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Epidural Analgesia Care: A Self-directed Leaming Module

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Epidural Analgesia Care: A Self-directed Learning Module

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ABSTRACT

Adequate postoperative pain management is very important for patients recovering from surgery. Inadequate pain control after surgery leads to many complications that may compromise a patient's health status. Continuous epidural analgesia infusion is an effective and safe measure for postoperative pain management. It not only provides adequate pain control posteratively, but also decreases the risk for postoperative complications. Because of its effective pain control, epidural analgesia infusion has become a common measure used by physicians for postoperative pain management.

This independent study project involved the development of a self-directed learning module for registered nurses providing care to patients receiving epidural analgesia infusion for postoperative pain management. Malcolm Knowles' adult learning theory was used to direct this independent study project. The surgical intensive care unit educator where the module was implemented was consulted to determine of the module objectives and contents, and these objectives were based on the needs of the unit's nurses. An extensive literature review was conducted to gather the most current information regarding postoperative epidural analgesia care and was included in the educational module. The self-directed learning module was made available to the nurses to review, and is being utilized as a tool for yearly validation. This study project concludes with recommendations for nursing practice, research, education, and health policy.

EPIDURAL ANALGESIA CARE: A SELF-DIRECTED LEARNING MODULE

Introduction

For the past decades, pain management has become a major concern for health care providers. Many pain management measures have been used, and many studies have been conducted to better understand the basic mechanism of pain. Studies have shown that inadequate pain management following surgery is a source of fear, helplessness, and demoralization (Dipiro et al., 1999). Pathophysiologic alternations related to pain may complicate existing disease and alter patient outcomes. An increase in understanding of the anatomy and physiology of pain may lead to improved approach and increased awareness of the importance of pain management. In recent years, continuous epidural analgesia infusion is increasingly used by physicians for pain management due to its effectiveness. In addition, the increased interest in pain management has improved the understanding of the basic mechanism of nociception and the pathophysiology of unrelieved pain. The development of multidisciplinary involvement has led to improvement in the field of pain management and improved patient outcomes.

Management of postoperative pain with a combination of low-dose opioid and low-concentration local anesthetic via an epidural route is an effective treatment modality and is becoming an increasingly common measure of postoperative pain control. Although continuous epidural analgesia is effective in postoperative acute pain management, it also imposes many potential side effects and complications, with some of these potential complications can be life-threatening. Because of the increased popularity of the continuous epidural analgesia, health care providers will constantly be presented with patients who have continuous epidural analgesia in their working environment. In order to provide the most effective and safest care for these patients, it is important for the nurses to have thorough understanding of the potential side effects and complications related to continuous epidural analgesia infusion.

This independent project was designed to revise the current analgesia learning module for a 24-bed surgical intensive unit of a Midwest hospital. The purpose of this learning module was to facilitate the nurses in gaining more knowledge about continuous epidural analgesia infusion and its potential complications as well as appropriate nursing interventions.

Clinical Problems

Due to the national nursing shortage and high turnover rate of nurse in the surgical intensive care unit, the majorities of the nurses who are currently working in the targeted unit are new graduated nurses and have very little working experience. These nurses have had very little training on continuous epidural analgesia care. The surgical intensive care unit educator felt the need to provide these nurses the most current information in epidural care to increase their knowledge. In addition, the current epidural analgesia care learning module in the unit was last revised in 1998. The current epidural analgesia learning module needs to be revised, and the most current information has to be included in the revised module. In order to provide a competent and effective care to the patients, the nurses must have to understanding the potential complications and its appropriate nursing interventions related to epidural analgesia infusion.

Purpose

The goal of education is to facilitate the process of change in an individual so that he or she may function more fully (Hamilton & Gregor, 1986). The purpose of this project was to revise the current epidural analgesia care learning module for the 24-bed surgical intensive care unit nurses of a Midwest community hospital. The aim of this project was to increase the nurses' understanding and knowledge of epidural analgesia care, hence improving their competency to provide effective and safe care for patients receiving epidural analgesia infusion as their pain management.

