KINGSTON HEALTH SCIENCES CENTRE

Regional Analgesia/Anesthesia:

Epidural/Paravertebral, Spinal and Peripheral Regional

LEARNING GUIDE

Kingston Health Sciences Centre

Centre des sciences de la santé de Kingston

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Hôpital Général de Kingston General Hospital

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This learning guide has been developed
by

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NOTE: This learning guide contains information current at the time of distribution. Policies and procedures are frequently revised. Please refer to related policies and procedures contained in the Clinical Policy and Procedure Manual for ongoing current information.

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MODULE A: INTRODUCTION TO REGIONAL ANALGESIA/ANESTHESIA

Module A: Introduction to Regional Analgesia/Anesthesia

Regional analgesia and anesthesia can provide excellent pain relief after surgery or trauma to the chest, abdomen, pelvis or lower limbs. The benefits of regional analgesia include; more effective analgesia than with parenteral routes, reduced opioid use, reduced risk of sedation, improved pulmonary function, early mobilization and ambulation.

Learning Objectives

1. Review the basic structure and function of the nervous system as relevant to Regional Anesthesia/Analgesia
2. Identify and describe the functioning of the components of the spinal cord and surrounding membranes and spaces (i.e. epidural, spinal, paravertebral space)
3. Describe the indications/contraindications for insertion of an epidural catheter, single-shot spinal, single-shot or continuous regional nerve block.
4. Describe rationale for medication selection
5. Describe the physiological effects of an opioid analgesic and or/a local anesthetic administered regionally.
6. Describe the desired and adverse effects associated with the administration of regional opioid or local anesthetic.
7. Describe the nursing monitoring and care post regional anesthesia.
8. Assess, implement and evaluate nursing interventions in the event of the occurrence of side effects.
9. Learn how to perform a comprehensive pain, dermatome (sensory), and motor function assessment for epidural, spinal, and paravertebral anesthesia.
10. Learn how to perform a sensory and motor function check for peripheral regional anesthesia.

Definitions

Analgesia	Refers to a reduction in or the absence of the sensation of pain without a loss of consciousness
Anesthesia	Local or general insensibility to pain with or without the loss of consciousness induced by an anesthetic.
Continuous Regional Analgesia	Refers to the continuous delivery of a prescribed dose of local anesthetic and/or opioids through a dedicated Continuous Ambulatory Delivery Device (CADD) pump.
Epidural Analgesia	Refers to local anesthetic and/or opioids administered into the epidural space targeting the nerves within the central nervous system (CNS). Epidural analgesia is used to manage surgical or

	nonsurgical pain in a particular region of the body e.g. surgical (laparotomy) or nonsurgical (fractured ribs).
Independent double check	A process in which two independent nurses (RN or RPN) conducts a verification before the intervention is implemented, which can be performed in the presence or absence of the first nurse. Most critical is to maximize the independence of the double check by ensuring that the first nurse does not communicate the expected outcome, which would create bias and reduce the visibility of the mistake.
Independent verification	A process in which the nurse independently confirms current treatment with the current patient care orders
Intermittent Regional Analgesia	Refers to the delivery of a prescribed dose of local anesthetic (bolus) given either manually through the epidural filter or programmed through the epidural (CADD) pump.
Local Anesthetic	Local anesthetics bind to and inactivate sodium channels to block nerve conduction and transmission of pain signals from nerve fibres (i.e. Bupivacaine and Ropivacaine)
Local Anesthetic Systemic Toxicity (LAST)	A life threatening adverse reaction resulting from local anesthetic reaching significant systemic circulating levels. Early signs: numbness/tingling around lips, metallic taste, dizziness, blurred vision, tinnitus, decreased hearing, restlessness, tremor. Late signs: cardiac arrhythmias, bradycardia or tachycardia, seizures, severe hypotension, cardiac collapse.
Patient Controlled Epidural Analgesia (PCEA)	A form of intermittent regional analgesia whereby the patient can self-administer a breakthrough dose of analgesia at pre-set intervals as needed.
Paravertebral analgesia	Refers to local anesthetic injected into a space outside the CNS on either side of the vertebral column where spinal nerves emerge through the spaces between the individual vertebrae. This type of block can be used in surgical procedures requiring unilateral analgesia e.g. thoracotomy, liver surgery, cholecystectomy, breast surgery, nephrectomy, or rib fractures. Paravertebral nerve blocks are monitored and managed like an epidural block due to its close proximity to the spinal cord.
Regional Analgesia	Refers to a local anesthetic agent injected near a specific nerve or group of nerves to induce reduction in sensation to pain in that region of the body. Regional analgesia includes neuraxial

	(epidural/intrathecal) and peripheral nerve blocks.
Spinal (Intrathecal) Analgesia	Refers to local anesthetics and/or opioids administered into the subarachnoid space also known as the intrathecal space. Spinal routes of administration have the advantage of upward spread within the cerebral spinal fluid (CSF) and close proximity to spinal cord structures. Spinal dosing of opioids is 1/10 that of epidural dosing. Local anesthetics may be used to provide sensory and motor blockade for operative procedures instead of or in addition to general anesthetics.

Authorization

Registered Nurses (RNs) who have successfully completed the outlined organizational knowledge and skill evaluation may care for and monitor patients:

- receiving epidural/paravertebral analgesia/anesthesia (Module B)
- after they have received peri-operative spinal opioid analgesic and/or local anesthetic (single-shot) (Module C)
- receiving a continuous infusion of a peripheral regional nerve block (Module D)
- after a peri-operative peripheral regional nerve block (single-shot) (Module D)

Registered Practical Nurses (RPNs) who have successfully completed the outlined organizational knowledge and skill evaluation may care for and monitor patients

- after they have received peri-operative spinal opioid analgesic and/or local anesthetic (single-shot) (Module C)
- after a peri-operative peripheral regional nerve block (single-shot blocks only, not continuous infusions) (Module D)

The authorization process involves:

- Reviewing the Kingston Health Sciences Center (KHSC) Regional Analgesia/Anesthesia Regional Learning Guide
- Review of related policies and procedures in the Clinical Policy and Procedure Manual. P-100, P-101, P-102
- Attend a theoretical teaching session
- Successful completion of the written test (80% pass) relating to the specific skills required

Review of Related Anatomy and Physiology

To clearly understand the use of regional analgesia/anesthesia, it is helpful to review the anatomy and physiology of the spinal column and of pain transmission.

Vertebral Column

The vertebral column is composed of the bony outer structures that house and protect the spinal cord. It consists of 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 3 - 4 coccygeal. The intervertebral discs are pads of cartilage that lie between the vertebrae, serving as shock absorbers and acting as an axis for movement.

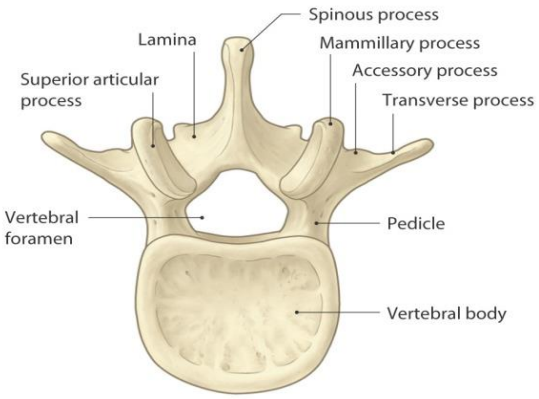


Figure 1. Vertebra

Each vertebra consists of a:

Vertebral Body: The central portion that gives it strength

Laminae: The bony spines that project laterally and posteriorly

Transverse process: A bony spine that extends laterally on each side of the vertebra

Vertebral foramen: A central canal that surrounds the spinal cord.

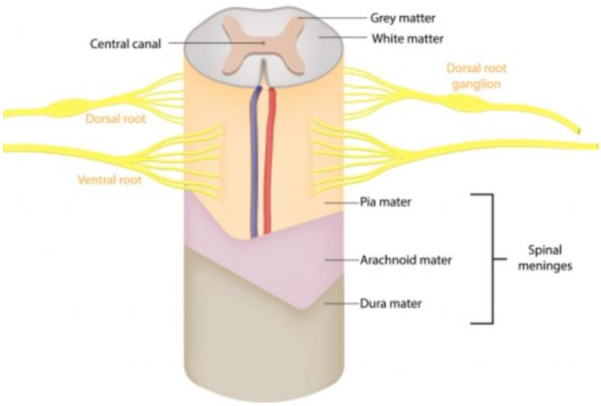


Figure 2. Anatomy of the Spinal Cord

Three layers of membranous coverings, known as meninges, surround the spinal cord.

Pia mater: Innermost layer. It adheres directly to the spinal cord. Contains many blood vessels to supply the spinal cord.

Arachnoid mater: The middle transparent layer. It is separated from the pia mater by the CSF filled subarachnoid space (also known as the spinal or intrathecal space).

Dura mater: The strong, tough outer later. It consists of dense, fibrous connective tissue.

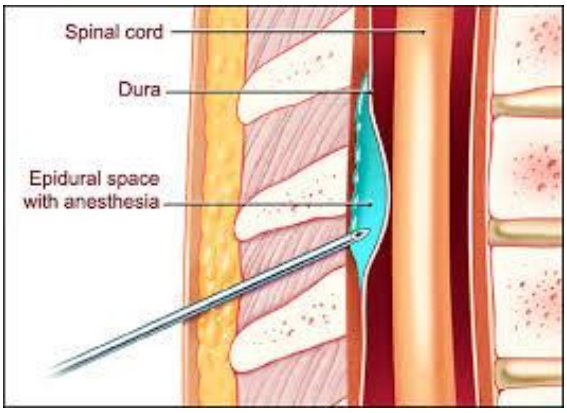


Figure 3. Epidural Space

The epidural space lies between dura mater (outer part of meninges) and ligamentum flavum.

It acts as a protective cushion for the cord and extends from the base of the skull to the sacrum.

The epidural space contains fat, connective tissue, blood and lymphatic vessels and spinal nerves as they leave the spinal cord.

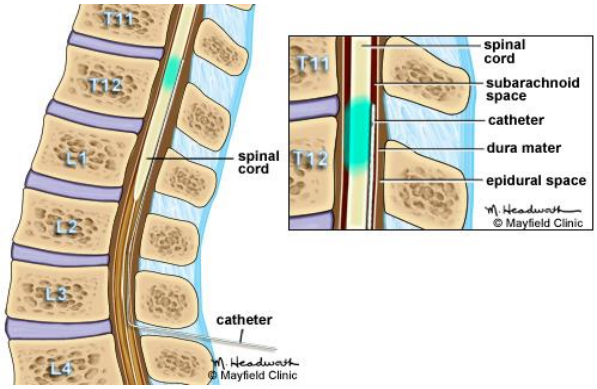


Figure 4. Intrathecal Space

The intrathecal space is (also known as subarachnoid space or spinal space) located between arachnoid space and pia mater.

The large blood vessels supplying the brain and spinal cord lie in the intrathecal space.

Opioid agents given into the intrathecal space is referred to as a “spinal”. Opioids spread via the CSF to act directly upon the opioid receptors in the dorsal horn of the spinal cord.

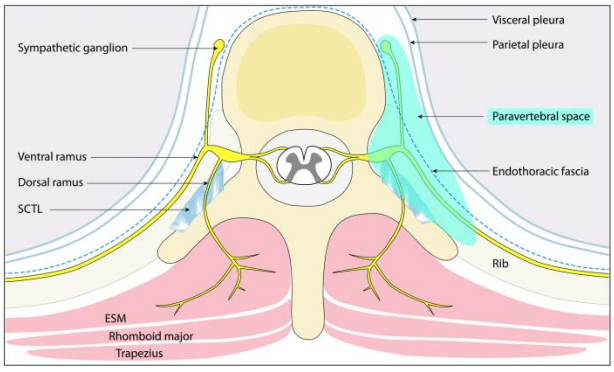


Figure 5. Paravertebral Space

The paravertebral space is the area beside the vertebrae. Nerves leave the spinal cord and exit through a space between the individual vertebrae.

Spinal Nerves and Dermatomes

There are 31 pairs of spinal nerves containing motor, sensory, and sympathetic nerve fibers that travel from the spinal cord to the periphery.

Skin segments innervated by specific sensory roots of the spinal nerves are called dermatomes (see figure 6). Dermatomes are significant in determining the level of analgesia when local anesthetic agents are administered by the epidural, paravertebral, spinal and peripheral regional routes.

Epidural and paravertebral techniques are targeted to provide analgesia at a specific dermatome range.

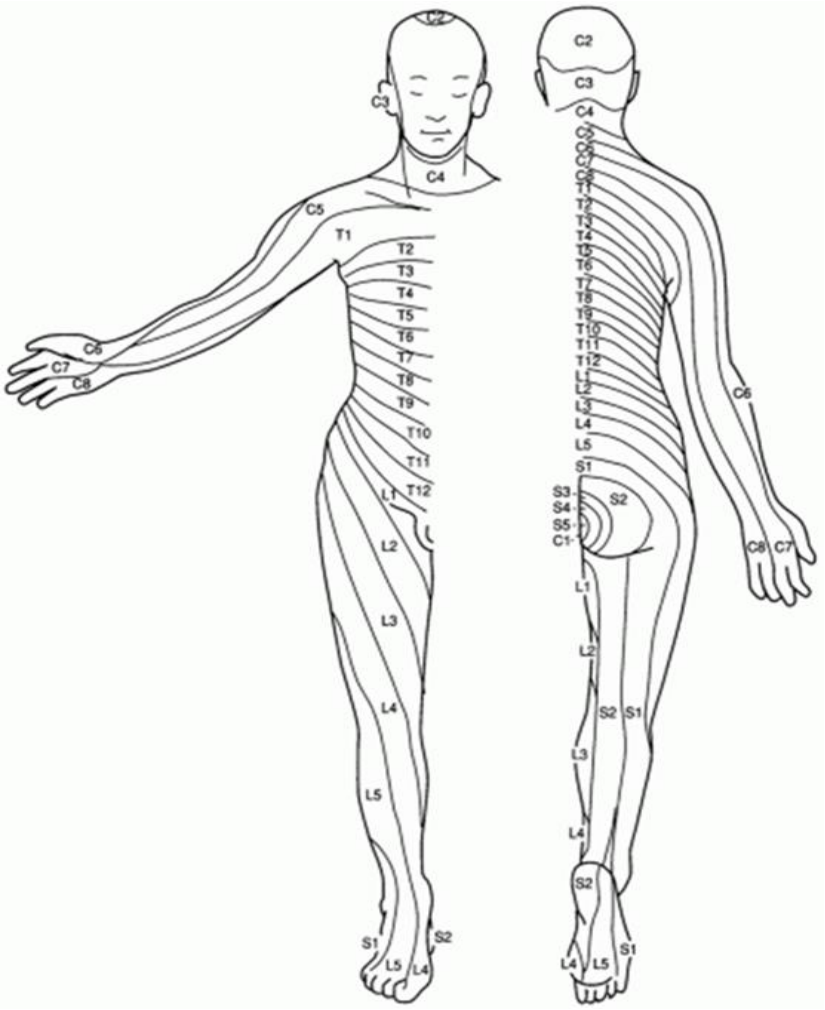


Figure 6: Dermatomes

Pain Transmission

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Pain is always subjective and its interpretation is affected by previous painful experiences, whether physical or emotional. It is a critical symptom that affects quality of life and patient outcomes in both acute and chronic illness.

