CONTINUOUS EPIDURAL ANALGESIA (CEA)

SELF INSTRUCTIONAL LEARNING PACKET (SILP)

Developed by the BCCH Acute Pain Service with assistance from the C&W Department of Learning and Development

(Revised May 2015)
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>3</td>
</tr>
<tr>
<td>Purpose</td>
<td>3</td>
</tr>
<tr>
<td>Nursing Responsibilities</td>
<td>3</td>
</tr>
<tr>
<td>Learning Objectives</td>
<td>4</td>
</tr>
<tr>
<td>Instructions for Completing the Self-Instructional Learning Packet (SILP)</td>
<td>4</td>
</tr>
<tr>
<td>2. ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM</td>
<td>5</td>
</tr>
<tr>
<td>Structural Division of the Nervous System</td>
<td>5</td>
</tr>
<tr>
<td>Functional Division of the Nervous System</td>
<td>7</td>
</tr>
<tr>
<td>The Components of the Spinal Cord and Surrounding Membranes and Spaces</td>
<td>9</td>
</tr>
<tr>
<td>Review Questions</td>
<td>10</td>
</tr>
<tr>
<td>Answers to Review Questions</td>
<td>11</td>
</tr>
<tr>
<td>3. ANATOMY OF THE EPIDURAL SPACE</td>
<td>12</td>
</tr>
<tr>
<td>Epidural Space</td>
<td>12</td>
</tr>
<tr>
<td>Intrathecal Space</td>
<td>12</td>
</tr>
<tr>
<td>CEA and the Epidural Space</td>
<td>12</td>
</tr>
<tr>
<td>4. THE PAIN RESPONSE MECHANISM</td>
<td>13</td>
</tr>
<tr>
<td>Pain Receptors</td>
<td>13</td>
</tr>
<tr>
<td>Transmission of the Pain Impulse</td>
<td>13</td>
</tr>
<tr>
<td>5. INDICATIONS AND CONTRAINDICATIONS FOR CEA</td>
<td>14</td>
</tr>
<tr>
<td>Indications for CEA</td>
<td>14</td>
</tr>
<tr>
<td>Contraindications for CEA</td>
<td>14</td>
</tr>
<tr>
<td>6. PHARMACOLOGY OF CEA MEDICATIONS</td>
<td>17</td>
</tr>
<tr>
<td>CEA OPIOIDS</td>
<td>17</td>
</tr>
<tr>
<td>Pharmacology of CEA Opioids</td>
<td>17</td>
</tr>
<tr>
<td>Expected Effects of CEA Opioids</td>
<td>17</td>
</tr>
<tr>
<td>Adverse Side Effects of CEA Opioids</td>
<td>18</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

In the hospital setting, the nurse cares for children experiencing both acute and chronic/complex pain. Continuous epidural analgesia (CEA) is a technique of infusing an opioid and/or a local anesthetic via an epidural catheter and has been in use at BC Children’s Hospital (BCCH) since 1991. CEA provides pain relief using low doses of opioids and local anesthetics. It provides relief that is continuous, titratable, site-specific and long-acting. CEA is known to improve patient outcome and shorten hospital stay.

The administration and monitoring of opioids and local anesthetics via a continuous epidural infusion is recognized an advanced skill by the CRNBC and BCCH Nursing Department. CEA is a high-risk activity and requires annual recertification. Only nurses who have current certification may care for a patient receiving CEA. In addition the nurse must complete an epidural-specific pump in-service. This self-instructional learning packet (SILP) will prepare you to care for children receiving CEA.

All nursing staff responsible for caring will be required to complete this SILP.

**Purpose**
The purpose of this CEA SILP is to provide you with the knowledge and skills needed to provide safe nursing care to a child with an indwelling epidural catheter.

**Note:** CEA is used with both children and adolescents at BCCH. For the purpose of this SILP, the term ‘child/children’ will be used to denote both children and adolescents.

**Nursing Responsibilities**

1. Monitoring and recording the efficacy of the CEA and informing the Acute Pain Service (APS) anesthesiologist on-call when the patient requires a change in medication.

2. Monitoring and treating the patient for undesired or adverse effects that may result from the administration of the specific agents according to the CEA orders and contacting the APS anesthesiologist on-call for advice and further assessment for events not addressed in the standard orders.

3. Monitoring the patient for epidural catheter related problems such as leaking, occlusion, disconnection, migration and infection.

4. Assuring controlled delivery of the prescribed medication by the verification of medication infused with the CEA orders and ensuring proper infusion pump operation.

5. Providing ongoing nursing care to prevent limb or buttock pressure sore development during CEA administration.

**Note:** For patients after cardiothoracic surgery, call the cardiac anesthesiologist on-call first. The APS anesthesiologist is available if needed for additional support.
Learning Objectives

1. To review the basic structure and function of the nervous system as relevant to CEA.

2. To identify and describe the functioning of the components of the spinal cord and surrounding membranes and spaces, specifically the epidural space.

3. To describe the indications/contraindications for insertion of an epidural catheter.

4. To describe the rationale for drug selection.

5. To describe the physiological effects of an opioid analgesic and/or a local anesthetic administered via an epidural.

6. To describe the desired and adverse effects associated with the administration of an epidural opioid or local anesthetic.

7. To describe the insertion and placement of an epidural catheter.

8. To describe the difference between a thoracic, lumbar and caudal epidural catheter.

9. To describe the nursing monitoring and care of the epidural catheter and infusion pump.

10. To assess and implement nursing interventions in the event of the occurrence of side effects.

Instructions for Completing the Self Instructional Learning Packet (SILP)

1. Complete the SILP at your own speed.

2. Read each section of this SILP in the order that it is presented.

3. Work through the exercises as directed.

4. Check your answers to the exercises.

5. Review the content at anytime. [You should also review Nursing Policy & Procedure for a more detailed review of all the monitoring and care required for CEA.]

6. When you have completed your SILP, take it to your Unit Educator and complete a hands-on bedside validation.
2. ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM

Structural Division of the Nervous System

Structurally, the nervous system is divided into the central nervous system (CNS) and the peripheral nervous system (PNS).

The central nervous system is composed of the brain and spinal cord. The spinal cord is divided into 4 segments: cervical, thoracic, lumbar and sacral.

The peripheral nervous system consists of cranial nerves, spinal nerves and autonomic nervous system.

The cranial nerves are 12 pairs of nerves arising from the brain stem to supply mainly the head and neck. The cranial nerves are affected in the event of a CEA overdose.

The spinal nerves are 31 pairs of nerves arising from the spinal cord to supply the trunk and limbs. Each spinal cord segment is referred to as a level and when blocked with local anesthetic results in characteristic decrease in sensory (dermatome) and occasionally motor (myotome) function. Only nerves from the thoracic, lumbar and sacral levels are routinely affected by CEA.

![Diagram of the Nervous System](http://universe-review.ca/I10-13-spinal.jpg)

The Cranial and Spinal Nerves

The cranial and spinal nerves may be afferent (sensory) or efferent (motor) nerve fibres. The afferent nerve fibres carry impulses toward the CNS and the efferent nerves carry the impulses away from the CNS.

The segmental spinal nerves carry motor, sensory and sympathetic fibres.

Sympathetic fibres (sympathetic nervous system) are the smallest and most easily “blocked” nerves. They are part of the autonomic nervous system. They modulate smooth muscle function and activation results in vasoconstriction, pupillary dilatation, sweating and pilomotor erection (goose pimples and hairs standing on end).