Conceptual Framework

Malcolm Knowles was a pioneer in the field of adragogy. Much of his work provides clarification and insight into the nature of adult learning. The term andragogy was originally formulated by a German teacher who used it to describe the elements of Plato's education theory. The word andragogy is derived from the Greek words "anere" for adult and "agogy" meaning leading, and it is different from pedagogy. In pedagogy, the concern is with transmitting the content, while with andragogy, the concern is with facilitating the acquisition of the content (Smith, 2002). It is because the target audiences of this project were adult nurses, that Knowles's most famous adult learning theory was appropriated to be the conceptual framework for this project. In this project, the development of the self learning module was guided by the concept of his adult learning theory.

According to Knowles (1975), self-directed learning is a process whereby people take the initiative in assessing their needs for learning, in developing educational goals, in identifying resources for learning, in selecting and applying appropriate learning strategies, and in evaluating learning outcomes. In his adult learning theory, Knowles emphasized the differences between adult learning and the tradition pedagogical learning process. For Knowles, andragogy was premised on four crucial assumptions about the characteristics of adult learners that are different from the assumptions about pedagogy. Based on Knowles's adult learning theory, the four assumptions are as following:

1. Self-concept: The adult learner's has a great need to be independent and self-directed.
2. Experience: The adult learner's experience serves as a rich resource for his/her own learning, and adult learner learns more effectively through experiential techniques of education such as discussion or problem solving.
3. Readiness and motivation to learn: The adult learner's readiness is influenced by social roles while the motivation is internal. People learn what they want to know.
4. Orientation to learning: The adult learner changes from one of postponed application of knowledge to immediacy of application, and the orientation toward learning shifts from subject-centeredness to problem centeredness (Knowles, 1975, p.57).

Knowles's conception of andragogy is an attempt to build a comprehensive theory of adult learning that is anchored in the characteristics of adult learners. His adult learning theory tends to focus on age and the stage of development and has been used by many educators as their guideline for developing their strategies for teaching adults.

Malcolm Knowles put his four assumptions of adult learning together and developed into a model that could be taken by educators and learners. He suggests that there are five steps involved in developing a learning model for adult learners and those steps are diagnosing the learning needs, formulating the learning needs, identifying human material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes (Lingeman & Mazza, 1986).

Malcolm Knowles' model is appropriated for this self-directed learning module project. The target audiences for this project were adult nurses who were interesting in learning more about continuous epidural analgesia infusion so they can be more capable take care their patients who have the infusion. They felt the needs to learn and gain more knowledge in this particular area. The nurses then can apply their new knowledge into their practice. Malcolm Knowles' concept was incorporated in preparation of the self-directed learning module. Self-directed learning modules are designed for independent use for learning of topics that meet specific needs.

The role of an educator in adult learning is to facilitate the learners to learn rather than being a teacher. A teaching-learning approach that poses problems makes the learners and the facilitator jointly responsible for a process in which all grow. In self-directed learning, the facilitator's responsibilities are to direct, support and provide feedback to the learners while the learners' responsibilities is to acquire the new knowledge provided on their own pace. According to Dyck (1986), learning occurs more readily when the learner can participate responsibly in the learning process; and a significant learning is likely to occur when the learner perceives the subject matter to have relevance for the learner's own purpose. The facilitator and learners must build a collaborative relationship and assume their own responsibilities to achieve the set goal. The feedback from the learners is also very important for the facilitator so that he or she can re-evaluate the learning materials and the strategies of teaching and making changes as indicated.

Definitions

The following definitions were used to explain some key words within the project that may unfamiliar to some readers.

1) Pain: The word is derived from the Latin "peone" and the Greek "poine," meaning "penalty" or "punishment." It is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Acute pain is nociceptive pain that follows injury to body and generally disappear when injury heals (Dipiro et al., 1999).

2) Nociception: Sensory experience of pain which involves stimulation, transmission, perception, and modulation (Dipiro et al., 1999).

3) Epidural analgesia: Analgesia induced by introduction of the analgesic into the epidural space of the vertebral canal (Miller, 2005).

4) Pain stimulation: A noxious stimulus sensitizes or stimulates nociceptors (Dipiro et al., 1999).

5) Pain transmission: Action potential continues from the site of noxious Stimulus to the dorsal horn of the spinal cord and then ascends to higher center (Dipiro et al., 1999).