There are three major types of pain: acute; chronic malignant (cancer); and chronic non-malignant pain.

These three types can further be sub-classified as;

- Somatic: arising from bone, joints, muscle, skin or connective tissue
- Visceral: arising from internal organs
- Neuropathic pain: arising from nerves and can be generated from both central and peripheral nervous tissue.

Pain transmission is called nociception and can be described as a four step process.

1. Transduction - Damaged cells release substances that activate and sensitize nociceptors (pain receptors in the periphery). This activation leads to the generation of an action potential.

2. Transmission - The action potential continues from the damaged tissue to the spinal cord then up to higher brain centers (brain stem, thalamus and cortex). Regional techniques (epidural, paravertebral, spinal and peripheral nerve blocks), block sodium channels in the cell membrane, thereby inhibiting nerve transmission to pain centers in the central nervous system.

3. Perception of Pain - The conscious experience of pain.

4. Modulation - Inhibition of pain impulses happen with the release of endogenous opioids, serotonin and norepinephrine.

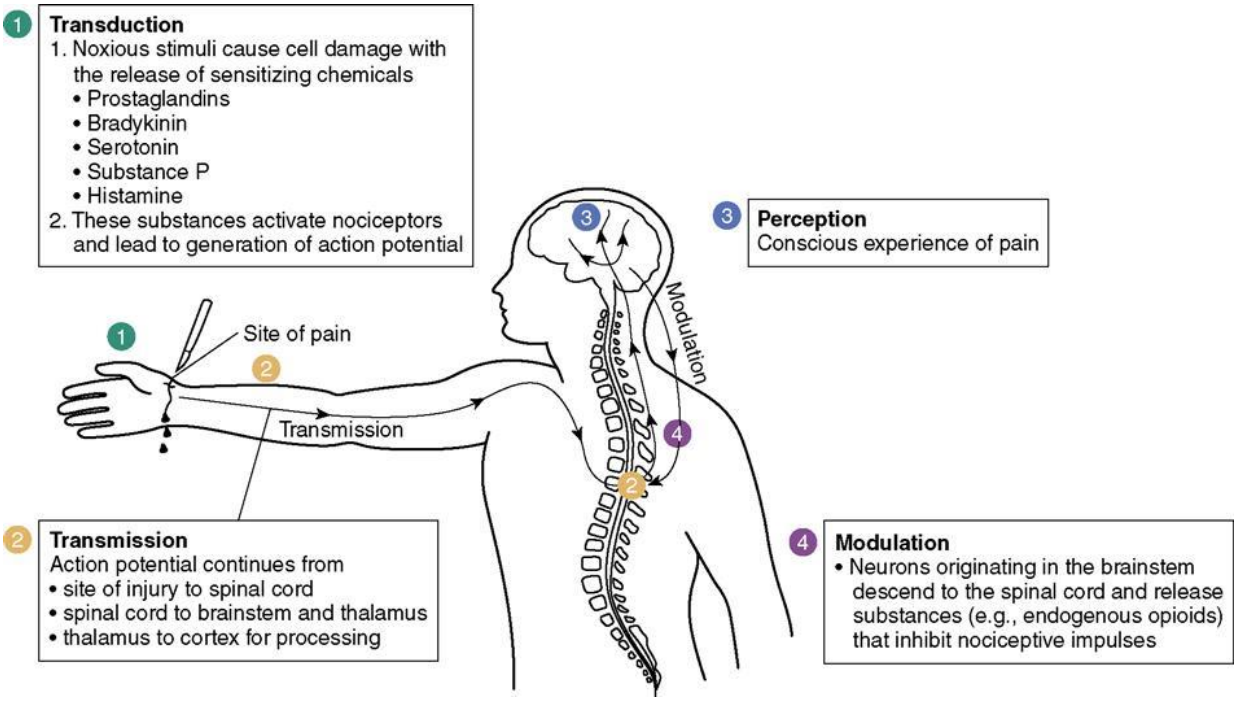


Figure 7: Pain Transmission

Clarifying Regional Anesthesia

There are a variety of techniques that can be used for site specific analgesia and anesthesia. Regional techniques can be subdivided into two categories;

1. modalities acting within the CNS (brain and spinal cord)
2. modalities acting outside the CNS.

More specifically, neuraxial analgesia (epidural and spinal) are examples of modalities acting within the CNS, while upper and lower extremity and truncal blocks are examples of nerve blocks acting outside the CNS. Although the paravertebral space is not located directly within the CNS, paravertebral blocks are treated like an epidural due to their close proximity to the spinal cord.

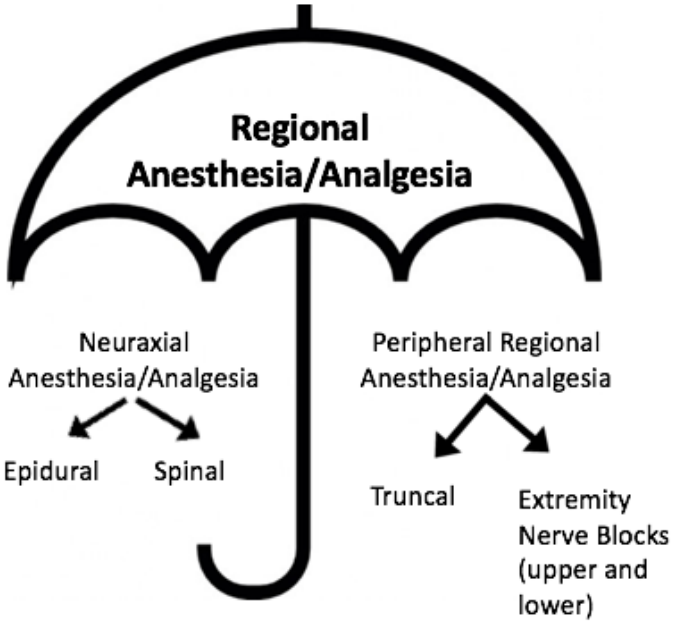


Figure 8: Regional Anesthesia/Analgesia Umbrella

For a peripheral nerve block, ultrasound technology is used to directly visualize the nerve or nerve plexus that will be blocked with local anesthetic (LA). Once visualized, LA is injected as close to the target nerve or nerve plexus as possible. The LA bathes the nerve, blocking sodium channels and thereby interrupting the transmission of painful impulses. The result will be blockade of sensory and motor nerve fibers.

In contrast to upper and lower extremity nerve blocks, truncal blocks do not require direct visualization of the nerve or nerve plexus. Instead of injecting around the nerve, LA is injected into and spreads through muscle planes in order to target as many specific nerve endings as possible (see page 42-46 for common upper and lower extremity and truncal blocks). Truncal blocks will result in blockade of sensory nerve fibers only. There will be no motor block with a truncal block.

The Effects of Neuraxial Analgesics/Anesthetics on Pain Transmission

Medications used in neuraxial analgesia/anesthesia include both opioids and LA's. Each may be given individually or in combination.

Opioid Agents

Mechanism of Action

Opioids administered via the epidural space will diffuse across the dura mater, arachnoid membrane, and into the intrathecal (spinal) space to act on opioid receptors.

Opioid agents given into the intrathecal (spinal) space spread via the CSF to act directly upon the opioid receptors in the dorsal horn of the spinal cord, preventing pain signals from being transmitted to the brain.

Therapeutic Effect

The lipid solubility of the drug injected is a major determining factor affecting the onset and duration of analgesia. The more lipid soluble (lipophilic) the drug (i.e., fentanyl) the more rapidly it passes through the meninges and is absorbed. In comparison to fentanyl, morphine and hydromorphone are less lipophilic. Drugs that are less lipophilic (hydrophilic) have a slower rate of absorption and may persist longer in the CSF, which offers a more widespread analgesia with longer duration of action.

Opioid	Onset of Action	Peak Effect	Duration
Morphine	30 – 60 minutes	60 minutes	12 – 24 hours
Hydromorphone	15 – 30 minutes	45 – 60 minutes	12 – 18 hours
Fentanyl	5 – 15 minutes	10 – 20 minutes	2 – 4 hours

Table 1: Common Opioids Used in Epidural/Paravertebral/Spinal Anesthesia/Analgesia

Dosing Considerations

Approximately one third of the intravenous dose of opioid is required in the epidural space to achieve equivalent pain relief.

Opioid agents given into the intrathecal (spinal) space spread directly via the CSF to act upon opioid receptors, therefore, approximately one tenth of the dose used in the epidural space is required in the intrathecal (spinal) space to achieve equivalent pain relief. Because the medication spreads directly into the CSF, complications from spinal analgesia will occur sooner and with smaller doses than compared to epidural administration.

Opioid-Induced Sedation

Health care providers must carefully balance patient's needs for adequate pain management without increasing the risk of opioid-related respiratory depression. Opioid-induced sedation progressing to respiratory depression is an important and serious adverse event for patients receiving opioids for pain. The sequelae of opioid induced sedation progressing to respiratory depression include hypoxia, apnea, and respiratory arrest. Assessing sedation levels is a critical nursing responsibility.

The Pasero Opioid-Induced Sedation Scale (POSS) is a valid and reliable tool used to assess sedation when administering opioid medications to manage pain. This scale is used on most in-patient units. In contrast, the Richmond Agitation-Sedation Scale (RASS) provides a reliable and valid tool for use in critically ill patients with and without

mechanical ventilation and sedating medications. This scale is used in the intensive care unit.

Pasero Opioid-Induced Sedation Scale	
Score	Description
S	Sleep
1	Awake/alert
2	Slightly drowsy/easily roused
3	Frequently drowsy but rousable, drifts off to sleep during conversation
4	Somnolent, minimal or no response to verbal or physical stimulation

Table 2: Pasero Opioid-Induced Sedation Scale (POSS)

Richmond Agitation Sedation Scale (RASS)		
Score	Term	Description
4	Combative	Overly combative or violent, immediate danger to staff
3	Very agitated	Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff
2	Agitated	Frequent non-purposeful movement or patient-ventilator dyssynchrony
1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	Awake and alert
-1	Drowsy	Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice
-2	Light sedation	Briefly (less than 10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, but any movement to physical stimulation
-5	No response to voice or physical stimulation	No response to voice or physical stimulation

Table 3: Richmond Agitation Sedation Scale (RASS)

Naloxone

Naloxone is a short acting parenteral opioid antagonist. It is used to reverse opioid-induced respiratory depression and somnolence, whether caused by excessive doses given therapeutically or by self-administered overdose. In small doses it is also used for the treatment of pruritus caused by opioid administration.

Reversal of respiratory depression caused by excessive opioid while maintaining adequate pain control in the postoperative patient demands a cautious approach to the

administration of naloxone. To assist in this process, typical guidelines for dilution and dosing of naloxone are as follows:

1. Dilute 1 ampule (naloxone 0.4mg/ml) with 9 mL 0.9% Sodium Chloride (to yield a final naloxone concentration of 0.04 mg/mL)

2. Administer 0.04mg (1 mL) of diluted solution every two minutes until respiratory rate is greater than or equal to 10 breaths/min or to a maximum or 0.8 mg (20 mL) as ordered by the prescriber.

Naloxone can also be used to treat opioid-induced pruritus. Reducing adverse effects without compromising the quality of analgesia or increasing opioid consumption requires careful administration. To assist in this process, typical guidelines for dilution and dosing are as follows:

1. Dilute 1 ampoule (naloxone 0.4mg/ml) with 9 mL 0.9% Sodium Chloride (to yield a final naloxone concentration of 0.04 mg/mL)

2. Administer Naloxone 0.2mg (5mL) subcutaneous OR Naloxone 0.04mg (1mL) IV of diluted solution every 1 hours as needed for relief of opioid induced pruritus

Please note that orders for Naloxone for opioid induced pruritus and respiratory depression will be found on the APMS pre-printed order set.

Local Anesthetics

Mechanism of Action

Local anesthetic agents have the ability to alter the conduction of nerve impulses by blocking sodium channels on the nerve cell membrane.

Therapeutic Effect

The sensitivity of a nerve fibre to local anesthetic is dependent upon its size. Smaller diameter fibers (Aδ and C) that carry pain impulses are more easily blocked than the larger fibers that regulate sensory and motor function. Figure 9 illustrates the sequence of nerve fibre blockade: pain and sympathetic nerve fibres are blocked first and motor function nerve fibres are blocked last.

Sequence of Nerve Fiber Blockade

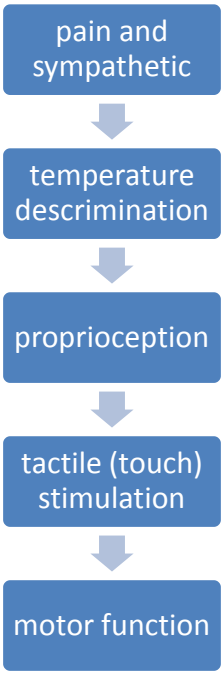


Figure 9: Sequence of Nerve Fiber Block

Local anesthetic agents administered neuraxially provide segmental analgesia along dermatomes (refer to Figure 6). The spread of analgesia provided is dependent upon the volume of drug provided: the higher the volume the greater the segmental spread. Conversely, the density of the sensory blockade is related to the concentration of local anesthetic administered.

