more is required to produce superior analgesia in major thoracotomy and abdominal / vascular surgery but it increases the risk of respiratory depression.

Advantages:

- Higher intrathecal success rate
- Earlier onset of sensory block than LA alone
- Enhance 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 cesarean delivery
- Early extubation, significantly reduces MAC

Disadvantages:

- Pruritus
- Sedation mainly with hydrophilic opioids
- Respiratory depression, rare with 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 strong history of herpes

Table 5.6. Incidence, Proposed Mechanisms and Treatment for Intrathecal Opioid-Related Side Effects

Complication	Incidence	Proposed mechanism	Treatment	Commentary
Pruritus	<ul style="list-style-type: none"> • 30%-100% • Increased in parturients • More with Morphine • Dose dependent 	<p>Exact mechanism unclear. Postulates include:</p> <ul style="list-style-type: none"> • opioid receptor-mediated central mechanism • "itch center" in the central nervous system, • Modulation of the serotonergic pathway • Prostaglandins 	<p>Reassurance /Calamine Lotion</p> <p>Naloxone 40 mcg titrating to a max of 400mcg</p> <p>Propofol 10 mg IV bolus +/- small dose 30mg/24hr infusion.</p> <p>Nalbuphine 4 mg IV Ondansetron 4-8mg IV</p> <p>Granisetron –3mg IV</p> <p>Sedative properties of antihistamines may be helpful in interrupting the itch-scratch cycle.</p>	<p>Propofol may be less effective for the parturient</p> <p>Histamine release does not appear to be causative</p>
Urinary retention	<ul style="list-style-type: none"> • 35% with morphine • Morphine > fentanyl 	<p>Interacts with opioid receptors in the sacral spinal cord, causing detrusor muscle relaxation and an increase in maximal bladder capacity</p>	<p>Opioid antagonist and agonist-antagonist including naloxone</p> <p>Unable to void for > 6 hrs -CBD</p>	<p>In ability to void postoperatively is a multifactorial problem.</p> <p>Look for primary cause</p>
Nausea and vomiting	<ul style="list-style-type: none"> • 30% • morphine>fentanyl • Likely dose dependent 	<ul style="list-style-type: none"> • Cephalad migration in the cerebrospinal fluid (CSF) interacts with opioid receptors in the area postrema. • Sensitization of the vestibular system to motion 	<p>Use smallest effective dose</p> <p>For ambulatory procedures, use lipophilic opioid</p>	<p>Intrathecal opioids appear to have a protective effect against intraoperative nausea and vomiting during caesarean delivery when compared with LA alone</p>

		<ul style="list-style-type: none"> Decreased gastric emptying. 	<p>Dexamethasone and droperidol have shown efficacy</p> <p>Ondansetron 4-8mg IV</p> <p>Granisetron 1-3mg IV</p>	
Respiratory depression	<ul style="list-style-type: none"> 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	<p>Prevention: training and monitoring</p> <ul style="list-style-type: none"> Opioid antagonist (naloxone) 	<p>Risk factors include</p> <ul style="list-style-type: none"> large dose; hydrophilic opioids concomitant use of opioid and sedatives, age >65 yr, opioid naïve patients <p>Late onset depression more apparent with morphine</p>

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

Dosage

- <60 years old: 5-10 mg morphine, undiluted, 4 hourly
- >60 years old: 2.5-5 mg morphine, undiluted, 4 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

Disadvantages

- May have a burning sensation at injection site.
- Onset of pain relief is delayed.
- There may be a delay between request for pain relief and actual administration.
- There is a risk of opioid overdose and respiratory depression.

Peripheral Nerve Block (PNB)

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

Indications

- To provide prompt and effective analgesia
- To allow adequate examination, intervention and mobilisation of an injured area without the requirement for 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.
- The visceral components can be controlled by central neuraxial nerve blocks. The somatic components can be controlled by peripheral nerve blocks. Peripheral nerve blocks are therefore quite useful in the settings of operations involving the walls of the abdomen or the thorax.
- Nerve blocks applicable for abdominal & thoracic surgery include:
 - Thoracic Paravertebral block (TPVB)
 - Lumbar Paravertebral block (LPVB)
 - Transversus abdominis plane (TAP) block
 - Intercostal nerves block (used for fracture ribs)

Table 5.7: 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 & Wrist Surgery as a supplement to Brachial Plexus Block

Table 5.8: 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 / Saphenous Nerve Block)	Knee Surgery ACL Repair Leg, ankle and foot surgery
Popliteal Nerve Block Tibial Nerve Block or Ankle Block	Ankle / Foot surgery

Table 5.9: Truncal Blocks and Indications

Block	Indication
Thoracic Paravertebral Block	Breast surgery Chest Surgery Chest injury / Fracture Ribs
Intercostal Nerve Block	Chest injury Fracture Ribs
Thoraco-Lumbar paravertebral Block	Lower abdominal surgery – Hernia Repair Lateral abdominal wall surgery

Transversus Abdominis Plane (TAP) Block	Abdominal surgery
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Table 5.10: LA selection & concentration

Local Anaesthetic	Initial Bolus	Infusion	Maximum dose mg/kg
Bupivacaine	0.25%-0.375%	0.1%	2-3
Ropivacaine	0.375%-0.5%	0.2%	3
Levobupivacaine	0.25%-0.375%	0.1%-0.2%	2-3

Table 5.11: Dose of LA for Continuous Infusion with or without PCA bolus

Type of block	Initial bolus (mls)	Basal Infusion (ml/h)	Bolus Volume (ml)	Lockout Interval (minutes)
Brachial plexus Block	20-30	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

Note: LA must be titrated according to analgesic effects and maximum doses in mg/kg (refer to Table 5.10)

Catheter Placement

- Place the catheter 1-2 cm distal to the tip of the needle in 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.

Tunneling and securing catheter

Secure the catheter by tunneling it through the subcutaneous layer.



Contraindications

- Patient refusal
- Drug allergy – allergy to local anaesthetics
- Coagulopathy – INR \geq 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 and arrhythmias.
- 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

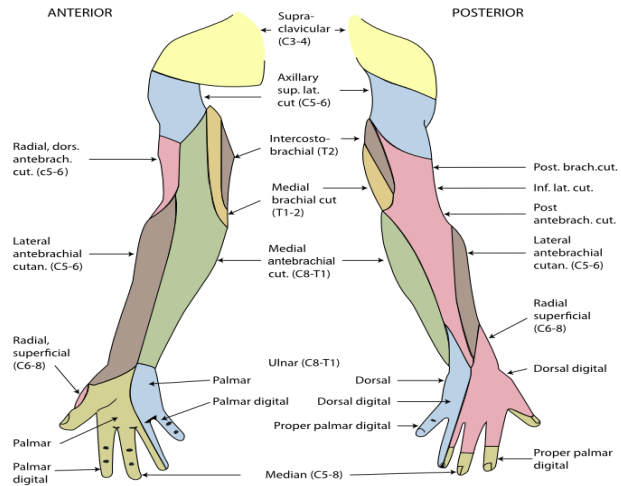
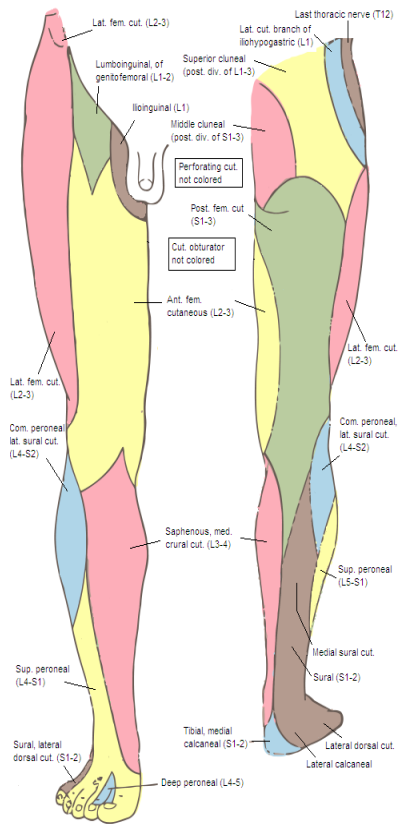


Figure 5.3: Cutaneous Innervation of the Lower Limbs



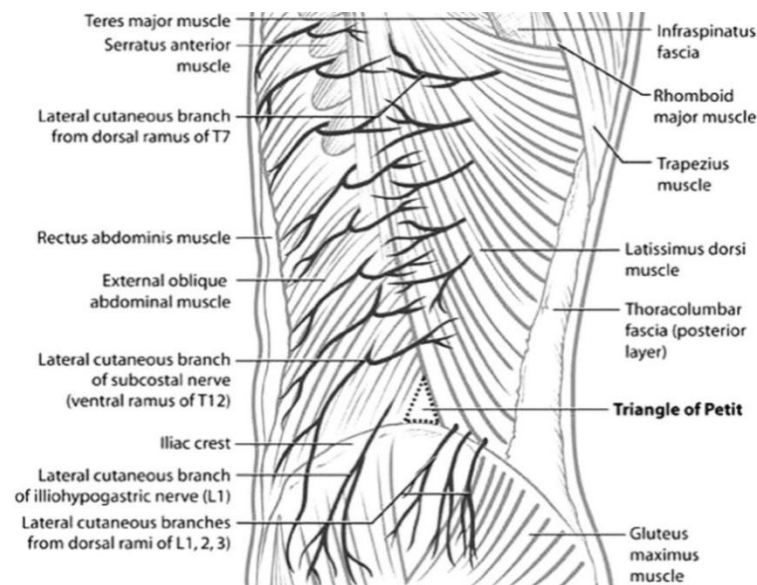
Transversus Abdominis Plane (TAP) Block

- Transversus abdominis plane is a potential space between the internal oblique and transversus abdominis muscles.
- The space can be identified and clearly visualised using the ultrasound and the local anaesthetics is injected into the plane between the two muscle layers; hence called the transversus abdominis plane block
- Using the ultrasound guided nerve block, the TAP block has been described with promises of better localization and deposition of the local anesthetics with improved accuracy. This block can be performed either pre-induction or post-induction of anaesthesia aiming to provide analgesia peri-operatively.

Anatomy

- Anterior abdominal wall is innervated by branches arising from the anterior rami of the spinal nerve T7 to L1 which include the intercostal nerves (T7-T11), the subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1).
- Anatomy of Angle of Petit (Borders)
 - Posterior - latissimus dorsi
 - Anterior - external oblique muscle
 - Inferior - iliac crest
 - Floor – Transversus abdominis muscle

Figure 5.4: Surface landmark of Triangle of Petit
(McDonnell J.G et al. Anesth Analg 2007; 104:193-197)



- TAP block may be used for analgesia for the following types of surgery:
 - Anterior abdominal wall surgery
 - Appendicectomy
 - Herniorrhaphy
 - LSCS
 - Abdominal hysterectomy
 - Tenckhoff catheter insertion
 - Retropubic prostatectomy
 - Laparoscopic surgery
 - Open Cholecystectomy

- For abdominal surgery, bilateral blocks may be given for midline incision. Here, care must be taken not to exceed the maximum dose of local anaesthetic.
- 15-20 mls of 0.375% ropivacaine or 0.25% levobupivacaine are deposited on either side to a maximum of 30 mls. The success of the block depends on the spread of the local anaesthetic rather than its concentration.
- The local anaesthetics deposited into the transversus abdominis neuro-fascial plane will spread cephalad and caudad on each side, from the iliac crest to the costal margins, thus blocking the nerves which lie between the fascial layers, providing the sensory block from T7 to L1.
- The duration of the block ranges from 4-24 hours. If analgesia is required beyond the duration of single injection, a catheter may be inserted into the TAP through a Tuohy needle and analgesia maintained with infusion of local anaesthetic at 7 to 10 mls/h .
- This block provides effective postoperative analgesia in the first 24 hours after major abdominal surgery, and has been found to reduce morphine requirement in post-operative patients.
- Complications are uncommon, and include:
 - Liver injury
 - Intra-peritoneal injection
 - Bowel hematoma
 - Transient femoral nerve palsy
 - Local anesthetic toxicity

Pain Management in Non-APS patient

- 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, onset of drugs, reliability of effect, duration of action, patient acceptability, cost, staff education and supervision available.
- Oral analgesic agents are simple, non-invasive, good efficacy and 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 better analgesic effect after surgery with faster onset than the same dose given orally but more expensive.
- NSAIDs and COX-2 inhibitors can be used as sole therapy in various acute pain settings.
- Frequent pain assessment, response to treatment and side effects, is important to achieve adequate analgesia.
- For those with severe pain, use IV morphine and titrate to comfort using 'Morphine Pain Protocol' to guide severe pain management (refer to Appendix 5)

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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 anaesthetics:

- 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 ischaemia /stroke / uncontrolled hypertension)
- Platelet dysfunction
- Allergic reactions

Complications related to technique

PCA

- Superficial phlebitis at the I/V site

Central neuraxial block

- Post Dural Puncture Headache (PDPH)
- Neurological Complications
 - Transient Neurological Symptoms (TNS)
 - Epidural abscess, meningitis, encephalitis
 - Haematoma – Epidural or Subdural
 - Meningitis – septic or aseptic
 - Cauda equina syndrome
 - Adhesive arachnoiditis
 - Traumatic / Ischaemic injury to 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 (K .Schwabe)

Subcutaneous morphine

- Cellulitis at the needle site

MANAGEMENT OF COMPLICATIONS

NAUSEA AND VOMITING

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

- Laproscopic 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 history of motion sickness
- Patients with 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 pin-point pupils**
- 2) **Stop the opioid**
- 3) **Call for help; ward doctor or APS team**
- 4) Stimulate 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 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 Naloxone 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 cause, must be ruled out as well.

Management

- Consider surgical problems and manage appropriately
- Use multimodal analgesia to reduce opioid requirements
- Consider changing opioid (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 patient immediately
2. Administer oxygen via facemask
3. **Rule out other causes:**
 - Inadequate fluid replacement (hypovolemia)
 - Surgical problem (e.g. bleeding)
 - Cardiac event
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 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

- Regular neurological examination (Bromage scoring) and follow up.
- Reduce epidural infusion rate, adjust or remove epidural catheter.
- 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 bi-frontal /occipital and may radiate to neck and shoulder.
- Severity ranges from mild to excruciating
- Associated symptoms are nausea, loss of appetite (LOA), 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 (post partum female). Exclude by checking for focal neurological deficit, neck stiffness, fever etc

Risk factors

1) Age <50 yr

- 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% resolving 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:

- 1) Epidural blood patch if conservative therapy fails. To be performed only by 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, but the incidence is extremely low.