6) Pain perception: Conscious experience of pain (Dipiro et al., 1999).

7) Pain modulation: Inhibition of nociceptive impulses by the neurons from the brain stem descend to the spinal cord and release substances such as endogenous opioids, seretoin, and norepinephrine that inhibit the transmission of nociceptive impulses (Dipiro et al., 1999).

Significant of the Project

Although studies have shown epidural analgesia is very effective for postoperative pain management, it also imposes side effects and potential complications. These side effects and potential complications include respiratory depression, pruritus, nausea and vomiting, hypotension, paresthesia, catheter migration, and epidural hematoma. In addition, neural toxicity and cardiac toxicity are the most life-threatening complications for continuous epidural analgesia infusion (Chestnut, 2005). Because of these side effects and potential complications associated with epidural analgesia infusion, it is vital for nurse to understand the mechanism of epidural analgesia and its potential complications so he or she can tailor the care plan and anticipate any potential problems that may occur.

In conversation with the surgical intensive care unit educator, the needs for the unit nurses were identified. The self-directed learning module will help the unit nurses to gain adequate knowledge for caring patients receiving epidural analgesia infusion. This project will present a better understanding of epidural analgesia care that the unit nurses can use into their practices.

Assumption and Limitation

The self-directed learning module was guided by Knowles' adult learning theory. The underlying assumptions for this study included:

1) The nurses are self-responsible, which will make the self-directed learning approach appropriate for them.
2) The goal of this project was not transmitting the information to the nurses, but facilitating them to acquire the information.
3) The nurses' past and present experiences are the cumulative experiences for them and will help them to better acquire new information.

The principles of self-directed learning serve as guides for planning effective strategies to educate adult learners. As mentioned previously, the past experiences and the readiness of the learner are two of the main components for adult learning. Learners who enter the self-directed learning environment without having mastered some of the basic skills or knowledge experience anxiety, frustration, and often failure (Nalon & Nalon, 1997). It was because some of the target audiences in this project were the nurses with very little experience on the topic of epidural analgesia care. The educator had to provide adequate assistance to the learners in order to help them in the process of acquire new information.

Review of Literature

In order to develop a most effective self-directed learning module, it is important to search for the most current information which relate to the topic. The purpose of a thorough review of literature is to gather as many as information that relate to the topic discussed and organize them so the learners can easy to read and understand the materials, hence to obtain the necessary information they needed.

Malcolm Knowles' adult learning model has been adopted by many educators, professions, and organizations as a guide for development of their teaching strategies. Nursing, as a profession, has a long standing commitment to professional education as a route to competence. In 1978, the American Nurses' Association published *Self-directed Continuing Education in Nursing* as guidelines for self-directed learning in nursing professions (DeSilets, 1986). Since then, self-directed learning models have been stylized by many hospitals for staff development, mandatory continuing education programs, and orientation programs.

Many reviewed articles revealed that self-directed learning for staff development is effective. Learners retained information over time as well as they had from more traditional programs. Participation rates were better because staff could participate at a time they chose. Motivation of the participates was high because of their commitment to their learning (Herrick, Jenkins, & Carlson, 1998).

Self-directed learning has many benefits. In one study of a large metropolitan teaching hospital, Ligerman and Mazza (1986) found both the instructors and the participants showed positive attitude about the hospital self-directed learning programs. From the instructors' point of view, the self-directed approach allow for active orientee participation in the learning process. The self-directed approach also allowed the instructor to be available on the clinical units as a resource where he or she was needed. Feedback from participants was also positive in that they felt they were more rapidly able to apply principles and policies to their work situation.

Self-directed learning also provides opportunity for professional development. Shannon (2000) stated "self-directed learning in medical practice provides significant benefits to nurses, including the opportunity to resolve specific patient problems. It also increases the nurse's capability to respond to the frequent changes in health care expectations" (p. 326).