When local anesthetic is given, nerve function will disappear in the following order:

1. Pain and Sympathetic (vasomotor)
2. Temperature discrimination and pain recognition
3. Touch and pressure sense
4. Proprioception (awareness of body position)
5. Motor function

As the LA wears off, function will return in reverse order. The dose of LA provided in a continuous epidural infusion is usually low enough that patients will retain motor function, while continuing to experience pain relief. Alternatively, the LA dose provided in a spinal anesthetic is usually high enough for a total nerve block where all of the above fibers will be blocked, including motor fibers.

Local Anesthetic Systemic Toxicity (LAST)

A rare but potentially life-threatening adverse reaction resulting from local anesthetic reaching significant systemic circulating levels. If this happens, stop the infusion immediately and call APMS.

Early signs	Late signs
Numbness/tingling around lips Metallic taste Dizziness Blurred vision Tinnitus Decreased hearing Restlessness Tremor	Decrease in cardiac electrical excitability Arrhythmia Bradycardia or tachycardia Seizures Hypotension Cardiac collapse

Table 4: Signs of LAST

Patient factors that increase risk of toxicity

Table 5 outlines several factors that can increase the patient's risk of LAST.

Extremes of age	In older adults, clearance of LA may be reduced due to deterioration of hepatic function and perfusion. Nerves may also be more sensitive to LAs and lower doses are necessary for adequate block than in younger patients. Infants under the age of four months may also be at an increased risk.
Organ dysfunction	Cardiac disease: Heart failure severe enough to affect hepatic and renal perfusion can reduce LA clearance, and increase the risk of LAST with repeated or continuous dosing. Patients with ischemic heart disease, arrhythmias/conduction disease, or heart failure may be more difficult to resuscitate if cardiac toxicity does occur. Hepatic disease: Severe liver disease increases the risk of LAST with continuous infusion or repeat block. Renal: Renal dysfunction does not increase risk for toxicity, unless metabolic acidosis ensues. The hyperdynamic circulation of uremic patients causes a rise in LA plasma levels.
Pregnancy	Hormonal changes may increase sensitivity of neural tissue to block and to cardiotoxicity. The increased cardiac output of pregnancy may cause rapid absorption of LA after injection.
Metabolic disturbances	Metabolic disturbances such as acidosis, hypoxia, hypercarbia may increase the risk of toxicity.

Table 5: Factors that Increase Likelihood of LAST.

Injection of LA in highly vascular sites can increase the risk of direct intravascular injection, and systemic absorption of LA. Regional anesthesia procedures that target particularly vascular sites include intercostal blocks, caudal and epidural anesthesia, interfascial plane blocks of the abdominal wall, psoas compartment blocks, sciatic blocks, and cervical and brachial plexus blocks.

Blocks that require large volumes and doses of local anesthetic may increase the risk of systemic absorption. For example, transverse abdominis plane (TAP) blocks are often performed bilaterally, and involve injection of a total of 20mL of LA per side to ensure adequate spread.

Management of LAST

Lipid rescue therapy with 20% Intralipid is widely recommended for treatment of LAST. Current research supports the theory that lipid emulsion acts as a dynamic carrier to shuttle local anesthetic away from high blood flow areas (i.e. heart and brain) and redistribute it to organs that store and detoxify the drug.

Propofol is prepared in 10% lipid emulsion and is never a suitable alternative. Propofol can have cardiovascular depressant effects, particularly with the high volume that would be required to treat LAST.

MODULE B:
EPIDURAL AND PARAVERTEBRAL ANESTHESIA/ANALGESIA

Module B: Introduction to Epidural and Paravertebral Analgesia/Anesthesia

Epidural analgesia/anesthesia involves the administration, either intermittently or continuously, of local anesthetic agents and/or opioid agents into the epidural space. Local anesthetics provide bilateral segmental analgesia/anesthesia (analgesic zone) when administered into the epidural space. In general, patients who have surgical procedures requiring incisions in areas affected by the mechanics of respiratory function or rehabilitative activities benefit from epidural analgesia (e.g. abdominal perineal resections, thoracotomy, or nephrectomy).

In most cases, a combination of opioid and local anesthetic is used, reducing the total amount of each agent required to relieve pain. Using less drug decreases the side effects associated with each of these agents. The most commonly used local anesthetic agents are lidocaine, bupivacaine, and ropivacaine.

Paravertebral administration of local anesthetic agents provides unilateral segmental analgesia by acting directly upon nerve roots to inhibit pain transmission. Patients who may require analgesia that is unilateral may benefit from paravertebral local anesthetic administration.

Benefits of Epidurals	Absolute Contraindications	Relative Contraindications
Post-operative analgesia for surgical patients	Hemorrhage, shock, or hypovolemia	Increased intracranial pressure
Manage chronic pain	Infection	Skeletal or spinal abnormality
Obstetrical pain relief	Coagulopathy/anticoagulation	Unstable spinal fracture
Post traumatic pain	Allergy or adverse reaction	Laminectomy
Early ambulation	Patient refusal	Back pain
Reduced side effects	Inadequate monitoring capability	Pre-existing neurological disease
		Cardiac conditions (e.g. valvular stenosis, left to right intraventricular shunt)

Table 6. Benefits and Contraindications of Epidural Analgesia/Anesthesia.

Frequently Used Preparations

All medications must be preservative free for neuraxial administration.

	Lidocaine	Bupivacaine	Ropivacaine
Onset of Action	10-20min	15-20min	15-30min
Peak Effectiveness	20min	30min	30min
Duration of Analgesia	3-8hours	5-26hours	5-24hours

Table 7: Common Local Anesthetics Used in Regional Anesthesia

Components of an Epidural/Paravertebral Catheter

- Continuous Ambulatory Drug Device (CADD) pump (+/- PCEA button)
- 22 micron particulate filter
- Catheter connector
- Microbore tubing set

Figure 10: CADD Pump with PCEA Button

Figure 11: Catheter Connector with 22 Micron Filter

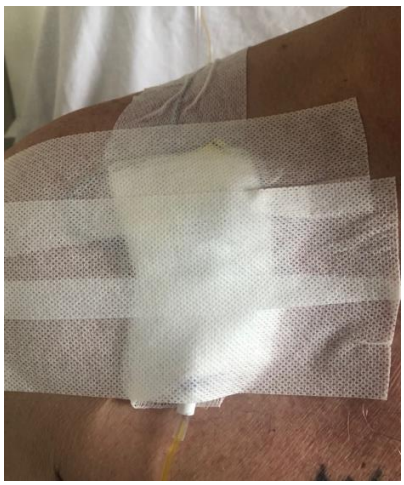


Figure 12: Epidural Filter Connected Securely to Anterior Chest

Safety Considerations for Epidural Infusions

1. Use non-ported, yellow tubing and a locked dedicated CADD infusion pump. Ensure solution is labelled for epidural administration with dedicated yellow sticker.
2. Assess integrity of system every shift and PRN (catheter clearly labelled “epidural”, non-ported tubing, luer connection secure, anchored well to anterior chest wall, and tape intact).
3. Ensure patient repositioned frequently, being mindful of pressure areas
4. Ensure patient has full lower limb motor control prior to ambulation.
5. Inspect and assess epidural insertion site every shift and PRN, and report any abnormal findings such as bleeding, hematoma, or drainage to APMS.
6. Only pharmacy will prepare epidural solutions.
7. Do not change the epidural catheter dressing. This can result in inadvertent removal of the epidural catheter. Reinforce site and tubing with tape and/or transparent dressing as needed.
8. Do not give any other opioids or sedating medications that have not been approved by APMS.
9. Maintain IV access throughout epidural infusion and for: 12 hours after an epidural infusion with hydromorphone and 2 hours after an epidural infusion with fentanyl.

Nursing Considerations

Patient Assessment: Sensory Block

How to complete a sensory block assessment:

1. Prepare the patient: apply ice to an unaffected area so that patient can identify the cold sensation.

2. Test sensory block on one side. Start at the upper anterior chest and work downwards until the patient states that the ice no longer feels cold. Continue downwards until the patient reports that it feels cold again. The dermatome levels between which the patient can detect altered sensation represent the analgesic zone.

3. Test sensory block on the opposite side. Repeat procedure as above. If the block is greater on one side than the other, document each side separately. Both right and left sides should be assessed separately to indicate if the block is unilateral or bilateral.

4. Documentation. The zone of analgesia is expressed as one dermatome below the upper sensation of icy cold and one dermatome above the lower sensation of icy cold. The intended zone of analgesia should cover the operative site. (See Figure 6 for dermatomes).

It is important to note that many patients may not demonstrate a sensory block to ice but may be pain free. This can be due to subjectivity in patient perception of cold or from a block of pain/sympathetic sensation only (Figure 9: Sequence of Nerve Fibre Block).

Blocks extending to the T4 region and above have the potential to affect cardio accelerator fibers and can result in bradycardia and hypotension. When assessing sensory blockade, be sure to assess T2 and T1 dermatomes by checking sensation to ice down the medial aspect of the arms (see Figure 6: Dermatomes). For example, if there is normal sensation to medial aspect of arms, the sensory block does not ascend above T2.

Patient Assessment: Motor Block

Local anesthetics can cause sensory and motor deficits in dermatomes that are not meant to be blocked. It is important to rule out a motor block to ensure it is safe for the patient to ambulate and for early detection of complications such as epidural hematoma or abscess.

To assess motor function, ask the patient to flex their knees and ankles. When documenting, chart their movement using the Bromage scale on the Regional Analgesia Flow Sheet. See Table 8: Bromage Scale.

Bromage Scale (Motor Block Scale)	
0	Full flexion of knees and feet
1	Just able to move knees
2	Almost complete block: able to move feet only
3	Complete block: unable to move feet or knees

Table 8. Bromage Scale

Managing Ineffective Analgesia

There are several strategies for managing ineffective analgesia:

- Provide breakthrough analgesia as ordered on the APMS order set.
- Assess level of sensory block by assessing sensation with ice. This will help you to assess whether the block is covering the entire surgical site.
- The spread of the epidural can be influenced by gravity. Try to reposition your patient to assist in the spread of solution.
- Assess the insertion site and catheter to ensure integrity of the system. Check that equipment is functioning correctly and that all connections are secure.
- Notify APMS of inadequate sensory block.

When to Notify APMS

You must notify APMS if you discover any of the following when caring for a patient with an epidural catheter infusing:

- Motor block (greater than 0 motor block on Bromage scale, Table 8)
- Ascending sensory block above T4
- Systolic blood pressure less than 90mmHg and/or heart rate less than 50 beats per minute
- Sudden onset of moderate to severe back pain
- Inadequate analgesia or persistent side effects despite treatment
- Catheter becomes disconnected from filter (wrap disconnected ends with sterile gauze as soon as possible to prevent contamination. Do not reconnect.)

Care After Epidural is Discontinued

As mentioned previously, the lipid solubility of the drug injected is a major determining factor affecting the onset and duration of analgesia. Morphine and Hydromorphone are hydrophilic and therefore may persist longer in the CSF. After discontinuation of

infusion, patients should continue to be monitored for signs of respiratory depression and IV access should remain for:

- 2 hours post-administration of epidural/paravertebral fentanyl
- 12 hours post-administration of epidural/paravertebral hydromorphone
- 24 hours post administration of epidural/paravertebral morphine.

Anticoagulation in Patient with Epidurals

Epidural hematoma is a rare but potentially catastrophic complication of epidural anesthesia. Bleeding that occurs in the confined epidural space can lead to the rapid development of a hematoma which causes compression of the spinal cord and can have disastrous consequences for the patient including paralysis. If an epidural hematoma develops after catheter insertion or removal, there is a 6 - 8 hour window where evacuation of hematoma improves chances of ischemic cord recovery. For this reason, coagulation status and anticoagulant/antiplatelet therapy must be carefully monitored.

Due to the risk of spinal and epidural hematoma when anticoagulants are given in the presence of neuraxial catheters, the Anticoagulant Therapy Warning is in Effect when under APMS care. This means that no doses of low molecular weight heparin, warfarin, platelet-aggregation inhibitors, direct thrombin inhibitors, thrombolytic agents or other anticoagulants are to be administered to any patient undergoing neuraxial analgesia without approval from APMS. Doses of unfractionated heparin greater than 5000 units SC q8h are not to be given either.

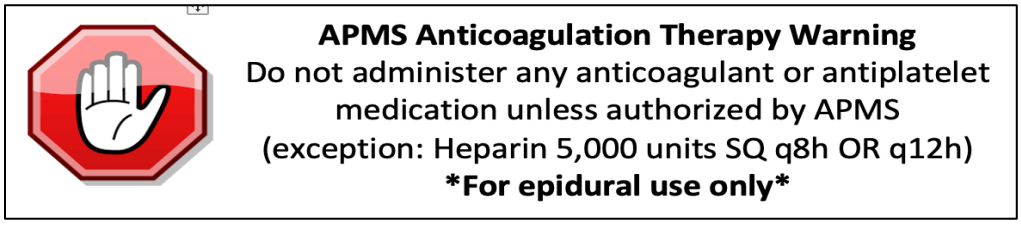


Figure 13: APMS Anticoagulation Therapy Warning

Table 9 provides a detailed list of anticoagulants and outlines which ones require approval by APMS and which ones are contraindicated.

