

(( اللهم لا سهل إلا ما جعلته سهلاً وأنت تجعل الحزن إذا شئت سهلاً )) باسم الله...



## Acute Pain Management

{Color index: [Important](#) | [Notes](#) | [Book](#) | [Extra](#) | [Editing File](#) | [comments or errors](#)}

Resources: lecture slides, 435teamwork, Book (Julian stone)

### Objectives

(not given)

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● **Pain:**

- Definition: It's an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. (International association of study of pain 1979).
- Pain is the fifth vital sign.
- Pain is subjective and difficult to quantify.
- The management of pain is a multidisciplinary team effort involving physicians, psychologists, nurses, and physical therapists.
- Unrelieved pain is morally and ethically unacceptable.

**Goal of pain treatment: why do we pay attention to pain?**

- Improve quality of the patient.
- Facilitate rapid recovery & return to full function.
- Reduce morbidity and mortality.
- Allow early discharge from hospital.
- Cost effective for both hospital and patients.

**Classification of pain**

<b>According to pathophysiology</b>	<u>Nociceptive:</u> due to activation and sensitization of peripheral nociceptors. <b>Manly related to acute pain (acute damage of tissue).</b>	<u>Neuropathic:</u> Due to injury or acquired abnormalities of peripheral OR central nervous system. <b>More related to chronic pain.</b>
<b>According to etiology</b>	Post operative pain	Cancer pain, <b>Fracture pain, stress pain, etc..</b>
<b>According to duration</b> We mainly depend on classification According to duration	Acute (< 3 months)	<b>Chronic:</b> If post op: depending on the type of operation. If not post op: > 6 months.
<b>According to location</b>	Toothache, earache	Headache, low backache

We mainly classify pain according to duration into: acute or chronic.

● **Acute Pain**

Caused by noxious stimulation due to: injury, a disease process or abnormal function of muscle or viscera.

- Recent onset.
- Limited duration.
- Has a causal relationship.

**It is nearly always nociceptive**

Nociceptive pain serves to detect, localize and limit the tissue damage.

Acute pain plays a useful **positive physiological role** by providing a warning of tissue damage. **So post op when you ask where the pain is the patient will point to it (pin-point it), Postoperative pain is a type of "Acute Pain".**

### Types of acute pain:

Type	Somatic		Visceral:	
Subtypes	<b>Superficial:</b>	<b>Deep:</b>	<b>Visceral:</b> True localized or Referred	<b>Parietal:</b> Localized or Referred
Origin	<u>Nociceptive</u> input from skin, subcutaneous tissue and mucous membranes	Arise from <b>deep tissue such as</b> Muscles, Tendons and Bones	Due to disease process, abnormal function of internal <b>organ</b> or its <b>covering</b> , e.g. Parietal pleura, Pericardium or Peritoneum.	
Nature of pain	<b>Well localized</b> Sharp, pricking, burning and throbbing	Dull aching and is <b>less well localized</b> in comparison to superficial (same as neuropathic pain) Intensity and Duration of stimulus affects the degree of localization	<b>Dull, diffuse and in midline.</b> For example it starts in the middle and then localizes to the appendix area Frequently <b>associated with</b> abnormal <b>sympathetic</b> activity causing <b>nausea, vomiting, sweating</b> and changes in HR and BP.	Sharp (due to organ irritation), often described as stabbing sensation either localized to the area around the organ or referred to a distant site (due to it's dermatome, as in MI or cholecystitis).

### Pattern of referred pain:

<b>Lungs</b>	<b>T2 – T6</b>
<b>Heart</b>	<b>T1 – T4</b>
<b>Aorta</b>	<b>T1 – L2</b>
<b>Esophagus</b>	<b>T3 – T8</b>
<b>Pancreas &amp; Spleen</b>	<b>T5 – T10</b>
<b>Stomach, liver and gall bladder</b>	<b>T6 – T9</b>
<b>Adrenals</b>	<b>T6 – L1</b>
<b>Small intestine</b>	<b>T6 – T9</b>
<b>Colon</b>	<b>T10 – L1</b>
<b>Ureters</b>	<b>T10 – T12</b>
<b>Uterus</b>	<b>T11 – T12</b>
<b>Bladder and prostate</b>	<b>S2 – S4</b>
<b>Urethra &amp; Rectum</b>	<b>S2 – S4</b>
<b>Kidneys, Ovaries &amp; Testis</b>	<b>T10 – L1</b>