Early diagnosis by monitoring patients for early signs of cord compression, such as progressive numbness or weakness, bowel and bladder dysfunction, followed by immediate decompression (less than 8 hours after the onset of neurological signs) results in good neurological recovery.

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 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:

Difficult puncture/bleeding during catheter insertion

Peri-operative anti-coagulation therapy or thromboembolism prophylaxis

Perioperative coagulation disorder

Management:

- Early diagnosis, high index of suspicion in patient 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 will result in better outcomes.

Subdural Hematoma

- 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.

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CHAPTER 7 ACUTE NEUROPATHIC PAIN

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 has been defined as “pain caused by a lesion or disease of the somatosensory nervous system”.

Acute neuropathic pain is now recognized as one of the causes of post surgical and post trauma pain. Early recognition of patients with acute neuropathic pain is essential because of its high risk of progression to chronic pain.

Characteristics of neuropathic pain

- Sharp, burning, stabbing, stinging, shooting, or an electric shock like in quality.
- Allodynia and hyperalgesia.
- Superficial or deep
- Intermittent or constant.
- Spontaneous or triggered by various stimuli.
- It may be present preoperatively and can be worse after surgery.

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

For post surgical and post trauma patients in whom pain persists despite high doses of strong opioids, acute pain neuropathic must be considered.

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

The prompt diagnosis of acute neuropathic pain is important as there is evidence that specific early analgesic interventions may reduce the incidence of chronic pain which is often neuropathic in nature.

Causes of acute neuropathic pain:

1. Post-operative: thoracotomy, Sternotomy, cholecystectomy, mastectomy, amputation of a limb and other surgery associated with a risk of nerve injury
2. Post trauma: brachial plexus avulsion, lumbosacral plexus injury, spinal cord injury and injury to peripheral nerves.
3. Infection: post herpetic neuralgia, Guillain-Barre syndrome
4. Neurological disorders: multiple sclerosis, trigeminal neuralgia and central post-stroke pain
5. Nerve compression: Carpal Tunnel Syndrome, acute sciatica

Recommended treatments

1. Anticonvulsants

Gabapentin

Start at 300mg nocte 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 nocte 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 antidepressant

Amitriptyline

Start at 10mg to 25 mg at bed time. Increase by 10 -25mg weekly up to a maximum of 75mg/day if tolerated

Side effects include dry mouth, sedation, disturbed vision, arrhythmia, palpitation, postural hypotension, urinary retention and constipation.

Caution in elderly patients and cardiac disease.

Nortriptyline, desipramine

Start at 10mg to 25 mg at bed time. Increase by 25mg every 3 -7 days up to a maximum of 150mg/day if tolerated

Duloxetine

Start at 30mg/day. Increase to 60mg before bedtime after a week up to twice daily.

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.

3. Ketamine

The starting dose of ketamine is usually 10 -25mg intravenously over 30 minutes but this is variable depending on effect. It is usually given with intravenous midazolam 2-5 mg to prevent hallucinations occurring. Reduction of pain and dysaesthesia may last up to six weeks following a single dose.

Continuous subcutaneous infusion

- Start with 1-2.5mg/kg/24hrs
- If necessary, increase by 50-100mg/24h
- Maximum reported dose is 3.6g/24h

Alternatively give as short term 'burst' therapy

- Start with 100mg/24h
- If 100mg not effective, increase after 24h to 300mg/24h
- If 300mg not effective, increase after further 24h to 500mg/24h
- Stop 3 days after last dose increment
-

50% of patients respond and the regimen can be repeated prn: the duration of benefit varies and undesirable effects are common. The use of prophylactic diazepam, midazolam or haloperidol is recommended.

Side effects:

There is a very small therapeutic range between analgesia and side effects which include:

- 20-30 per cent psychomimetic effects (bizarre dreams or hallucinations)
- Nystagmus
- Sedation
- Euphoria
- Neurobehavioral and cognitive depression
- Tolerance

4. Lignocaine

- IV – 1 to 2 mg/kg
- Continuous IV infusion – 0.5 to 1 mg/kg/h
- Continuous subcutaneous infusion – 10 to 80 mg/h

Dose is titrated based on symptoms of local anesthetic toxicity such as lightheadedness, dizziness, perioral numbness, slurring of speech, tinnitus, diplopia and convulsions. Side effects are nausea, hypotension, bradycardia, hypertension, paraesthesia, dizziness and vomiting.

Decrease the infusion rate or discontinue treatment if signs of toxicity are present.

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CHAPTER 8

ACUTE PAIN MANAGEMENT IN OPIOID TOLERANT PATIENTS

Opioids are commonly used for the management of cancer and non-cancer pain. Exposure to opioids, whether recreational or therapeutic, may lead to the development of opioid tolerance.

It is important to recognize opioid tolerant patients and plan their peri-operative management as such patients will need higher opioid doses and may also require additional analgesic techniques. Pain is often underestimated and under treated in opioid tolerant patients.

The main goals in treating acute pain in the opioid tolerant patients are effective pain relief and prevention of withdrawal symptoms.

Identification of opioid tolerant patients

There are 3 main groups of opioid tolerant patients

- Patients who have cancer pain treated with opioids
- Patients who have chronic non-cancer pain treated with opioids
- Patients who have an addiction disorder, or those with a previous disorder who are on a maintenance programme.

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 (eg analgesia) and undesired (eg 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 administration of the same or similar drug.

Addiction	<p>A disease that is characterized by aberrant drug seeking and maladaptive drug taking behaviours that may include cravings, compulsive drug use and loss of control over drug use, despite the risk of physical, social and psychological harm.</p> <p>While psychoactive drugs have an addiction liability, psychological, social, environmental and genetic factors play an important role in the development of addiction.</p> <p>Unlike tolerance and physical dependence, addiction is not a predictable effect of a drug.</p>
Pseudoaddiction	Behaviours that may seem inappropriately drug seeking but are a result of undertreatment of pain and resolve when pain relief is adequate.
Physical withdrawal	is a syndrome that occurs if an opioid is abruptly stopped, rapidly reduced or reversed by administration of an antagonist.

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).

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
Pilierection	

Adapted from Collett 1998

Acute pain management

It is important that an acute pain management plan is made. The plan should include the following:

- Identification of opioid tolerant patients
- Effective pain control
- Prevention of withdrawal symptoms
- Avoidance of overdose
- Treatment of psychological disorders such as anxiety.
- A step down analgesic plan which is acceptable to the patient.

The provision of effective analgesia

A multimodal approach is recommended.

- continuation of their usual background opioid dose to prevent withdrawal symptoms
- additional short acting opioids for acute pain.
- opioid sparing techniques such as:
 - Paracetamol and NSAIDs / COX-2 inhibitors prescribed regularly unless contraindicated.
 - Local anaesthetic infiltration or using catheter techniques
 - Ketamine at low doses for as a continuous intravenous infusion. Take note about contraindications and side effects.

Low dose intravenous ketamine infusion

Make up 100mg ketamine to 50ml normal saline and infuse at 1ml / hour starting dose. Then increase infusion rate by up to a maximum of 4mls/hr according to response.

Midazolam may be added if required.

Continue dose of usual opioid to prevent withdrawal

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

If a regional anaesthesia is planned, the baseline opioids may be continued in the perioperative period with additional doses for acute pain.

Additional opioid for acute pain

- For minor procedures, short acting 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 the treatment of choice for administering short acting opioids as it allows dose titration and

minimizes side effects. Patients will require increased bolus doses and may require a background infusion if unable to take their usual dose of opioid.

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 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 which includes the use of 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
- 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 / hr background infusion and starting bolus dose at 50% of the background infusion \pm 1mg bolus.

Example C

Miss C has Ca Stomach and is on Transdermal Fentanyl 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 Transdermal Fentanyl should be continued at the baseline dose. (100mcg/hr)
- 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

Step down analgesia plan

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 and have immediate release opioids prescribed on a regular basis
- The dose of immediate release opioids should be 1/6 of the calculated 24 hour oral requirement.

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
- 50% of the calculated oral equivalent (62.5mg) is given in a sustained release form e.g. 30mg of morphine sulphate sustained release twice daily.
- 1/6 of 62.5mg is given in the immediate release form on a PRN basis e.g. oral morphine 10mg up to 4 hourly.

Management of patients on buprenorphine

Buprenorphine is being increasingly used as a maintenance therapy in opioid addiction disorder. It is usually used in doses ranging from 8 – 32mg. 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 its binding to opioid receptors is not easily reversed by other opioids.

Perioperative pain management strategies for patients stabilized on buprenorphine

Minor procedures

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

Major procedures

- Continue the usual dose of buprenorphine + 25% increase
- Maximise non-opioid analgesia
- Consider 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

Table 8.3: Comparison of oral morphine and transdermal patch dosage

Oral Morphine (mg in 24 hours)	Buprenorphine patch (mcg per hour)	Fentanyl patch (mcg per hour)
10	5	-
15	10	-
30	20	-
45	-	12
60	35	-
90	52.5	25
120	70	-
180	-	50
270	-	75
360	-	100

Adapted from The British Pain Society, 2007

Summary

Guidelines for perioperative pain management in opioid tolerant patients

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; provide anxiolytics and other medications as clinically indicated.

Intraoperative

- Maintain baseline opioid requirement (oral, transdermal, intravenous).
- Titrate intraoperative and postoperative opioids according to response.
- Provide peripheral nerve or plexus blockade and consider neuraxial analgesic techniques when indicated.
- Use nonopioids 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 for a follow up appointment with patient's addictionologist./ pain medicine specialist.

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

Table 8.4: Suggested dose conversion ratio (from Cancer Pain CPG 2010)

To From	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
Methadone 100mg/day PO = Morphine 200-300mg/day PO

Table 8.5: Recommendations and Equianalgesic Dose Conversion Ratios for Perioperative Pain Management

Commonly used opioids	Recommendations	Conversion ratio
Oral Methadone	<ul style="list-style-type: none"> Continue if allowed orally Convert to oral morphine and then to IV if NBM 	O.Methadone : O.Morphine 1: 2-3 <i>When changing opioids, reduce by 50% for cross tolerance/ NMDA activity</i>
Oral Morphine	<ul style="list-style-type: none"> Continue if allowed orally Convert to IV morphine and maintain baseline if NBM Additional morphine as indicated 	O. Morphine : IV Morphine 2.5 : 1
Oral Oxycodone	<ul style="list-style-type: none"> Continue if allowed orally Convert to IV morphine and maintain baseline if NBM Additional morphine as indicated 	O.Oxycodone : IV Morphine 1: 0.6
Oral Tramadol	<ul style="list-style-type: none"> Continue if allowed orally Convert to IV morphine and maintain baseline if NBM Additional morphine as indicated 	O.Tramadol : O. Morphine 5:1 Convert oral morphine to parenteral morphine (see above)
Oral Codeine	<ul style="list-style-type: none"> Continue if allowed orally Convert to IV morphine and maintain baseline if NBM Additional morphine as indicated 	O.Codeine to IV Morphine O.Codeine _____ = IV Morphine 20
Transdermal Fentanyl patch	<ul style="list-style-type: none"> Continue Additional morphine as indicated 	
Transdermal Buprenorphine patch	<ul style="list-style-type: none"> Continue Additional morphine as indicated 	

Please note:

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

Depending on age, prior side effects, most experts recommend starting a new opioid at $\frac{1}{2}$ - $\frac{2}{3}$ of the calculated equianalgesic dose.

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CHAPTER 9 ANALGESIA FOR PROCEDURAL PAIN

Introduction

Pain is an important aspect of wound care. “Unresolved pain negatively affects wound healing and has an impact on the quality of life. Pain at wound dressing procedures can be managed by a combination of accurate assessment, suitable dressing choices, skilled wound management and individualized analgesic regimens. For therapeutic as well as humanitarian reasons, it is vital that clinicians know how to assess, evaluate and manage pain.

Management of 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 methods

All analgesics should be administered before a painful event. The type and route of analgesia depends on the anticipated severity of pain, and should be modified according to patient response.

Analgesia may be continued post-procedure, but if pain persists and is poorly controlled, regular analgesics should be given.

It is recommended to monitor the vital signs of patients receiving intravenous or subcutaneous opioids for at least 4 hours post –procedure.

Oral route

Mild to moderate pain:

Paracetamol and NSAIDs should be given at least 1 hour prior to the procedure. It can be given together with oral weak opioids like Tramadol or DF118 (refer Appendix 6)

Moderate to severe pain:

Strong opioids like immediate release formulations of oxycodone (Oxynorm) and aqueous morphine - may also be administered orally half an hour prior to the procedure.

Subcutaneous route

Indications:

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

S/C Morphine

- Will take at least 15 minutes to work
- Dose depends on age of patient and severity of pain
 - e.g. < 65yrs: 5mg -10mg
 - > 65yrs: 2.5mg -5mg

Intravenous route

IV morphine

Analgesia may be achieved using the Morphine Pain Protocol (Appendix 5). This involves the administration of IV Morphine 0.5 -1 mg bolus, repeated every 5 minutes, titrated to effect (i.e. a reduction in pain score) and monitoring for side effects (drowsiness and respiratory depression) using the respiratory rate and the sedation score. (Chapter 4).

Additional IV Analgesics

If the above analgesics techniques are not adequate, the following techniques may be used. Caution: All the following should only be given by doctors who have been trained in the administration of the analgesic.

- IV PCA Morphine with a bolus dose of 1-2 mg and a lockout interval of 5 minutes may be used during the procedure, with the advice of the Acute Pain Service anaesthetist.
- 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). May be given as IV PCA Fentanyl with a bolus dose of 10-20 mcg and a lockout interval of 2-3 minutes, with the advice of the Acute Pain Service anaesthetist.

Note:

The difference between IV Morphine 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 and can rapidly cause profound sedation and respiratory depression.

- IV Ketamine - 0.25 - 0.5 mg/kg titrated to effect.

Usually used in children, but may be used in adults in selected cases.

Note that the patient may have hallucinations with the use of this drug and IV Midazolam 1-2 mg may have to be used concomitantly.