Medications that do not require APMS approval for use with epidural in situ	Medications the require APMS approval for use with epidural in situ	Medications contraindicated for use with an epidural in situ
• heparin 5,000 units subcutaneously q8h or q12h	• Dalteparin 5,000 units subcutaneously daily. *This medication is reviewed on a case by case basis. The surgical service must contact APMS. The order from APMS to approve the medication will be written on a green order sheet.	• Low molecular weight heparin • dalteparin greater than 5,000 units • enoxaparin, tinzaparin • IV heparin • Warfarin • Factor Xa inhibitors • e.g. apixaban, fondaparinux, rivaroxaban • Platelet aggregation inhibitors • e.g. clopidogrel, dipyrimadole/ASA, dipyrimadole, eptifibatide, prasugrel, ticagrelor, ticlopidine • Direct thrombin inhibitors • e.g. argatroban, bivalirudin, dabigatran • Thrombolytic therapy • e.g. alteplase [except 2 mg dose for unblocking a peripherally inserted central catheter (PICC)], tenecteplase

Table 9: Anticoagulant Warning Table

Epidural Management in Pediatric Patients

Assessment

Use age appropriate pain assessment tools (i.e. Numeric Rating scale, Grimace Faces Scale). Parents may be able to report pain or distress in children, but child self-report remains the gold standard. Behavioural indicators of pain can include: facial expression, body movement, posture, inability to be consoled, crying, or groaning. Remember, the absence of signs of pain does not mean absence of pain

Pruritus

Pruritus is a common side effect. Consider administration of diphenhydramine IV q6h prn or naloxone IV infusion as per APMS order set.

Motor Block

As with an adult, assess motor block q4h and document on Regional Analgesia Flow Sheet. If the child is unable to follow commands but moves limbs spontaneously or to stimulation, motor block is not present**.**

Sensory Block

Test sensory block beginning at the expected top level of the block; move down 2 - 4cm at a time until below the level of the block:

- Verbal child: Ask child if the ice feels cold, less cold, or not cold. The block is not present when the ice feels “cold”
- Nonverbal child: The block is not present where the child squirms, flinches, makes a face, etc. or where the child responds negatively to gentle palpation or movement of the operative site

Assess sensory block q4h while awake and PRN (i.e. if changes in hemodynamic status or pain control).

Initiation of Epidural Catheters

The following procedure will be carried out by authorized RNs and/or nurse practitioners (NPs) for assisting with insertion of continuous epidural infusions initiated in a monitored setting, for example, the Post-Aesthetic Care Unit (PACU):

1. Complete safety checklist
2. Verify correct patient using two patient specific identifiers
3. Ensure the patency of IV lines prior to epidural insertion
4. Obtain baseline vital signs: Heart rate (HR), blood pressure (BP), oxygen saturation (SPO2%), respiratory rate (RR)
5. Place patient on cardiac monitor and interpret rhythm strip. Ensure strip and interpretation is included on the flow sheet
6. Assist with positioning

Assessment and Monitoring

The head of the bed must remain elevated to greater than 30 degrees for patients receiving continuous and patient controlled epidural and paravertebral infusions. When

the patient is receiving a continuous infusion and/or intermittent boluses of local anesthetic + / - opioid analgesic agent combinations assess the patient as outlined in Table 10: Epidural Assessment Schedule.

Indication	Assessment Parameters
At start of infusion or at the start of an intermittent bolus	Respiratory Rate (RR) Pain and level of sedation (LOS); Blood pressure (BP) and Heart rate (HR) Catheter site
At 5, 10 and 15 minutes	RR and effort HR and BP
At 30 minutes	RR and effort Pain and LOS BP and HR Sensory block (ice test) Motor block
At 1, 2 and 3 hours	RR and effort Pain and LOS BP and HR
Then every 4 hours and PRN for duration of infusion	RR and effort Pain and LOS HR and BP Motor block
Every 12 hours and PRN for duration of infusion	Sensory block; Epidural catheter site checks

Table 10: Epidural Assessment Schedule

The following are indications for PRN sensory and motor block assessments:

- Increasing pain
- Patient reports of numbness, tingling, or pins and needles sensation
- Lower limb weakness
- Sudden bowel or bladder incontinence
- Urinary retention
- Sudden pain at catheter site

The following are indications for PRN epidural catheter site checks:

- Change in pain, sensory and/or motor block
- Presence of fluid or redness at catheter site
- Elevated temperature
- Patient report of pain at catheter site
- Change in primary nursing responsibility

The IV access will remain unless otherwise ordered by prescriber:

- 2 hours post-administration of epidural/paravertebral fentanyl
- 12 hours for post-administration of epidural/paravertebral hydromorphone
- 24 hours post administration of epidural/paravertebral morphine.

Following removal of the epidural/paravertebral catheter, continue to assess sensory and motor block q4h and PRN for 12 hours. Call APMS stat if:

- There is increasing or new onset of loss of sensation and motor block
- New onset back pain at epidural site
- There is no resolution of sensory block within 12 hours

Recording and Reporting

Stop the infusion and notify APMS STAT if you observe or suspect:

- Respiratory rate <10 breaths per minute or dyspnea
- Systolic blood pressure less than 90mm Hg
- Heart rate less than 50 beats per minute
- Convulsions
- POSS score of 4
- Development of motor block
- Sensory block above T4 (anatomic nipple line) in combination with bradycardia and hypotension
- Signs and symptoms of LAST (refer to Table 4)
- Disconnection of the infusion line from the epidural catheter or any disconnect of the tubing.

Notify APMS if you observe:

- Inadequate pain relief
- New onset of pain in back
- Temperature greater than 38.5 C
- Side effects that are not alleviated with nursing interventions (i.e. nausea and vomiting, light headedness)
- Problems with the CADD infusion pump
- A written order for incompatible anticoagulant therapy
- Patient develops a motor block
- A sensory block more than 3 dermatomes above incision or injury site
- Leaking of fluid from catheter site.

Document on the Medication Administration Record (MAR): Continuous Parenteral Infusions and Bag Changes Page:

- Solution type and concentration
- Date and time of initiation and each solution bag change
- Discontinuation of therapy

The anticoagulant and antiplatelet warning sticker is placed on front of MAR with original transcription order.

Document in the Interprofessional Progress Notes or on the unit-specific flow sheet:

- Condition of catheter and insertion site
- Condition of the dressing
- Evidence of side effects/complications and actions taken to manage those.
- Evaluation of patient response to interventions.
- Communication with APMS staff.

Complete independent double checks at the following times:

- Prior to initiation of continuous epidural/paravertebral infusion
- With each solution bag change
- With prescribed changes in dose/rate by anaesthesiology or APMS

Complete independent verification with changes in nursing responsibility (e.g. shift changes, unit to unit transfers).

Potential Side Effects of Epidural/Paravertebral Opioid Administration

There are many potential side effects of administering opioids in the epidural or paravertebral space. Table 11 outlines these side effects, the etiology, assessment and how to prevent complications.

Side Effect	Etiology	Assessment	Prevention/Therapy
Respiratory Depression: Initial presentation is often increasing level of sedation (LOS). Depth of respiration may first become shallow with little change in rate	As a result of vascular absorption of drug. Most serious but least frequent effect More likely to occur if: • patient is >70 and receives large dose • history of impaired respiratory function • parenteral opioids, sedatives or antiemetics administered concurrently • medications given during surgery • patient lying flat • patient is obese More likely with morphine and hydromorphone than with fentanyl	Patient assessment includes monitoring of respiratory depth and rate, level of sedation (LOS) using Pasero Opioid-Induced Sedation Scale Assess for opioid toxicity (<1%, rare): drowsiness; mental clouding; pinpoint pupillary constriction; coma; respiratory depression; with fentanyl, may see muscle rigidity, laryngospasm Frequency and extent of the assessment varies according to the specific analgesic therapy that is being/has been administered.	Encourage deep breathing. Elevate head of bed 30^{o}. Patient may lie flat for linen changes, physiotherapy. Ensure patient has IV access DO NOT administer other opioids, sedatives, anti-emetics, without orders from APMS. Encourage early, assisted ambulation. Notify APMS if adult RR<10 and/or LOS 3 or 4. Administer PRN O_2 If patient is somnolent • attempt to rouse • assess RR • stop continuous infusion

Side Effect	Etiology	Assessment	Prevention/Therapy
			• call APMS Administer naloxone (0.4mg/mL available) IV as ordered (see naloxone administration guidelines). ***Call Code 99 for Anesthesia***
Pruritus	Tends to develop on face, trunk and/or upper extremities Not an allergy No rash or redness May be related to histamine release or central effect	Observe for itching.	Administer small doses of naloxone as ordered.
Urinary Retention	Due to opioid effect on spinal cord & spinal nerves innervating the bladder Occurs more frequently in men More common when epidural opioids are administered in lumbar area	Monitor input and output, and continue 24 h post-removal. Palpate abdomen prn for distended bladder. Observe for symptoms of discomfort, frequency and urgency.	Catheterize intermittently as ordered **NOTE:** foley catheters are not required for patients with thoracic epidural analgesia however patients with lumbar epidural analgesia may require foley catheterization.

Side Effect	Etiology	Assessment	Prevention/Therapy
Nausea/Vomiting	Due to vascular absorption of opioid	Monitor for nausea and vomiting.	Provide support measures. Administer antiemetic as ordered. Ondansetron is considered first line therapy for treatment of postoperative nausea and vomiting A second agent may be required. If ineffective, call APMS to have medications reassessed. On rare occasions, naloxone may be administered in low dosage to relieve nausea without loss of analgesia.

Table 11: Potential Side Effects of Epidural/Paravertebral Opioid Administration.

Potential Side Effects of Epidural/Paravertebral Local Anesthetic Administration

There are many potential side effects of administering local anesthetic in the epidural or paravertebral space. Table 12 outlines these side effects, the etiology, assessment and how to prevent complications.

Side Effect	Etiology	Nursing Assessment	Treatment
Hypotension	Due to sympathetic nerve block which causes vasodilation (degree of blockade is dose dependent) At high concentrations or rapid infusion rates, more sympathetic fibers become blocked and hypotension can occur, accentuated by hypovolemia	Assess for positional hypo-tension. Assess patient's fluid balance: HR, BP, urine output, CVP, etc. Assess patient for dizziness.	Call APMS. Administer fluid boluses prn as ordered. If BP drops > 20 mmHg and patient does not respond to fluid boluses, stop the epidural infusion (nursing judgment to turn pump off), elevate legs Teach the patient to move slowly from a prone to a sitting or standing position. Encourage PO fluid intake.
Bradycardia	Cardioaccelerator sympathetic block dependent on the concentration of local anesthetic being administered. May become apparent with sensory losses above T4	Assess HR, sensory losses.	Call APMS. Anticipate infusion rate reduction or decrease in concentration of local anesthetic.

Side Effect	Etiology	Nursing Assessment	Treatment
Sensory Loss	Related to dose and concentration of drug	Monitor for signs of a rising and denser level of sensory block unrelated to dose changes. Note if pain free, but bothered by sensory loss or numbness. Assess for potential skin break-down.	If the sensory block increases 3 or more dermatomes above the desired upper level, notify an anesthesiologist/APMS. If the sensory block increases 4 or more dermatomes above the desired upper level and the patient is compromised, notify APMS STAT. If sensory loss is a problem, the infusion rate will likely be decreased. Provide measures to prevent skin breakdown.
Motor Loss	Motor nerve blockade is more likely with higher concentration of drug (e.g., 0.25% vs. 0.1% bupivacaine and with lumbar epidural/ paravertebral catheters)	Prior to any ambulation assess motor blockage by using the motor strength impairment scale to check the patient's ability to flex the feet and knees (inability to bend at the knees may indicate a need to reduce or stop the infusion). Do not mobilize patients with a motor block. Check ankle flexion &	Call APMS. Anticipate stopping the infusion to rule out epidural hematoma. Goal is to control pain, but not have motor loss (some sensory loss may be expected). Ensure head of bed elevated 30º. May be flat for linen

Side Effect	Etiology	Nursing Assessment	Treatment
		extension or ability to move toes in orthopedic patients when large casts or immobilization dressings are preventing bending at knees.	changes and physiotherapy. Protect patient from injury until return of motor function.
Nausea and Vomiting	Usually will occur only if the patient also experiences hypotension	Monitor/question patient about nausea and vomiting, i.e. is it associated with movement?	Anti-emetics may be ordered (e.g., ondansetron, haldol dimenhydrinate). Encourage PO fluid intake, when able, to treat hypotension.
Urinary Retention	Due to sensory blockade of nerve fibers innervating the bladder Usually occurs in first 24 - 48 hours	Monitor input and output, and continue 24 h post-removal. Palpate abdomen prn for distended bladder. Observe for symptoms of discomfort, frequency and urgency.	Perform intermittent in and out catheterization as ordered. Encourage frequent voiding **NOTE:** foley catheters are not required for patients with thoracic epidural analgesia however patients with lumbar epidural analgesia may require foley catheterization.

Table 12: Potential Side Effects of Epidural/Paravertebral Local Anesthetic Administration

Potential Complications of Epidural/Paravertebral Analgesia/Anesthesia

There are many potential side effects epidural or paravertebral analgesia/anesthesia. Table 13 outlines these complications, the etiology, assessment and treatment options.

