

# **INTRA SPINAL MEDICATION DELIVERY**

**INTRATHECAL CONTINUOUS & INJECTION  
EPIDURAL CONTINUOUS & INJECTION**

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# INTRA SPINAL MEDICATION DELIVERY

**Intra spinal delivery can be used in any of several ways:**

- Single dose intrathecal
- Single dose epidural
- Intermittent epidural by scheduled bolus
- Intermittent Patient-Controlled Epidural (PCEA)
- Continuous infusion opioid alone
- Continuous infusion epidural opioid in combination with another medication
- Continuous infusion intrathecally via a permanent indwelling computerized pump

Numerous studies have shown that spinal opioids can provide post-operative analgesia with less central and systemic adverse effects. Spinal opioids may be used for:

## **Acute Pain**

- \* Perioperative pain
- \* Post-operative pain
- \* Labour pain
- \* Trauma pain
- \* Non-surgical pain (e.g., myocardial infarct, angina pectoris, Herpes Zoster virus, renal colic, thrombophlebitis)

## **Cancer Pain**

- \* Long-term therapy
- \* Home care

## **Chronic Non-Malignant Pain**

- \* Intractable pain such as ischemic pain, back pain, or intractable angina pectoris

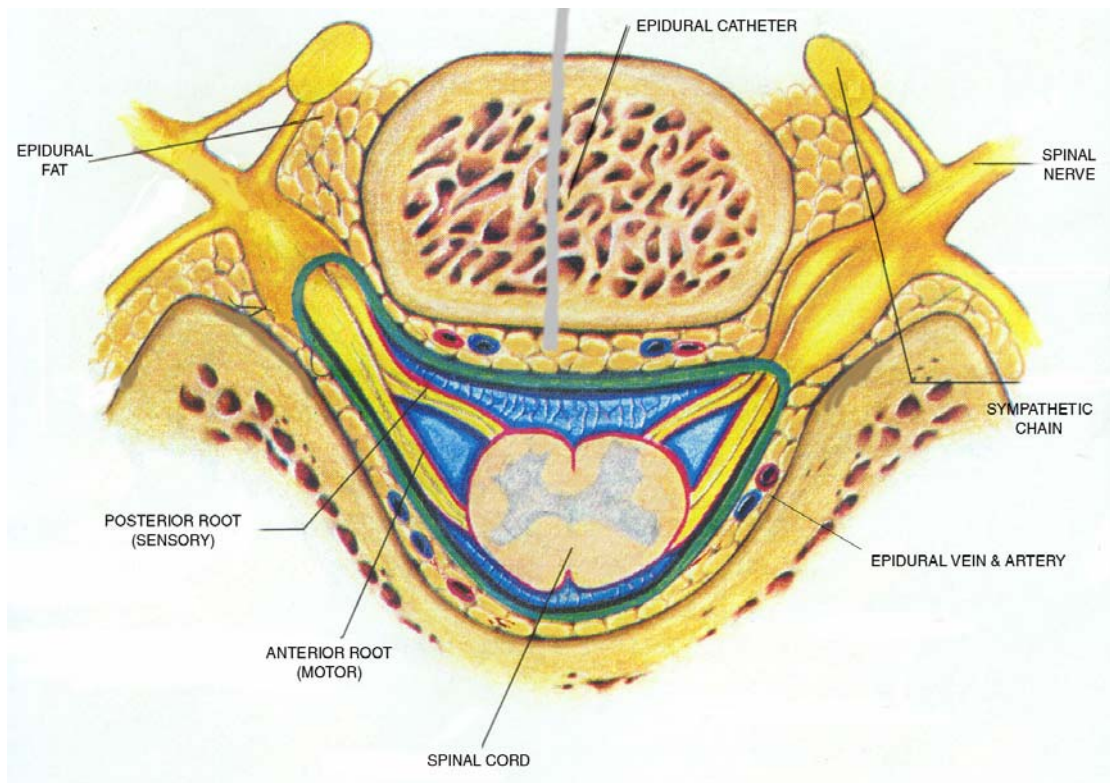
## Anatomy of the Spinal Cord

The spinal cord and the brain are covered by three membranes called meninges. The dura mater is the outermost layer which surrounds the brain and spinal cord like a sack. The innermost layer, or pia mater, adheres to the surface of the cord and the brain. Between the dura mater and the pia mater is the arachnoid membrane.