Many research studies were done to evaluate the benefits of self-directed learning modules in continuing education. Studies results showed that the use of self-directed learning modules for continuing education programs and staff development was flexible, convenience, accessible, portable, and cost efficient (Jenkins, Carlson, & Herrick, 1998). Furthermore, self-directed learning also can empower nurses. Research shows that nurses can be best empowered through an education that allows learners to be active while teachers assume the role of facilitators, and self-directed learning does both. Self-directed learning embodies the concept of empowerment. It is a reciprocal process which the learner develops individual learning objectives with the facilitator. There is two-way exchange between learner and facilitator on the content, methods and time frame of learning. Learning is guided by the means of the learning plan, which has five components including expected clinical behaviors, learning objectives, identification of resources, learning evidence and the term of evaluation (Majumdar, 1999).

Many other researchers also addressed self-directed learning module development and planning. Developing a self-directed learning module needs careful assessment and planning, as well as administrative support. There are four phases of module development which are assessment, planning, implementation, and evaluation.

Assessment is the first phase in developing a self-directed learning module. During the assessment phase, the goals, objectives, and outcomes are identified based on the needs of the learners. The planning phase begins with a goal statement and the development of specific objectives. The objectives can be developed by identifying the knowledge and skills to be learned. Implementation is the third phase in the development of self-directed learning modules. This is the phase when the module is put into place and learners are presented with the information. It is important for the educator to advise the learners that he or she is available for them when needed. Evaluation is based on the level of achievement of objectives and on the adequacy of the design format for the learning experience. Evaluation data that focus on the effectiveness of the module should be collected and analyzed. Evaluation should include clarity of objectives, instructions, availability of the resources, appropriateness of the content, validity of the pretest and posttest, and accessibility to the nurse educator (Jenkins et al., 1998).

Expected Result of the Project

Upon completion of the self-directed learning module, the surgical intensive care unit nurses will be able to identify the benefits, contraindications, to demonstrate the acquired knowledge of anatomy, physiology, pharmacology, and recognize the common side effects and potential complications related to epidural analgesia. The nurse will also be able to assess patients having epidural analgesia infusion, interpret physiological responses and initiate appropriate nursing interventions according to the assessments.

Nursing Practice

Adequate postoperative pain management is crucial for patient's recovery. Poor postoperative pain control may lead to complications which will delay patient's recovering process. Epidural analgesia is very effective for postoperative pain management and can reduce the risk of postoperative complications. However, it also imposes some rare but life-threatening complications; the nurse has to have a good knowledge and needs to stay current on the latest information that will aid in epidural analgesia care. This will help detect and prevent complications and thus provide the most optimum care to patients.

Research

Continuing research would be helpful in this area due to the increasing popularity of the epidural analgesia in pain management. Postoperative pain management has become one of the major concerns for health care providers in the past decades. It is critical for the nurse caring for this population to be able to utilize the most effective method to control patient's pain level postoperatively and minimize the risk of postoperative complications. This includes pharmacologic measures as well as other measures which will minimize the pain level.

Education

In order to provide safe and effective care for patients receiving epidural analgesia, education must be ongoing. The nurse needs to be educated about the latest information on epidural analgesia infusion. Continuing education will aid in anticipating potential complications that may occur and appropriate nursing interventions. Nurses should continually educate themselves by reading scholarly journals, attending conferences, and participating in organizations and inservices that will aid in providing the most current knowledge base for effectively managing the epidural analgesia and pain management.

Policy

Policy has to be made by the institution to include the newly revised self-directed learning module into its practice. This module will be a requirement for the nurse taking care of patients having epidural analgesia infusions. New employees should also review the self-directed learning module and pass the posttest during their orientation period. The self-directed learning module needs to be revised on a regular basis in order to include the most current information in the module.

Summary

The conceptual framework for self-directed learning module is based on concepts from lifelong learning. Lifelong responsibility for one's own learning is an important ideal in health care profession. Nurse, as a profession, must make a commitment to the pursuit of lifelong learning, continuing to acquire new knowledge during their career. The self-directed learning module developed for the surgical intensive care nurses will provide the needed education regarding epidural analgesia care. By reviewing the self-directed learning module, the unit nurses will be able to enhance their knowledge on this particular area. This will prepare the unit nurses to provide effective and component quality care to patients receiving continuous epidural analgesia infusion. The use of self-directed learning module will encourage the nurses to be self-motivated and allows the unit nurse educator to be the resource rather than the teacher.