Complications	Etiology	Nursing Assessment	Treatment
Inadequate Analgesia	The spread of epidural/paravertebral analgesia is somewhat gravity dependent. Thus, if the patient is laying on his/her side, the nerve roots on that side may receive more of the epidural medication, causing the different sides of the body to have different levels of analgesia. There may be insufficient dose or volume of drug provided. There may be catheter malposition such as kinking, compression, breakage, or migration.	Assess patient's pain at rest and with activity to obtain most accurate information. Assess sensory block with ice to determine presence/absence of temperature discrimination. Assess catheter site for damage or leakage at insertion site. Ensure that the catheter is secure. Check tubing connections.	Encourage change of patient's position q2h. Assist with early ambulation. Consult APMS and the attending service to rule out complications, as necessary. Notify APMS if analgesia is inadequate.
Infection	Rare with short-term neuraxial analgesia. When it does occur, it is likely due to hematogenous spread from infections in	Observe catheter insertion site for purulent drainage, redness, or swelling. Assess temperature and vital signs**.**	Ensure that catheter connections are secure and the occlusive dressing over the insertion site is intact. Report fevers > 38.5 ° C to

Complications	Etiology	Nursing Assessment	Treatment
	other organs (septicemia) or to introduction of organisms from the skin at time of catheter placement or bolus administration.		APMS. Anticipate catheter removal; tip may be sent for C&S. Notify APMS if nuchal rigidity (posterior neck pain) or back pain at insertion site develops.
Catheter Migration The catheter in the epidural/paravetebral space could potentially migrate to an area outside the epidural/paravertebral space, into the epidural vein, into the subarachnoid space, or the paravertebral space.	An area outside the epidural/ paravertebral space (e.g. catheter inadvertently pulled out)	Assess if catheter is secure and dressing intact Loss of analgesic effect. Loss of demonstrable sensory block.	See specific modality for details regarding frequency of monitoring respiratory rate, LOS, etc. Assess catheter insertion site and dressing q12h and prn for drainage, redness, secureness, etc. Provide supportive therapy. APMS will aspirate catheter if they suspect migration in order to verify catheter placement; there should be no aspirate.
	The epidural vein. Resulting in accidental IV administration of an opioid or local anesthetic agent.	For opioid administration assess for: • Increased analgesic effect • Nausea and vomiting • Hypotension • LOS • Respiratory depression, progressing to arrest. For local anesthetic administration assess for: • Circumoral numbness (numb tongue and lips) • Jittery feeling • Tinnitus	

Complications	Etiology	Nursing Assessment	Treatment
		• Confusion • Muscle twitching • Hypotension • Bradycardia • Respiratory depression • Seizures • Cardiac arrest (will usually be seen within 5-10 min of administration)	
	The subarachnoid space. Resulting in accidental administration of opioid or local anesthetic into CSF	For opioid administration assess for: • Increase in analgesic effect • LOS • Respiratory depression, progressing to arrest • Headache • Hypotension For local anesthetic administration assess for: • Sudden onset of motor weakness/loss • Ascending sensory loss • Respiratory depression, progressing to arrest • Hypotension	
	The catheter positioned in the paravertebral space could migrate into the epidural space.	Due to increased concentration of local anesthetic used (bupivacaine 1.25mg/ml or	

Complications	Etiology	Nursing Assessment	Treatment
		2.5mg/ml), assess for: • Increased sensory loss • Development of motor block • Change of unilateral block to bilateral block • Assess if catheter secure and dressing intact.	
Wet or Loose Dressing	May be due to leakage from epidural space over time, or from accumulation of perspiration. May be due to catheter migration. If the dura mater was punctured during insertion, CSF leaks from the subarachnoid space, through the insertion site and collects under the dressing.	Assess for development of spinal headache (see below). Assess catheter site. NOTE: A small amount of serosanguinous drainage at the catheter site is normal and may be due to localized edema.	If dressing wet, cover site with sterile gauze and notify APMS.
Catheter Disconnect		An unwitnessed catheter disconnect will result in the need for catheter removal.	Wrap the loose end of the catheter in sterile gauze and notify APMS.
Spinal Headache When the dura mater is punctured CSF can leak into the epidural space, lowering the CSF pressure. This	If dura mater is punctured, CSF leakage may occur.	Patient complains of headache that increases in severity, especially when the head is raised or the body is upright.	Notify APMS. Position the patient horizontally and administer analgesics and fluid boluses as ordered.

Complications	Etiology	Nursing Assessment	Treatment
results in a very severe headache, which appears at any time within the first week after the puncture. The leak is usually self-limiting, and the headache resolves with horizontal positioning and rest.		Observe for clear drainage around insertion site.	If the headache intensifies or persists, an epidural blood patch may be used to "patch" the hole in the dura mater. This involves the anesthesiologist performing an epidural and injecting the patient's own blood into the epidural space to clot off the leak.
Epidural Hematoma	Epidural hematomas are very rare but they are the most serious complication associated with an epidural or spinal catheter in situ. It almost always occurs in conjunction with errors in the patient's coagulation mechanisms and usually happens within 1 to 2 days after catheter insertion. Bleeding within the epidural space compressed the spinal cord, causing cord ischemia which leads to paralysis and/or damage below the level of the hematoma. Severe localized back pain is the universal symptom associated with an epidural hematoma. Back pain is never accepted as a normal consequence of epidural catheter placement and its presence demands immediate medical attention. If a hematoma is suspected: • Stop the epidural infusion. • Immobilize the patient. • Notify APMS STAT.		

Table 13: Potential Complications of Epidural/Paravertebral Anesthesia/Analgesia

CADD Pump Operating Instructions

Resetting the reservoir volume:

1. Press Stop/Start button
2. Unlock box for epidural bag access;
3. Remove old bag and aseptically attach the new bag;
4. Relock box ensuring tubing is not kinked in the process.
5. Scroll down arrow until Reservoir Volume is highlighted – press select
6. Unlock the key pad using the CADD pump key (key hole opening right side lockbox)
7. Scroll up or down arrows to adjust the value then press save
8. Press Stop/Start button
9. Press 'Review pump settings'
10. Choose 'Accept' value to confirm the value is correct for the highlighted patient specific parameter.
11. Continue until all specific parameters have been reviewed, accepted and display checkmarks. Press next
12. Start pump? Press yes
13. Use the key to relock pump – Start pump? Press yes

To monitor and document volume infused and PCEA doses given/attempted press:

1. From the home screen press Reports (no need to stop pump).
2. Press 'Given and PCEA Dose Counters'

Changing the battery:

1. Press stop/start;
2. "Stop pump?" displays. Press Yes
3. Remove the used batteries;
4. Insert new batteries;
5. Press the power switch to turn the pump on;
6. The screen displays "Do you want to start a new patient?" Press No
7. Press stop/start to start the pump;
8. "Start pump?" displays. Press Yes

Quality Control and Patient Safety

Each shift, assess and ensure the following:

- Infusions are run through dedicated CADD yellow-striped non-ported tubing;
- The system is maintained using dedicated yellow CADD pump lockbox.
- The epidural solution is labeled for epidural or regional nerve block use ONLY.
- The epidural filter is wrapped in gauze and taped to anterior shoulder or arm to prevent inadvertent disconnect epidural line.

APMS CADD pumps are specifically programmed. These pumps cannot be used for palliative/chronic pain patients requiring CADD pump medications intravenously or subcutaneously.

If the catheter becomes disconnected or the line has been severed call APMS immediately. Cover ends with sterile gauze to keep ends as sterile as possible. Never use alcohol to clean disconnected line. Note: if a critical incident occurs secure CADD pump with solution and tubing in place for APMS and Clinical Engineering to inspect.

Authorization Test: Epidural and Paravertebral Analgesia/Anesthesia

1. Mr. D is a 60 year old gentleman who is POD #3 with a thoracic epidural. He rings his call bell and describes a sudden onset of retrosternal chest pain as well as shortness of breath. The surgical team is urgently made aware of the change in his condition and an ECG and bloodwork are ordered. Results of the ECG show ischemic changes and bloodwork reveals positive troponin. The patient is diagnosed with a NSTEMI and the team would like to start therapeutic anticoagulation. What should you do?

   a. Initiate therapy STAT as per service orders
   b. Call APMS STAT
   c. Give the patient Tylenol and reassess in 1 hour
   d. Remove the epidural as per the preprinted order set

2. Mrs. M is a 68 year old woman who is POD#3 from a liver resection. She rings to tell you, embarrassed, that she was incontinent in bed. While you help her to clean up, she says, “I should mention to you that I am not sure my epidural is still working because I am having some increased pain in my back”. You tell her you will go check her MAR to see if she is due for Acetaminophen, but before you do, you do a set of vital signs. Vital signs show a BP of 87/46, HR 50, RR 20, SpO2 95%, and temperature 36.1. What is your next action?

   a. Administer Acetaminophen as promised to the patient
   b. Call the surgical service to get an order for a catheter
   c. Check sensory and motor block
   d. Increase the rate of the epidural to achieve better analgesia

3. You are an RN on a surgical unit and you are completing your morning assessment. You check to ensure the epidural filter is securely attached to the anterior chest, and you notice the epidural line has become disconnected from the filter. What do you do?

   a. Use an alcohol swab and thoroughly clean the end of the filter before securely reconnecting
   b. Flush the epidural line with 10cc of sterile NaCl 0.9% before securely reconnecting
   c. Leave disconnected, wrap the filter in sterile gauze, and call APMS
   d. Remove the epidural as per the order

4. You are caring for a 72 year old patient with a thoracic epidural. Your first set of vital signs shows a BP of 95/63, HR 66, RR 15, SpO2 94%. The patient denies pain, rating it as a 0/10. There is a sensory block from T4-T8 bilaterally. There is no motor block. Four hours later, you do another routine set of vital signs and you notice that the blood pressure is now 87/50. The patient remains pain free. What should you do first?

    a. Place the patient in supine position
    b. Call APMS with concerns that the epidural is causing hypotension
    c. Recheck sensory and motor block and inform APMS
    d. Call the surgical team for further orders

5. The most serious complication of a longstanding indwelling epidural catheter is:

    a. Infection
    b. Ineffective analgesia
    c. Tinnitus
    d. Respiratory depression

Mrs. C had an abdominal aortic aneurysm repair yesterday. She was transferred from the Intensive Care Unit to a regular floor bed this morning. Mrs. C has an epidural catheter at T8. A continuous epidural infusion of Hydromorphone 10mcg/mL and Bupivacaine 1mg/mL is running at 5cc/hr. You have come on shift at 1500 and do your first assessment. You find that Mrs. C is rating her pain 5/10 at rest and 9/10 with activity and can demonstrate a sensory block to ice from T10-T12. Her vital signs are HR 120, RR 24, BP 148/92, Sp02 94% on 50% ventimask.

6. Why is Mrs. C having so much pain?

    a. Mrs. C had major surgery and should expect to have severe pain
    b. The sensory block is too narrow
    c. The sensory block is too wide
    d. Mrs. C’s bowel function is returning causing crampy pain

7. What should you do to address Mrs. C's pain problem?

    a. Reassure her that some pain is to be expected
    b. Obtain an order from the vascular service for IM morphine
    c. Call the APMS and suggest Mrs. C's infusion be decreased
    d. Call the APMS and suggest Mrs. C's infusion be increased

8. Ask a patient receiving an epidural infusion containing local anesthetic to wiggle her toes, bend her knees, lift her legs off the bed, and to squeeze her buttock to assess:

    a. Lower extremity sensory deficit
    b. Local anesthetic systemic toxicity (LAST)
    c. Lower extremity muscle weakness
    d. Respiratory depression

9. Patient receiving unilateral continuous paravertebral analgesia should have a sensory block to ice on both sides.

    a. True
    b. False

10. Absence of a sensory block to ice, even if the patient is pain free, is an indicator that an epidural or paravertebral catheter is not functioning.

    a. True
    b. False

11. Mr. J, a 73 year old gentleman who is POD #5 from an open thoracotomy. The epidural was maintained with Hydromorphone 10mcg/Bupivacaine 1mg/ml and was removed this morning. The surgical team has written for him to be discharged home this afternoon once a ride is available. What do you do?

    a. Call the patients daughter for an estimated time of when she will be able to pick up her father

    b. Remind the surgical team that the patient must remain in hospital for at least 8 hours post epidural removal

    c. Remind the surgical team that the patient must remain in hospital for at least 12 hours post epidural removal

    d. Tell the patient's daughter she can pick up her father tomorrow morning

12. Which local anesthetic provides the most rapid onset?

    a. Lidocaine
    b. Bupivacaine
    c. Morphine
    d. Fentanyl

MODULE C:
SPINAL (INTRATHECAL) ANALGESIA/ANESTHESIA

Module C: Introduction to Spinal (Intrathecal) Analgesia/Anesthesia

Local anesthetics, such as bupivacaine, may be injected into the intrathecal space to provide sensory and motor blockade. This is referred to as spinal analgesia/anesthesia. This procedure is done for operative procedures with or without general anesthetics. Opioids and local anesthetics administered into the intrathecal space spread directly via the CSF to act upon opioid receptors in the brain, therefore spinal dosing is 1/10 that of epidural dosing.

Spinal opioid solubility affects drug duration, onset, and spread of effect. Lipid soluble opioids (e.g. fentanyl) have a quicker onset of action but a shorter duration of effect, approximately 5 hours. Morphine and hydromorphone are more water soluble and thus are slower to act but remain in the CSF for a longer period of time, approximately 24 hours. For this reason, routine monitoring of respiration rate is required for 24 hours post administration of spinal opioids.

The APMS staff will only follow up on patients who have received spinal anesthesia when there is the addition of Spinal Epimorph®. Epimorph® is a preservative-free opioid made specifically for spinal injection. It is the anesthesiologist's responsibility to indicate on the Neuraxial Analgesia Post Procedure Order Set if the patient received spinal Epimorph® intraoperatively.

Absolute Contraindications	Relative Contraindications
Presence of local and systemic infection	Increased intracranial pressure
Inadequate monitoring capability and/or lack of resuscitative equipment and medications	Skeletal or spinal abnormalities
Coagulopathy or anti-coagulant therapy	Prior laminectomy with opening of dura
History of adverse reaction to proposed agent	
Patient refusal	

Table: 14. Contraindications for Spinal Analgesia/Anesthesia

Safety Considerations for Spinal Analgesia

- Ensure patient repositioned frequently, being mindful of pressure areas
- Ensure patient has full lower limb motor control prior to ambulation
- Head of bed should be maintained at 30 degrees for 24 hours post procedure

Managing Ineffective Analgesia

- Provide breakthrough analgesia as ordered
- Evaluate sensory block by assessing sensation to ice
- Use nonpharmacological interventions such as positioning, distraction, and relaxation
- Notify APMS

Nursing Considerations

Patient Assessment: Sensory Block

To assess a patient's sensory block, apply ice to an unaffected area so that the patient can identify the cold sensation. Work downwards until the patient states that the ice no longer feels cold. This is the level of sensory block. Document this on the Neuraxial Analgesia (Epidural/Paravertebral, Spinal) flow sheet as the dermatome affected.

Patient Assessment: Motor Block

The administration of spinal anesthesia will always cause a motor block. To assess motor function, ask the patient to flex their knees and ankles. When documenting, chart their movement using the Bromage scale (see Table 8). As the motor block wears off, the patient will regain control of lower extremities. They may begin to experience pins and needles in the skin and this is normal. The patient may continue to experience some pain relief until the spinal anesthetic recedes completely. Be sure to provide breakthrough analgesia as ordered. Do not attempt to mobilize the patient until the motor block has completely receded.