Topical local anaesthetics

Lignocaine 2% plain (max dose 3mg/kg body wt) or lignocaine 2% with adrenaline (max dose is 7mg/kg body wt) diluted in Normal Saline. Soak gauze in LA Solution and place on the wound for 3-5 mins before procedure.

Inhalationals

Methoxyflurane (Penthrox)

- used as an inhaler 5 mins prior to 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 are not recommended as it may result in fatal renal toxicity
- Precautions
- Diabetic patients
- Liver disease

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 it. 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

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 as a result 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 take 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 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. Children **do not like** intramuscular (IM) injection. IM injection is unpredictable, largely ineffective and children will deny having pain to avoid injection. Intravenous, oral and rectal are the preferred methods of administration.
3. 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.
4. Severe pain is best treated with **continuous methods** of analgesic administration (e.g. infusion, PCA).

5. Neonates and some ex-premature infants (up to 60 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.
6. 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 eg. PCA.

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

Because pain is a subjective experience, a self assessment scale may be more 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 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.

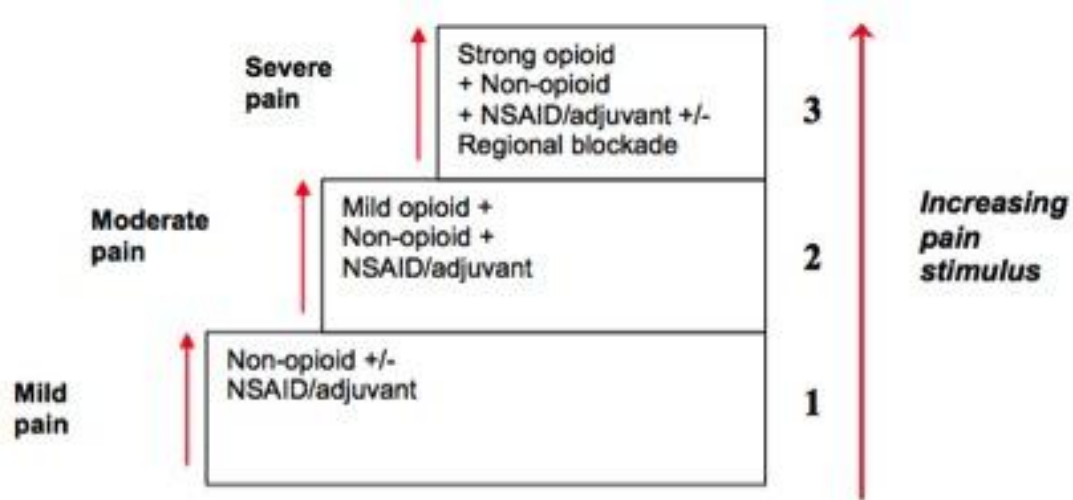
In the Ministry of Health hospitals, the selection of pain measuring tools has been standardized so as to allow a consistent approach towards pain management throughout the country. FLACC scale is used for pain measurement in paediatric patients from age 1 month to 3 years. Wong-Baker Faces scale is used for paediatric patients from above 3 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.

Figure 10.1: WHO Analgesic Ladder



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 favourite toys, watching videos, video games, TV, music by head phones. Other techniques include **breathing techniques** i.e. **deep breathing** (rhythmically with slow deep breathes) and **blowing** (imaginary candles or take a deep breathe and 'blow away the pain'), **hypnosis***, **guided** and **superhero imagery**.

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 of

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 sensation, such as pain.

PHARMACOLOGICAL METHODS

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

MANAGEMENT OF PROCEDURAL PAIN

Painful procedures are performed on children in order to diagnose and treat a wide variety of disease, for example, lumbar puncture, bone marrow aspiration, intravenous cannulation, change of dressing (Burns) and removal of drains.

Pain management for procedures should include both pharmacological and non-pharmacological strategies whenever possible. Nonpharmacologic interventions should be used to supplement, not to replace pharmacologic approaches. Individuals prescribing and administering pharmacologic agents must be knowledgeable about the onset, duration, and mechanism of action for these agents and be skilled in managing adverse effects and complications should they occur.

Pharmacological Methods

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:

- local anaesthetics,

- simple analgesic
- nonsteroidal antiinflammatory drugs (NSAIDs),
- Ketamine
- opioids,
- anxiolytics, and sedatives.
- Nitrous oxide (Entonox)

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

Local Anaesthetic

- commonly used for dermal procedures eg venepuncture, suture
- injected subcutaneously or intradermally
- applied topically to the skin eg EMLA cream. Lignocaine gel

EMLA Cream

EMLA cream consists of a eutetic 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 (eg 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 site of application sometimes make 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.

Ametop (Amethocaine)/ AnGEL

A 4% amethocaine gel is used as a percutaneous local anaesthesia. This formulation of 4% amethocaine (tetracaine) produces more rapid and prolong surface anaesthesia than EMLA. It is used extensively for procedural pain including venepuncture, intravenous or arterial cannulation, lumbar puncture, and others.

Lignocaine -Adrenaline -Tetracaine (LAT)

1-3ml of the solution is applied directly to the wound for 15-30 minutes using a cotton-tipped applicator. The solution and gel have been used in children more than 1 year of age. The use of LAT should be avoided in highly vascular surfaces, mucous membrane and wounds larger than 6 cm. Caution: If lignocaine is injected following LAT, the maximum dose of lignocaine (5mg/kg) should not be exceeded.

Currently both Ametop and LAT are unavailable in this country. 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.

Infiltration of Local Anaesthetics

Infiltration of local anaesthetic eg lignocaine, bupivacaine or levobupivacaine into subcutaneous area are effective for procedures like lumbar puncture, bone marrow aspiration.

Safe maximum dose of LA

Lignocaine	7.0 (with adrenaline)
Bupivacaine	2 - 3
Ropivacaine	3
Levobupivacaine	2 - 3

Nitrous oxide (N₂O) Analgesia

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
- Premedicated
- Ventilated in the PICU
- Extubated within the last 24 hours

* Requires an anaesthetist to be present

Fasting

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

Pre-requisites for safe administration

- Parental consent for sedation and procedure
- Fasting
- N₂O prescribed documented indicating % concentration administered

- No contra indications present
- Healthcare worker administering N₂O and observing the child is allocated to this task only
- Inability to provide N₂O 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 '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 N₂O.

The self-administration demand flow system is operated by the child unaided such that sedation leads to 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 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, is capable of producing deep sedation and unconsciousness and therefore this method is not included in this document.

Safe delivery of N₂O

- Provide 100% oxygen for 2-3 minutes before procedure
- Monitor HR, RR, O₂ saturation, conscious state
- Administer N₂O in oxygen
- Maintain verbal contact with the child at all times
- Provide 100% O₂ for 3 minutes after the procedure
- Provide 100% O₂ if child experiences adverse effects(desaturation, deeply sedated)

Recovery

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

Adverse effects of N₂O

- 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. N₂O is known to interfere with Vitamin B₁₂ and folate metabolism. Megaloblastic bone marrow changes can be detected following exposures of several hours. Leucopenia, megaloblastic anaemia and sub-acute 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 N₂O for longer than two weeks
- For all children requiring N₂O three times a week or more for a period of two weeks or more:
 - Add Folate 250mcg/kg (max 10mg) oral daily Add Vitamin B₁₂ 5mg/day oral daily

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 phenomenon.

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.

Indications

- Burns
- Repeated wound dressing

Recommended Dosage:

Oral: 2-10mg/kg (parenteral preparation can be given orally). Usually at 5mg/kg.

Intramuscular: 1-2mg/kg

Continuous infusion: as below

Preparation of solution for continuous ketamine infusion:

Add 5 mg/kg of Ketamine and make up to 50 mls with normal saline

1 ml of solution = **0.1 mg/kg** of ketamine

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.

Suggested Ketamine Infusion

Table 10.1: Suggested Ketamine Dose for Infusion

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

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) Sedation score of 3 (unarousable)
- iii) Inadequate analgesia (painscore>4)
- iv) Hallucinations or bad dreams

MANAGEMENT OF MAJOR COMPLICATIONS

APS doctor should be notified immediately. STOP the ketamine 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

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 venepuncture, 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.

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

GUIDELINES FOR PAIN MANAGEMENT IN CHILDREN WITH BURNS

Basic Principles

1. Pain 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, usually acute and short lasting, but of great intensity.

4. A **multimodal approach** is the mainstay in 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 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

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

Morphine sulphate:	0.3 mg/kg 4 hourly
Codeine:	0.5 - 1.0 mg/kg/dose 4 hourly
Oxycodone:	0.2 - 0.3 mg/kg/dose 4 hourly

2). Paracetamol

Oral

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

Rectal

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

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:

- with extensive dressings changes and wound debridement
- 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

To 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.

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

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

Patients Already On PCA Morphine Or IV Morphine Infusion

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 µg/kg) of morphine infusion every 5 min till desired effect.

For patients on PCA morphine

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

MANAGEMENT OF POST-OPERATIVE PAIN

METHODS

- 1). Paracetamol
- 2). Non-steroidal anti-inflammatory drugs e.g. diclofenac,
- 3). Tramadol
- 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 □□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 h 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 10.2: 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 (hr)oral/ rectal	Max. daily dose (mg/kg/d)	Duration of max dose (hr)
28-32 weeks PCA	20	20	O 10-15/ R 15	O 8-12/ R 12	30	48
32-52 weeks PCA	20	30	O 10-15/ R 20	O 6-8/ R8	60	48
> 3 months	20	40	O 15/ R 20	O 4/ R6	90	72

PCA, - postconceptual age , O – oral, R - rectal

- *Rectal administration should be avoided in neutropenic patient 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 (PERFALGAN)

Intravenous paracetamol (Perfalgan) is now available. It provides higher effect site concentration with higher analgesic potency. When administered intravenously, 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 lean body weight (LBW). For obese children, this is less than their measured weight.

Formulation of IV Perfalgan

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 (Perfalgan)

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 undergoing 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 alternative route of administration (oral/ rectal) are 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 10.3: Guidelines for Intravenous Paracetamol dosing

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

Side Effects

- Injection site pain
- Injection site reaction
- Nausea
- Vomiting

Risk Management Strategies

With the advent of a liquid product for infusion, there is potential for other (oral) liquid Paracetamol formulation 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 pharmacy and the operating suites only.
- Perfalgan should not be stored in general paediatric wards.
- Perfalgan should be prescribed by anaesthetists, pain team and intensivists. In general, Perfalgan 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 (PERFALGAN) 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.
- Perfalgan should be infused over 15 minutes using a paediatric chamber/infusion burette. It should not be given via a syringe pump.
- Oral or rectal paracetamol should not be prescribed simultaneously with IV paracetamol (Perfalgan)

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 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 peri-operative period.

Contraindications :

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

Table 10.4: NSAIDs preparations, dose and route

NSAID	Dose mg/kg	Route	Interval hours	Maximum daily dose mg/kg/day	Licensed from age
Ibuprofen	5	oral	6-8	20	3 months
Naproxen	7	oral	12	15	
Diclofenac	0.3 to 1	oral	8	3mg/kg/day for only a maximum of 2 days	6 months
	1	rectal	8		

TRAMADOL

Tramadol hydrochloride is a weak opioid analgesic with noradrenergic and serotonergic properties that may contribute to its analgesic activity. It does not produce gastritis, gastric ulcers or effect platelet aggregation. Tramadol can be given by oral route, as 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 is on tricyclic antidepressants, selective serotonin reuptake inhibitors, major tranquillisers, 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

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 infusion and accumulation may occur. The aim of this technique is to have a child free of pain with stable cardio respiratory observations.

In general, **Morphine** is the preferred drug for children. Fentanyl is an alternative choice. The use of Pethidine is not recommended in children because of its metabolic product Norpethidine that 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 apnoea
2. Airway obstruction
3. Head injury, raised intracranial pressure

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.

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 (40-100mcg/kg)

- **12 months and under 50Kg:** 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 50mls normal saline

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

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

Table 10.5: Suggested Morphine Infusion

	Infusion rate	Maximum infusion rate
Neonates	0.5-0.7 ml/hr	1ml/hr
1-3 months	0.5-1ml/hr	2ml/hr
Children > 3 months	1-2 ml/hr	4ml/hr

Bolus doses of 0.5ml – 1ml 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/hr. 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 appropriate respiratory rate for age.

2. FENTANYL

Fentanyl should only be **used in the intensive care unit under close monitoring.**

It should be used in children more than 1 year of age.

1. Prior to commencing fentanyl infusion, the patient should be **titrated to comfort** with 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 20mcg/kg of Fentanyl in 50mls normal saline

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

Loading Dose:

Initial bolus dose **0.4 mcg/kg (1ml)**

Table 10.6: Suggested Fentanyl Infusion

Only to be used > 1 year of age		
	Infusion rate	Maximum infusion rate
Children > 1 year	1-2 ml/hr	4ml/hr

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 available at the bedside.
4. IV line for opioid infusion is to be used **only** for infusion of opioid unless anti-reflux valve is used.
5. Monitoring :
Blood pressure, pulse rate, respiratory rate, pain score and sedation score **half-hourly for the first 2 hours, hourly for the next 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 yr) or < 15/min (1-5 yrs) or < 20/min (< 1yr)
- Systolic BP< 80mmHg(>1yr)or<60mmHg(<1yr)
- Sedation score of 3 (unarousable)
- Inadequate analgesia (pain score >4)
- Severe vomiting or pruritus

MANAGEMENT OF MAJOR COMPLICATIONS

APS doctor should be notified immediately.

Hypoventilation or Unarousable :

1. Stop infusion
2. Oxygen12L/min.via Hudsonmask
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

Severe Vomiting

1. Before any antiemetic, ensure always that patient is adequately hydrated, good analgesia, and that hypoglycemia and hypotension are not causative factors.
2. Reduce or stop infusion if necessary.
3. Give Ondansetron 0.15mg/kg IV or Granisetron 0.05mg/kg IV over 10 min.