The **Epidural Space** lies between the dura mater and the wall of the vertebral canal. It contains blood and lymphatic vessels as well as fatty and connective tissue, which provides anatomical padding for the spinal cord. This space narrows as it ascends the spinal canal.

The subarachnoid space is also called the **Intrathecal Space**. It lies beneath the arachnoid membrane and is filled with cerebrospinal fluid.

### Anatomical Layers

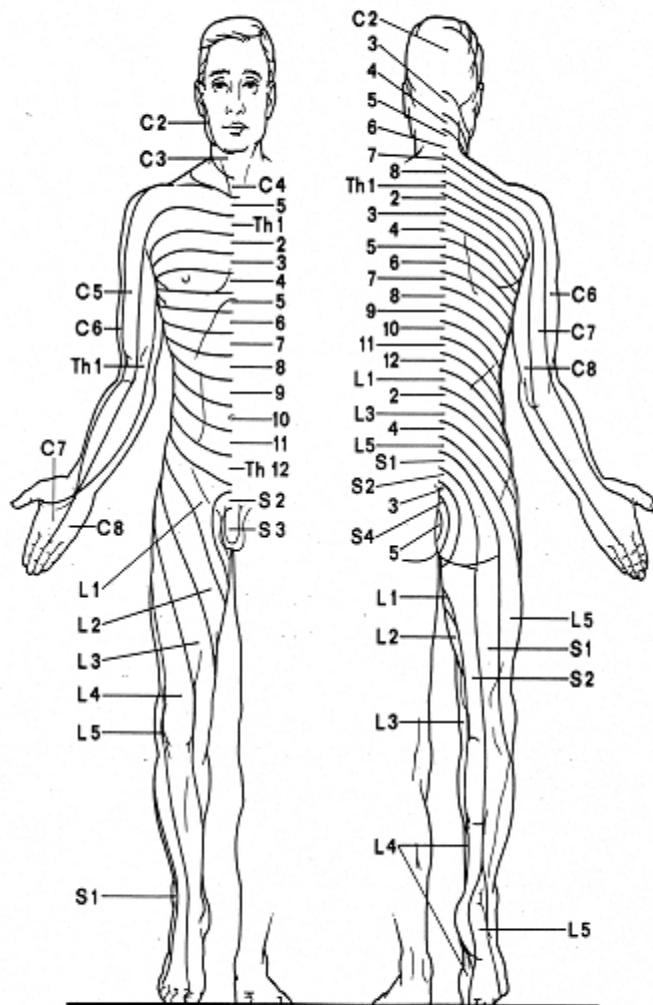


# Spinal Cord Anatomy

## The Spinal Nerves

Spinal nerves carry three types of fibres. Sensory fibres carry impulses responsible for touch, temperature, pressure and pain. Motor fibres innervate various muscle groups and are responsible for movement. Sympathetic fibres are responsible for increases in blood pressure, dilation of pupils, and the formation of goose bumps.

### DERMATOME CHART



BUCKHOFER  
CASTRA

### The house of Regional Anaesthesia

#### ASTRA

Generally speaking, the 31 pairs of spinal nerves are responsible for sympathetic, sensory, and motor responses along identified dermatomes. A dermatome is a segmental skin area that is innervated by a spinal cord segment. Dermatomes follow an orderly sequence from head to toe.

The diagram illustrates the dermatomes of the body. The letters and numbers on the diagram indicate the level of vertebrae from which the spinal nerves supplying the area are derived. The space between the lines indicate the skin area which is innervated by the particular segment.