Spinal Analgesia/Anesthesia Complications

A potential complication of spinal analgesia/anesthesia is a post-dural puncture headache. This occurs when the spinal needle inadvertently causes a puncture in the dura mater causing a CSF leak. The patient will describe a post-dural headache as severe pain in the frontal and/or occipital region that may be associated with neck pain. The headache is often made worse by sitting or standing and improves when lying flat. Other symptoms include nausea, vomiting, and photophobia. Most will resolve on their own with time, rest, fluids, caffeine, and a combination of Acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs).

Occasionally, the sensory block may spread upward, and the patient may get a high spinal block. Blocks above the T4 region have the potential to affect cardioaccelerator fibers and can result in bradycardia and hypotension. When assessing sensory blockade, be sure to assess T2 and T1 dermatomes by checking sensation to ice down the medial aspect of the arms (see Figure 6). For example, if there is normal sensation

to medial aspect of arms, the sensory block does not ascend above T2. The patient may complain or weakness in the arms or dyspnea.

Discharge from PACU criteria

In order for a patient who has received spinal analgesia/anesthesia to be discharged from PACU, there must be regression on the sensory block by 2 dermatomes, and the sensory block must be lower than T10 and the Bromage score (see Table 8) must be at least 2. In terms of vital signs, there must be no evidence of orthostatic hypotension (decrease in systolic blood pressure of >20mmHg or decrease in diastolic blood pressure of >10mmHg) when the patient is moved from the supine to sitting position.

Spinal Anesthesia in Pediatrics

Caudal anesthesia is one of the most popular regional blocks in children and is useful when anesthesia of lumbar and sacral dermatomes is necessary. The caudal epidural space is the lowest portion of the epidural system and is entered through the sacral hiatus. This technique is a useful adjunct during general anesthesia and for providing postoperative analgesia. The quality and level of the caudal blockade is dependent on the dose, volume, and concentration of the injected drug.

Indications	Relative Contraindications
Inguinal hernia repair	Anatomical abnormalities of the spine
Myelomeningocele repair	Degenerative neuromuscular disease
Lower limb surgery	Patient and family refusal
Lower abdominal surgery	Coagulopathy
Early extubating desired after cardiac surgery	Bacterial infection
	Increased intracranial pressure
	Ventriculoperitoneal shunts

Table 15: Indications and Contraindications of Spinal Anesthesia in Pediatrics

Pediatric Care Considerations

Assessment of Pain in Pediatric Patients

When assessing pain in pediatric patients it is beneficial to use age appropriate pain assessment tools i.e. Numeric Rating scale, Grimace Faces scale. Parents may be able to report pain or distress in children, but child self-report remains the gold standard. Behavioural indicators of pain can include facial expression, body movement, posture, inability to be consoled, crying, groaning. It is important to remember that in the pediatric population, absence of signs of pain does not mean absence of pain

Assessing the Block

Assessing the sensory block may prove difficult in infants and children, especially if they have received sedation. In infants, pinprick or response to cold stimuli may be used, as well as observation of ventilation rate and pattern.

In children over 2 years of age, the Bromage scale is used (see Table 8). If the child is unable to follow commands but moves limbs spontaneously or to stimulation, motor block is not present. Assess motor and sensory block q1h while awake and PRN (i.e. if changes in hemodynamic status or pain control)

Following the block, care should be taken to avoid placing the patient in the Trendelenburg position or lifting the lower limbs. In the event of a rapidly rising level of blockade, the patient may be placed in reverse Trendelenburg position.

Apnea and Former Preterm Infants

Apnea can occur in former preterm patients following general anesthetic. Regional anesthesia decreases the risk of postoperative apnea as well as the risk of desaturation and bradycardia. However, respiratory rate and oxygen saturation should be monitored continuously via pulse oximetry.

Assisting with the Initiation of Spinal Anesthetic

1. Verify correct patient using two identifiers.
2. Establish and ensure patency of IV.
3. Obtain baseline vitals, BP, HR, temperature, oxygen saturation, and RR.
4. Place patient on cardiac monitor and interpret rhythm strip. Ensure strip and interpretation is included on the flow sheet.
5. Assist with positioning.

Assessment and Monitoring

1. For the first 4 hours post bupivacaine and fentanyl/epimorphine, monitor RR q30 minutes for 2 hours then q1h for following 2 hours. If no opioids administered, monitor RR q4hrs and prn
2. Monitor LOS and pain q4h
3. Elevate the head of the bed 30 degrees.
4. Maintain IV access.
5. Assess motor block on a scale of 0-3, using the scale on the Neuraxial Analgesia (Epidural/Paravertebral, Spinal) Flow Sheet (Bromage scale) q1h until return of full motor function (or pre procedure/surgery motor function).
6. Assess the level of sensory block with ice, using the dermatome chart on the Neuraxial Analgesia (Epidural/Paravertebral, Spinal) Flow Sheet, q1h until return of full sensation (or pre-procedure/surgery sensation).

Reporting and Recording

Notify APMS STAT if you observe:

- RR less than 10 breaths per minute or dyspnea
- systolic blood pressure less than 90mm Hg
- heart rate less than 50 beats per minute
- convulsions
- POSS score of 4
- development of new motor block, or sensory block that increases by more than 3 dermatomes above the desired upper level and the patient is compromised
- signs and symptoms of LAST (refer to Table 4)

Potential Side Effects of Spinal Opioid Administration

There are many potential side effects of administering opioids in the intrathecal (spinal) space. Table 16 outlines these side effects, the etiology, and assessment and prevention techniques.

Side Effect	Etiology	Nursing Assessment	Prevention/Therapy
Respiratory Depression: Initial presentation is often increasing level of sedation (LOS). Depth of respiration may first become shallow with little change in rate	Due to vascular absorption of drug. Most serious but least frequent effect More likely to occur if: • patient is >70 and receives large dose • history of impaired respiratory function • parenteral opioids, sedatives or antiemetics administered concurrently • medications given during surgery • patient lying flat • patient is obese More likely with morphine and hydromorphone than with fentanyl Latent respiratory effects may occur after spinal	Patient assessment includes monitoring of respiratory depth and rate, level of sedation (LOS) using Pasero Opioid-Induced Sedation Scale (POSS, see table 2). Assess for opioid toxicity (<1%, rare): drowsiness; mental clouding; pinpoint pupillary constriction; coma; respiratory depression; with fentanyl, may see muscle rigidity, laryngospasm Frequency and extent of the assessment varies according to the specific analgesic therapy that is being/has been administered.	Encourage deep breathing. Elevate head of bed 30^{o}. Patient may lie flat for linen changes, physiotherapy. Ensure patient has IV access DO NOT administer other opioids, sedatives, anti-emetics, without orders from APMS. Encourage early, assisted ambulation. Notify Anesthesia/APMS if adult RR<10 and/or LOS = 4. Administer PRN O_2 If patient is somnolent (LOS = 4): • attempt to rouse;

Side Effect	Etiology	Nursing Assessment	Prevention/Therapy
	morphine/hydromorphone due to drug circulating in CSF around respiratory centre in brain		• assess RR; • stop continuous infusion; • call APMS Administer naloxone (0.4mg/mL available) IV as ordered (see naloxone administration guidelines). ***Call Code 99 for Anesthesia***
Pruritus	Tends to develop on face, trunk and/or upper extremities Not an allergy No rash or redness May be related to histamine release or central effect	Observe for itching.	Administer small doses of naloxone as ordered.
Urinary Retention	Due to opioid effect on spinal cord & spinal nerves innervating the bladder Occurs more frequently in men	Monitor input and output, and continue 24 h post-removal. Palpate abdomen prn for distended bladder. Observe for symptoms of discomfort, frequency and urgency.	Catheterize intermittently as Ordered Administer small doses of naloxone as ordered.

Side Effect	Etiology	Nursing Assessment	Prevention/Therapy
Nausea/Vomiting	Due to vascular absorption of opioid Latent effects may occur 6-10 h after spinal morphine due to drug circulating in CSF around vomiting centre in brain	Monitor for nausea and vomiting.	Provide supportive measures. Administer antiemetics as ordered. Ondansetron is considered first line therapy for treatment of postoperative nausea and vomiting A second agent may be required. If ineffective, call APMS to have medications reassessed. On rare occasions, naloxone may be administered in low dosage to relieve nausea without loss of analgesia.

Table 16: Potential Side Effects of Spinal Opioid Administration

Potential Side Effects of Spinal Local Anesthetic Administration

There are many potential side effects of administering local anesthetic in the intrathecal (spinal) space. Table 17 outlines the potential side effects, the etiology, and assessment and treatment options.

Side Effect	Etiology	Nursing Assessment	Treatment
Hypotension	Due to sympathetic nerve block which causes vasodilation (degree of blockade is dose dependent) At high concentrations or rapid infusion rates, more sympathetic fibers become blocked and hypotension can occur, accentuated by hypovolemia	Assess for positional hypotension. Assess patient's fluid balance: HR, BP, urine output, CVP, etc. Assess patient for dizziness.	Call APMS. Administer fluid boluses prn as ordered. If BP drops > 20 mmHg and patient does not respond to fluid boluses, elevate legs, anticipate the need for Ephedrine (vasoconstrictor). Teach the patient to move slowly from a prone to a sitting or standing position. Encourage PO fluid intake.
Bradycardia	Cardioaccelerator sympathetic block dependent on the concentration of local anesthetic being administered. May become apparent with sensory losses above T4	Assess HR, sensory losses.	Call APMS. Anticipate infusion rate reduction or decrease in concentration of local anesthetic. Anticipate the need for atropine (an anticholinergic or parasympatholytic).

Side Effect	Etiology	Nursing Assessment	Treatment
Sensory Loss	Related to dose and concentration of drug Progression of sensory loss Pain sensation ↓ temp. discrimination ↓ proprioception ↓ vibration sense ↓ pressure sensation	Monitor for signs of a rising and denser level of sensory block unrelated to dose changes. Note if pain free, but bothered by sensory loss or numbness. Assess for potential skin break-down.	If the sensory block increases 3 or more dermatomes above the desired upper level, notify an anesthesiologist/APMS. If the sensory block increases 4 or more dermatomes above the desired upper level and the patient is compromised, notify an anesthesiologist/APMS STAT. If sensory loss is a problem, the infusion rate will likely be decreased. Provide measures to prevent skin breakdown.
Motor Loss	Motor nerve blockade is more likely with higher concentration of drug (e.g., 0.25% vs. 0.1% bupivacaine	Prior to any ambulation assess motor blockage by using the motor strength impairment scale (Bromage scale) to check the patient's ability to flex the feet and knees. Do not attempt to mobilize patients with a motor block.	Call APMS. Goal is to control pain, but not have motor loss (some sensory loss may be expected). Ensure head of bed elevated 30º. (May be flat for linen changes and

Side Effect	Etiology	Nursing Assessment	Treatment
		Check ankle flexion & extension or ability to move toes in orthopedic patients when large casts or immobilization dressings are preventing bending at knees.	physiotherapy.) Protect patient from injury until return of motor function.
Nausea and Vomiting	Usually will occur only if the patient also experiences hypotension	Monitor/question patient about nausea and vomiting, i.e. is it associated with movement?	Antiemetics may be ordered (e.g., ondansetron, haloperidol, and dimenhydrinate). Encourage PO fluid intake, when able, to treat hypotension.
Urinary Retention	Due to sensory blockade of nerve fibers innervating the bladder Usually occurs in first 24 - 48 hours	Monitor input and output, and continue 24 h post procedure Palpate abdomen prn for distended bladder. Observe for symptoms of discomfort, frequency and urgency.	Perform intermittent in and out catheterization as ordered. Encourage frequent voiding

Table 17: Potential Side Effects of Spinal Local Anesthetic Administration

Potential Complications of Spinal Analgesia/Anesthesia

There are many potential complications of spinal analgesia/anesthesia. Table 18 outlines the potential complications, the etiology, and assessment and treatment options.

Complications	Etiology	Nursing Assessment	Treatment
Infection	Rare with short-term neuraxial analgesia. When it does occur, it is likely due to hematogenous spread from infections in other organs or to introduction of organisms from the skin at time of bolus	Assess temperature and vital signs. Notify APMS if nuchal rigidity (posterior neck pain) or back pain at insertion site develops.	Report fevers > 38.5 ° C to APMS.
Spinal Headache	When the dura mater is punctured CSF can leak into the epidural space, lowering the CSF pressure. This results in a very severe headache, which appears at any time within the first week after the puncture. The leak is usually self-limiting, and the headache resolves with horizontal positioning and rest.	Patient complains of headache that increases in severity, especially when the head is raised or the body is upright. Observe for clear drainage around insertion site.	Notify APMS. Position the patient horizontally and administer analgesics and fluid boluses as ordered. If the headache intensifies or persists, an epidural blood patch may be used to "patch" the hole in the dura mater. This involves performing an epidural and injecting the patient's own blood into the epidural space to clot off the leak.

Complications	Etiology	Nursing Assessment	Treatment
Spinal Hematoma	Spinal hematomas are very rare but they are the most serious complication associated with a spinal catheter in situ. It almost always occurs in conjunction with errors in the patient's coagulation mechanisms and usually happens within 1 to 2 days after procedure. Bleeding within the spinal space compressed the spinal cord, causing cord ischemia which leads to paralysis and/or damage below the level of the hematoma. Severe localized back pain is the universal symptom associated with a spinal hematoma. Back pain is never accepted as a normal consequence of a spinal anesthetic and its presence demands immediate medical attention. If a hematoma is suspected: • Immobilize the patient. • Notify APMS STAT.		