Recommendations for PONV Prophylaxis:

Children at increased risk of PONV

IV Ondansetron (Zofran) 0.15mg/kg OR IV Granisetron (Kytril) 0.05mg/kg over 10 min

For all children undergoing adenotonsillectomy, strabismus and laparoscopic surgery,

give IV Dexamethasone 0.15 mcg/kg (max: 4mg)

AND

IV Ondansetron (Zofran) 0.15mg/kg OR IV Granisetron (Kytril) 0.05mg/kg over 10 min

PATIENT CONTROLLED ANALGESIA (PCA)

INTRODUCTION

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

The patient pushes a button if she / he feels pain. The PCA machine then delivers a small amount of opioid into the blood stream. It can be used by any child who is able to understand the concept of pushing a button when it hurts.

Morphine is the preferred drug for PCA.

Indications :

1. Post-operative pain
2. Burns
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

N.B. These contraindications are relative, and should be discussed with APS team if doubt exists.

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 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

Morphine

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

1ml of solution = **10mcg/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/hr) – only for first 24 hours
1 hour limit	: 13 mls

Fentanyl:

Caution: Only to be used if contraindication for Morphine. It must be prescribed by an anaesthetist and monitored in intensive care or high dependency unit.

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

1 ml 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.

Other Modalities:

NCA (Nurse Controlled Analgesia) is appropriate for the control of pain infants and pre- verbal children who cannot use a PCA. It is useful for moderate to severe pain that has significant incident/movement component. The prescription is similar to the PCA except that the lockout interval ranges from 10-30 minutes in any hour and it is usually prescribed with a background infusion. It has been successfully used in hospitals overseas but not commonly used in Malaysia.

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.
3. IV line for PCA is to be used for **PCA only** unless anti-reflux valve is used.
4. Monitoring:
Record blood pressure, pulse rate, respiratory rate, pain score, sedation score and vomiting score **half-hourly for the first 2 hours, hourly for the next 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

Severe Vomiting

4. Before any antiemetic, ensure always that patient is adequately hydrated, good analgesia, and that hypoglycemia and hypotension are not causative factors.
5. Reduce or stop infusion if necessary.
6. Give Ondansetron 0.15mg/kg IV or Granisetron 0.05mg/kg IV over 10 min.

Recommendations for PONV Prophylaxis:

Children at increased risk of PONV

IV Ondansetron (Zofran) 0.15mg/kg OR IV Granisetron (Kytril) 0.05mg/kg over 10 min

For all children undergoing adenotonsillectomy, strabismus and laparoscopic surgery,

give IV Dexamethasone 0.15 mcg/kg (max: 4mg) AND IV Ondansetron (Zofran) 0.15mg/kg OR IV Granisetron (Kytril) 0.05mg/kg over 10 min

LOCAL ANALGESIA

Instillation of LA

Local anaesthetics can be instilled onto small open wounds either by dropping 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 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 2mg/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 1-3ml/hr using an epidural catheter placed on the surface of the foam dressing. Care must be taken not to exceed 0.5mg/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. Bupivacaine, Ropivacaine and Levobupivacaine provides much more prolonged analgesia and is to be preferred than other local anaesthetics. The maximum dose of is 2mg/kg.

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 and lateral cutaneous nerve blocks - 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 opioid 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 **Ropivacaine 0.2%**

0.5ml-0.75ml/kg titrated up to maximum of **2 mg/kg ++ Fentanyl 1 mcg/kg**

via epidural catheter.

3. Infusion can be started ~ **1/2 hour** after the bolus dose.

Preparation of infusion solution:

1. Levobupivacaine 0.1% / plain Bupivacaine 0.1%

10 mls Levobupivacaine 0.5% OR plain Bupivacaine 0.5%
+ 40 mls normal saline
(Total volume = 50 ml)

2. Levobupivacaine 0.125% / plain Bupivacaine 0.125%

10 mls Levobupivacaine 0.5% OR plain Bupivacaine 0.5%
+ 30 mls normal saline
(Total volume = 40 mls)

3. Ropivacaine 0.1%

25mls Ropivacaine 0.2%
+25mls normal saline
(Total volume = 50 mls)

OR

6.7mls Ropivacaine 0.75%
+ 43.3 mls normal saline
(Total volume = 50 mls)

Additive:

Fentanyl: 1-2 mcg/ml

Dosage for Infusion:

Neonates (< 5kg)

Bupivacaine 0.1% Rate: 0.1-0.2 ml/kg/hr

Levobupivacaine 0.125% Rate: 0.1-0.2 ml/kg/hr

Infants (< 1 year old / 5-10kg)

Bupivacaine 0.1% + Fentanyl 1 mcg/ ml Rate: 0.2-0.4ml/kg/hr

Ropivacaine 0.1% + Fentanyl 1mcg/ ml Rate: 0.2-0.4ml/kg/hr

Levobupivacaine 0.1% + Fentanyl 1mcg/ ml Rate: 0.2-0.4ml/kg/hr

Children > 1year old/ >10kg

Bupivacaine 0.1% + Fentanyl 2 mcg/ ml Rate: 0.2-0.4ml/kg/hr

Ropivacaine 0.1% + Fentanyl 2 mcg/ ml Rate: 0.2-0.4ml/kg/hr

Levobupivacaine 0.1% + Fentanyl 2 mcg/ ml Rate: 0.2-0.4ml/kg/hr

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.

- 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 10.7: Suggested Maximum Dose 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)

- No other **opioid** is to be given except on the order of the anaesthetist / APS doctor.
- Naloxone(Narcan) must be available at the bedside.
- Monitoring

Record the blood pressure, pulse rate, respiratory rate, pain score, sedation score and vomiting score **half-hourly for the first 2 hours, hourly for the next 4 hours and then 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
- The infusion rate **must not** be altered except on the order of the anaesthetist / APS doctor.
- 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
- 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 12 L/min via Hudson mask
3. Naloxone 0.01 mg/kg IV stat

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 commence CPR
4. Naloxone 0.01 mg/kg IV stat

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 evidenced by decreased sensation and/or motor block in the arms or respiratory difficulty)

1. Stop infusion
2. Oxygen 12 L/min
3. Check ventilation and assist if required
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.

PAIN SCORING SYSTEM FOR PAEDIATRIC PATIENTS

FLACC Scale for 1 month-3 years

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
<p>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.</p> <p>0 for no pain to 10 for the most severe pain.</p>			

FACES for 3-7years

Wong-Baker FACES pain rating scale

Ask the child to choose a face which best describes his or her pain. Then multiply the score by 2 to get a maximum total score of 10. Be careful that some children might confuse the faces as a happiness measure.



The Wong-Baker faces scale (adapted from Wong DL, et al., eds. *Whaley and Wong's essentials of pediatric nursing*. 5th ed. St Louis, MO: Mosby, 2001)

NUMERICAL SCALE for > 7 years

Refer to Chapter 4 (Assessment and 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

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

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

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CHAPTER 11

OBSTETRIC ANALGESIA AND ANAESTHESIA SERVICE (OAS)

Introduction

Labour and delivery result in severe pain in almost all women. Pain results in physiological response that may harm the mother and the fetus. The provision of optimal obstetric anaesthetic care of 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 influence pain intensity, duration and quality. Rational pain management requires an awareness of the underlying mechanisms involved and an understanding of how pharmacological and non-pharmacological interventions can disrupt this mechanism.

The alleviation of pain and suffering is one of the fundamental principles guiding medical practice, yet the amelioration of pain during childbirth has historically attracted much controversy. In our country the methods of pain relief have been delayed by superstition, religious beliefs and “old wives tales”, as well as opposition from some members of the medical profession.

The three essentials of obstetric pain relief are *simplicity, safety* and *preservation of maternal and fetal homeostasis*. With respect to the fetus, the most important is the transfer of oxygen, which is dependent on the concentration of inhaled oxygen, uterine blood flow, the oxygen gradient across the placenta, and the umbilical blood flow.

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 sedative and anaesthetic drugs. Hence when these agents are given to the mother, they rapidly cross the placenta and may cause neonatal respiratory depression.

2. Analgesia

Analgesia is essential to the safe, satisfactory and humane performance of surgical performance and abnormal deliveries. Although analgesia is not absolutely necessary for all spontaneous deliveries, it may relieve unnecessary suffering.

3. Duration

In most surgical procedures analgesia is required for only a few hours. Obstetric analgesia may be required for 12 hours or even longer.

4. Effect on Labour

Analgesic techniques used should exert little or no deleterious effect on uterine contractions and voluntary expulsive efforts.

5. Timing

Surgical patients most often can be prepared for anaesthesia by withholding food and fluid for several hours. Labour begins without warning and obstetrical anaesthesia may be 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.

Mechanisms of Pain Transmission in the Parturient

An understanding of the mechanisms of pain transmission during labour and many factors that influence pain intensity, duration, distribution and quality is essential if optimal labour analgesia is to be provided.

Most of these factors vary as labour progress; thus the stages of labour are considered separately.

Figures. 11.1 and 11.2 are schematics of the peripheral nociceptive pathways involved in the pain of childbirth.

Figure 11.1: Pain pathways in a parturient.

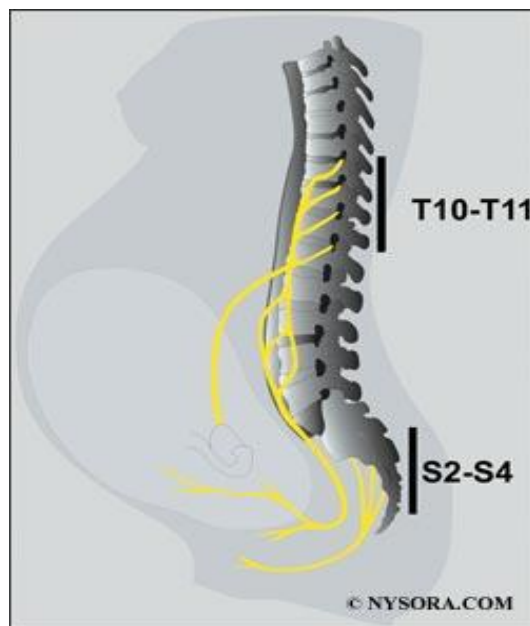
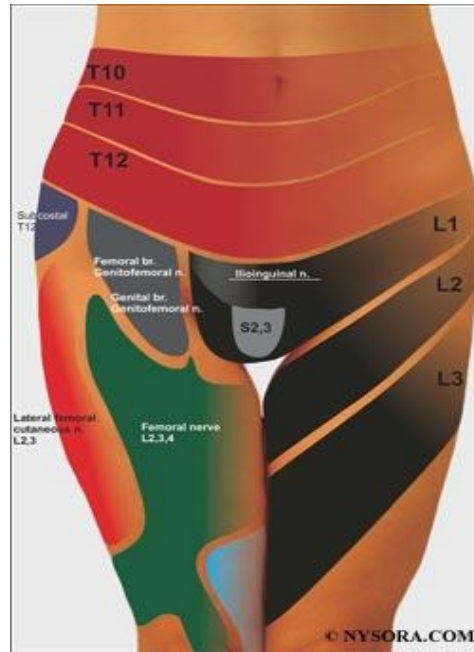


Figure 11.2: Dermatomes of the lower abdomen, perineal area, hips and thighs



Labour pain can be divided into the three stages of labour.

First stage of labour

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 initiating 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 bradykinin, leukotrienes, prostaglandin, serotonin, lactic acid and substance P.

Pain is visceral in nature and it is poorly localized, diffuse, dull and vague. It is usually referred often as periodic and builds to a peak.

The pain fibers are transmitted via T10, T11, T12 and L1 spinal nerves.

Second Stage of Labour

- Pain during second stage occurs when cervix is fully dilated, and continues from the uterine body contractions and distension of the lower uterine segment.
- 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.

- The pain is transmitted via the pudendal nerve, a somatic derivative from the S2, S3 and S4 sacral nerve roots.
- The pain is somatic in nature and is well localized, sharp definite, and intense.

Third Stage of Labour

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.

Factors That May Influence the Pain of Childbirth

Table 11.1 Factors That Influence Pain

Physical	Psychological and Ethnocultural	Proposed Neurohumoral Mechanism
1. Age and parity	1. Attitude towards labour	1. Endogenous opioids
2. Physical condition	2. Fear and anxiety	2. Hormones
3. Size of infant/birth canal	3. Expectation of pain	3. Placenta with or without amniotic fluid substance
4. Abnormal fetal presentation	4. Prior experience of pain	4. Substance P
5. Stages of Labour	5. Knowledge of childbirth	5. Nociceptin / ORL-1 receptor system
6. Speed and Degree of cervical dilatation	6. Support and environment	6. Spinal cord noradrenergic-cholinergic system
7. Frequency of contraction.	7. Confidence to cope with labour	-
8. Maternal position in labour	8. Education and social class	-
9. Menstrual history	9. Culture and Beliefs	-

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.

To identify and understand the pregnancy and labour induced stresses experienced by the labouring woman, it is essential that the anesthesiologist providing obstetric pain relief have an understanding of these physiological changes.

Respiratory System

As pain becomes severe, minute ventilation of the unmedicated parturient increases by 75-150% to 300% during the first and second stages of labour respectively. This results in maternal hypocarbia ($\text{PaCO}_2 \leq 20$ mmHg) and alkalemia ($\text{pH} > 7.55$). Hypocarbia may cause hypoventilation between contractions, which may result in maternal and fetal hypoxia and loss of maternal consciousness.

Potential causes of fetal hypoxaemia during maternal hyperventilation are :

- Uteroplacental and fetoplacental vasoconstriction.
- A left shift of maternal oxyhemoglobin dissociation curve which causes O₂ to be bound tightly to maternal hemoglobin and compromises the transplacental transfer of O₂ to the fetus.

Cardiovascular System

Labour results in progressive increase in maternal cardiac output. Each uterine contraction increases cardiac output by 10-25% and this is associated with a 5-20% 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 caval 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.
- The increase is proportionate to the frequency and duration of uterine contractions.
- Caesarean section under general anaesthesia is associated with marked increase beta-endorphins.
- The increase of endorphins during labour reflects the stress of labour.
- Lumbar epidural analgesia is associated with a 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. Pain resulted in a marked increase in circulating concentration of catecholamines

as well as a 50% decrease in uterine blood flow of the gravid uterus. After administration of epidural analgesia there was a 55% decrease in plasma concentration of epinephrine and a 25% decrease in plasma concentration of norepinephrine (Shnider et.al).

Acid Base Balance

Pain, anxiety and increased skeletal muscle activity (eg. Hyperventilation) during labour may result in both maternal and fetal metabolic acidosis. Woman who received effective analgesia had less metabolic acidosis as did their fetuses than woman who delivered without analgesia (Rooth et.al.).