## Systemic responses to acute pain:

Efferent limb of the pain pathway is: **sympathetic nervous system, and endocrine system.**

<b>CVS</b>	<ul style="list-style-type: none"> <li>● Tachycardia.</li> <li>● Hypertension.</li> <li>● Increased systemic vascular resistance.</li> </ul> <p>ASA 1 and 2 patients can tolerate these changes but patients with HTN and active symptoms will not. For example, Hypertensive patient underwent an appendectomy and was in severe pain. 1) There will be an increase in HR and subsequent increase in BP which may lead to ischemic heart disease. The patient may also suffer from hemorrhagic stroke. If you treat the pain you can avoid all this!</p>
<b>Respiratory</b>	<ul style="list-style-type: none"> <li>● Increased oxygen demand and consumption.</li> <li>● Increased minute volume.</li> <li>● Splinting and decreased chest excursion.</li> <li>● Atelectasis, increased shunting, hypoxemia.</li> <li>● Reduced vital capacity, retention of secretions and chest infection.</li> </ul> <p>When the patient is in pain they can't take deep breaths (especially if they underwent abdominal or thoracic surgery) with the sympathetic stimulation there will be an increase in secretions, there will also be retention of secretions because the patient can't cough due to the pain. This accumulation and retention of secretion will cause infection (Pneumonia) and hypoxia. Treating this pain will reduce mortality and morbidity.</p>
<b>GIT and Urinary</b>	<ul style="list-style-type: none"> <li>● Increased sympathetic tone.</li> <li>● Decreased motility, ileus and urinary retention.</li> <li>● Hypersecretion of stomach.</li> <li>● Increased chance of aspiration because the patient is weak due to the anesthetic medication and opioids &gt; aspiration &gt; pneumonia.</li> <li>● Abdominal distension leads to decreased chest excursion.</li> <li>● Increased sphincter tone.</li> <li>● Paralytic ileus.</li> </ul>
<b>Endocrine</b>	<ul style="list-style-type: none"> <li>● Increase secretion of Stress hormones: Catecholamine, Cortisol and Glucagon</li> <li>● Decreased secretion of Insulin and testosterone.</li> </ul> <p>This will cause hyperglycemia &gt; delayed healing in wounds, infections, etc.</p>
<b>Hematological</b>	<ul style="list-style-type: none"> <li>● Increased platelet adhesiveness.</li> <li>● Reduced fibrinolysis and hypercoagulability</li> <li>● Increased chance of DVT's &gt; PE.</li> </ul>
<b>Immune</b>	<ul style="list-style-type: none"> <li>● Leukocytosis.</li> </ul>

	<ul style="list-style-type: none"> <li>● Lymphopenia.</li> <li>● Depression of reticuloendothelial system and increased stay in the hospital.</li> </ul>
<b>General sense of well-being</b>	<ul style="list-style-type: none"> <li>● Anxiety, Sleep disturbances.</li> <li>● Depression.</li> </ul>

The challenge in acute pain management is to meet 2 goals: to relieve postoperative pain and to relieve it without causing opioid related complications like respiratory depression.

### ● Chronic Pain

- Chronic pain is defined as that which persists beyond the usual course of an acute disease or after a reasonable time for healing to occur.
- Period varies between 6 or > months in most definitions. Period is 1-2 months for a patient post-op. Patient underwent simple drainage and you expect for him to be in pain for one week post-op, if it takes longer (up to 1-2m) then this is classified as chronic.
- Chronic pain may be nociceptive, neuropathic, or a combination of both. For example a sickler patient with hand and foot disease, they usually present to the hospital with an acute attack crisis and it will be a very bad situation due to the absence of neuroendocrine stress response. So the patient may present screaming of pain with normal HR and BP, so people don't usually believe that they are in pain.
- Patients with chronic pain often have an absent neuroendocrine stress response.
- They have prominent sleep and mood disturbances. Which is why we need psychiatrists to help in treating patients with chronic pain.