Table 18: Potential Complications of Spinal Administration

Authorization Test: Spinal (Intrathecal) Analgesia/Anesthesia

1. A patient who has had spinal anesthesia complains of a headache. Which of the following is an appropriate action by the nurse?

   i. Increase fluid intake
   ii. Reduce surrounding stimuli if possible
   iii. Keep the head of the bed flat
   iv. Administer PRN Acetaminophen
   v. Notify APMS

   a. All of the above
   b. i, ii, iii, v
   c. v
   d. i, ii, v

2. Mrs. N is a 91 year old who fell and broke her hip at home when she slipped on the tile floor in her kitchen. You are caring for her post ORIF. You are notified on report that she had spinal anesthetic with Epimorph®. She complains of significant nausea. You check her MAR for antiemetics and confirm she has not had anything for nausea. What do you administer?

   a. Ondansetron 4mg IV
   b. Dimenhydrinate 25mg IV
   c. Dimenhydrinate 50mg IV
   d. Haloperidol 0.5mg IV

3. You are caring for a patient post Total Knee Arthroplasty (TKA). You are told on report that they had a spinal anesthetic with Epimorph®. You obtain a baseline set of vital signs which show a BP 95/60, HR 65, RR 6, Sp02 92% on room air. The patient has been very drowsy since admission to your unit. You try to wake them by calling their name with little success. You shake their shoulder in an attempt to stimulate them. There is only a sluggish response to stimulus. Which of the following is an inappropriate action by the nurse?

   a. Apply nasal prongs at 2L/min
   b. Assess Pasero Opioid Induced Sedation Scale (POSS)
   c. Call APMS and administer Naloxone as per order
   d. Call APMS and administer Flumazenil as per order

It is 1600 and you have just admitted two post-operative hip replacement patients. Patient A received 100mcg of spinal Epimorph® at 1300 in addition to spinal anesthesia and patient B received spinal anesthesia only at 1230. Both patients are comfortable, report pain scores of 2/10 at rest and can demonstrate a sensory block to ice from T12-L3.

4. Patient A will likely have analgesia for longer than patient B because spinal Epimorph® can provide analgesia for up to 24 hours.

    a. True
    b. False

5. Patient A will need to be monitored for which serious complication of spinal opioids for 24 hours:

    a. Pruritus
    b. Nausea
    c. Respiratory depression
    d. Post-dural puncture headache

6. It is unnecessary to assess for the presence of motor block in patients who have or are receiving a local anesthetic agent prior to ambulation.

    a. True
    b. False

7. Unlike epidural analgesia, spinal analgesia involves the placement of the agent:

    a. Directly into the subarachnoid space
    b. Between the dura mater and the ligamentum flavum
    c. Directly into the spinal cord
    d. Into an epidural vein

8. Early signs and symptoms of local anesthetic toxicity include ALL but one of the following. Indicate the exception.

    a. Tinnitus
    b. Perioral numbness
    c. Dizziness
    d. Hypertension

9. All are important nursing actions for the safe and competent care of the patient who has had spinal analgesia, except:

    a. Ensure patient repositioned frequently, being mindful of pressure areas
    b. Ensure patient has full lower limb motor control prior to ambulation
    c. Head of bed should be maintained at 30 degrees for 24 hours
    d. Head of bed should be maintained flat for 24 hours

MODULE D: CONTINUOUS/INTERMITTENT PERIPHERAL NERVE BLOCKS

Module D: Introduction to Continuous and Intermittent Peripheral Regional Analgesia/Anesthesia

Peripheral regional techniques can be used to provide analgesia, as well as anesthesia for surgical procedures. Regional techniques used at KHSC are most often "single-shot" applications, usually providing 8-12 hours of analgesia. However, many of these techniques can also be done with a larger needle that allows a catheter to be placed along a nerve sheath. A continuous infusion of local anesthetic can be delivered through this catheter allowing for continuous analgesia for an indefinite amount of time, providing longer lasting pain management. Table 19 outlines indications for peripheral regional analgesia/anesthesia as well as absolute and relative contraindications.

For a peripheral nerve block, ultrasound technology is used to directly visualize the nerve or nerve plexus that will be blocked with local anesthetic (LA). Once visualized, LA is injected as close to the target nerve or nerve plexus as possible. The LA bathes the nerve, blocking sodium channels and thereby interrupting the transmission of painful impulses. The result will be blockade of sensory and motor nerve fibers.

In contrast to upper and lower extremity nerve blocks, truncal blocks do not require direct visualization of the nerve or nerve plexus. Instead of injecting around the nerve, LA is injected into and spreads through muscle planes in order to target as many specific nerve endings as possible (see page 42-46 for common upper and lower extremity and truncal blocks). Truncal blocks will result in blockade of sensory nerve fibers only. There will be no motor block with a truncal block.

Indications	Absolute contraindications	Relative contraindications
Suspected difficult airway Patient at risk for respiratory depression High risk for postoperative nausea and vomiting Goal to minimize opioid use Continuous sympathetic blockade in the management of vascular and plastic surgery	Patient refusal Systemic infection or local infection at the site of injection Underlying nerve damage	Risk for compartment syndrome Coagulopathy or concomitant anti-coagulant therapy

Table 19. Indications and Contraindications for Peripheral Regional Nerve Blocks

The following tables and diagrams outline common upper extremity regional nerve blocks (Table 20) and associated nerve distribution (Figure 14), common lower extremity regional nerve blocks (Table 21) and associated nerve distribution (Figure 15). Lastly, common truncal blocks are illustrated (Figure 16 and Table 22). Common Upper Extremity Regional Blocks

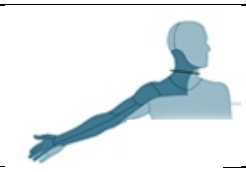
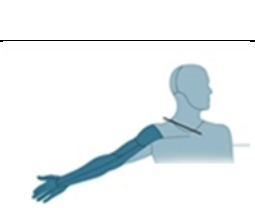
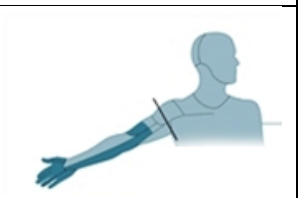
Upper Extremity Brachial Plexus Nerve Blocks	Area of Injury/Surgery	Area of Extremity Blocked	Nursing Considerations
Interscalene • Single-shot • Continuous	Shoulder, upper arm		Reassure patient of common benign side effects: • 100% of patients receiving interscalene nerve blocks will have phrenic nerve palsy resulting in diaphragm paralysis (same side as block). Monitor for shortness of breath. • Horner's Syndrome (myosis, ptyosis) Instruct patient to ensure limb protected Look for PRN pain meds & requirements
Supraclavicular	Arm, forearm		
Infraclavicular	Arm, forearm, hand		
Axillary block	Forearm, hand		

Table 20. Common Upper Extremity Regional Blocks

Nerve Distribution Upper Extremity

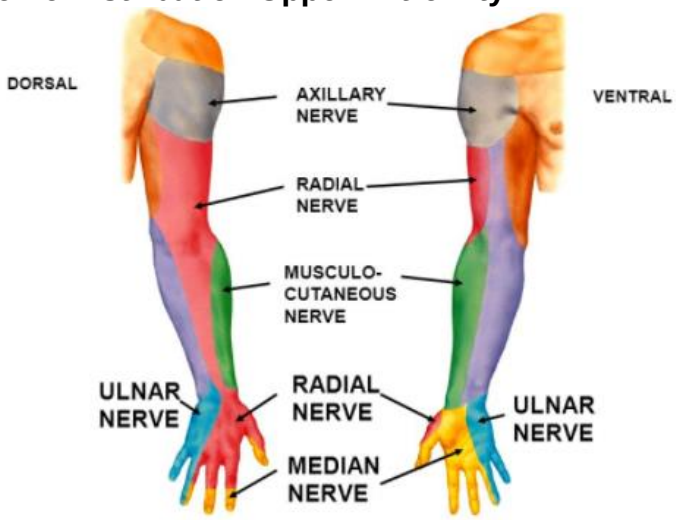


Figure: 14. Upper Extremity Nerve Distribution.

Common Lower Extremity Regional Blocks

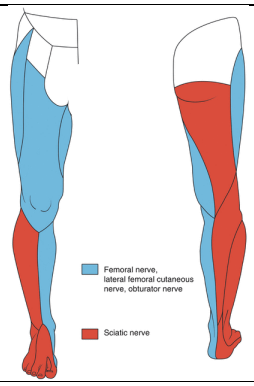
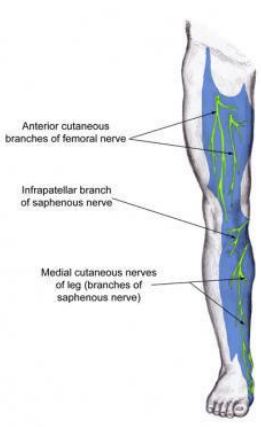
Lower Extremity Nerve Block	Area of Injury/Surgery	Area of Extremity Blocked	Nursing Considerations
Femoral • Single-shot • Continuous	Anterior thigh Knee Medial Ankle		Assess sensory and motor block. Do not mobilize if complete motor block. Instruct patients: Do not stand or walk without assistance until block wears off. Assess for LAST (refer to Table 4) Note: Adductor Canal blocks will have a sensory block only
Sciatic/Popliteal Saphenous	Distal tibia/fibula Ankle (Saphenous) – medial side of knee/ankle		
Adductor Canal • Single-shot • Continuous	Anterior thigh Knee Medial Ankle		

Table 21. Common Lower Extremity Peripheral Nerve Blocks

Nerve Distribution Lower Extremity

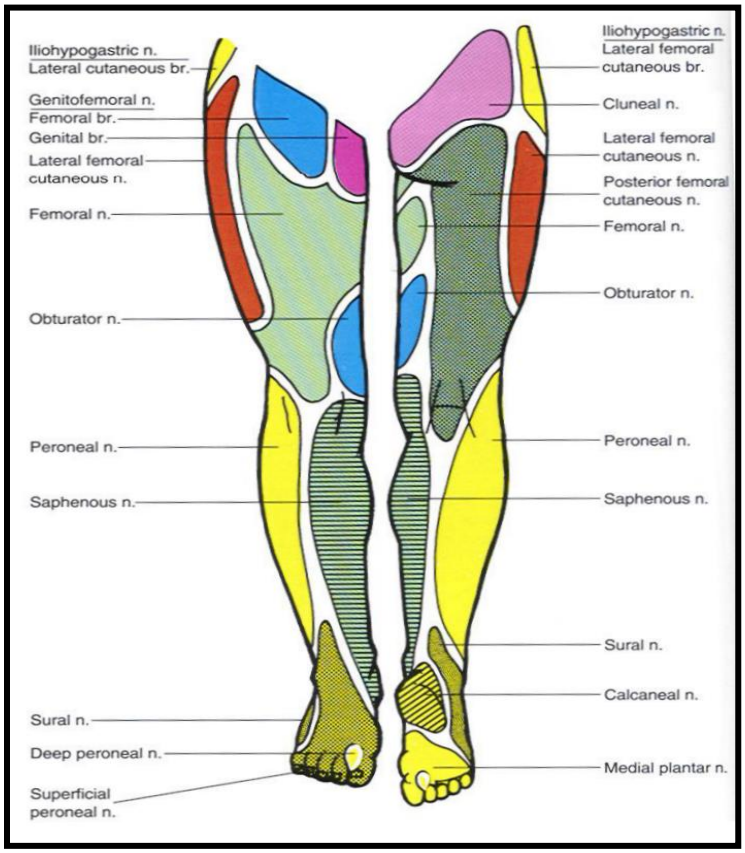


Figure: 15. Lower Extremity Nerve Distribution

Common Truncal Blocks

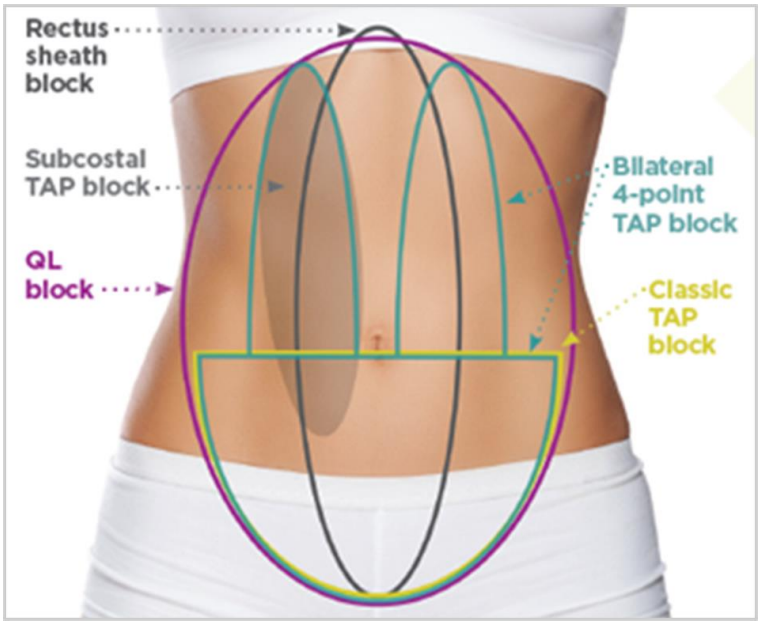


Figure: 16. Truncal Blocks

Truncal blocks can be single-shot doses or continuous infusions.

Common Truncal Blocks	Area of Injury/Surgery	Nursing Considerations
Paravertebral Block	Thoracotomy, rib fractures, nephrectomy, liver resections, open cholecystectomy Site specific	Paravertebral blocks are treated like an epidural block due to its close proximity to the spinal cord. For this reason, anticoagulation is an important consideration Look for PRN pain meds & requirements Assess sensory block Assess for LAST (refer to Table 4) Ensure infusion pump is clearly labelled as regional nerve block if patient receiving continuous infusion Inspect and asses nerve block insertion site every shift and report abnormal findings (bleeding, hematoma, drainage)
Transverse Abdominal Plane (TAP) Block	Lower abdominal/pelvic surgeries Upper abdominal surgeries with sub-costal incision T8-L1 most reliably T10-L1	
Rectus sheath block	Abdominal surgeries with midline incision	
Erector Spinae Plane Block	Rib fractures, lung lobectomies, vertebral surgery, one sided abdominal surgeries (i.e. Liver or gallbladder) T2-T9	
PECS II	Unilateral breast surgery	

Table: 22. Common Truncal Blocks.

Potential Complications of Nerve Blocks

Table 2 outlines potential complications for nerve blocks and related nursing responsibilities.