Effect of Maternal Fear on the Fetus

Maternal fear during labour is a complex response and can 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 physician and nurses may promote or dispel fear 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.

GUIDELINES FOR REGIONAL TECHNIQUES FOR LABOUR ANALGESIA

A. Prior To Performance Of Regional Technique:

- Detailed pre-anaesthetic evaluation is performed, which includes an assessment of patient's medical, surgical and anaesthetic history.
- Consent from patient taken, and risks of regional analgesia discussed.
- Establish intravenous access, minimum 18G cannula.
- Appropriate equipment and supplies for resuscitation should be checked and be immediately available during administration of regional analgesia, including:
 - Oxygen supply.
 - Suction apparatus.
 - Self-inflating bag and for positive-pressure ventilation.
 - Face mask.
 - Laryngoscope with different blades.
 - Endotracheal tubes (sizes 6-7mm).
 - Oropharyngeal airways.
 - Drugs: Thiopentone, Suxamethonium, Atropine, Ephedrine, Phenylephrine, Calcium chloride, Sodium bicarbonate, Naloxone, 20% lipid emulsion (intralipid)

B. Criteria for Initiation of Epidural Analgesia for Labour

- 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).

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 analgesia.

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 that, pain score can be monitored hourly.
- Document lower limb weakness using Bromage score and level of sensory block (if present).
- 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.

PROTOCOLS FOR MANAGEMENT OF LABOUR PAIN

1. Lumbar Epidural
2. Combined Spinal-Epidural
3. PCA fentanyl

1. Lumbar Epidural

Patient Controlled Epidural Analgesia

- Insert epidural catheter
- Administer Test dose (see Table 11.2)
- 5 mins after the test dose, if no complications occur, patient controlled epidural analgesia (PCEA) is started, using either PCEA Regime 1 or 2 (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.
- 6. 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.

Continuous 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)
- 7. 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.
- 8. 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.

Table 11.2 Labour Epidural Infusion Regimes

	PCEA Regime 1	PCEA Regime 2	Continuous infusion
Drug	0.05% Ropivacaine + Fentanyl 2 mcg /ml	0.1% Levobupivacaine + Fentanyl 2 mcg /ml	0.1% Ropivacaine or 0.1% Levobupivacaine + 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 10 mls	10-15 mls 0.1% Ropivacaine OR 0.1% Levobupivacaine + Fentanyl 50-100 mcg
PCEA Settings or Infusion Rate	Bolus 10 mls Lockout interval 10 mins Basal infusion 10 mls/hr One hour limit not set	Bolus 5 mls Lockout interval 10 mins Basal infusion 5 mls/hr 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	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% Levobupivacaine + Fentanyl 50 mcg

2. 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.

CSE followed by Continuous infusion 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 bolus 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.

CSE followed by PCEA

PCEA may also be used, following the PCEA Regime 1 or 2 (see Table 11.2)

CSE followed by continuous infusion

A continuous infusion may also be used via the epidural catheter (see Table 11.2)

Ambulation

- Ambulation should only be considered 45 minutes after initiation of block and more than 15 minutes after the last top-up, and only if maternal and fetal observations are satisfactory.
- 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:
 - a. Patient able to sustain straight leg raise for ≥ 5 sec. on each side.
 - b. Patient able to weight bear - this must be tested with the help of two staff members.
 - c. Patient should only ambulate within the Labour room and must be accompanied by a nurse at all times.

3. PCA Fentanyl

- This 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 (e.g. 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 technique². 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

MANAGEMENT OF COMPLICATIONS OF REGIONAL ANALGESIA

Hypotension

Hypotension is defined as a 20-30% decrease in systolic blood pressure (compared with baseline) or Systolic blood pressure of less than 100mmHg.

Maternal hypotension and its complication can be minimized or avoided in many cases if the anaesthesiologist appropriately assess the mother's fluid and cardiovascular status before proceeding with regional anaesthesia, and treats the hypotension promptly.

Management:

- a. Administer only as much local anaesthetic to relieve maternal pain, as this will reduce the extent of sympathetic block and hence reduce the risk of hypotension. Dose should be titrated to the minimum dose necessary to achieve sensory analgesia.
- b. Position patient to ensure Left Uterine Displacement (LUD).
- c. Administer IV fluids and supplement oxygen.
- d. Administer IV Phenylephrine 50-100 mcg or Ephedrine (6-30mg) if the above measures do not result in prompt increased BP.
- e. If maternal bradycardia is observed, administer IV Atropine (0.4-1 mg) to block any untoward vagal overactivity that may be contributing to the hypotension.
- f. If there is profound hypotension, further investigation should be made to determine whether an accidental intrathecal injection has occurred.

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 anaesthesiologist and obstetric specialist 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 should be removed only by the OAS team.³ 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.

Post Dural Puncture Headache (PDPH)

- **Definition:** Severe postural headache 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
- **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 and 15% will be severe, incapacitating and always require treatment.
- **Characteristics:** Severe, typical occipital and bifrontal headache, occurring when patient sits or stands and relieved 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

- Meningitis
- Cerebral infarction
- Cerebral haemorrhage
- Migraine
- Pre-eclampsia
- Metabolic (hypoglycaemia, electrolyte imbalance)

Management of PDPH

- Explanation and reassurance to the patient.
- Daily (at least once) review and record, by anaesthesiology medical officer and patient alerted to the specialist/consultant in-charge of obstetrics of the day.
- 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 over 24 hours. Analgesia: Use **regular** paracetamol and NSAID, providing the latter is not contraindicated. Supplemental parenteral opioids are frequently required.

- Suggested regime:
 - T. PCM 1g QID
 - T. Diclofenac 50 mg TDS
 - T. Tramadol 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 cola 40 mg. Note this may be a cause of irritability in breastfed babies.
 - Patient should be primed for possibility of an epidural blood patch on the first visit.
- 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 has a much higher failure rate than after 24 hours.
- Prophylactic blood patching for accidental dural puncture is not widely accepted and carries potential risks for patients who may not develop headache.
- Ensure the patient does not have local or systemic sepsis (examination, white cell count, temperature).

Management of a blood patch procedure.

- Explain procedure and obtain consent.
- IV access and infusion of crystalloid.
- 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.
- Identify epidural space in the usual manner.
- Withdraw 20ml of venous blood from non-drip arm under aseptic conditions.
- Slowly inject blood into the epidural space via the Tuohy needle. Stop once 15-20 mls has been given or sooner if back pain or cessation of headache occurs.
- 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 is 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

Unintentional Intravascular Injection of Local Anaesthetic

Intravenous injection of large doses of local anaesthetic causes CNS symptoms (e.g. restlessness, dizziness, tinnitus, confusion, seizures and loss of consciousness). Convulsions result in serious damage to mother and fetus. It also causes serious CVS effects (e.g. bradycardia, arrhythmias, depressed ventricular function, ventricular tachycardia and fibrillation and cardiac arrest). Bupivacaine cardiotoxicity may be fatal in pregnant women.

Management of Unintentional Intravenous injection of Local Anaesthetic:

- Stop convulsions with a barbiturate or benzodiazepine
- Maintain **Airway** and **Breathing** by administering 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 Appendix 8: Management of Severe LA Toxicity
- Prevent maternal respiratory and metabolic acidosis.

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, or
- 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 of Total Spinal:

- High spinal anaesthesia may occur several minutes after an epidural injection of local anaesthetic.
- Communicate with the patient. Agitation, dyspnoea, and difficulty may herald the onset of total spinal anaesthesia.
- Avoid aorto-caval compression.
- Maintain **Airway** and **Breathing** by administering 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 (Phenylephrine 50-100mcg or Ephedrine 6-30 mg) as needed. Do not hesitate to give Adrenaline if needed
- Monitor maternal blood pressure, ECG, oxygenation and fetal heart rate

Inadequate Analgesia

The 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 (e.g. obesity, abnormal lumbar spine anatomy, depth of epidural space, longitudinal connective tissue band between the dura) increase the likelihood of an unsatisfactory result.

Management of an inadequate epidural block:

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 50-100 mcg 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

Pruritus

Pruritus is the most common side effect of intrathecal opioid administration. It 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.

Management of Pruritus:

- Reassurance, as effects are normally transient and self limiting
- In severe cases, titration of IV Naloxone 40 mcg every 5 minutes up to 400 mcg or intravenous Nalbuphine 2.5 – 5mg
- Avoid antihistamines as it may cause more sedation and increase the risk of respiratory depression

POST-OPERATIVE ANALGESIA

Objectives:

- To provide an appropriate management plan for analgesia following a routine caesarean section using a multimodal approach.
- To provide safe and effective post-operative analgesia that is safe for both mother and baby

Options:

- Intrathecal Morphine
- Epidural Morphine
- Epidural cocktail
- Patient Controlled Analgesia (PCA) using morphine

All the techniques above should be supplemented with oral or suppository Paracetamol and/or NSAIDs.

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-dependent 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 labialis reactivation; a 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 – 0.2 mg (100 - 200 mcg)
- Example : To prepare 0.15mg :
 - Take 1 mg (0.1ml) of Morphine in 1 ml syringe. Add 0.9ml 0.5% Heavy Bupivacaine and discard 0.85 ml. Administer the remaining 0.15ml (150 mcg) morphine with the desired amount of 0.5% heavy Bupivacaine +/- Fentanyl

A typical patient may be given 1.8 ml heavy Bupivacaine + 22.5 mcg Fentanyl (0.45ml) + 150 mcg morphine (0.15ml) = total volume 2.4 mls. 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.
- No other sedative or parenteral opioids in the first 24 hours.

Management of Side Effects

Pruritus

- Face, nose and upper extremities are the areas involved
- Possible mechanism – μ receptor mediated, stimulation of trigeminal nerve, oestrogen, itch centre in the brain
- Usually requires no treatment. Reassure patient that the presence of this side effect indicates that the morphine is working and it should subside within a day
- Administer IV Naloxone 40 mcg boluses to effect if required (maximum 400 mcg total) in extreme cases.
- Avoid Antihistamines – this will cause sedation and is not the proper antidote as this side effect is not an allergic reaction

Nausea and vomiting

See “*Prevention and management of postoperative nausea and vomiting associated with caesarean section*”

Inadequate analgesia

- This is extremely uncommon, particularly if combined with NSAIDs and women 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 / anaesthesiologist.
- Administer high-flow oxygen via face-mask
- Administer Naloxone 0.1mg IV or subcutaneous and titrate to effect up to 0.4mg

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.

Indications

- 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

Technique

- Administered at the end of surgery
- Dose: 3 mg
- To prepare: Take 10 mg (1 ml) of Morphine in 10 ml syringe. Add 9 ml normal saline and discard 7 ml. Administer the remaining 3 ml (3 mg) Morphine and flush the catheter with 2 mls normal saline.
- Epidural catheter to be removed in OR before discharge to the ward. Document complete removal of catheter.

Post-operative Management

- Routine post-caesarean section observations - hourly pulse, respiratory rate and blood pressure for four hours and then 4-hourly.
- 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 patients medication chart to remind 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

Epidural cocktail

When neuraxial morphine is contraindicated, epidural cocktail of 0.1% Ropivacaine + Fentanyl 2mcg/ml can be administered during the postoperative period as part of a CSE or epidural technique.

Patient controlled analgesia

- Following LSCS done under GA or when regional technique is contraindicated.
- Morphine is the drug most commonly used.
- If patient is allergic to Morphine --> Fentanyl or Tramadol would be the alternatives
- Anaesthetic MO need to fill-up relevant forms and arrange for PCA pump as for any other post-op patient on PCA
- No opioids / sedatives should be given while PCA is in progress. If pain relief inadequate, please inform the OAS team.

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

- 50-100 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 mild-moderate analgesic agents. However, it is still useful as part of the multimodal approach of pain management.

Tramadol (50-100 mg tds) can be used as an alternative if there are contraindications for the use of Diclofenac or paracetamol but can only be initiated 24 hours after spinal/epidural Morphine (will cause more PONV). Tramadol also interacts with 5HT3 antagonists (Ondansetron, Granisetron) making both drugs less effective.

Prevention of Post-operative Nausea and Vomiting (PONV) Associated with Caesarean Section

- Higher incidence following spinal, epidural and PCA Morphine
- The risk assessment for PONV based upon the following 4 factors:
 1. Female sex
 2. Non-smoking status
 3. History of PONV or motion sickness
 4. Post-operative opioid use

Table 11.3: Incidence of PONV by Number of Risk Factors

Number of Risks	Incidence of PONV (%)
0	10
1	20

2	40
3	60
4	80

- Prophylaxis to be given in OT after clamping of the umbilical cord
- All patients : IV Dexamethasone 8 mg + IV Ondansetron 4mg or Granisetron 1 mg
- For treatment of PONV in ward if the above measures failed (to be ordered by anaesthetic MO):
- IV Metoclopramide 10mg 8 hourly/PRN or repeat IV Ondansetron 4 mg or Granisetron 1 mg stat dose for severe PONV

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 however 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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CHAPTER 12

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 (McGrath 2004). Uncontrolled pain can lead of prolonged stay in the day surgery unit and is a major cause of nausea and vomiting, which further delays discharge. Pain also limits early mobilisation 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 carers 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 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 according to 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 hemodynamic 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:
 - Interscalene nerve block 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 block for surgery to the elbow, forearm and hand.
 - Axillary nerve block 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 block

- Intrathecal (spinal) anaesthesia may be performed for operations such as knee arthroscopy, and other lower limb surgery.
- As with all regional blocks, supplementation with other forms of analgesia should 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.
- Low dose low concentration local anaesthetic given spinally with the addition of a short acting opioid (fentanyl) gives good postoperative analgesia and a smooth transition to oral analgesia.
- 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 is fully worn off, and this may take some hours.

B. Parenteral and oral analgesics

Paracetamol (PCM)

1. May be used
 - Orally as premedication or postoperatively in the day surgery ward.
 - Rectally after induction of anaesthesia. Note that patients and/or parents should be informed of the intention to use rectal administration of drugs.
2. It is often used in combination with other drugs, such as weak opioids and NSAIDs, as part of balanced analgesia.
3. Paracetamol may be given in doses limited to 4 g/day in adults. It should be used with caution in patients with liver disease.