Sensory fibres transmit sensations of touch, temperature, pressure and pain. The blunting of temperature sensation (hot vs cold) is a good indicator of the blunting of pain sensation.

A dermatome is an area of skin that is innervated by a single spinal cord segment. The following dermatome chart illustrates the spinal nerves that carry fibres necessary to cause specific sensation in parts of the body. An understanding of the dermatomes is necessary to assess the level of sensory block a patient is experiencing while receiving CEA with local anesthetic.

**KEY POINT:**
In most cases of CEA with a local anesthetic, it is desirable that the patient have a decrease in cold sensation (to ice test) in the dermatome of the surgical incision.

- In LUMBAR CEA, the sensation level should NEVER be at or above the nipple line (T4).
- In THORACIC CEA there should be a band of decreased sensation in the thorax with normal sensation in the lower abdomen. The upper aspect of the inner arm or 5th finger (T1) should NEVER be affected.

**THESE ARE INDICATORS OF A HIGH BLOCK!**
SEE PAGE 24 FOR EMERGENCY MANAGEMENT STEPS!

### Key Levels of Dermatome Blockade

<table>
<thead>
<tr>
<th>Cutaneous Landmark</th>
<th>Segmental Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little finger</td>
<td>C8</td>
</tr>
<tr>
<td>Upper aspect inner arm</td>
<td>T1</td>
</tr>
<tr>
<td>Nipple line (midway sternal notch and xiphisternum)</td>
<td>T4-5</td>
</tr>
<tr>
<td>Tip of xiphoid</td>
<td>T7</td>
</tr>
<tr>
<td>Umbilicus</td>
<td>T10</td>
</tr>
<tr>
<td>Inguinal ligament</td>
<td>L1</td>
</tr>
<tr>
<td>Outer side of foot</td>
<td>S1</td>
</tr>
</tbody>
</table>
**Motor fibres** go to various muscle groups and are responsible for initiating movement. These nerves are the thickest and most heavily myelinated fibres. This makes them most resistant to the effects of a local anesthetic.

**A myotome** is a group of muscles innervated by a single spinal cord segment. The following myotomes illustrate the spinal nerves that carry fibres necessary to cause specific movement in the lower extremities. An understanding of the myotomes is necessary to assess the level of motor block a patient is experiencing while receiving CEA with local anesthetic.

<table>
<thead>
<tr>
<th>Hip</th>
<th>Knee</th>
<th>Ankle</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2</td>
<td>Flex</td>
<td>L3</td>
</tr>
<tr>
<td>L3</td>
<td></td>
<td>Extend</td>
</tr>
<tr>
<td>L4</td>
<td>Extend</td>
<td>L5</td>
</tr>
<tr>
<td>L5</td>
<td></td>
<td>S1</td>
</tr>
<tr>
<td>S1</td>
<td>Plantar</td>
<td>S2</td>
</tr>
<tr>
<td>S2</td>
<td>Flex</td>
<td></td>
</tr>
</tbody>
</table>

The following **Motor Assessment Scale (MAS)** is used to monitor the level of motor block in a patient receiving CEA with a local anesthetic. There should be NO upper or lower extremity weakness when a thoracic epidural catheter is used.

**Motor Assessment Scale**  
0 - No weakness (able to lift leg off bed against gravity)  
1 - Able to flex/extend knees, but weak (L3/4 and L5/S1)  
2 - Able to planter flex ankles (toward floor), but cannot flex knees (L3/4, L5/S1)  
3 - Cannot move ankles or knees (L3/4, L5/S1, S1/S2)  

**If Motor Score is 2 or 3 notify APS anesthesiologist.**

**KEY POINT:**  
In most cases of CEA with a local anesthetic, it is desirable that the patient be able to flex the knees and the ankles against gravity. The ideal CEA results in minimal or NO Motor Block.

**Functional Division of the Nervous System**

Functionally, the nervous system is divided into the **somatic nervous system** and **autonomic nervous system**.

The **somatic system** controls conscious activities, such as perception of the world around us and involuntary responses to stimuli.

The **autonomic nervous system** controls involuntary (smooth) muscles and the functions of glands. The autonomic nervous system maintains the body's steady state, without conscious control. This includes regulating vital functions of temperature, respiration, blood pressure, digestion and energy metabolism. Tissue structures controlled by the autonomic nervous system are the smooth muscle and cardiac muscle; organs affected are the heart, blood vessels, irises, hair muscles, thoracic and abdominal organs and glands.
The autonomic nervous system is divided into two parts: the **sympathetic nervous system** and the **parasympathetic nervous system**.

### Diagram:

**Parasympathetic**
- Constricts pupil
- Stimulates salivation
- Inhibits heart
- Constricts bronchi
- Stimulates digestive activity
- Stimulates gallbladder
- Contracts bladder
- Relaxes rectum

**Sympathetic**
- Dilates pupil
- Inhibits salivation
- Relaxes bronchi
- Accelerates heart
- Inhibits digestive activity
- Stimulates glucose release by liver
- Secretion of epinephrine and norepinephrine from kidney
- Relaxes bladder
- Contracts rectum

### Table:

<table>
<thead>
<tr>
<th>Parameter Affected</th>
<th>Parasympathetic Effects</th>
<th>Sympathetic Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Stroke volume</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Cardiac output &amp; blood pressure</td>
<td>Decreased</td>
<td>Increased</td>
</tr>
<tr>
<td>Coronary vessels</td>
<td>Constriction</td>
<td>Dilation</td>
</tr>
</tbody>
</table>


The **sympathetic division** of the autonomic nervous system originates in the thoracic (T1 to T12) and upper lumbar (L1 and L2) regions of the spinal cord. Physical or emotional stress elicits a rapid response from the sympathetic nervous system, producing a combination of responses called the *fight or flight response*. Sympathetic stimulation increases blood and energy supply to vital organs (e.g., heart, brain and skeletal muscle) in this emergency response. Sympathetic stimulation can cause peripheral vasoconstriction (e.g., cold hands and feet).

The **parasympathetic division** originates in the cranial region and the sacral portion (S2 to S4) of the spinal cord. For the most part, the division balances the effects of sympathetic stimulation through inhibition of organ function.

The following are examples of the parasympathetic and sympathetic effects on the heart.
The Components of the Spinal Cord and Surrounding Membranes and Spaces

The spinal cord floats in cerebrospinal fluid (CSF) within the spinal canal of the vertebral column.

The epidural space is a potential space between the dura mater (the outermost covering of the spinal cord) and the ligamentous wall of the spinal canal (vertebrae). The epidural space contains fatty tissue, lymph vessels and veins.

The subarachnoid (intrathecal) space is next to the inner side of the dura mater and contains the cerebrospinal fluid (CSF).

The epidural space can be accessed at all levels between the vertebrae but is most commonly and safely accessed at the caudal and lumbar intervertebral levels. This is because the spinal cord ends at L1 and L2. The catheter can then be threaded up the spinal canal (in the epidural space) to the desired vertebral level. The epidural space may also be accessed at the thoracic level. This is most useful for major thoracic or upper abdominal surgery.