IMPORTANT for the exam

Chronic pain	Acute pain
lasts longer than expected: hypersensitivity	caused by external or internal injury or damage.
uncoupled from the causative agent	
becomes a disease in its own right	can be easily located
it's intensity no longer correlates with a causal stimulus. A simple touch may cause severe pain due to hypersensitivity/ Allodynia	its intensity correlated with the triggering stimulus
has lost its warning and protective function	has a distinct warning and protective function.
is a special therapeutic challenge that requires interdisciplinary procedures	

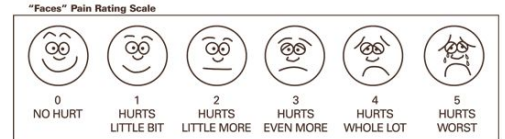
**Pain assessment:** Ask your patients about their pain (Onset, Location, Description, Aggravating and relieving factors, Previous treatment, Effect, Intensity). Use SOCRATES, but the patient post-op will not be able to answer these questions, so we use other tools.

**Measurement tools:** provide a valuable means of overcoming this problem.

**Color scales & Faces scales**

**Children between 3-8** (age range is IMP)

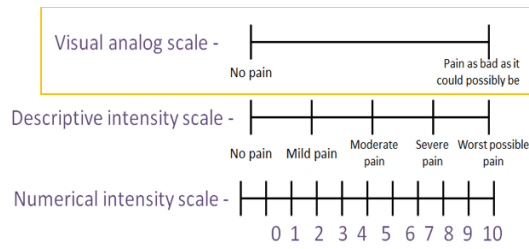
- Usually have a word for pain
- Can articulate more detail about the presence and location of pain; less able to comment on quality or intensity.



**- Visual analogue scale**  
**- Descriptive intensity scale**  
**- Numerical intensity scale**

**Children older than 8 and Adults**

- Use the standard visual analog scale



We usually depend on numerical:  
0-3 mild  
4-6 moderate  
7-10 severe

**The WONG BAKER FACES SCALE.**

- Ask patient to point to the faces that matches their feelings.
- The number used to record the score.
- Used in patients with language barriers or with kids.
- 0-No pain and 10-Severe pain.
- User friendly.
- Easy to explain to patient.
- Compact to carry
- Could be used as three scales because it combines:
  - Facial expression.
  - Numbers.
  - Words.

**FLACC scale**  
**For neonates:**

Categories	Behavioral Observation Pain Rating Scale		
	0	1	2
Face	No particular expression or smile; disinterested	Occasional grimace or frown, withdrawn	Frequent to constant frown, clenched jaw, quivering chin
Legs	No position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking

## ● Pain Management

- Pain management continues to be a challenge to nurses.
- PCA (patient-controlled analgesia) & epidural analgesia are advances in analgesia that may assist nurse with this challenge.
- Pain management can be evaluated in terms of its ability to meet 2 main goals:
  - To relieve postoperative pain.
  - To relieve patient of inhibition of respiratory movement without sedation.

### Pharmacology of pain management:

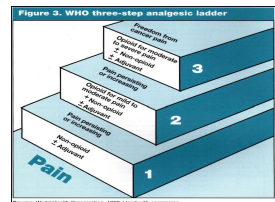
There are many different techniques, non-pharmacological & pharmacological, both **regional** and **non-regional** to provide **post op analgesia**.

### 1- Non Pharmacological:

Hydrotherapy	Movement & Positioning	Intradermal water blocks
Acupuncture	Heat and cold	Touch and massage
Aromatherapy	Audioanalgesia	TENS (Transcutaneous electrical nerve stimulation)

### 2. Pharmacological:

<b>NON OPIOID WHO class (I)  (for mild pain)</b>	ASA Acetaminophen NSAIDs
	± Adjuvant: Medications used for other reasons that may help in reducing the pain like antidepressant, anticonvulsants, steroids (to reduce the swelling and pain), SKELETAL muscle relaxant: a patient was given a smooth muscle relaxant through needle and went into an arrest.



<b>OPIOIDS</b>
<b>Weak opioid: WHO Ladder II (for moderate pain)</b>

**Tramadol**, Codeine, Hydrocodone, Oxycodone, Dihydrocodeine

Other opioids: Hydrocodone, Tylenol.

Tylenol alone is similar to paracetamol when you add numbers to its name it means it has added codeine.

Tylenol 2 - 15mg of Codeine - Tylenol 3 - 30mg of Codeine - Tylenol 4 - 60mg of Codeine (Codeine is the drug for mild to moderate pain).