Non-steroidal anti-inflammatory drugs (NSAIDs) & Cyclo-oxygenase2 inhibitors (Coxibs)

1. NSAIDs or Coxibs are the drugs of choice and form the basis of most day surgery analgesic regimes, in patients with no contraindications.
2. NSAIDs or Coxibs may be used:
 - Orally as premedication or postoperatively in the day surgery ward.
 - Rectally after induction of anaesthesia. Note that patients and/or parents should be informed of the intention to use rectal administration of drugs.
 - Intravenously at or after induction of anaesthesia.
 - Intramuscular NSAIDs should be avoided. Diclofenac given IM can lead to haematoma and abscess formation.

(For doses of the different NSAIDs and Coxibs, please refer to the Drug Formulary, Appendix 9)

Morphine

The routine use of morphine is not advisable for day surgery as it causes significant nausea and vomiting and excessive sedation.

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 treatment of severe pain in the Post-Anaesthesia Care Unit (PACU)
3. High dose fentanyl should be avoided as it can lead to postoperative nausea and vomiting (PONV) and somnolence.

Oxycodone

1. Oxycodone is available as IV or oral preparations. IV oxycodone may be used for intraoperative analgesia or in the PACU.
2. Oral oxycodone (immediate release (IR) formulation) may also be used for postoperative analgesia in the PACU and continued at home.

Remifentanyl

1. Remifentanyl has limited use in day surgery because of its extremely short duration of action.

Tramadol

1. Tramadol is useful for postoperative analgesia in patients whose pain is expected to be moderate to severe. It can be administered IV or orally.
2. Its main disadvantage is a high incidence of nausea and vomiting.
3. The commonly used dose of Tramadol is 50 mg 6-8 hourly.
4. Ultracet ®, a combination of Tramadol 37.5 mg and Paracetamol 325 mg, may also be used for postoperative analgesia.

Codeine / Dihydrocodeine

1. Dihydrocodeine is safe and is effective for postoperative analgesia in patients with moderate pain. Only oral Dihydrocodeine is available (DF118).
2. Codeine is only available in combination with paracetamol, as an oral preparation (Panadeine ®)

Pain management in the Post-Anaesthesia Care Unit (PACU)

- Whatever the intraoperative analgesia used, additional analgesia is necessary for those patients with moderate to severe pain (pain score ≥ 4) in the RR.
- Rapid and short-acting IV opioids may be titrated to the desired effect. Fentanyl is the opioid of choice in the immediate recovery period. IV fentanyl 10-20 mcg boluses can be given repeatedly at 3 to 5 minute intervals while closely monitoring the patient's sedation score, respiratory rate and haemodynamics.
- Supplementary analgesics should also be given, to take effect as the short-acting opioid wears off or to take effect before any regional block wears off.
- Any unexplained pain must be evaluated by the surgical team.

Pain management in the Day Surgery Unit before discharge

1. There should be a smooth transition to oral medications in the Day Surgery Unit and patients are allowed to take them as soon as they can tolerate orally.

2. For mild to moderate pain, oral analgesics are usually sufficient. Paracetamol, NSAIDs or COX-2 inhibitors are the first line of treatment if not given intra- or pre-operatively.
3. For moderate to severe pain requiring rapid relief, parenteral opioids such as IV Tramadol 0.5-1mg/kg or IV Oxycodone 2-5 mg in titrated doses, may be used. Alternatively, oral drugs such as Tramadol 50 mg or IR oxycodone (Oxynorm ®) 5-10 mg may be used.

Non-pharmacological methods of pain management

Non pharmacological techniques are useful in Day Surgery patients and include the following:

1. Physical methods (RICE - Rest, Ice, Compression, Elevation)
 - a. Ice packs help reduce oedema, reduce muscle spasm and alter the patient's pain threshold.
 - b. Bandages immobilize and reduce pain but if applied too tightly, they can increase postoperative pain and local oedema, impede the patient's ability to mobilize and early return to function.
 - c. Elevation of the affected part (e.g. above the heart level for upper limbs) reduces oedema which is a significant cause of pain immediately after surgery.
2. Transcutaneous electric nerve stimulation (TENS) has been shown to be useful in allowing an increased range of function in patients postoperatively, reducing their pain scores and requirements for analgesia.
3. Reassurance, relaxation and distraction, hypnotherapy, aromatherapy, yoga acupuncture and music therapies may reduce pain and anxiety postoperatively.

Analgesic therapy on discharge

1. The clinician should review the patient prior to discharge, assess the efficacy of pain relief and provide specific drugs and discharge instructions.
2. Patients should be comfortable and their pain controllable with oral analgesics before they are discharged from the day surgery unit.
3. Patients must be provided with an adequate supply of analgesics to take home.

4. Comprehensive written information about when and how often to take the analgesic medications must be given to the patient as well as the carer, because of the amnesic effects of certain anaesthetic agents.
5. An emergency telephone number (depending on your hospital protocol) should be given to the patient in case problems persist.
6. It is important to encourage patients to take analgesics pre-emptively and regularly, starting before the effect of the local anaesthetic has worn off.
7. Before going to bed, oral analgesia should be taken so that the patient does not wake up in severe pain.
8. Postoperative telephone calls should be made to check on patients at home. After discharge, patient follow-up is essential to monitor the effectiveness of pain treatment.

Analgesia according to the anticipated severity of pain

1. The degree of postoperative pain can be anticipated by the surgery type and the pain managed accordingly. As far as possible, all pain should be treated, whether it is mild, moderate or severe.
2. Table 12.1 lists the anticipated severity of pain for common day surgery procedures together with the recommended perioperative analgesia. As different patients may experience different levels of pain perioperatively, the analgesia will still have to be titrated to the patient's needs.
3. Before discharge from the Day Care Unit, the patient should not experience more than mild pain (i.e. pain score ≤ 3)
4. Table 12.2 gives the suggested analgesic regimes for take-home analgesia according to the anticipated severity of pain. The amount of analgesia required in the PACU can be used as an indicator for the analgesic requirements at home.

Special considerations

Groups of patients requiring special considerations include the following:

1. Elderly patients

- a. May develop oversedation disproportionate to the amount of opiate administered, and dosages should be reduced appropriately.
- b. Problems of dementia, deafness and visual disturbances may make pain assessment difficult.
- c. Be careful of renal toxicity and gastric irritation with the use of NSAIDs.

2. **Cognitively impaired**, emotionally disturbed and non-English/non-BM speaking patients require extra explanation, attention and time with interpreters or specialized health care workers.
3. **Patients with chronic pain** on opioids prior to surgery may require higher starting and maintenance doses postoperatively.
4. **Patients who receive central neural blockade** (e.g. spinal anaesthesia) for the surgery should have return of their motor and sensory function and preferably void before discharge. Those who have residual numbness after limb anaesthesia should be advised about limb protection. Supplementary analgesics should be given before the block wears off.

Conclusion

- Satisfactory pain control is pivotal to the success and popularity of day surgery. As more extensive and painful procedures are being performed as day surgery, 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.

Table 12.1: Anticipated Postoperative Pain by Surgery and Selection of Peri-operative 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 Curretage Hysteroscopy Other 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/Coxibs + Paracetamol	Oral NSAIDs/Coxibs + Paracetamol	Oral NSAIDs/Coxibs + 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/Coxibs + Paracetamol (if not given preop)	Oral NSAIDs/Coxibs (if not given preop) Oral or IV Tramadol Oral Oxynorm IV fentanyl (titrated to effect)	Oral NSAIDs/Coxibs (if not given preop) Oral or IV Tramadol Oral Oxynorm IV fentanyl (titrated to effect)

*For cases done by anaesthesiologists

Table 12.2: Suggested Regime for Home Analgesia in Adult Day Surgery Patients according to Pain Severity **

MILD PAIN	MODERATE PAIN	SEVERE PAIN
Non-drug techniques RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.	Non-drug techniques RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.	Non-drug techniques RICE (Rest, Ice, Compression, Elevation), Relaxation, Distraction, etc.
Regular Oral Paracetamol OR / AND Regular / PRN Oral NSAIDs or Oral COX2 inhibitors	Regular Oral Paracetamol OR / AND Regular / PRN Oral NSAIDs or Oral COX2 inhibitors	Regular Oral Paracetamol OR / AND Regular / PRN Oral NSAIDs or Oral COX2 inhibitors
	PRN Oral Tramadol or Oral Oxycodone (Oxynorm)	Regular and PRN Oral Tramadol or Oral Oxycodone (Oxynorm)

**Patients with contraindications to NSAIDs / PCM are excluded from this regime.

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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 pathology.
- Mechanisms underlying chronic pain include a complex interaction of physiological, emotional, cognitive, social, and environmental factors.

Table 13.1: Differences between Acute and Chronic 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 an injury	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 resulting from damage to the central or peripheral 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 when 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: <ul style="list-style-type: none"> • 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 a 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 single 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 the fact that the injury has healed. Duration of pain is usually more than 3 months. Patients often 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. Diabetic peripheral neuropathy c. Post spinal cord injury pain d. Central post-stroke pain
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Table 13.2: Summary of Differences between Acute and Chronic Pain

Acute pain	Chronic Pain
Symptom	Disease
Tissue injury/inflammation	Tissue injury may not be present OR pain persists even after tissues have healed
Onset recognizable	Gradual onset
Short-term-resolves when tissue heal	Long term-does not resolve despite healing/no injury
Warning sign	False alarm
Psychological impact(anxiety)is usually short term	Associated with psychological problems e.g. depression,anger,fear

Making a diagnosis of chronic pain

- History of the presenting complaint in detail including a past medical and surgical history, family, social and psychological evaluation
- A thorough physical examination
- A review of available records, investigations, previous treatments and current medications
- A working diagnosis

Principles of management of chronic non-cancer pain

- Make a diagnosis - differentiate between acute and chronic pain.
- The patient may already be known to have chronic pain e.g. in emergency department where s/he is a “regular visitor” 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.

- All patients with chronic pain who are coming for repeated admissions or treatment because of pain should be referred to a Pain Service.
- Analgesic management of patients with chronic non-cancer pain in the ward:
 - Avoid Inj. Pethidine and other injections (e.g. IM Diclofenac). Pethidine is not recommended in chronic pain conditions because of its high addiction potential.
 - Give regular oral analgesics e.g. Tramadol 100 mg QID + Paracetamol 1 gram QID
 - If you suspect neuropathic pain, add antineuropathic agents like 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.
- Other management of the patients with chronic non-cancer pain in the ward:
 - Refer to a physiotherapist 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 (as described in no. 4 above).
 - Refer to a pain clinic for assessment and follow-up.
- 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 a doctor.
 - Physical assessment to look for primary and secondary musculoskeletal effects of chronic pain. This is usually done by 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 management plan (short term and long-term). This usually
 - pharmacotherapy, using appropriate drugs
 - nerve blocks and other interventions,
 - active physiotherapy, including exercises and activities that patients can do at home
 - psychological therapy, including relaxation training and other pain management strategies
 - 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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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.
- If you are unsure about what analgesic technique to use please discuss it with your specialist before informing the patient.
- Patient should be well informed and educated regarding mode, benefits of analgesia and possible complications.
- The choice of analgesia explained to the patient should be documented in the anaesthetic record (GA form).

II. Responsibility of Medical Officers in the Operating Theatre

- To fill up the APS Audit Form 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 drug 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 $\leq 4/10$ 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

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 mcg

Lockout interval = 3 min

3 Patients on Subcutaneous morphine

<60 years: 5 - 10mg 4 hourly

>60 years: 2.5 - 5mg 4 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 $\leq 4/10$.
- 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 drugs are given; 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

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 taking orally and can take oral analgesics.
- The patient on PCA requires less than 10 mg/day of morphine.
- The epidural has been in situ for 3-5 days, remove the epidural catheter as risk of infections 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 depending on the WHO analgesic ladder)

Oral analgesics available and standard dose 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 more than 4/10.

See the patient as soon as possible 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 5 mls of 1-2% 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 1-2% 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**. 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, 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 Metoclopramide 10-20mg tds
- IV/PO Ondansetron 4 mg tds
- IV Granisetron 1-3 mg od/bd

4) **Pruritus**

- Reassurance
- Calamine Lotion
- Naloxone 40 mcg titrating to a max of 400mcg
- 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


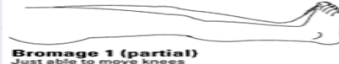


- Sedation Score =2 and Respiratory Rate < 8/min
- Sedation Score =3 regardless of Respiratory Rate
- pin point pupils

Management

- Stop APS technique
- Oxygen at 3L/min via nasal prong/face mask where necessary
- Stimulate and encourage patient to breath
- IV Naloxone 0.1mg boluses every 1-2mins until patient wakes up or RR >10
- Monitor SaO₂, 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 to exclude nerve injury
- Reassure the patient
- Reduce the infusion rate and add oral analgesic if tolerating orally
- Change to epidural opioid or use PCA morphine.
- Inform specialist if Bromage score ≥ 2 ; **it is absolutely essential to rule out** other causes such as epidural haematoma and CNS infections

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

VIII: Recommendations on Neural Blockade and Anticoagulant Refer to Appendix7

APPENDIX 2: NURSING OBSERVATION CHART

PCA	EPIDURAL	PCEA	NERVE BLOCK	OTHERS
MORPHINE △	COCKTAIL	COCKTAIL	* UPPER LIMB	INTRATHECAL OPIOID
FENTANYL △	-Bupivacaine △	-Bupivacaine △	BRACHIAL	- fentanyl △
OXYCODONE △	-Ropivacaine △	-Ropivacaine △	PLEXUS	- morphine △
OTHERS △	-Levo- bupivacaine △	-Levo- bupivacaine △	BLOCK	- others △
Conc.....mg/ml	PETHIDINE △	OTHERS △	- interscalene △	Dose.....mg
Bolus Dose	OTHERS △	Conc... + Fentanyl	- supraclavicular △	INTRAVENOUS OPIOID
.....mg	Conc.....+ Fentanyl	..... mcg/ml	- infraclavicular △	INFUSION △
Lockout.....mins	.....mcg/ml	Bolus dose.....ml	- axillary △	Drug.....
Background	Infusion	Lockout.....mins	* LOWER LIMB	Bolus Dose.....mg
.....ml/hr	Rate.....ml/hr	Background.....ml/hr	FEMORAL BLOCK △	Conc..... mg/ml
Loading Dose	Epidural inserted	Loading Dose	SCIATIC NERVE BLOCK △	Infusion Rate.....ml/hr
.....mg at	by.....	..... ml at.....hr	3 in 1-BLOCK △	SUBCUTANEOUS MORPHINE △
.....hr	Level:	Epidural inserted	OTHERS △	OTHER TECHNIQUES △
	Anchored at	By.....	Drug.....	.....
	skin.....cm	Level:	infusion.....ml/hr	
		Anchored at skin.....cm		