Retrieved October 29, 2008 from: http://www.frca.co.uk/images/pain_lumbar_puncture.gif
Review Questions

1. What structures comprise the central nervous system and the peripheral nervous system?

2. Describe the functions of the sympathetic division of the nervous system.

3. List one function of each of the following nerve fibres:
   - Motor:
   - Sensory:
   - Sympathetic:

4. Where is the epidural space located?

5. What space contains the cerebrospinal fluid (CSF)?

6. Where is the epidural space most commonly accessed?
Answers to Review Questions

1. The central nervous system is comprised of the brain and spinal cord. The peripheral nervous system is comprised of cranial and spinal nerves.

2. The sympathetic nervous system increases blood and energy supply to vital organs (heart, brain, skeletal muscles). Often referred to as fight or flight reaction.

3. Functions of the following nerve fibres:
   - Motor fibres are responsible for muscle contraction.
   - Sensory fibres are responsible for the perception of touch, pressure, temperature and pain.
   - Sympathetic fibres are responsible for the dilation of pupils, increase in blood pressure, cause sweating, form goose pimples and contract the erector pilli muscles and peripheral vasoconstriction.

4. The epidural space is a potential space outside the dura mater of the brain and spinal cord.

5. The intrathecal or subarachnoid space.

6. An epidural puncture is commonly done at the caudal and lumbar levels. The thoracic approach may also be used. The cervical approach is rarely used.

If you were able to answer the questions correctly, congratulations, you have a good understanding of the nervous system and are ready to proceed to the next section of this packet.
3. ANATOMY OF THE EPIDURAL SPACE

**Epidural Space**

The **epidural space** is a potential space above the **dura mater** (the outermost covering of the spinal cord) and the ligamentous wall (**ligamentaum flavum**) of the bony spinal canal (vertebrae).

The dura mater is actually the outermost layer of three membranes that comprise the meninges, the pia mater, the arachnoid mater and the dura mater. It is these membranes that become inflamed in meningitis or arachnoiditis.

The epidural space contains fatty tissue, segmental spinal nerves, lymphatic vessels, arteries and veins.

The **spinal cord** is cushioned in **cerebrospinal fluid (CSF)** within the thick covering, the dura mater, that contains the CSF and provides a layer of protection for the spinal canal in addition to the vertebral column.

**Intrathecal Space**

The **subarachnoid (intrathecal) space** refers to the space between the dura mater and the spinal cord. It is the area where CSF is collected from when a lumbar puncture is done and is also where medication is placed for spinal analgesia/anesthesia.

Another way to conceptualize the epidural space is as a series of vertical cylinders arranged inside each other. The smallest cylinder, at the core, is the spinal cord. It is ensheathed by three cylinders of meninges: the pia, the arachnoid and the dura from inside to outside respectively. The outermost cylinder is the spinal canal, formed by the vertebrae and the ligaments between them. The **SPINAL or SUBARACHNOID** space is between dura and arachnoid and contains the CSF. The **EPIDURAL or EXTRADURAL** space is between the vertebral canal and the dura. It is ‘outside’ the dura cylinder and is the first space you enter when passing a needle from the spinal canal towards the spinal cord.

**CEA and the Epidural Space**

- In **CEA** the **epidural catheter** is located outside the **dura mater** in the **epidural space**.

- There is **NO CSF** in the epidural space.

- There is **NO risk** of a **dural puncture headache** if the dura mater is not punctured.

- The amount of medication needed in the epidural space is about 10 times that used in the spinal space.
4. THE PAIN RESPONSE MECHANISM

Pain Receptors
The first step in the pain response begins with the excitation of the pain receptors (nerve endings) by a painful stimulus such as heat or pressure.

The resulting tissue damage causes the release of chemical substances which regulate (stimulate or inhibit) the transmission of pain impulses.

Examples of these chemical substances are prostaglandins, bradykinin, serotonin, histamine and potassium and hydrogen ions.

Transmission of the Pain Impulse
The sensory nerve fibres of the peripheral nervous system carry the pain impulses to the spinal column terminating in the dorsal horn of the spinal cord.

The impulses cross over (decussate) and ascend the spinal cord to the thalamus.

From the thalamus the impulses are transmitted to the cerebral cortex where the pain is perceived and interpreted.

5. INDICATIONS AND CONTRAINDICATIONS FOR CEA

Indications for CEA

(1) Any child having major surgery in an area where the dermatomes can be blocked via CEA.
   - Examples of thoracic CEA are thoracotomy, pectus excavatum repair and abdominal surgery above the umbilicus.
   - An example of lumbar CEA is major lower limb/pelvic surgery.
   - An example of a caudal CEA is a KSAI procedure.

(2) With inadequate pain relief or unacceptable side-effects from systemic analgesics.

(3) When other routes of pain management have been used with unsatisfactory results (e.g., cancer and/or complex chronic pain).

Contraindications for CEA

(1) Bleeding abnormalities or when patients are receiving anticoagulant therapy.

(2) Local skin infection (at the potential puncture site) or systemic sepsis.

(3) Abnormal anatomy (patient may still receive a CEA after assessment by Anesthesia).

(4) Allergy to the opioid or local anesthetic being used.

(5) Increased intracranial pressure (ICP).

(6) Patient with fluctuating neurological status.

(7) Patient (and/or parental) refusal to consent to the procedure. The consent is part of the anesthetic record unless the epidural is inserted as a separate procedure, in which case a separate consent form is obtained.
Review Questions

1. Describe the pain response pathway.

2. Describe the type of patient who may benefit from epidural analgesia/anesthetic?

3. List three contraindications to continuous epidural analgesia (CEA).
1. Pain initially stimulates the free nerve endings in tissue. The pain response is transmitted along the peripheral nerves to the dorsal horn in the spinal cord where it crosses over to the central nervous system which carries the "pain response" up the spinal cord and into the brain.

   It is important to note that the pain pathway can be modulated in many ways (pharmacological and non-pharmacological) by various mechanisms which ultimately influence pain perception.

2. Children who are undergoing thoracic, major abdominal or lower extremity surgery. Any child with inadequate pain relief or unacceptable side-effects from systemic analgesics and/or where other routes of pain management being used have had unsatisfactory results (e.g., cancer and/or complex chronic pain).

3. Children who have bleeding problems, local skin infection at the insertion site, sepsis, allergies to the analgesic and/or local anesthetic used, and increased intracranial pressure (ICP).
6. PHARMACOLOGY OF CEA MEDICATIONS

KEY POINTS:
1. Only preservative-free medications are used in the epidural space. [See Appendix C for more information on medications.]
2. Infusion bags for CEA are prepared by the Department of Pharmacy or the APS anesthesiologist ONLY.
3. Only the APS anesthesiologist may administer epidural medication boluses.
4. Opioids and local anesthetics may be used alone or combined when used for CEA.
5. All CEA and related medication orders are written by the APS anesthesiologist ONLY regardless of the route (PO, IM, SC, IV and epidural).

CEA OPIOIDS

Epidural Opioid (Hydromorphone): Epidural opioids provide good relief of somatic pain and may decrease sympathetically and parasympathetically mediated visceral pain. Opioids act in the spinal cord and brain by acting on opioid receptors to modulate the effects of the neurotransmitters released during painful stimuli. The opioids act by diffusing from the epidural space into the CSF.

Pharmacology of CEA Opioids
The onset of action and the duration of the opioid effect are dependent on the lipid solubility of the specific agent. The greater the opioid lipid solubility, the more rapid the onset of action and the shorter the duration of action.

Highly lipid soluble drugs, such as Fentanyl (Sublimaze), relieve pain rapidly, but for a short time. Hydromorphone has lower lipid solubility and therefore a slower onset and a longer duration of action.