### Strong Opioids: WHO Ladder III (for severe pain)

**Morphine**, Fentanyl, Pethidene, Hydromorphone, Methadone, Oxycodone

#### Adjuvants therapy:

Anticonvulsant	NMDA antagonists	Corticosteroids	Clonidine
Antidepressants	Sk. Muscle relaxants	Local Anesthetics	Sedatives

Step 4 (Ladder 4) is usually for palliative care, you keep the patient sedated.

### ● WHO Analgesic Guidelines:

- **Oral** medications whenever possible (once the patient can tolerate oral intake oral medication should be given).
- Dose “by the clock” – but always have “as needed” medications for breakthrough pain. During the 48h post-op medication is given by the clock (every 6h for example) whether or not the patient felt pain. If the pain increases with cough or patient is vomiting then you can consider PRN medication.
- Titrate the dose.
- Use appropriate dosing intervals.
- Be aware of relative potencies.
- Treat side effects. Most common side effects of Morphine are nausea, vomiting and constipation so when considering a treatment/analgesic you have to consider its adverse effects.

### ● Methods of acute post-op pain relief:

- Intramuscular.
- Intravenous - Intermittent Bolus.
- Intravenous - Continuous Infusion (usually given in palliative treatment).
- **Patient Control Analgesia (PCA).**
- **Epidural analgesia.**
- **Peripheral Blocks.**

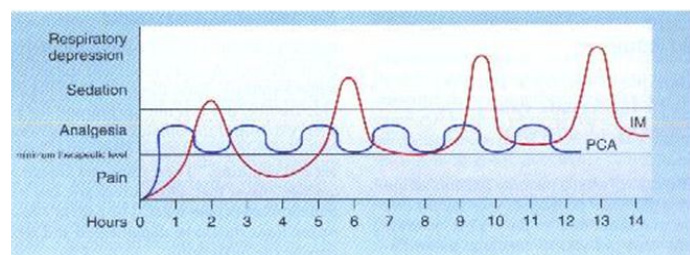
### ★ Infusion devices:

**1. PCA (Patient Control Analgesia):** because of variation of pain intensity and the response to analgesia between patients, PCA was introduced.

PCA are modified infusion pumps (machine) that allow patients to **self administer** a small dose of **opioid** when pain is present, thus allowing patients to titrate their level of analgesia against the amount of pain they are experiencing. Each time the patient presses it releases a small amount of morphine or fentanyl etc.. to control that pain. It could also be given as a continuous infusion.



- PCA is based on the belief that patients are the best judges of their pain.
    - They should be allowed an active role in controlling their pain.
  - That pain relief should be secured as quickly as possible.
  - Patient selection:
    - Patient should not be denied access to this modality simply because of age (those <3 and >70). The same patient selection guidelines and consideration for the use of PCA apply to children.
    - Screen for cognitive and physical ability to manage their pain by using the PCA. the patient should know when and how to use it!
    - Should have the understanding of pain relief, using the demand button and when to use the demand button. A doctor teaching science came in to the hospital after being exposed to a substance that had lead to the loss of all 10 fingers! He can not use the PCA (it's not a contraindication but it can't be provided for him).
    - PCA not offered to confused patient, and those who become confused should have PCA discontinued.
    - Important to remind parents and caregivers not to press the demand button. There is a Parent PCA for neonates.
  - PCA is well tolerated. Usually given as 1ml in 6min after that it gets locked "safety period" even if the patient presses it it won't release more.
  - Offer flexibility in dose size and dose interval in individual patients. If a patient is still in pain with this parameter, what we can do? We can increase the dose or decrease the interval. Or if the patient has severe NIV, we can decrease the dose or prolong the interval.
  - Therapeutic serum level can be reached relatively quickly because the drug is administered into the vascular system directly. Oral medications usually peak at 1h, IM peak at 30 min whereas IV medication peaks at 2-5min
  - Patient can secure an early therapeutic serum level with loading doses (when we insert the PCA, we give the double dose of the demand dose. E.g. if 1 mg in 6, when we insert the PCA we give 2 mg) titrated to individual pain needs.
  - A steady state plasma level occurs because the elimination of the drug from the plasma is balanced by the patients self administered drug injection.
  - PCA also eliminates the lag time between pain sensation and administration of analgesia.
  - The pump documents:
    1. The total number of mg of drug delivered.
    2. The number of times the patient requests a bolus.
    3. Number of times medication is delivered in response to demands.
  - This information is helpful when assessing whether the established PCA parameters are appropriate to patient's need.
- 
- **IM vs. IV PCA:** Relationship of mode of delivery of analgesia to serum analgesic level. Not required to know this.