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. **Monitoring**
Record 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 10 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/Anaesthesia MO 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**
Give the patient IV Metoclopramide (Maxolon) 10mg 8hrly PRN, if still no relief, call APS Team
 - iv. Any persistent **numbness or weakness (Bromage score>2)**, call APS Team
 - v. **Other Problems**
For inadequate analgesia (Pain Score>4), call the APS Team 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

<u>PAIN SCORE</u>	<u>SEDATION SCORE</u>	Bromage Score												
<p>VISUAL ANALOGUE SCORE</p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; width: 200px; height: 20px; margin: 0 10px;"></div> </div> <p style="margin-top: 10px;"> 0 5 10 </p> <p style="margin-top: 5px;"> No Pain Worst Pain </p>	<p>0 = Patient is awake</p> <p>1 = Mild (occasionally drowsy)</p> <p>2 = Moderate (frequently drowsy, easily rousable)</p> <p>3 = Severe (difficult to rouse)</p> <p>S = Sleeping (easy to rouse)</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="text-align: center;"></td> <td style="font-size: 8px;">No Residual Motor Block; Full flexion of knee and feet</td> <td style="text-align: center; vertical-align: middle;">0</td> </tr> <tr> <td style="text-align: center;"></td> <td style="font-size: 8px;">Partial Block Remains: just able to flex knees with free movement of feet</td> <td style="text-align: center; vertical-align: middle;">1</td> </tr> <tr> <td style="text-align: center;"></td> <td style="font-size: 8px;">Almost complete block; only able to move feet; Unable to flex knee</td> <td style="text-align: center; vertical-align: middle;">2</td> </tr> <tr> <td style="text-align: center;"></td> <td style="font-size: 8px;">Complete Motor Block; Unable to move feet or knees</td> <td style="text-align: center; vertical-align: middle;">3</td> </tr> </tbody> </table>		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
	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

Name: R/N:

Age/Sex: Unit/Ward: Weight:kg BMI:.....

Medical problems: ASA:

Diagnosis: Operation:

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 △
OXYCODONE △	-Ropivacaine △	-Ropivacaine △	PLEXUS	- morphine △
OTHERS △	-Levo- bupivacaine △	-Levo- bupivacaine △	BLOCK	- others △
Conc.....mg/ml	MORPHINE △	OTHERS △	-interscalene △	Dose.....mg
Bolus Dose.....mg	PETHIDINE △	Conc.....+ Fentanyl...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 △	OTHER TECHNIQUES
	Anchored at skin .....cm	Level:	Drug.....	.....
	Length of catheter in space	Skin to space .....cm	Bolus..... mls	
	.....cm	Anchored at skin.....cm	given at .....(time)	
		Length of catheter in space.....cm	Infusion.....ml/hr	

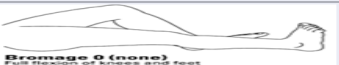



PCA EPIDURAL PCEA NERVE BLOCK OTHERS

Drug Used: Anticoagulant:

DATE								
TIME								
Seen by								
Dose used								
Pain score at rest								
Pain score with activities								
Heart Rate (HR)								
Blood Pressure (BP)								
Sedation score								
Respiratory Rate (RR)								
Nausea /vomiting(Worst score)								
Pruritus (Worst score)								
Numbness(dermatome)								
Motor weakness (Bromage Score)								
Urinary retention (Y /N), CBD present?								
Able to sleep? (Y/N)								
Ambulation (Y/N)								
Epidural site								
Plan								

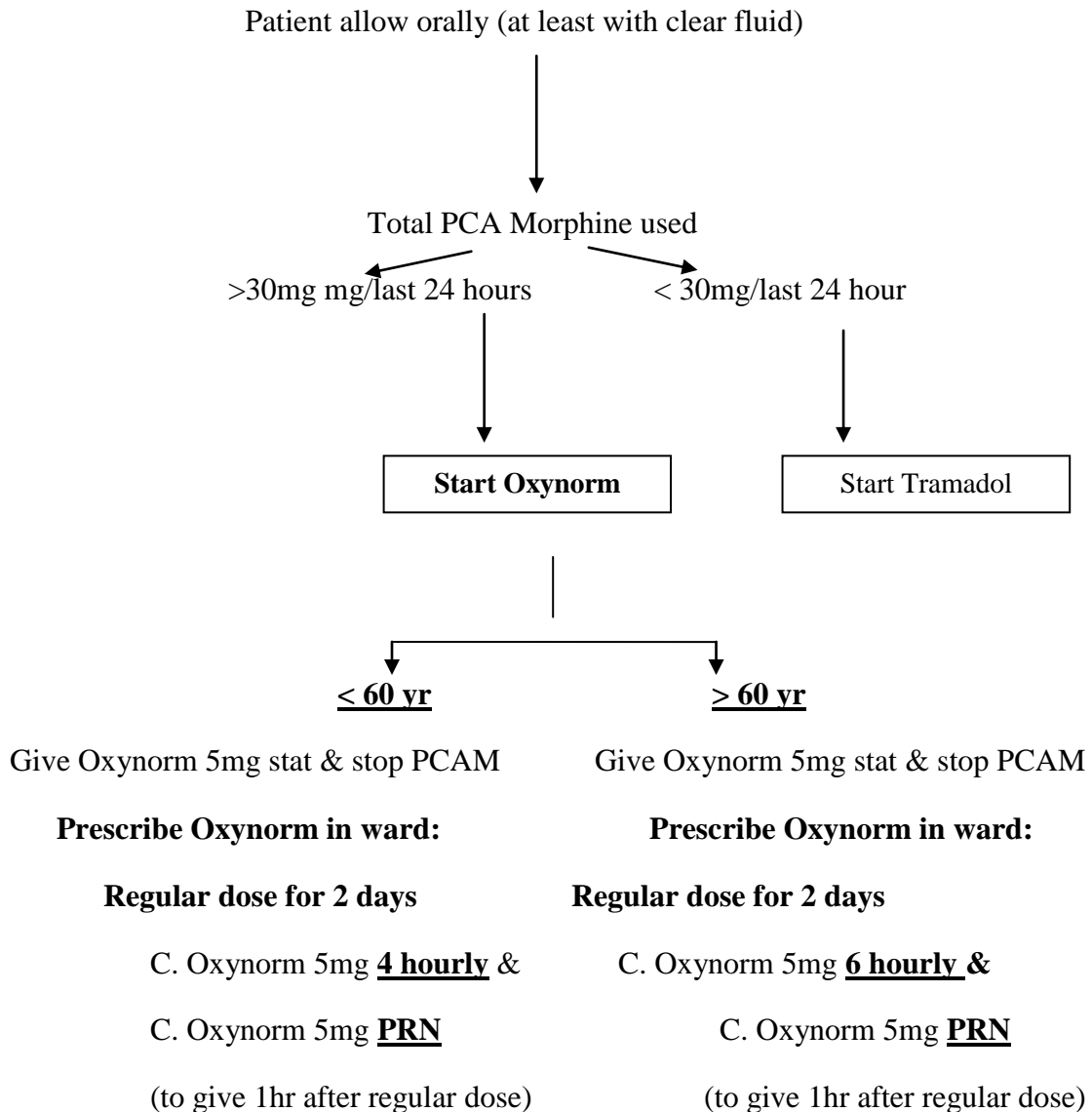
Level of Satisfaction: Excellent Good Satisfactory Poor

Complication score: 0 = none
 since last review 1 = mild, no treatment needed
 2 = moderate, helped by treatment
 3 = severe, despite treatment

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

APPENDIX 4: GUIDELINE FOR USE OF OXYNORM[®]

USE OF OXYNORM[®] IN PATIENT WEANED OFF PCA MORPHINE



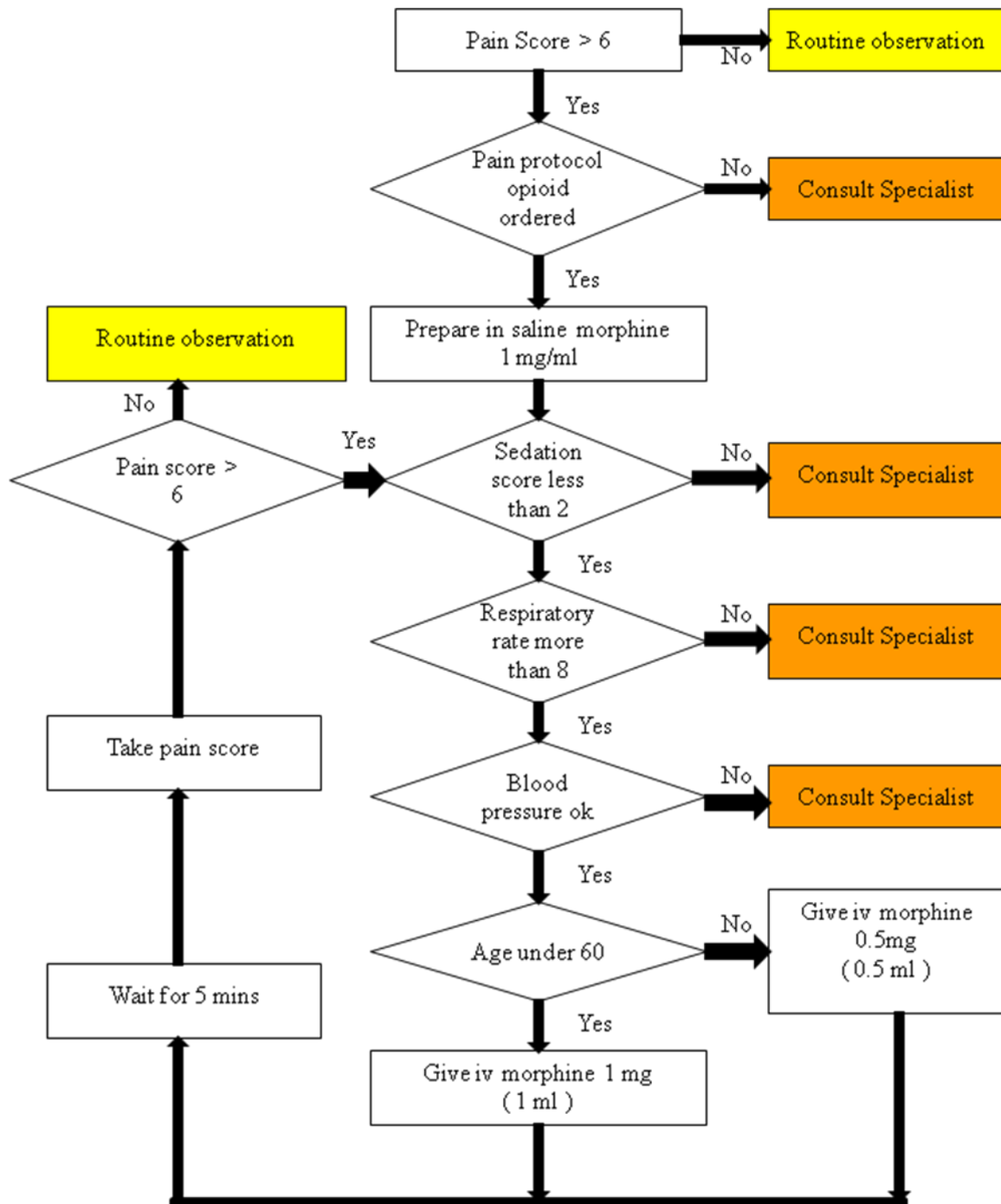
****Continue/combine with regular Paracetamol ± NSAID/Cox II unless contraindicated**

****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 PAIN PROTOCOL (ADAPTED FROM THE ACUTE PAIN SERVICE, ROYAL ADELAIDE HOSPITAL, SOUTH AUSTRALIA)



APPENDIX 6: ANALGESIC LADDER OF ACUTE PAIN MANAGEMENT

MILD		MODERATE		SEVERE		UNCONTROLLED
				7-10		To refer to APS for: PCA or Epidural or others
1 - 3		4-6		7-10		
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 400 mg / day) DF118 30-60mg 6 -8 hrly	Regular Tramadol 50-100mg QID OR Morphine 5-10 mg 4hrly SC/IV + PCM 1gm QID ± NSAID / COX2 inhibitor	PRN Morphine 4hrly oral/SC/IV Oxynorm 5-10 mg 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
- NSAIDs should be used with caution in patients with asthma, thrombocytopenia, coagulopathies, and renal, hepatic or cardiac impairment.
 - 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.
 - In the elderly (over 65 years), avoid or consider using a lower dose of NSAID
 - Those at risk of GI problems or with symptoms (epigastric pain) may be “buffered” with Proton Pump Inhibitors.
 - For those with severe pain, use SC or IV morphine and titrate to comfort (see appendix 5 Morphine Pain Protocol)
 - Used of Oxynorm only for APS team
 - Refer to APS team for uncontrollable severe pain

APPENDIX 7: Neural Blockade and Anticoagulant

Drug	Time to peak effect	Elimination Half-life	Acceptable time after drug for block performance	Acceptable time for next drug dose after block	Acceptable time after drug for catheter removal	Acceptable time after catheter removal for next drug dose
Heparin						
UFH s.c. prophylactic	<30 min	1-2 h	4 h and normal APTT	1h	4 h and normal APTT	1h
UFH i.v. treatment	<5 min	1-2 h	4 h and normal APTT	4h	4 h and normal APTT	4h
LMWH s.c. prophylactic	3-4 h	3-7 h	12h	4h	12h	4h
LMWH s.c. treatment	3-4 h	3-7 h	24h	4h	24h	4h
Heparin alternatives						
Fondaparinux	1-2 h	17-20 h	>36 h	12 h	42 h	12 h
Antiplatelet Drugs						
NSAIDs	1-12 h	1-12h	No additional precautions			
Aspirin	12-24 h	Not relevant irreversible effect	No additional precautions			
Clopidogrel	12-24 h		7days	Contraindicated while catheter in place		6 h
Ticlopidine	8-11 days		10 days			6 h
		24-32 h but 90 h in chronic use				