<table>
<thead>
<tr>
<th>Pharmacokinetics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opiate</strong></td>
</tr>
<tr>
<td>Fentanyl</td>
</tr>
<tr>
<td>(1-2 mcg/kg/hr)</td>
</tr>
<tr>
<td>Hydromorphone</td>
</tr>
<tr>
<td>(0.5-1.5 mcg/kg/hr)</td>
</tr>
</tbody>
</table>

Expected Effects of CEA Opioids
(1) Reduction of pain (synergistic effect when combined with local anesthetic) and its adverse effects.
(2) Normal sympathetic system function (e.g., heart rate, blood pressure and cardiac output).
(3) Normal sensory function (e.g., no touch, proprioception or temperature effects).
(4) Normal motor nerve function which allows child to ambulate.
(5) Ability to interact and carry out activities of daily living without the effects of systemic opioids (e.g., drowsiness).
Adverse Side Effects of CEA Opioids

(1) Respiratory Depression
This is a rare (less than 1% incidence) and serious but easily treatable side-effect. It results from migration of the opioid into the CSF and up to the respiratory centre in the brainstem. Respiratory depression can be delayed up to 24 hours after commencement and/or discontinuation of epidural opioids.

All patients will experience subtle respiratory depression that can be detected with sophisticated testing. The effect on respiration may be potentiated by:
- Systemic opioids given in addition to the epidural opioid (e.g., IV or oral medications containing codeine or morphine).
- Antiemetics, antipruritics, tranquilizers and/or sedatives given in addition to epidural opioid.
- Multiple doses/boluses of epidural opioid.
- Increasing systemic disease such as sepsis or respiratory failure.

Signs and Symptoms
- Decreased level of consciousness (KEY POINT).
- Decreased respiratory effort or depth.
- Decreased respiratory rate (RR).
- Decreased SpO2 (not reliable if the patient is receiving supplementary oxygen).

Nursing Monitoring
- All patients receiving epidural opioids will have hourly assessment of Arousal Score, respiratory rate, depth and effort while awake.
- While sleeping the Arousal Score should be done every 4 hours and if the respirations appear shallow, laboured, slow or if excessive somnolence is suspected.
- All patients receiving epidural opioids will have continuous SpO2 monitoring.

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure</td>
<td>Q4H</td>
</tr>
<tr>
<td>Level of Arousal</td>
<td>Q1H while awake. While sleeping: do Q4H and more frequently if RR shallow or &lt;12BPM age &gt;10 yrs; &lt;14BPM age 2-10</td>
</tr>
<tr>
<td>Respiratory Rate and Depth</td>
<td>Q1H</td>
</tr>
<tr>
<td>Pulse</td>
<td>Q1H</td>
</tr>
</tbody>
</table>

Nursing Actions (Emergency Procedures)
- If the respiratory rate is less than appropriate for the child’s age AND/OR arousal score is greater than 2: rouse the patient, encourage breathing, stop the epidural infusion, apply Oxygen (O2) at 6-10 litres by face mask, apply or check pulse oximetry and call the ordering physician.
- If the respiratory rate is less than appropriate for the child’s age AND unable to rouse the patient AND the SpO2 is less than 90% on 6-10 litres O2 by face mask: stop the epidural infusion, stay with the patient, call a code blue, begin resuscitation procedures and administer Naloxone as ordered. **Always take into account a patient’s normal saturation range.**
(2) **Nausea and Vomiting**
The most common side-effect of CEA opioids and may occur in up to 40% of patients. The minimum effective dose of opioid should always be used. In severe cases, Naloxone can be given by continuous low dose infusion or small incremental doses to reverse severe nausea and/or vomiting.

**Nursing Actions:**
- Give antiemetics as ordered. Assess for effectiveness.

**Note:** Sedating antiemetics (e.g., Dimenhydrinate) may potentiate the respiratory depressive effect of opiates.

(3) **Pruritus**
A common side-effect of CEA opioids. In severe cases, Naloxone can be given by continuous low dose infusion or small incremental doses to reverse severe itching.

**Nursing Actions:**
- Give antipruritic as ordered. Assess for effectiveness.

**Note:** Sedating antipruritics (e.g., Diphenhydramine) may potentiate the respiratory depressive effect of opiates.

(4) **Constipation**
Rare with short-term CEA and more common with long-term opioid use.

**Nursing Actions:**
- Assess for constipation every shift while on CEA.
- Administer laxatives/stool softeners as ordered.
- If no results contact attending physician for further orders.

(5) **Urinary Retention**
All patients with lumbar CEA will require a urinary catheter for surgical reasons. Patients with thoracic CEA that do not have a urinary catheter need to be encouraged to void.

**Signs and Symptoms:**
- Inability to void at 8 hours post-operatively
- Bladder palpable above the pubis

**Nursing Actions:**
- Assess for urinary retention every shift while on epidural infusion.
- Monitor intake and output
- Palpate bladder for distension
- **Maintain** urinary catheter if present, until CEA therapy is discontinued.
- Report signs and symptoms of urinary retention to APS anesthesiologist
- Catheterize as ordered
(6) **Inadequate Pain Management**

This may occur in up to 10% of patients receiving CEA. Catheter dislodgement or leaking is the most common cause.

**Signs and Symptoms:**
- Irritability, crying
- Withdrawing, quiet
- Increase in BP
- Sweating
- Guarding
- Self-report of feeling uncomfortable or having pain

**Assessment:**
Assess pain according to age and stage of growth and development using appropriate pain assessment tool.
- If child is experiencing pain, contact APS anesthesiologist, or the cardiac anesthesiologist for cardiothoracic patients.
- A Rescue Bolus (Local Anesthetic and/or Opioid) is given by the anesthesiologist ONLY.
- The APS or cardiac anesthesiologist will indicate monitoring required after a bolus is given and MUST be available (on module) for 30 minutes after the bolus is given.

**Nursing Actions:**
- Complete a pain assessment using an age and developmentally appropriate pain assessment tool. Record findings on pain documentation flowsheet q4h prn depending on patient status and as per APS anesthesiologist instructions.
- Reassess the patient for surgical complication (e.g., compartment syndrome, tight cast or dressing, or new pain source).
- Call APS anesthesiologist for re-assessment and additional analgesia orders.
- Administer adjunct medications as ordered by the APS anesthesiologist.
- Encourage use of non-pharmacological pain strategies (e.g., distraction and imagery).

(7) **Infection**

Most commonly localized to the epidural insertion site. Systemic infection or infection in the epidural space (abscess) is a rare complication.

**Signs and Symptoms:**
- **Epidural abscess or systemic infection:** fever, headache, dizziness, tachycardia, neck rigidity, complaints of back pain or behavioural changes such as lethargy.
- **Insertion site infection:** redness, swelling, tenderness, drainage, fever and complaints of pressure/pain at the insertion site.
Assessment:
• Assess the insertion site for redness, swelling, drainage and complaints of pressure or discomfort at the epidural catheter site every 4 hours. Record any abnormal findings and notify the anesthesiologist.
• Assess for signs and symptoms of systemic infection, headache, fever, stiff neck, back pain, dizziness lethargy and complaints of back pressure/pain q4h. Record any untoward signs/symptoms and notify the anesthesiologist.
• Ensure epidural catheter is secured to the back and the catheter filter to the anterior clavicle area.