Explanation: At 2h we will have a peak with little sedation, at 4h there is still some level but not enough to cover the pain so the patient will ask for another dose by this time. At 6h the patient will be given the same dose as he was given the first time (50mg or 100mg) with the previous accumulation the peak becomes higher. We have to consider patients with liver and kidney disease, they will have more accumulations and may develop adverse effects much sooner like respiratory depression. With PCA, There is usually a steady (balanced) plasma level due to the patients self admission of medication, so the patient will be free of pain but not sedated “fully awake”. This will allow the patient for early mobilization out of bed.

What usually happens?

Patient feels pain > calls the nurse > the nurse receives the order and screens > prepares the medications > given IM > drug is absorbed > patient is sedated but after 4h he will complain of pain once again and ask for the nurse (the cycle repeats) but with PCA the patient can just simply press the button

### Benefits of PCA:

- Decreased nursing time.
- Increased patient satisfaction, as PCA allows patient control over their pain.
- Used in a variety of medical and post-op surgical conditions.
- Decreased narcotic usage.
- Decreased level of sedation.
- Earlier ambulation.
- Decreased overall pain scores reported by patients.
- Increased compliance to post op care.\*\*
- Less anxiety.
- More autonomy regarding pain control.
- Improved rest and sleep pattern.

\*\* You'll tell the patient “Once you start physiotherapy take one dose before you go this will increase the patients compliance to post op care.

## 2. Epidural Anesthesia: Can be used for anesthesia or analgesia

- EPIDURAL = administration of medication into epidural space.
- INTRATHECAL (spinal) = administration of medication into subarachnoid space.

### OVERVIEW OF THE SPINAL ANATOMY:

- **Spinal cord:**
  - Located and protected within vertebral column
  - Extends from the foramen magnum to lower border of L1 (adult) S2 (kids)
  - SC taper to a fibrous band (conus medullaris)
  - Nerve root continue beyond the conus (cauda equina)
  - Surrounded by the meninges (dura, arachnoid & pia mater.)
- **Epidural space:**
  - Potential space between the dura mater and ligamentum flavum
  - Made up of vasculature, nerves, fat and lymphatic
  - Extends from foramen magnum to the sacrococcygeal ligament

**Benefits of epidural anesthesia:**

- Better pain control
- Earlier ambulation
- Improved Pulmonary Mechanics
- Decreased incidence of DVT
- Faster return of bowel function

Indications	Contraindications	
<p><b>The objective of epidural analgesia is to relieve pain.</b></p> <p>Major surgery Trauma (# ribs), Palliative care (intractable pain), <b>Labour and Delivery.</b> If patient can't tolerate GA</p>	<p><b>Absolute:</b></p> <ul style="list-style-type: none"> <li>- Patient refusal</li> <li>- Infection/abscess near the injection site</li> <li>- Coagulation disorder</li> <li>- Spinal deformity</li> <li>- increased ICP</li> <li>- Sepsis, Hypovolemia.</li> <li>- Known allergy to opioid or local anesthetic</li> </ul>	<p><b>Relative:</b></p> <ul style="list-style-type: none"> <li>- Hypotension</li> <li>- hypovolemia</li> <li>- Anticoagulant</li> <li><b>Neurological disease with documentation.</b></li> </ul>

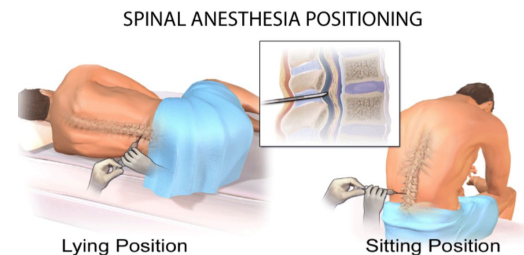
- Indications of GA: Upper airway and ENT.
- Patients with Aortic Stenosis are contraindicated for spinal anesthesia.

**INSERTION OF EPIDURAL CATHETER**

**1. Positioning of patient:**

Patient assume a sitting or side-lying position with the back arched toward the physician.