Potential Complication	Nursing Responsibilities
Inadvertent intravascular injection	Observe for LAST (refer to Table 4)
Infection	Observe for increase in temperature, swelling, redness at site, and increased pain
Nerve damage	Although rare, will become apparent once block has receded. Nerve damage will manifest as light, intermittent tingling and numbness lasting a few weeks and in some cases, can become a persistent painful paresthesia with associated sensory and motor loss, lasting months to years.
Hematoma	Results from the catheter needle puncturing a blood vessel during insertion. If this occurs, direct pressure should be applied to the site.
Injury to blocked area	The patient will not feel pain in the blocked limb; careful attention should be paid to skin integrity to ensure no skin breakdown occurs. The patient should be assisted with repositioning and the affected limb should be placed in anatomical position. Caution should be used if using heat or ice. If a motor block is present, the patient should be reminded not to mobilize, as this can lead to falls.

Table 23. Potential Complications for Nerve Blocks and Related Nursing Responsibilities

Patient Assessment: Sensory and Motor Block

When using ice to assess the analgesic zone, the ice will feel cold on unblocked areas and less cold on blocked areas. The intended zone of analgesia should cover the operative site.

Because innervation of the arm comes from different nerves, the extent of blockage is best assessed by evaluating functions unique to each terminal nerve. A method of performing such as assessment is the 4P’s: push, pull, pinch, pinch.

Assessing Blockade of Upper Extremities (Brachial Plexus)

Nerve Assessed	Action
Radial Nerve	Patient is asked to *push* the arm by extending the forearm at the elbow against resistance
Musculocutaneous Nerve	Patient is asked to resist the *pull* of the forearm at the elbow
Median Nerve	The ability to distinguish a *pinch* at the palmar base of the index finger
Ulnar Nerve	The ability to distinguish a *pinch* at the palmar base of the little finger

Table 24. 4 P's for Upper Extremity Blocks.

Assessing Blockade of Lower Extremities

For lower extremity evaluation, the 4 P's are modified slightly to become push, pull, pinch, punt. This method allows for a rapid qualitative assessment of the sciatic, obturator, lateral femoral cutaneous and femoral nerves.

Nerve Assessed	Action
Sciatic Nerve	Patient is asked to plantar flex (*push*) the foot against resistance
Obturator Nerve	The ability to adduct the leg toward midline against resistance (*pull*)
Lateral Femoral Cutaneous Nerve	The ability to distinguish a *pinch* at the proximal lateral thigh
Femoral Nerve	The assessor raises the knee and asks the patient to extend the knee against resistance (*punt*)

Table 25. 4 P's for Lower Extremity Blocks.

Documentation of Sensory and Motor Function

Document assessment of sensory and motor function (upper and lower extremity nerve blocks) on the Peripheral Regional Blocks: Continuous/Intermittent and/or Single Shot: Assessment and Monitoring Flow Sheet using the scale below.

Sensory and Motor Assessment for Upper and Lower Extremity Nerve Blocks			
Grade	Motor	Grade	Sensation
2	No weakness	2	Normal-No block
1	Some weakness of legs/feet	1	Partial sensation
0	Unable to move	0	Complete numbness

Table 26. Sensory and Motor Assessment for Upper and Lower Extremity Blocks.

Motor Block

For patients with lower extremity nerve blocks, it is important to assess for the presence of a motor block to ensure it is safe for the patient to ambulate. To assess motor function, ask the patient to flex their knees and ankles. When documenting, chart their movement using the Bromage scale (refer to Table 8).

Care of the Affected Limb (Upper and Lower Extremity)

Patients will have limited motor control of the affected limb as well as limited sensation. Limbs must be protected from trauma, burns, bumps or pressure. Patients with femoral blocks should be cautious when weight bearing on the blocked side because of the potential for distal motor function impairment. However, ambulation is not restricted during therapy when necessary precautions are taken. Motor and proprioceptive functions must be assessed prior to any ambulation to prevent falls or other untoward events.

Managing Ineffective Analgesia

- Provide breakthrough analgesia as ordered on APMS order set
- Evaluate sensory block by assessing sensation to ice
- Assess catheter insertion site and integrity of system
- Use nonpharmacological interventions such as positioning, distraction, and relaxation
- Notify APMS

When to Notify APMS

Notify a member of the APMS team if you notice any of the following with your patient with a nerve block:

- Systolic blood pressure less than 90mmHg and/or heart rate less than 50 beats per minute
- Progressive motor block
- Inadequate analgesia
- Signs and symptoms of LAST (refer to Table 4)

Assessment and Monitoring:

When the patient is receiving a continuous infusion and/or single-shot peripheral nerve block of local anesthetic agents, assess the patient according to the guidelines outlined in Table 27.

Indication	Assessment Parameter
At the start of the infusion or at the time of single-shot dose	Pain BP and HR Catheter site if applicable Sensory and motor function
15 and 30 minutes	Pain BP and HR Signs and symptoms of LAST (refer to Table 4)
1 hour	Pain BP and HR Signs and symptoms of LAST (refer to Table 4)
q4h and PRN for duration of infusion and/or sensory and motor deficit and until the resumption of previous sensory and motor function	Pain BP and HR Signs and symptoms of LAST (refer to Table 4) Sensory and motor function
Q12H and PRN for duration of infusion and/or sensory and motor deficit and until the resumption of previous sensory and/or motor function	Catheter site Catheter connections Paresthesia Sensory and motor function

Table 27. Assessment Schedule for Nerve Blocks

Indications for PRN sensory and motor block assessments include:

- Increasing pain
- Patient reports of numbness, tingling, or pins and needles sensation
- Lower limb weakness
- Sudden bowel or bladder incontinence
- Urinary retention
- Sudden pain at catheter site

Indications for PRN catheter site assessments:

- Change in pain
- Presence of fluid at catheter site
- Patient report of pain at catheter site
- Elevated temperature
- Change in primary nursing responsibility

Ensure the patient has established IV access and that it is patent for 6 hours post administration of local anesthetic.

Recording and Reporting:

Discontinue the infusion and notify APMS STAT if you observe or suspect the following for your patient with a nerve block:

- systolic blood pressure less than 90mm Hg
- convulsions
- LAST (see Table 4)
- catheter migration
- disconnection of the infusion line from the peripheral nerve catheter (if infusion line present)
- dressing rolls up or falls off and catheter is exposed (if applicable)

Notify APMS if you observe the following for your patient with a nerve block:

- Inadequate pain relief
- Temperature greater than 38.5^{o} C
- Challenges with the CADD infusion pump (e.g. pump malfunction, downstream occlusion, low battery)
- Paresthesia/sensory/motor block that is distressing to the patient
- A written order for anticoagulant therapy
- Redness, excessive bruising, swelling, and infection (i.e. pain, warmth, discharge)
- Leaking from the catheter site (if catheter present)

The removal of the peripheral nerve block catheter is done by a member of the APMS team. Post removal of peripheral nerve block catheter, call APMS if any of the following;

- There is alteration to sensation or movement during and following removal
- If persistent fluid leakage, localized bleeding, or expansion of bruising is noted
- If sensory block is not resolved within 24 hours after catheter removal

Complete independent double checks at the following times:

- prior to initiation of continuous peripheral nerve block infusion
- with each bag change
- with prescribed changes in dose/rate by APMS

Complete independent verification with changes in nursing responsibility (e.g. shift changes, unit to unit transfers).

To verify parameters programmed on pump press select on CADD pump console to confirm:

1. Local anesthetic drug and concentration
2. Continuous infusion rate
3. Patient Controlled Regional Analgesia (PCRA) dose if applicable and lockout time

If there is a discrepancy between the patient care orders and the parameters

programmed on the CADD pump, notify APMS to make necessary changes. Nurses do not clear totals of local anesthetic delivered

Assessment and documentation will be performed for the duration of sensory and motor deficits in both single-shot or infusion interventions except patients with planned discharge home before sensory/motor blockade has resolved. These patients will be followed-up by APMS.

If the patient is receiving both a continuous regional infusion and intravenous Patient Controlled Analgesia (PCA-IV), a separate analgesia flow sheet must be used and documentation must be appropriate to each individual modality.

CADD Pump Operating Instructions

For initiation of continuous nerve block infusion and/or with each change of pump solution bag reset the reservoir volume:

1. Press Stop/Start button
2. Unlock box for local anesthetic solution bag access
3. Remove old bag and aseptically attach the new bag
4. Relock box ensuring tubing is not kinked in the process
5. Scroll down arrow until Reservoir Volume is highlighted – press select
6. Unlock the key pad using the CADD pump key (key hole opening right side lockbox)
7. Scroll up or down arrows to adjust the value then press save
8. Press Stop/Start button
9. Press ‘Review pump settings’
10. Choose ‘Accept’ value to confirm the value is correct for the highlighted patient specific parameter.
11. Continue until all specific parameters have been reviewed, accepted and display checkmarks. Press next
12. Start pump? Press yes
13. Use the key to relock pump – Start pump? Press yes

To monitor and document volume infused and patient controlled regional analgesia (PCRA) doses given/attempted press:

1. From the home screen press Reports (no need to stop pump).
2. Press ‘Given and PCRA Dose Counters’

How to change the battery:

1. Press stop/start;
2. “Stop pump?” displays. Press Yes
3. Remove the used batteries from the top of the pump
4. Insert new batteries
5. Press the power switch to turn the pump on
6. The screen displays “Do you want to start a new patient?” Press No
7. Press stop/start to start the pump “Start pump?” displays. Press Yes

Quality Control and Patient Safety:

Each shift, assess and ensure infusions are run through dedicated CADD yellow-striped non-ported tubing. Ensure the system is maintained using dedicated yellow CADD pump lockbox. The local anesthetic solution must be labeled “for regional nerve block use ONLY”. Assess that the connection filter is wrapped in gauze and taped securely to skin to prevent inadvertent disconnect of catheter tubing.

If the catheter becomes disconnected or tubing severed, call APMS immediately. Cover end with sterile gauze to keep end as sterile as possible. Never use alcohol to clean disconnected line. If a critical incident occurs, secure CADD pump with solution and tubing in place for APMS and Clinical Engineering to inspect. Refer to Administration Policy 06-170.

Ensure patients have received education about the possible signs/symptoms of LAST (refer to Table 4) when they should call for help.

Care of the Anesthetized Limb

- Move anesthetized limb with caution.
- Reposition q2h to avoid skin breakdown.
- Provide skin care and maintain proper alignment
- Avoid contact with hot or cold objects
- For upper extremity nerve blocks, place a pillow under the arm to protect the elbow and prevent ulnar nerve injury
- For lower extremity nerve blocks, place a pillow under the limb to prevent injury to the peroneal nerve. Prior to mobilizing, assess quad function. Always use 2 people to assist with first time transfers, and the patient should not to mobilize on blocked leg until sensation returns.

Authorization Test: Peripheral Regional Analgesia/Anesthesia

1. Mrs. S is a 58 year old woman who you are caring for after a Total Shoulder Arthroplasty (TSA). She has just been transferred to your unit from PACU. Her postoperative pain regime includes Acetaminophen 650mg PO q4h, Hydromorphone 1-2mg PO q3h PRN, and a Ropivacaine infusion running at 7cc/hr through a continuous interscalene nerve catheter. She reports her pain is well controlled, 3/10 with rest and activity. She has been tolerating clear fluids and you offer her an apple juice. Shortly after she finishes her juice, she rings her call bell to tell you she notices a metallic taste in mouth and tingling in her lips. What do you do?

    a. Explain to Mrs. S that she is on some new medications since her surgery which could be distorting the taste of her juice
    b. Hold her next schedule dose of Acetaminophen as she is likely having an adverse reaction to Tylenol
    c. Call APMS
    d. Call the orthopedic surgery resident for additional orders

2. Metallic taste and circumformal tingling is a potential side effect of:
    a. Severe uncontrolled pain
    b. Local anesthetic systemic toxicity
    c. Horner's syndrome
    d. Spinal hematoma

3. As a peripheral block is wearing off, what generally returns first?

    a. Sensation
    b. Sympathetic resolution
    c. Motor ability
    d. Proprioception

4. If a peripheral regional nerve catheter becomes infected, there may be:

    a. A rise in the patient's temperature
    b. Localized redness over the catheter site

c. Tenderness over the catheter site
d. All of the above

5. Medications that can be ordered by the surgical team while the patient has a continuous peripheral regional nerve catheter in situ are:

a. Ondansetron
b. Morphine
c. Lorazepam
d. None of the above

6. Local anesthetics prevent nerve conduction by binding to which channels?

a. Magnesium
b. Calcium
c. Potassium
d. Sodium

7. Interscalene blocks are suitable for surgeries around?

a. Shoulder, medial elbow and hand
b. Shoulder, clavicle, A-C joint, and proximal humerus
c. Elbow, forearm, and hand
d. Shoulder only

8. Ipsilateral hemidiaphragm paresis (one sided diaphragm paralysis) is a common side effect with interscalene blocks

a. True
b. False

9. You are caring for a 75 year old gentleman who had an adductor canal block for a total knee arthroplasty. You are working with the physiotherapist to ambulate the patient for the first time. Which is true about an adductor canal block?

a. It blocks both sensory and motor nerve fibers
b. It blocks sensory nerve fibers only
c. It blocks the motor fibers of the femoral nerve

d. It leads to quadriceps muscle weakness

10. You are caring for a 46 year old woman who slipped and fell on some ice and sustained multiple left sided rib fractures. Which is true about an erector spinae plane block?

    a. The sensory block will be unilateral
    b. The sensory block will be bilateral
    c. It is useful for major abdominal surgeries
    d. It provides both sensory and motor blockade

11. You are working on one of the surgical units and admit a patient post right total shoulder arthroplasty who had a one shot interscalene nerve block. You notice that their eyelid is drooping. You check pupillary reflex and notice the right pupil is constricted. You recognize this complication of interscalene nerve blocks to be?

    a. Horner's syndrome
    b. Anisocoria
    c. Opioid intoxication
    d. Local Anesthetic Systemic Toxicity (LAST)

12. What is your first nursing action?

    a. Stop infusion
    b. Reassure patient this is a common side effect of interscalene nerve blocks
    c. Call APMS STAT
    d. Call surgical service for further order

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