Nursing Actions:
• Monitor and record vital signs as prescribed.
• Use strict aseptic technique when giving care related to the epidural catheter.
• Inspect and palpate epidural catheter site dressing at the beginning of each shift and PRN if there are indications of infection or drainage present.
• Report any abnormal findings to APS anesthesiologist.
• Maintain closed administration system throughout CEA therapy.

Note: Clear drainage at the epidural catheter site is usually related to leakage of the epidural solution and may RARELY indicate leakage of CSF fluid. Blood tinged drainage is usually related to the time of insertion and may RARELY indicate catheter migration into the epidural venous system.

(8) Epidural Catheter Disconnect/Removal/Occlusion
For accidental disconnect of the tubing from the catheter:
  a. STOP epidural infusion.
  b. WRAP exposed end of catheter in sterile gauze.
  c. CALL the APS or cardiac anesthesiologist on-call immediately.

For accidental removal of the epidural catheter:
  a. STOP epidural infusion; WRAP the catheter end in sterile gauze.
  b. PLACE a sterile dressing over the insertion site.
  c. WRAP the catheter tip and save for anesthesiologist to examine.
  d. CALL the APS or cardiac anesthesiologist on-call immediately.

For accidental removal of epidural catheter dressing:
  a. STOP epidural infusion.
  b. PLACE a temporary sterile bandage over the insertion site.
  c. CALL the APS or cardiac anesthesiologist on-call immediately.

(9) New Onset Back Pain
This is extremely rare but serious. For new onset back pain at or around epidural site call APS anesthesiologist on-call immediately to assess for possible abscess or hematoma.

Note: For patients after cardiothoracic surgery, call the cardiac anesthesiologist on-call first. The APS anesthesiologist is available if needed for additional support.
CEA LOCAL ANESTHETIC

Epidural Local Anesthetic (Bupivacaine): Epidural local anesthetics act by blocking conduction of impulses through the nerves as they traverse the epidural space. Due to the smaller size and decreased myelination of the sympathetic and sensory nerve fibres, transmission is impaired at lower concentrations than in motor nerve fibres.

Pharmacology of CEA Local Anesthetic
The number of nerves blocked depends on the epidural catheter site and the concentration and volume of drug injected. Since the drug position is affected by gravity, it may move up or down in the space to some degree depending on the patient's position. The typical concentration used in CEA is 0.1% Bupivacaine whereas in the operating room a concentration of 0.25% in used (2.5 times as much).

KEY POINTS:
1. The term “block” is often used to describe the effects of the local anesthetic.
2. The degree of block of sensory, motor and sympathetic fibres depends on the site of the epidural catheter, concentration of local anesthetic, volume of drug used and position of the patient.
3. The concept of “differential blockade” means that with a low concentration of local anesthetic it is possible to decrease painful sensations (provide analgesia) while preserving motor function.
4. Low doses of a combined opioid and a local anesthetic can provide a “synergistic” effect resulting in improved pain relief compared to when either drug is used alone while reducing the side-effects of each drug.

Expected Effects of CEA Local Anesthetic
(1) Analgesia with decreased sensation which is detected by the “ice test.” For maximum analgesia, the area should correspond to the area of surgical incision.

The ICE TEST
- Choose an area where sensation is expected to be normal (e.g., the shoulder tip).
- Ask the child to remember what it feels like.
- Move to an area where altered sensation is expected and ask the child if it feels the same as the shoulder tip or different (e.g., less cold, warm, fuzzy, thick or far away).
- A pre-verbal child should respond to cold where there is NO block. Piloerection (goose pimples) of the skin or a grimace may be observed.

KEY POINT:
The patient should not lose the ability to feel, but sensation may be altered (e.g., rather than feeling the cold of the ice, they may report that the ice feels warm).

Sensory Block: Some children may experience numbness of the skin on the lower abdomen, buttocks, legs and feet during lumbar epidural analgesia therapy. This usually disappears a few hours after therapy has been discontinued. It is a concern for those
children who may be predisposed to pressure sores, dislocated hip, or compartment syndrome.

It is very important to turn an immobilized patient with CEA every two hours because of the potential for pressure related injury of skin, muscle and nerves.

**Signs and Symptoms:**
Feeling numb to ice in the dermatomes supplied by nerves at and around the level of the catheter and may progress to higher levels such as umbilicus (T10) and nipple line (T4). The child may describe the ice as feeling warm.

**Nursing Actions:**
- *Assess sensory function upon 1st arrival to unit with transferring RN.*
- Monitor and record sensory function every 4 hours.
- Turn every two hours to protect from injury (e.g., pressure, improper alignment).
- Call APS anesthesiologist if sensory level is at or above normal parameters for lumbar (T4 or nipple line) and thoracic (T1/C8 inner aspect of arm) CEA immediately.

<table>
<thead>
<tr>
<th>Sensory Assessment Scale for Lumbar Epidural</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = No numbness</td>
</tr>
<tr>
<td>1 = Buttocks, toes are numb to ice (S1)</td>
</tr>
<tr>
<td>2 = Groin and below are numb to ice (L1)</td>
</tr>
<tr>
<td>3 = Umbilicus and below are numb to ice (T10)</td>
</tr>
<tr>
<td>4 = Xiphoid process of the sternum and below are numb to ice (T6)</td>
</tr>
<tr>
<td>5 = Nipple line and below are numb to ice (T4)</td>
</tr>
</tbody>
</table>

**Notify APS anesthesiologist if sensory score is 4 or above.**

<table>
<thead>
<tr>
<th>Sensory Assessment Scale for Thoracic Epidural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please Use Dermatome Block Guide</td>
</tr>
</tbody>
</table>

**Notify APS anesthesiologist if sensory score is above T1.**

(2) Mild vasodilation and decreased sweating due to the concurrent block of the sympathetic fibres.

(3) Some muscle weakness but no appreciable motor block. The patient should always be able to move the toes and/or extend the knees. Arms should never be affected.

**KEY POINT:**
Ambulation is recommended for surgical patients. If no motor block is present, the patient may be ambulated (i.e., dangling at the edge of the bed, to a chair or to the bathroom) ONLY with 2 person assistance with nursing staff or as directed by the APS anesthesiologist. Do not ambulate a patient if contraindicated by surgery.

**Unintentional Motor Block:** Motor weakness of the legs may occur after a local anesthetic bolus (given by APS anesthesiologist). In most instances it should not last more than 1-2 hours after medication administration.
Note: Any child returning from the operating room (OR) should have improving motor function as the higher concentration of local anesthetics used in the OR wears off. If increasing, new onset dense motor block or unresolved motor block within first 12 hours after initiation on epidural – call APS anesthesiologist immediately.

**Signs and Symptoms**
- Progressive inability to flex knees and/or move ankles and toes.

**Nursing Actions:**
- Monitor and record motor function every 4 hours.
- Call APS anesthesiologist if child is unable to flex knees and/or move ankles and toes.
- Do not ambulate a child receiving lumbar or caudal CEA without contacting the APS anesthesiologist for ambulation instructions/orders (the child is usually able to dangle or be assisted to a chair with assistance).

**Motor Assessment Scale**
- 0 = No weakness (able to lift leg off bed against gravity)
- 1 = Able to flex/extend knees, but weak (L3/4 and L5/S1)
- 2 = Able to plantar flex ankles (toward floor), but cannot flex knees (L3/4, L5/S1)
- 3 = Cannot move ankles or knees (L3/4, L5/S1, S1/S2)

Notify APS anesthesiologist if motor score is 2 or 3.