- This helps to spread the vertebrae apart

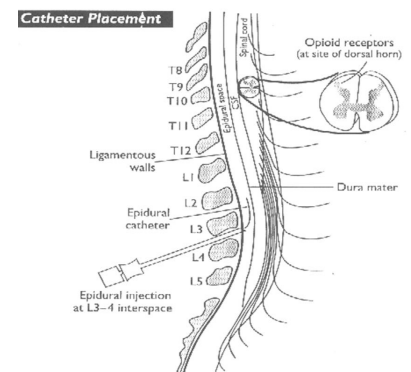


**2. The site is dependent upon the area of pain.**

Height of sensory block: **Lumbar-T4, Thoracic-T2**

**3. Fixing the catheter:**

Incision	Level:
Thoracic	T4-T6
Upper abdo	T6-T8
Lower abdo	T8-T10
Pelvic	T8-T10
Lower extremity	L1-L4



Structures pass when inserting spinal or epidural needle: skin, subcutaneous tissue, supraspinous ligament, interspinous ligament, ligamentum flavum (the hardest ligament in the back), epidural space (potential space), dura, arachnoid, subarachnoid space.

**Guidelines:**

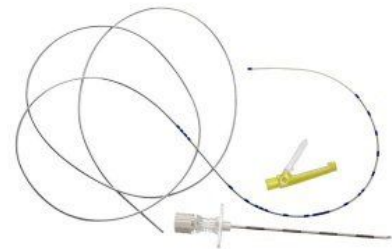
Collect items > Assess patient > Inspect site > Wash hands > **Aspiration test – Glucose test** > Administer > Document > Evaluate the outcome

**EPIDURAL CATHETERS:** usually 18 gauge marked needles whereas spinal is 27-29 gauge, we use thinner needles in epidural to avoid CSF leakage

Ideal Placement (adult) **10-12 cm** at the skin with usually 5-7cm inside

Epidural catheters have markings that indicate their length.

- There is a mark at the **tip** of the catheter,
- The 1st single mark up the catheter is **5cm**.
- Double mark up the catheter is **10 cm**.
- Triple mark on the catheter is **15 cm**.
- Four marks together indicate **20cm**.



You want to cause negative pressure by either using Normal Saline or Air, NS will create a space but you might confuse CSF with NS. To differentiate do a dipstick and check glucose content if +ve then CSF, if -ve NS. Air advantage is more sensitivity, but the disadvantage is if the dura is punctured there is increased chance of pneumocephalus.

**A change in depth of the catheter indicates migration either into or out of the epidural space:**

Catheter migration <u>into</u> a blood vessel in the epidural space or subarachnoid space	Catheter migration <u>out</u> of the epidural space
<ul style="list-style-type: none"> <li>● Rapid onset LOC</li> <li>● Decrease/loss of sensory or motor loss (marcain)</li> <li>● Toxicity (LAST)</li> <li>● Profound hypotension</li> </ul>	<ul style="list-style-type: none"> <li>● ineffective analgesia</li> <li>● no analgesia</li> <li>● drugs deposited into soft tissue.</li> </ul>

**COMMONLY USED MEDICATIONS:**

- **OPIOIDS:**
  - **Fentanyl + Morphine:** affect the pain transmission at the opioid receptors.
- **Local Anesthesia (L.A.):**
  - **Bupivacaine** (marcaine): inhibits the pain impulse transmission in the nerves with which it comes in contact.

**Methods Of Administration:**

- **Bolus** (Fentanyl, Duramorph).
- **Continuous Infusion** (Marcaine+Fentanyl).

All drugs administered epidural should be preservative free.  
 All epidural opioids should be diluted with normal saline prior to intermittent bolus administration.

**ASSESSMENT OF THE BLOCK: NOT REQUIRED.**

Motor Assessment	Sensory assessment:
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- Bromage Score