## **Intrathecal Injection**

The intrathecal route is a direct one because no dura exists to be penetrated. The drug is deposited close to the opioid receptors in the dorsal horn of the spinal cord. Intrathecal injection immediately produces high cerebrospinal fluid concentrations of the medication. Vascular reabsorption of the drug does occur, but is clinically irrelevant. The dose required for intrathecal injection is approximately one-tenth to one-twentieth of that required for an epidural dose. Because excellent analgesia results from such a small dose, patients are less sedated and have fewer side-effects.

At VHHSC, an intrathecal injection is usually completed during the surgical procedure and is a one-time- only event.

## **Epidural Injection Or Continuous Infusion**

The epidural dose is deposited on top of the dural membrane. The epidural injection or infusion is complicated by the pharmacodynamics of dural penetration, epidural fat deposits and systemic opioid absorption. At VHHSC, an epidural catheter is usually placed by the anesthetist prior to or during the surgical procedure. In rare cases, it may be placed on the patient care unit. The catheter is usually placed at the level of the lumbar or thoracic vertebrae. The location of catheter placement is to promote maximal analgesic coverage. Once the catheter is placed under strict aseptic procedure, it is connected to an epidural infusion device. The catheter placement site is dressed with a clear sterile dressing and the epidural catheter is taped to the patient's back and brought up over the patient's shoulder. The reason for this elaborate taping is because the catheter is not sutured in place and has a high likelihood of becoming dislodged.

## **Patient Controlled Epidural Analgesia (PCEA)**

Patient controlled epidural analgesia is the use of an epidural catheter and a patient controlled pump device. This method is currently in use at our hospital on an experimental basis.

## A Comparison of the Opioid Dose Required by the Various Routes:

IM or IV Opioid	Epidural	Intrathecal
1f 10 mg of morphine is used as a standard	By the epidural route 1/10 of the IV dose	By the intrathecal route 1/10 of the epidural dose or 0.1 mg would provide the same analgesia

## Medications

### Definitions:

**Hydrophilic** - Water Loving. This medication will dissolve very well in water, and will thus not dissolve well in fatty tissue, as is found in the epidural space, and therefore will have a slower rate of absorption.

**Lipophilic** - Fat Loving. This medication will dissolve very well in fatty tissue, and will thus have a fast rate of absorption.

### Opioids:

Opioids modulate the transmission of pain within the spinal cord by binding to presynaptic and post-synaptic receptors in the substantia gelatinosa of the dorsal horn of the spinal cord.

**Morphine:** The onset of the action of morphine epidurally is slowest with morphine and occurs about 30-45 minutes after infusion of the medication at the epidural space. Morphine is hydrophilic and so dissolves better in water. This means that it remains in the epidural space longer. The risk for **late-onset** respiratory depression is high with hydrophilic morphine. Hydrophilic drugs such as morphine remain largely dissolved in the CSF, allowing spread from a subarachnoid or epidural injection site. A relatively widespread analgesia follows.

**Fentanyl:** Fentanyl is highly lipophilic, and thus the onset of analgesic action is fastest and occurs in about 5-10 minutes. Minimal amounts of the drug are dissolved in the CSF, and so little is available for rostral (toward the head) migration in the CSF to reach the medulla and the respiratory centre. The analgesia produced is segmental.

**Meperidine:** Meperidine is medium in its lipophilicity and has an onset of analgesic action in about 10-15 minutes.

## Local anesthetic agents:

Local anesthetic agents act by diffusing across the nerve cell membrane, attaching to the sodium channel, and blocking the conduction of nerve impulses.

**Bupivacaine:** This medication is a local anesthetic agent, and is usually combined with an opioid for continuous infusion. The concentration is very dilute at 0.1 or 0.2%.

## Other agents:

**Clonidine:** In clinical practice, analgesic effects have been demonstrated following epidural or intrathecal administration of clonidine. Clonidine is a selective alpha-2 adrenergic agonist that produces analgesia in humans by a non-opioid mechanism. It is believed to inhibit painful impulses by activating the post-junctional alpha-2 adrenoreceptors in the dorsal horn of the spinal cord. It is mainly used as an adjuvant to opioids or anesthetic agents. Clonidine prolongs the duration of action of local anesthetic agents and opioid analgesics.