These effects occur primarily at the segmental nerve levels around which the drug is placed. As well, a few segments above and below the catheter site may be affected depending on the factors previously discussed.

**KEY POINTS:**
2. Differential blockade: a patient who can move the hips and legs is at lower risk for positioning and pressure palsies.

**Adverse Side Effects of CEA Local Anesthetic**

(1) Hypotension
The patient's blood pressure may drop due to vasodilatation of the affected dermatomes. This is most likely to occur following a bolus of local anesthetic or in the setting of increasing blockade in a patient who is in negative fluid balance. A rare cause of hypotension is catheter migration into the subarachnoid space (See Spinal Anesthesia). CEA related hypotension in children is usually mild. If moderate to severe hypotension is present other causes MUST be ruled out.

**Nursing Actions:**
If blood pressure drops more than 30% from child's normal (e.g., normal of 100/60 dropping to below 70/40):
- STOP the CEA and stay with the patient
- Apply 100 % oxygen and CALL CODE BLUE if clinically indicated
- Call APS anesthesiologist immediately
(2) **High Sensory Block**
High sensory block is related to:
- Medication error
  - Wrong drug, dose, concentration, or rate
  - Programming or pump error
- Sub-dural catheter insertion. (See Unintentional Intravenous Administration)
- Catheter migration to sub-arachnoid space. (See Unintentional Spinal Anesthesia)

Increasingly high sensory block can lead to:
- Dyspnea
- Difficulty coughing
- Hypotension
- Bradycardia
- Decreased level of consciousness
- Apnea

Another (rare) symptom of a high block is Horner’s Syndrome – signs include:
- Unilateral dropping of the eyelid (ptosis) and sunken appearance of eye (enophthalmos)
- Pupils unequal – smaller on effected side (miosis)
- Lack of sweating/flushing on affected side (anhidrosis)

**Nursing Actions:**
- STOP the CEA and stay with the patient
- Apply 100 % oxygen and CALL CODE BLUE if clinically indicated
- Call APS anesthesiologist immediately
- Raise the head of the bed if stable BP

**KEY POINT:**
In most cases of CEA with a local anesthetic, it is desirable that the patient have a decrease in cold sensation (to ice test) in the dermatome of the surgical incision.
- In LUMBAR CEA, the sensation level should NEVER be above the nipple line (T4).
- In THORACIC CEA there should be a band of decreased sensation in the thorax with normal sensation in the lower abdomen. The upper aspect of the inner arm (T1) should NEVER be affected.

**THESE ARE INDICATORS OF A HIGH BLOCK!**

(3) **Unintentional Intravenous Administration (systemic toxicity)**
Local anesthetics may accidentally be infused into the extensive epidural venous plexus at the time of epidural catheter insertion or later due to catheter migration. **Large doses of local anesthetics are systemically toxic.**

**Signs and Symptoms:**
- Increasing plasma levels of local anesthetics lead to serious cardiovascular and neurological toxicity. This may occur gradually in the setting of CEA at the higher dose range or more acutely in the rare case (< 1%) of intravascular catheter migration.
- The most common initial signs are numbness around the mouth, jitteriness and ringing the ears.
Assessment:
• Observe for: tingling of the lips, ringing or buzzing in the ears, twitching, possible seizures, behavioural changes and complaints of chest heaviness/difficulty breathing. If present, stop the CEA.

Nursing Actions:
Monitor for any of the following signs of toxicity:
  o Numbness/tingling of the lips and tongue, slurred speech
  o Light-headedness
  o Ringing in the ears
  o Alteration in level of consciousness, drowsiness and restlessness
  o Visual disturbances
  o Seizures
• STOP the CEA and stay with the patient
• Apply 100 % oxygen and CALL CODE BLUE if clinically indicated
  o Obtain a bag of 20% Intralipid from pyxis and bring code cart to the bedside
• Call APS anesthesiologist immediately

Note: Call APS anesthesiologist for any seizure activity, even in patients with a known seizure disorder.

(4) Unintentional Spinal Anesthesia
(See hypotension above). This may occur if the catheter inadvertently penetrates the dura during insertion or with gradual migration of the catheter through the dura into the CSF. The dose received may be 10 times what is intended and the effects of the local anesthetic may spread up to the brain and affect vital centres.

Signs and Symptoms:
• Severe hypotension and bradycardia.
• Rapidly ascending motor paralysis affecting the respiratory muscles; causing hypoventilation and affecting ability to talk or close the glottis to protect the airway and apnea.
• Loss of consciousness (LOC).

Nursing Actions:
Call APS anesthesiologist immediately if there are any changes in vital signs consistent with rapid onset of motor block and/or hypotension:

In the case of seizures and apnea:
• STOP the CEA and stay with the patient.
  o Apply 100 % oxygen and CALL CODE BLUE if clinically indicated
• Call APS anesthesiologist immediately

(5) Inadequate Pain Management: See CEA Opioids, Item 6.
(6) Infection: See CEA Opioids, Item 7.
(7) Catheter Disconnect/Leaking/Occlusion: See CEA Opioids, Item 8.
KEY POINTS:
Any adverse effect with CEA must result in:
1. Re-identification of the CEA solution bag being administered and as prescribed by the APS anesthesiologist on the Hydromorphone Epidural Analgesia Physician’s Orders. Checking the infusion pump to ensure the correct operation, programming and delivery of the CEA solution.

Note: If there is any doubt regarding the veracity of the solution or the functioning of the infusion pump, the CEA should not be recommenced without starting a new solution bag and/or a new pump and prescribed by the APS anesthesiologist.
Review Questions

1. Which nerves fibres are the most sensitive to Bupivacaine? What are the expected results?

2. Explain the rationale for the selection of Hydromorphone as the drug for epidural analgesia.

3. What two factors are responsible for the degree of the block affected by the local anesthetic?

4. How does an epidural opioid cause analgesia?

5. List 1 expected side effect and effect of an epidural opioid analgesic:
6. Identify 2 medical interventions for hypotension associated with an epidural infusion.

7. Explain how and when ambulation can occur with a CEA.

8. A seven year old patient who is receiving a local anesthetic infusion of Bupivacaine develops hypotension and displays loss of consciousness. What is the most likely cause of this? Describe the interventions that should be taken.

9. Why is some degree of respiratory depression experienced by all patients receiving opioid analgesics via the epidural route?

10. What are the drugs that must always be available on the unit when a patient is receiving epidural opioid analgesics and local anesthetic? Explain the rationale.
**Answers to Review Questions**

1. The sensory nerves. It is expected there will be a decreased sensation of pain (sensory) with minimum accompanying weakness (motor).

2. Hydromorphone is the drug of choice for epidural analgesia as it has a lower lipid solubility which prolongs the duration of action and improves the spread in the CSF.

3. (1) The catheter location and site.  
   (2) The concentration of local anesthetic.  
   (3) The particular drug used.

4. Analgesic is administered into the epidural space. The analgesic moves across the dura mater into the subarachnoid space and the CSF. The drug binds with the opiate receptors in the dorsal horn of the spinal cord producing analgesia.

5. Reduction of pain (no effect on motor or sympathetic fibres) – desired and expected. Pruritis, urinary retention, respiratory depression – expected.

6. Contact APS anesthesiologist and administer IV fluids/bolus and Epinephrine as ordered.

7. Ambulation can occur when a patient is without a motor block, using a 2 person assist, under direction of the APS.

8. The cause is most likely due to catheter migration into subarachnoid space (CSF): accidental spinal anesthesia. The classic symptoms are severe hypotension and an effect on the speech. The effects are exaggerated as anesthetic in the CSF is more potent than in the epidural space.