Self-directed learning module is very effective and commonly used by nursing profession for orientation programs, mandatory in-service education, staff development, and nursing education. However, self-directed learning does not mean learning in isolation, rather it is a skill which required careful nursing. Nursing educators must believe that self-directed learning modules are a valuable system for adult learners to be successful. Educators must also believe in the principles of adult education and convey their confidence in the learners' ability to acquire knowledge and skills independently. Educators must facilitate a learning environment in which learners can continue to grow.

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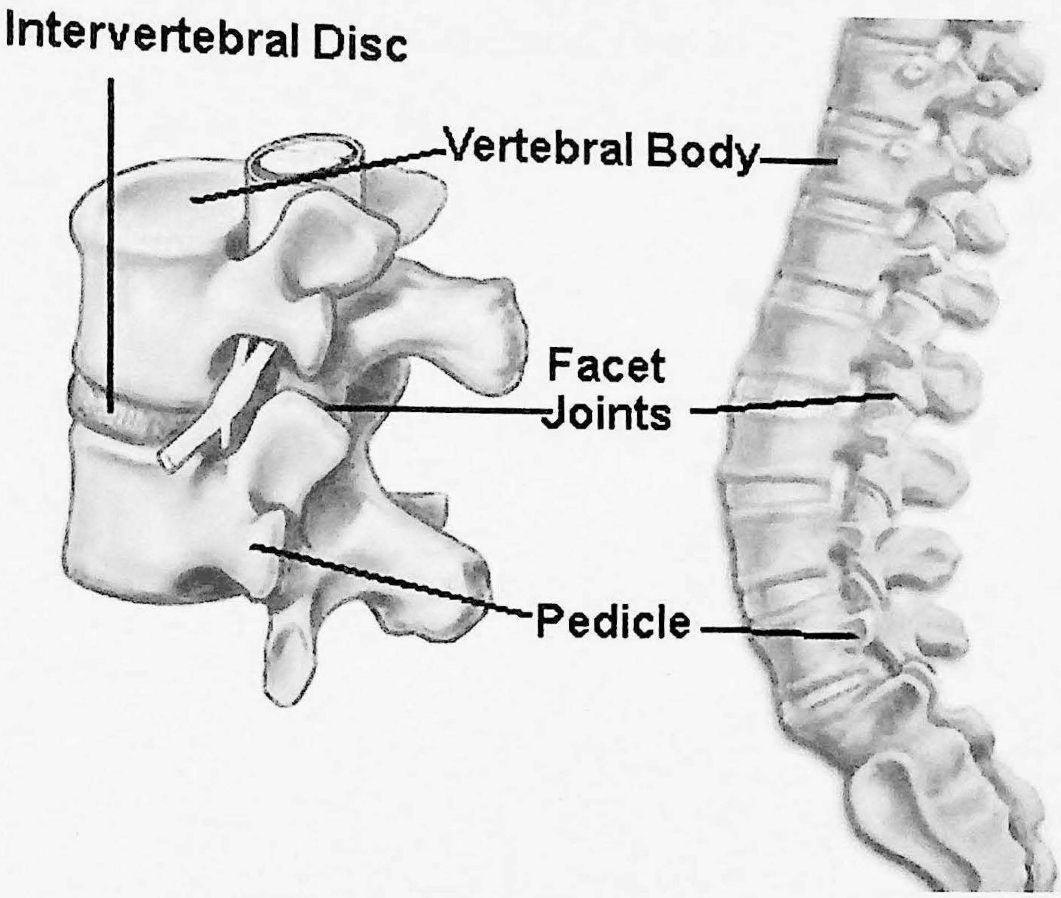
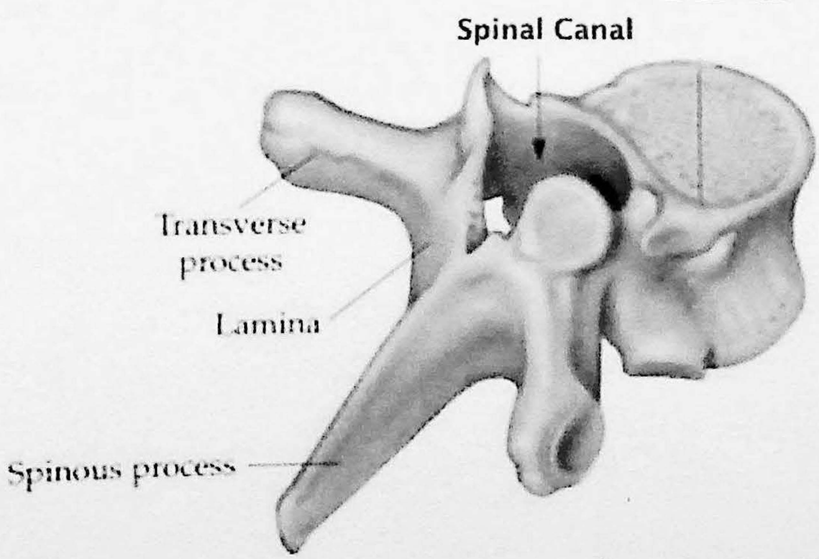
Epidural Analgesia Care