## Side-Effects of the Opioids:

### 1. Respiratory depression

Respiratory depression is the most severe side-effect of opioid administration. The risk is usually less in epidural or intrathecal administration compared to parenteral administration. There is a risk of late onset respiratory depression. This varies with the lipophilicity of the drug. Being hydrophilic, morphine has the greatest risk for the longest time of late onset respiratory depression. This is because a large amount of morphine dissolves in the CSF and is available for rostral migration to the respiratory centre in the medulla. Consequently, patients with a morphine infusion epidurally must be monitored and maintain an IV access for 12 hours once the infusion is discontinued. **This is especially important to note when patients have had a one-shot intrathecal injection of morphine and are day patients.**

**THEY MUST NOT LEAVE THE HOSPITAL UNTIL AFTER 12 HOURS. THEY ARE AT RISK FOR LATE ONSET RESPIRATORY DEPRESSION.**

**THE SAME CARE MUST BE UNDERTAKEN WHEN PATIENTS RECEIVE A ONE SHOT INTRATHECAL INJECTION AND ARE THEN GIVEN A PATIENT CONTROLLED ANALGESIC PUMP. GENERALLY, THE PCA PUMP MUST ONLY BE PROGRAMMED WITH A PATIENT BOLUS DOSE. GREAT CARE MUST BE TAKEN TO MONITOR RESPIRATORY RATE FOR AT LEAST 12 HOURS AFTER THE INTRATHECAL DOSE WAS GIVEN.**

Patients receiving Fentanyl or Meperidine are at a decreased risk for late onset respiratory depression because less of the drug is dissolved in the CSF and less is available to diffuse to the respiratory centre in the medulla. Patients receiving Fentanyl or Meperidine must be monitored and maintain an IV access for 6 hours after discontinuation of the infusion.

## **Predisposing factors to the development of respiratory depression following spinal opioids:**

- \* Large doses of opioids
- \* Concomitant use of parenteral opioids, sedatives, or both
- \* High risk patients
- \* Advanced age (> 65)
- \* Opioid naive patients
- \* Intrathecal opioids compared with epidurals
- \* Use of water-soluble opioids such as morphine

**If the patient has an epidural infusion or has had an intrathecal injection in the operating room, and is found to have a Sedation Scale of 3 and a Respiratory Rate of less than 8 per minute, the following actions must be initiated:**

- Stop the infusion
- Start oxygen at 8 litres per minute by mas
- Administer Naloxone as per preprinted orders
- Call the Acute Pain Service physician Stat and First Call Anesthetist
- Administer further Naloxone as per preprinted orders

## **2. Nausea and vomiting**

The incidence of nausea and vomiting following intrathecal and epidural opioids is approximately 30% and the same as that following IV administration. This side-effect is likely the result of the cephalad migration of the medication in the CSF and interaction with the area postrema. Sensitization of the vestibular system and delayed gastric emptying may also play a role in nausea and vomiting.

Discern whether the nausea is due to poor pain control. If it is not, administer an antiemetic, taking into consideration the type of nausea present. Remember that antiemetics can be sedating.

## **3. Gastrointestinal Effects**

Post-operative ileus is a common complication after major abdominal surgery. After GI surgery, colon mobility is inhibited for 48-72 hours. Motility in the stomach usually recovers within 12-24 hours. Intrathecal and epidural opioids may also delay stomach emptying and small bowel transit time.

#### **4. Pruritus**

A common side-effect of intrathecal and epidural opioids is pruritus. It may be generalized but is more often localized to the face, neck, or upper thorax. It may be associated with the type of opioid. Fentanyl often causes segmental pruritus but morphine may cause generalized itching. It usually occurs within a few hours of injection and may be greater with the intrathecal route. It should decrease over time. Pruritus is likely caused by cephalad migration of the drug in the CSF and its interaction with the trigeminal nucleus in the medulla.

Benadryl, an antihistamine, may be used to treat the itching. This medication will also contribute to respiratory depression, so the nurse must monitor closely. A second option for treatment is an IV naloxone infusion titrated to reduce the pruritus while maintaining analgesia.