   Interventions are:  
   (1) Call Code Blue  
   (2) Discontinue CEA  
   (3) Contact APS anesthesiologist  
   (4) Stay with the patient

9. It is due to the spread of analgesic into the CSF and up to the respiratory centre. It will be most noticeable in the depth rather than rate of respirations.

10. Naloxone - antagonist used to reverse opioid induced respiratory depression.  
    20% intralipids - unsure of mechanism but it’s believed it’s binds with Bupivacaine
7. NURSING CARE OF THE EPIDURAL CATHETER

Insertion of an Epidural Catheter for CEA

An epidural catheter is inserted in a surgical suite by an anesthesiologist usually during a general anesthetic and prior to the start of surgery. This procedure can be done on an awake or sedated patient. The child is placed in the lateral decubitus position. The skin is prepped and an epidural needle is inserted into the lumbar, caudal or thoracic area and advanced into the epidural space. A flexible catheter is threaded through the needle into the epidural space.

Placement of the Epidural Catheter

The needle is removed and the catheter is secured in place by a sterile, transparent, occlusive dressing. To ensure that the catheter will not be dislodged, the remaining tubing must be secured along the patient's back and up over the shoulder with tape. This type of catheter placement is called a percutaneous catheter and is used for short term pain management.

Secured Epidural Catheter

A luer lock cap and a filter are attached to the distal end of the catheter. The filter is a 0.2 micron viral/bacterial filter that prevents the ingress of particulate/infectious material. The filter may be secured with tape to the upper chest. A 2 x 2 may be placed between the filter and the child's skin to protecting the child's skin from injury. If the filter should accidentally be separated from the catheter the APS anesthesiologist should be informed, no further drugs/fluids injected and the end of the catheter covered with a sterile dressing.

The APS anesthesiologist administers the initial dose of the analgesic (loading dose). This is to assess for appropriate placement and monitor for side effects. After the child is stabilized, s/he will be returned to the unit.

Epidural Catheter Dressing

For short term epidural catheters, the dressing will be removed by the APS anesthesiologist or nurse clinician when the epidural catheter is taken out. If the occlusive dressing is wet or not intact, reinforce the area with a sterile occlusive dressing applied over the original dressing. The APS anesthesiologist should be notified.

When observing the dressing site remember the following:

- Dressings should remain dry and intact.
- Care should be taken to avoid tension or pulling on the exposed catheter.
- The surrounding area should be checked for swelling and inflammation (do not disturb the dressing).
- The filter should be secure and protected - ensure the patient is not lying on the filter leading to skin breakdown.

Tubing and Filter Changes

Most epidural catheters are not needed and/or discontinued within 48-72 hours after insertion. The epidural catheter is assessed daily and all required tubing changes will be done by the APS anesthesiologist ONLY.
Review Questions

1. Describe the procedure you would follow if the filter should accidentally be disconnected from the epidural catheter.

2. Describe what you would do if you found the insertion site dressing was not intact.

3. Who is responsible for removing the epidural catheter?
Answers to Review Questions

1. The end of the catheter would be covered with a sterile 2 x 2, no further injections would occur and the anesthetist/delegate would be called.

2. Cover the original dressing with a new sterile occlusive dressing.

3. The anesthesiologist or pain nurse clinician will remove the catheter.
8. APPENDICES

Appendix A: Definition of Terms
Appendix B: Nursing Care of the Child with CEA Local Anesthetic
Appendix C: Drug Monographs
Appendix D: Pain Management Documentation Flowsheet
**APPENDIX A: DEFINITION OF TERMS**

Afferent Nerve: Any nerve that transmits impulses from the periphery toward the central nervous system (sensory neurons).

Anesthesia: Partial or complete loss of sensation with or without loss of consciousness.

Analgesia: Absence of normal sense of pain.

Autonomic Nervous System: The branch of the nervous system that works without conscious control; it governs the glands, cardiac muscle and the smooth muscle, such as the digestive system, the respiratory system and the skin.

Caudal: Pertaining to any tail-like structure, i.e., caudal equina the terminal portion of the spinal cord and the roots of the spinal nerves below the first lumbar nerve.

Dura Mater: Outer most covering of the brain and spinal cord.

Efferent Nerve: Any nerve that carries impulses from the central nervous system toward the periphery.

Epidural Space: Potential space outside of the dura mater of the brain and spinal cord.

Intrathecal: Within the spinal canal, i.e., into the CSF.

Motor Neuron: Any nerve that carries impulses from the central nervous system to muscles.

Myotome: A group of muscles innervated by a single spinal nerve.

Nociceptor: A nerve for receiving and transmitting painful stimuli.

Sensory Neuron: Any nerve that transmits impulses from the periphery toward the central nervous system.

Somatic Nervous System: Governs the striated or skeletal muscles (voluntary).

References:
APPENDIX B: NURSING CARE OF THE CHILD WITH CEA LOCAL ANESTHETIC

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure</td>
<td>Q4H</td>
</tr>
<tr>
<td>Level of Arousal</td>
<td>Q1H while awake. Arousal Score if RR shallow or less than 12 breaths/minute (BPM), less than 14 BPM (age 2-10), less than 20 BPM (6 mo – 2 yr)</td>
</tr>
<tr>
<td>Respiratory Rate and Depth</td>
<td>Q1H</td>
</tr>
<tr>
<td>Pulse</td>
<td>Q1H</td>
</tr>
</tbody>
</table>

**Note:** When taking the blood pressure you are monitoring for the vasodilatation effect of the anesthetic. If blood pressure falls more than 20 points (systolic or diastolic) below the child’s normal reading notify the APS anesthesiologist immediately.

**Motor and Sensory Assessment**
Sensation and motor function are done q4h or more frequently as needed. It is important to do a complete bilateral head to toe assessment as segmental blocks may occur at different levels. Record assessment findings on Pain Management Documentation Flowsheet BCCH 755. [See Appendix E.]

**Sensory Assessment Scale with Lumbar CEA**
0 = No numbness  
1 = Buttocks, toes are numb to ice (S1)  
2 = Groin and below are numb to ice (L1)  
3 = Umbilicus and below are numb to ice (T10)  
4 = Xiphoid process of the sternum and below is numb to ice (T6)  
5 = Nipple line and below are numb to ice (T4)

**Notify APS anesthesiologist if sensory score is 4 or above.**

**Thoracic Epidural- See Dermatome Guide**

**Note:** The child should not lose the ability to feel but sensation may be altered (e.g., rather than feeling the cold of the ice they may report that the ice feels less cold than in areas unaffected by the local anesthetic).

**Motor Assessment Scale**
0 = No weakness (able to lift leg off bed against gravity)  
1 = Able to flex/extend knees, but weak (L3/4 and L5/S1)  
2 = Able to planter flex ankles (toward floor), but cannot flex knees (L3/4, L5/S1)  
3 = Cannot move ankles or knees (L3/4, L5/S1, S1/S2)

**Notify APS anesthesiologist if motor score is 2 or 3.**

**Note:** Do not ambulate a child receiving lumbar or caudal CEA until you contact the APS anesthesiologist for ambulation instructions/orders. The child is usually able to dangle or be assisted to a chair with assistance.
**APPENDIX C: DRUG MONOGRAPHS**

**BUPIVACAINE (MARCAIN) – for CEA Use**

**Onset of Action:**
- 4-17 minutes, varying with concentration.
- 3-7 hours, varying with concentration.

**Duration of Action:**
- Addition of Epinephrine prolongs the duration of action and decreases the toxicity of Bupivacaine by slowing the uptake of bupivacaine into the systemic circulation.