**Bromage 3 (complete)**  
 Unable to move feet or knees



**Bromage 2 (almost complete)**  
 Able to move feet only

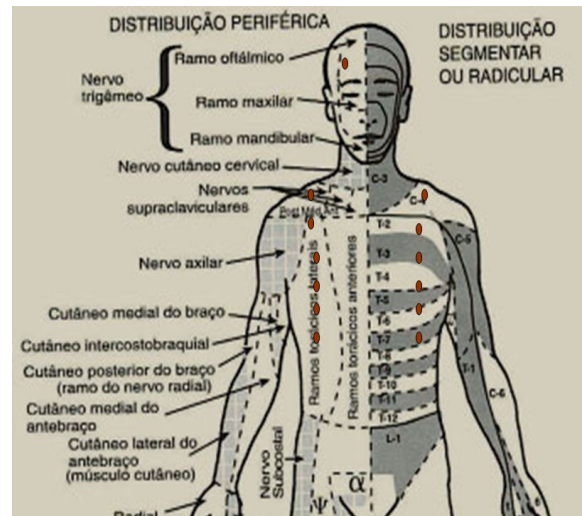


**Bromage 1 (partial)**  
 Just able to move knees



**Bromage 0 (none)**  
 Full flexion of knees and feet

- Use **ice** in the tip of a glove
- Start in **upper neck** and move **down** the **thorax** bilaterally, assessing all potential dermatomes
- Level of block is where intensity of cold changes or the cold sensation is absent
- assess the dermatomes **below the pelvis**



Patterns of referred pain (dermatome):

- Heart (presentation of MI: left shoulder pain, jaw pain, sternal pain) : T1 - T4 (T4 landmark in nipple line)
- Lungs: (T2-T6)
- Pancreas and spleen: T5-T10 (T10 landmark is umbilicus)

**Adverse Effects L.A**

Complication	Management
Hypotension	<ul style="list-style-type: none"> <li>● Assess intravascular volume status.</li> <li>● No trendelenburg positioning.</li> <li>● Teach patient to move slowly from a lying position to sitting to standing position.</li> <li>● <b>Treatment: fluids.</b></li> </ul>
Temporary lower-extremity motor or sensory deficits.	<b>Lower the rate or concentration.</b>

Urine retention	<b>Catheterization.</b>
Local anesthetic toxicity (neurotoxicity)	<b>Stop infusion.</b>
Respiratory insufficiency	<ul style="list-style-type: none"> <li>- <b>Stop infusion.</b></li> <li>- ABC (100% o2 &amp; call for help).</li> <li>- Assess spread and height of block.</li> <li>- Alter analgesia.</li> </ul>
Post dural puncture headache (PDPH) MOST COMMON	<b>Symptomatic treatment, Autologous blood patch.</b>
Infection	
N/v	
Intravenous placement of catheter	
Subdural placement of catheter	
Haematoma	

## Practice Questions:-

**Q1: The circulating levels of which of the following hormones is not increased postoperatively?**

- A. Insulin
- B. Glucagon
- C. ADH
- D. Growth hormone

**Q2: Which of the following is true regarding “Neuropathic pain”?**

- A. Pain of the central origin can be because of the direct insult to nociceptive pathways.
- B. Complete lesion of the dorsal roots causes severe neuropathic pain
- C. Neuropathic pain due to injury to PNS is more well characterized than due to central cause.
- D. Inflammatory pain is not associated with tactile allodynia, heat/cold hyperalgesia and spontaneous pain unlike neuropathic pain

**Q3: Which one of the following is the earliest sign of lidocaine toxicity?**

- A. Nystagmus

- B. Light-headedness
- C. Tonic-clonic seizures
- D. Shivering

**Q4: End results of the surgical stress response include all of the following except?**

- A. Hyperglycemia
- B. Poor wound healing
- C. Positive nitrogen balance
- D. Impaired immunocompetency

**Q5: The “Snap” felt just before entering the epidural space represents passage through which ligament?**

- A. Posterior longitudinal ligament
- B. Ligamentum flavum
- C. Supraspinous ligament
- D. Interspinous ligament

**Q6: Which of the following concentrations of epinephrine corresponds to a 1:200,000 mixture?**

- A. 0.5 µg/mL
- B. 5 µg/mL
- C. 50 µg/mL
- D. 0.5 µg/mL

**Answers:**

Q1: A | Q2: C | Q3: B | Q4: C | Q5: B | Q6: B |

Q6 explanation: 1:200,000 means,  $1\text{g}/200,000\text{mL} = 1000\text{mg}/200,000\text{mL} = 1\text{mg}/200\text{ mL}$   
 $1\text{mg}/200\text{mL} = 1000\text{ }\mu\text{g}/200\text{ mL} = 10\text{ }\mu\text{g}/2\text{ mL} = 5\text{ }\mu\text{g}/\text{mL}$