#### **5. Urinary Retention**

Urinary retention following intrathecal or epidural opioids is more common than after IV or IM administration of opioids. Urinary retention is likely related to opioid interaction with opioid receptors located in the sacral spinal cord. In humans, epidural morphine causes marked detrusor muscle relaxation within 15 minutes of injection, which persists for up to 16 hours. This leads to an increase in maximal bladder capacity and urinary retention. The effect can be reversed with naloxone, but the analgesia will be reversed at the dose required.

A simple in and out catheterization as in the preprinted orders will prevent the patient from experiencing problems.

### **Side-Effects of the Local Anesthetic Agents**

#### **Hypotension:**

Onset of sensory blockade is more rapid than that of motor blockade. With epidural and intrathecal injection, sympathetic blockage may be two to three dermatomal segments higher than sensory blockade. Sensory blockage may be two to three segments above motor blockade. With very dilute concentrations of local anesthetics, motor blockade is almost non-existent, sensory blockade can sometimes inhibit painful stimuli without numbness, and sympathetic block often exists without significant hypotension.

Motor impairment and orthostatic hypotension may still occur. In order to provide safe care, the nurse must carefully assess the patient prior to each time the patient mobilizes.

For sudden hypotension not associated with position change, treatment may involve the following:

- \* **Discontinue the infusion**
- \* **Rapid infusion of IV fluids**
- \* **Protection of the airway from aspiration**
- \* **Ventilatory support by manual resuscitation bag and mask if needed**

Hypotension resulting from rapid changes in position usually requires only that the patient be placed back in the lying position until the blood pressure returns to normal. Change positions slowly. The nurse may consider the use of a TED stocking or tensor bandages to prevent venous pooling during position changes.

### **Motor Changes:**

Motor impairment in thoracic epidurals may involve intercostal with or without abdominal muscle weakness or paralysis. This occurrence can lead to decreased chest expansion and difficulty breathing.

### **Urinary Retention:**

Sensory with or without motor impairment may manifest itself as an inability to void or lack of bladder sensation. Insertion of a catheter may be required.

### **Systemic Toxicity:**

A rare occurrence is systemic toxicity to local anesthetic agents. The patient should be monitored for the presence of visual disturbances, tinnitus, lightheadedness, facial tingling, metallic taste, excitability and seizures.

### **Side-Effects of Clonidine:**

Spinal Clonidine produces the side-effects of hypotension, bradycardia, sedation and dry mouth. The hypotensive effect is exaggerated in patients who have hypertension and when Clonidine is administered in the thoracic region as opposed to the lumbar region. Spinal Clonidine has a local effect on the sympathetic nerves in the spinal cord.

## A Summary of Side-Effects

Opioids	Local Anesthetic	Clonidine
** Respiratory Depression		
Sedation		Sedation
	Hypotension	Hypotension
	Sensory Blockade	
Nausea and Vomiting Gastrointestinal effects	Motor Blockade	Bradycardia
Pruritus		Dry Mouth
Urinary Retention	Urinary Retention	

## General Complications

**Catheter Migration:** Pulsations within the spinal cord may allow the tip of the catheter to enter the sub-arachnoid space. When significant amounts of opioid are administered into the CSF, profound respiratory depression and hypotension may occur. The catheter can also migrate into one of the epidural veins. Conversely, the catheter can migrate out of an effective site for infusion. This is manifested by the patient having poor pain control.

**Epidural Hematoma:** Patients who are receiving heparin or low molecular weight heparin are contraindicated for having an epidural catheter because of the risk of epidural hematoma. Regular observation of the epidural insertion site should occur.

**Accidental disconnection:** Occasionally, the epidural catheter becomes disconnected from the infusion set-up. Any catheter entering the epidural or intrathecal space requires that aseptic technique be maintained in order to reduce the chance of infection. Once disconnection occurs, wrap the open portion of the catheter in sterile gauze and call the Acute Pain Service physician.

## Nursing Monitoring Parameters

Monitoring is based upon the side-effects and problems that may occur. When combinations of medications are administered, monitoring must take into account the combinations of medications and caution where side-effects are additive.