**Dosage:**
- Individualized, varying with the degree of anesthesia required and the patient response.
- 0.1-0.5 mg/kg/hr (Infants < 3 months of age should receive < 0.25 mg/kg/hr).

**Administration:**
- It is recommended that epidural placement of the needle or catheter be confirmed by the use of a test dose at the time of placement.
- A test dose of 0.2-0.3 mg/kg Bupivacaine, with or without Epinephrine, is given 5 minutes prior to the full dose; sensory anesthesia occurring within a few minutes of the test dose indicates subarachnoid injection; central nervous system or cardiovascular toxicity indicate intravascular injection.
- Solutions containing preservative (e.g., methylparaben) must not be used epidurally.
- **Cannot be given by nurses.**
- Do not mix with any other drug.

**Possible Adverse Reactions:**
- Cardiovascular depression, hypotension; ensure that Epinephrine is available.
- Central nervous system stimulation, anxiety, restlessness, confusion, particularly in the event of inadvertent, intravascular injection.
- Central nervous system depression, in the event of inadvertent intrathecal injection.
- Palsies, involving extra ocular muscles, legs, anal and bladder sphincters (rare).
- Headache (uncommon).
- Adverse reactions associated with Epinephrine if present: anxiety, tremor, light-headedness, respiratory difficulty, tachycardia, palpitations and hypertension.

**Formulary Products:**
- Marcain: 0.25% - 10 ml vial.
- Sensorcaine 0.5% - 20 ml vial.
- Marcain: 0.75% - 20 ml vial.
- Sensorcaine 0.25% with 1:200,000 (5 mcg/ml) Epinephrine - 20 ml vial.
- Sensorcaine 0.5% with 1:200,000 (5 mcg/ml) Epinephrine - 20 ml vial.
FENTANYL CITRATE (SUBLIMAZE) – for CEA Use

Onset of Action: X 5-10 minutes.

Duration of Action: X 2-5 hours.

Dosage: X 0.25-1.0 mcg/kg/hr.

Administration: X Proper placement in epidural space should be verified before each dose.
X A single dose may be diluted with preservative free saline to a maximum volume of 20 ml per dose (usual volume = 0.1- 0.3 ml/kg).
X The usual rate of administration for continuous infusion is 10 ml or less per hour; maximum rate is 15 ml per hour - a greater rate would increase patient discomfort.
X Continuous epidural infusions are given at a rate of 0.25-1.0 mcg/kg/hour.
X Pain on injection, if present, may be eliminated by slowing the injection rate or decreasing the concentration of the solution.
X Nurses cannot give this drug.

Possible Adverse Reactions: (incidence if known in brackets)
X Respiratory depression; possibly persisting longer than the analgesic effect (2-4 hours); ensure that Naloxone is available.
X Respiratory depressant effects may be additive if other central nervous system depressants such as sedatives or other opioids are given concurrently.
X Nausea or vomiting.
X Pruritis (frequent, especially opioid naive patients), may require low dose Naloxone.
X Urinary retention is often seen in opioid naive patients; may require catheterization or low dose Naloxone.

Contraindications: X Usual contraindications to opioids.

Formulary Products: X Fentanyl Citrate solution 50 mcg/ml - 2 ml, 5 ml, 10 ml and 20 ml ampoules (50 mcg = 0.05 mg).
HYDROMORPHONE – for CEA Use

Onset of Action:  X 15-60 minutes.

Duration of Action:  X Up to 24 hours after a single dose.

Dosage:  X Loading dose 6-10 mcg/kg.
         X Infusion rate: 0.3-1.5 mcg/kg/hr.

Administration:  X Proper placement in epidural space should be verified before each dose.
                 X May be diluted with preservative free normal saline to a maximum volume of 15 ml per dose (usual volume is 0.1-0.3 ml/kg).
                 X Preservative free solutions must be used.

Possible Adverse Reactions:  X Respiratory depression may not be evident for 12-24 hours after initiation of dose or increase in dosage.
                           X Ensure that Naloxone is available on the unit.
                           X Respiratory depression will be longer duration than analgesic effect.
                           X Respiratory depressant effects may be additive, if other central nervous system depressants such as sedatives and other opioids are given concurrently.
                           X Urinary retention
                           X Nausea and vomiting may be seen in about 20-25% of patients and diminishes with continued opioid treatment.
                           X Pruritis seen in about 40% of patients, incidence is less with patients previously treated with an opioid, may require low dose Naloxone.
                           X Adverse reactions are reversible by INTRAVENOUS administration of Naloxone, for respiratory depression 10 mcg/kg, for side effects of the opioid 0.001 mg/kg IV q15 minutes or 0.001 mg IV/hour.

Contraindications:  X Usual contraindications to opioids
                    X Upper airway obstruction or significant respiratory depression.
                    X Septicemia or local infection at epidural puncture site.

Formulary Products:  X Hydromorphone - Preservative-free: 1.5, 3 or 10 mcg/ml.

Epidural Formulation: X May be prepared with Bupivacaine 1 mg/ml.
**NALOXONE HCL (NARCAN) – NOT for CEA Use**

**Given intravenously to treat opioid induced respiratory depression.**

**Onset of Action:**

**Duration of Action:**

- 1-2 minutes after IV administration.
- Varies with dose; approximately 15-45 minutes after 0.4 mg given IV.
- Duration of Naloxone is shorter than duration of opioid action; therefore, close monitoring of patient's respiration is necessary to determine need for repeated dosage with Naloxone.

**Dosage:**

- For TOTAL reversal of narcotic effect (may affect analgesic level):
  - Infants < 5 years or < 20 kg: 0.1 mg/kg IV q2-3 minutes
  - Infants > 5 years or > 20 kg: 2 mg/dose q2-3 minutes
- For postanesthesia narcotic reversal: 0.01 mg/kg q2-3 minutes as needed based on response.
- 0.001 mg/kg (1 mcg/kg) may be given hourly in a continuous infusion (preferred method) or 0.0005 mg/kg by intermittent IV q15 minutes for treatment of pruritus and urinary retention common side effects of opioids.

**Administration:**

- For continuous infusion the following formula will give the required concentration of Naloxone in an IV solution (D5W): patient's weight (kg) = x mg

\[
\frac{x}{10}
\]

in 100 ml of IV solution; this will give a rate of 1 mcg/kg/hr (= 1 ml/hr rate). The rate is titrated to patient's response.
- Use or discard the prepared Naloxone IV solution within 48 hours of preparation.

**Adverse Reactions:**

- Reversal of analgesia if Naloxone dose is too high.
- Nausea and vomiting, rare, more likely with high doses.
- Tremor and hyperventilation if abrupt return to consciousness.
- Hypotension, hypertension, pulmonary edema, tachycardia although rare.
- Seizures although rare.
- Acute withdrawal symptoms may be precipitate if a physical dependence on opioids has developed.

**Formulary Products:**

- Naloxone 0.4 mg (400 mcg)/ml - 1 ml ampoule.
- Naloxone 1 mg/ml – 2 ml ampoule.
9. REFERENCES