Drug	Time to peak effect	Elimination Half-life	Acceptable time after drug for block performance	Acceptable time for next drug dose after block	Acceptable time after drug for catheter removal	Acceptable time after catheter removal for next drug dose
Dipyridamole	75 min	10 h	No additional precautions			6 h
Oral Anticoagulants						
Warfarin	3-5 days	4-5 days	INR \leq 1.4	After catheter removal	INR \leq 1.4	1 h
Rivaroxaban	3 h	7-9 h	21 h	5 h	Manufacturer recommends caution with use of neuraxial catheters	
Dabigatran†	0.5---2.0 h	12-17 h	36 h	6 h		
Thrombolytic drugs						
Streptokinase	<5 min	4-24 min	Contraindicated		Not applicable	10 days

Abbreviations

UFH = unfractionated heparin, APTT = activated partial thromboplastin time, LMWH = low molecular weight heparin, s.c. = subcutaneous, i.v. = intravenous, NSAIDs = non-steroidal anti-inflammatory drugs, INR = international normalised ratio

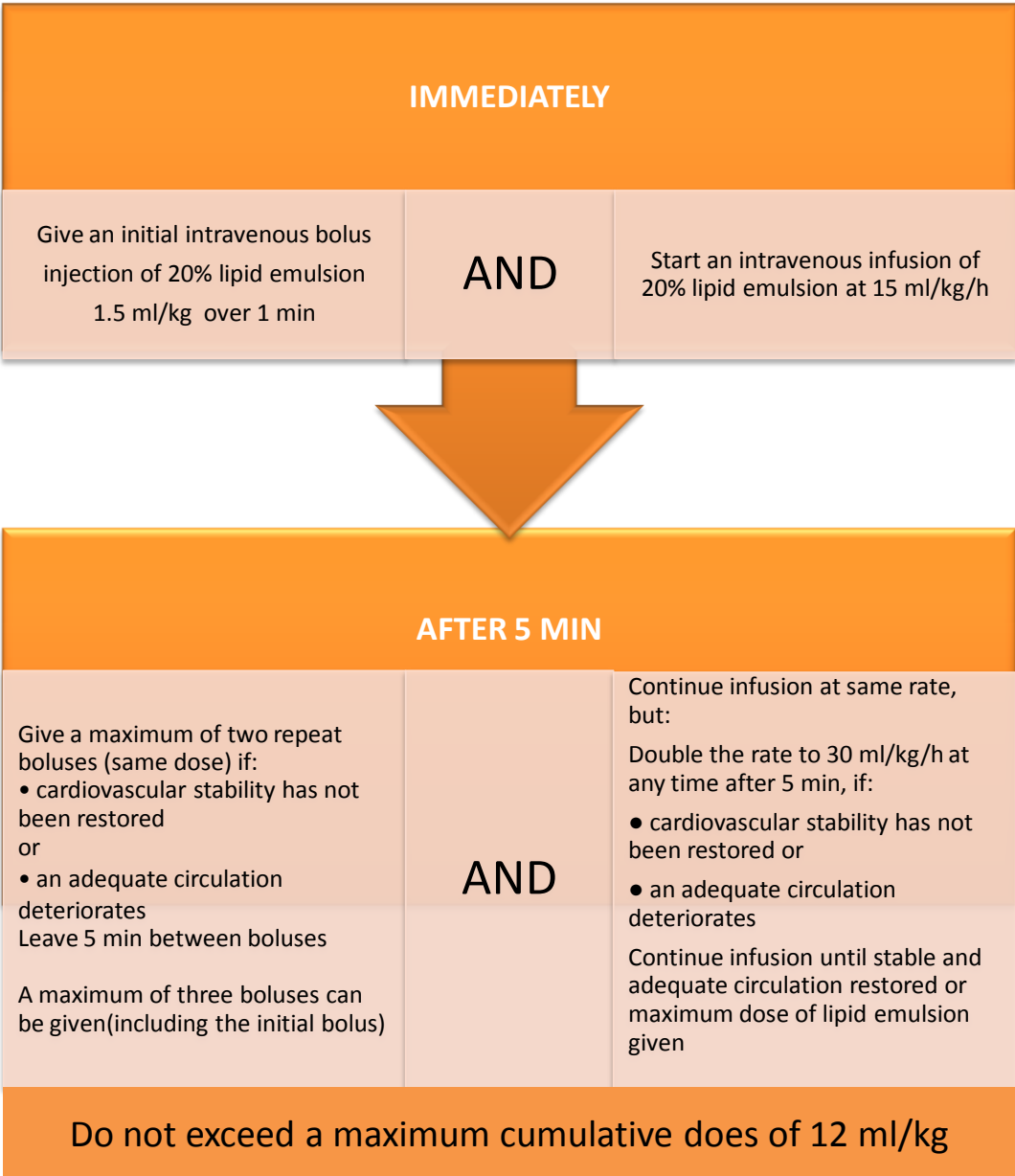
Adapted from “Regional Anaesthesia in Patients with Abnormalities in Coagulation” by the Joint Working Party of the Association of Anaesthetists of Great Britain & Ireland (AAGBI), Obstetric Anaesthetists’ Association (OAA) and Regional Anaesthesia UK (RA-UK), 2011 and University of Washington Medical Center (UWMC) Anti-coagulation Guidelines on Neuraxial Procedures,2011

Please note: All patients should be informed and monitored for motor block (spinal/epidural hematoma) for 24 hrs after removal of the catheter

APPENDIX 8: MANAGEMENT OF SEVERE LOCAL ANAESTHETIC TOXICITY

Management of Severe Local Anaesthetic Toxicity

<p>1 Recognition</p>	<p>Signs of severe toxicity:</p> <ul style="list-style-type: none"> • Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions • Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur • Local anaesthetic (LA) toxicity may occur some time after an initial injection 	
<p>2 Immediate management</p>	<ul style="list-style-type: none"> • 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 in the presence of metabolic acidosis) • Confirm or establish intravenous access • Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses • Assess cardiovascular status throughout • Consider drawing blood for analysis, but do not delay definitive treatment to do this 	
<p>3 Treatment</p>	<p>In circulatory arrest</p> <ul style="list-style-type: none"> • 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 <p>Give intravenous lipid emulsion (following the regimen overleaf)</p> <ul style="list-style-type: none"> • Continue CPR throughout treatment with lipid emulsion • Recovery from LA-induced cardiac arrest may take >1 h • Propofol is not a suitable substitute for lipid emulsion • Lignocaine should not be used as an anti-arrhythmic therapy 	<p>Without circulatory arrest</p> <p>Use conventional therapies to treat:</p> <ul style="list-style-type: none"> • hypotension, • bradycardia, • tachyarrhythmia <p>Consider intravenous lipid emulsion (following the regimen overleaf)</p> <ul style="list-style-type: none"> • Propofol is not a suitable substitute for lipid emulsion • Lignocaine should not be used as an anti-arrhythmic therapy
<p>4 Follow-up</p>	<ul style="list-style-type: none"> • Arrange safe transfer to a clinical area with appropriate equipment and suitable staff until sustained recovery is achieved • Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days 	



Adapted from The Association of Anaesthetists of Great Britain & Ireland 2010

APPENDIX 9: Drug Formulary

SUGGESTED MEDICATION DOSAGES AND SIDE EFFECTS

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	Preferred drug in elderly. Liver damage following over dosage. Maximum dose 4 g daily
	Perfalgan (IV) Aqueous solution: 10mg/ml paracetamol, available in 50ml and 100ml vials	>50 kg, 1 g 6 hourly up to max 4g/day 10-50 kg, 15 mg/kg/dose max 60mg/kg in 4 divided doses Administration: Infusion over 15 minutes. Renal & hepatic impairment: 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,	Gastroduodenal ulcer Asthma Bleeding disorder Renal dysfunction	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/Coxib therapy. Concurrent use with aspirin inhibits aspirin's antiplatelet effect (mechanism unclear)
	Mefenemic Acid	250-500 mg 8 hourly	Hypertension Allergic reaction in susceptible individuals,	Ischaemic heart disease Cerebrovascular disease	
	Ibuprofen	200-400 mg, 8 hourly Max: 2400 mg/day Elderly patients: 200 mg 3 x a day	Increase in CVS events	Inflammatory bowel disease	
	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 mg daily			
	Parecoxib	20-40mg 6-12 hourly (max 80mg/day for max duration of 48 hours) Elderly (>65 years & <50kg) reduce to half the dose with a maximum daily dose of 40mg. Renal & hepatic impairment : <i>Do not use</i>			

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 Vomiting 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: <i>do not use</i> Hepatic dysfunction: <i>do not use</i>	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, Epilepsy	

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Strong opioids	Morphine	<p>SC (Adults):</p> <p><65 yrs: 5mg-10 mg 4 hrly</p> <p>>65 yrs: 2.5 mg- 5mg 4hrly</p> <p>IV: Follow morphine pain protocol (Appendix5)</p> <p>Oral: Starting dose 5- 10 mg, 4 hourly of IR</p> <p>Elderly: 2.5 - 5 mg, 4 - 6 hourly of IR</p>	<p>Nausea</p> <p>Vomiting</p> <p>Pruritus</p> <p>Sedation</p> <p>Constipation</p> <p>Respiratory depression</p> <p>Myoclonus</p>	<p>Acute bronchial asthma</p> <p>Respiratory depression</p> <p>Head injuries, Renal and <i>hepatic dysfunction:</i> <i>needs</i> dose adjustment (refer Chapter 3)</p>	<p>Metabolites can accumulate causing increased therapeutic and adverse effects</p> <p>Both parent drug and metabolites can be removed with dialysis, watch for “rebound” pain effect</p>
	IV Fentanyl	<p>to be prescribed by APS team only</p> <p>Renal dysfunction : appears safe, however, a dose reduction is necessary</p> <p>Dialysis patients : appears safe</p> <p>Hepatic dysfunction : appears safe, generally no dose adjustment necessary</p>	<p>Nausea</p> <p>Vomiting</p> <p>Sedation</p> <p>Constipation</p> <p>Respiratory depression</p>		<p>No active metabolites and appears to have no added risk of adverse effects; monitor with high long term user</p> <p>Metabolites are inactive, but use caution because fentanyl is poorly dialysable</p> <p>Decrease hepatic blood flow affects metabolism more than hepatic failure.</p>

Drug Class	Drug	Recommended Dosages	Side Effects	Caution and Contra-indication	Comments
	Oxycodone IR (oxynorm)	<p>Starting dose (oral): 5 -10 mg 4 - 6 hourly</p> <p>Renal dysfunction : Use cautiously with careful monitoring, adjust dose if necessary</p> <p>Dialysis patients: <i>do not use</i></p> <p>Hepatic dysfunction: Use cautiously and monitor patient carefully for symptoms of opioid overdose Decrease initial dose by 1/2 to 1/3 of the usual amount</p> <p>Elderly patients : 2.5- 5 mg every 4-6 h</p>	<p>Nausea</p> <p>Vomiting</p> <p>Sedation</p> <p>Constipation</p> <p>Respiratory depression</p>	<p>Acute bronchial asthma</p> <p>Respiratory depression</p> <p>Con-comittent used of sedative drugs</p> <p>Head injuries, Renal and <i>hepatic dysfunction: needs</i> dose adjustment (refer Chapter 3)</p>	<p>Metabolites and parent drug can accumulate causing toxic and CNS-depressant effects</p> <p>In severe hepatic impairment, the parent drug may not be readily converted to metabolites</p>

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contra-indications	Comments
	Gabapentin	Day 1: start at 300mg 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
	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			
	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	Swallow whole,do not chew / crush

				with Warfarin	
Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contra-indications	Comments
Bisphosphonates	Pamidronate	60 - 90 mg as a single infusion over 2 - 4 hrs every 4 weeks	Asymptomatic hypocalcemia, hypophosphataemia, hypomagnesaemia Flu-like symptoms Mild fever Local injection-site reactions Malaise Rigor	Hypersensitivity to bisphosphonates. Hyperparathyroidism In renal impairment, reduce dose and increase infusion duration required	Rehydrate patients with normal saline before or during treatment. Not to be given as bolus injection.
	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	In patients with poor dental hygiene, there is higher risk of ONJ. Dental referral is advised.	
	Clodronate	800-3200 mg daily (oral) Max: 3200 mg/day	Gastrointestinal 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 Contra-indications	Comments
Corticosteroid	Dexamethasone	<p data-bbox="654 233 846 600">Oral/ IV/SC: 8 - 16 mg daily or divided doses (initial dose), then to reduce to lowest possible dose (usually 2 mg/day)</p> <p data-bbox="654 1493 846 1633">Elderly patients :5 mg daily and taper as soon as feasible</p>	<p data-bbox="868 233 1016 380">Increased or decreased appetite</p> <p data-bbox="868 415 980 443">Insomnia</p> <p data-bbox="868 478 1005 506">Indigestion</p> <p data-bbox="868 541 1008 569">Nervousness</p> <p data-bbox="868 604 992 632">Myopathy</p> <p data-bbox="868 667 1003 737">Oral candidiasis</p> <p data-bbox="868 772 1011 842">Adrenal suppression</p>	<p data-bbox="1039 233 1213 302">Peptic ulcer disease</p> <p data-bbox="1039 317 1195 386">Concomitant NSAIDs use</p> <p data-bbox="1039 415 1179 527">Liver or cardiac impairment</p>	<p data-bbox="1235 233 1403 415">Should be given before 6 pm to reduce risk of insomnia</p> <p data-bbox="1235 457 1398 548">Efficacy may reduce over 2 - 4 weeks</p> <p data-bbox="1235 590 1398 737">Use lowest possible dose to prevent side effects.</p> <p data-bbox="1235 779 1406 1150">Anticipate fluid retention and glycemic effects in short-term use and CV and bone demineralization with long-term use</p> <p data-bbox="1235 1192 1377 1283">Monitor for rash or skin irritation</p>

Drug Class	Drug	Recommended Dosages	Side Effects	Cautions and Contraindications	Comments
Lignocaine (topical)	Lignocaine 5%	Elderly patients : 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
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	Metoclopramide	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 Extrapyramidal 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	