Refer to Patient Care Guidelines: P-090, P-103, P-135.

Please note that when an epidural infusion is initiated, two nurses must check the infusion concentration and pump settings and sign on the Pain Flowsheet. With each change in epidural infusion concentration, two nurses must check and sign again on the Pain Flowsheet.

## Patient Education

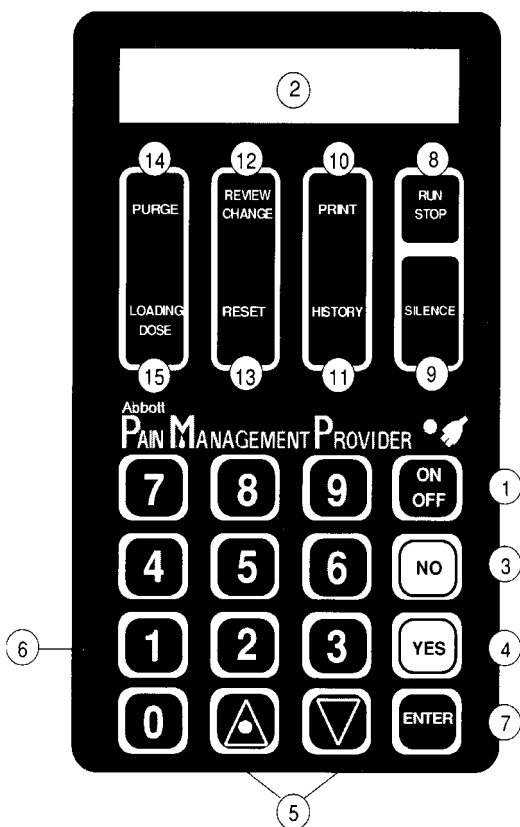
- All patients should receive a copy of the teaching brochures entitled:
  - “Postoperative Pain Management”
  - “What is an Epidural?”
- Please reinforce with the patient:
  - Use of a pain intensity scale
  - Definition of comfort level and what good pain management looks like
  - What an epidural infusion or an intrathecal injection is and how it works
  - Possible side-effects and their treatment
  - Care with moving or ambulating to protect the catheter
  - When to notify the nurse, e.g., dressing is loose or fallen off, wet feeling on back, sudden increase in pain, any adverse effects



# Pain Management Provider Pump

## Abbott Pain Management Provider Tips For use with List No. 13960

See System Operating Manual for complete pump instructions including warnings and cautions.



- |   |                                |
|---|--------------------------------|
| 1 ON/OFF BUTTON   | 8 RUN/STOP                     |
| 2 DISPLAY   | 9 SILENCE ALARM                |
| 3/4 RESPOND TO<br>QUESTIONS   | 10 PRINT/STOP PRINTING         |
| 5 • LOCK/UNLOCK<br>• KEYPAD<br>• SET CLOCK<br>• SET DECIMAL<br>POINTS | 11 VIEW PROGRAM                |
| 6 NUMBER KEYPAD   | 12 CHANGE PROGRAM<br>PARAMETER |
| 7 SELECT VALUES AND<br>ADVANCE  | 13 CLEAR PROGRAM<br>PARAMETER  |
|   | 14 PURGE TUBING                |
|   | 15 DELIVER LOADING<br>DOSE     |

### TECHNICAL ASSISTANCE

1-800-338-7867  
(In Alaska and Hawaii: 619-485-7474)

An epidural and/or intrathecal infusion requires a special pump. The pump used must be distinguishable from all other infusion devices. The biggest danger is that a nurse **will not realize that the catheter is infusing epidurally or intrathecally, and will increase or change the infusion rate as though it were an intravenous infusion. Errors such as these have happened in our hospital.**

Great care and thought must be put into programming an epidural or intrathecal infusion as the dose requirements are so much smaller than by any other route.

The infusion device must ideally lock and have the programmed infusion rate locked in as well. Ongoing intrathecal infusions are currently only managed by specially trained individuals. For epidural infusions, the **Pain Management Provider** meets these criteria.

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