Self-directed Learning Module





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Learning Package for Epidural Analgesia

Objectives

Upon completion of this self-directed learning package, the Registered Nurse will able to:

1. Describe the anatomy of the epidural space and the action of narcotics and local anesthetics at this level.
2. Discuss the contraindications for insertion of epidural catheters.
3. Discuss side effects and complications that may be seen with epidural analgesia.
4. Explain nursing management of the patient receiving epidural analgesia and/or anesthesia with special attention to the assessment of:
    - ♦ adequacy of respiratory function
    - ♦ level of sensation
    - ♦ level of motor movement
    - ♦ level of consciousness
5. Describe nursing interventions for patients who have received epidural/spinal analgesia.
6. Describe nursing interventions for patients receiving continuous epidural analgesia with narcotic.
7. Describe nursing interventions for patients receiving continuous epidural analgesia with anesthetic mixtures.

Introduction

The infusion of narcotics, alone or in combination with local anesthetic agents, into the epidural space is becoming an increasingly common form of postoperative pain control. Epidural analgesia can provide excellent pain control, allowing patients to perform activities such as deep breathing and coughing comfortably. This may in turn contribute to improved recovery. Research has indicated that continuous epidural infusions can be managed safely on surgical units. This self-directed learning package is designed to give registered nurses the knowledge necessary to care for patients receiving epidural analgesia for postoperative acute pain management.

Anatomy of the Spinal Cord and Epidural Space

It is important for nurses to have an understanding of the anatomy and physiology of the spinal cord as well as the epidural space since some potential complications are related to the placement of the epidural catheter. The spinal cord extends downward through the bony vertebral column to the level of the first lumbar vertebral. It consists of an inner core of gray matter surrounded by white matter. The anterior horns of the spinal cord contain cells of the motor system, whereas the dorsal horns contain sensory neurons. The meninges are the fibrous coverings that surround the spinal cord (Hasen, 1998).

Surrounding the spinal cord in the bony vertebral column are three membranes: the pia mater (the inner membrane), arachniod mater (the middle membrane), and dura mater (the outer membrane). The epidural space is a potentioal space which extends from the base of the skull to the coccyx. It is bordered by the ligamentum flavum posteriorly and the dura mater anteriorly, hence the name epi (above) dural. Normally, the epidural space contains blood vessels, adipose tissue, connective tissue, and spinal nerve roots. In nonpregnant patients, this space has a negative pressure, a feature which is important in verifying needle placement during insertion and in promoting the spread of medication (Cousins & Bridenbaugh, 1999).

The intrathecal or subarachnoid space lies just below the epidural space. This space contains cerebrospinal fluid (CSF) and is where medication is introduced for a spinal block. It is important to recognize the difference between a spinal block and an epidural block. Medication deposited in the epidural space must diffuse through the subarachnoid space to the spinal nerves and spinal cord to have the desired effect. For this reason, the epidural route requires approximately 10 times the dose necessary for a spinal block. A second difference between these two techniques is that while it is common to leave a catheter in the epidural space for continuous infusions, this is only rarely done in the intrathecal space.

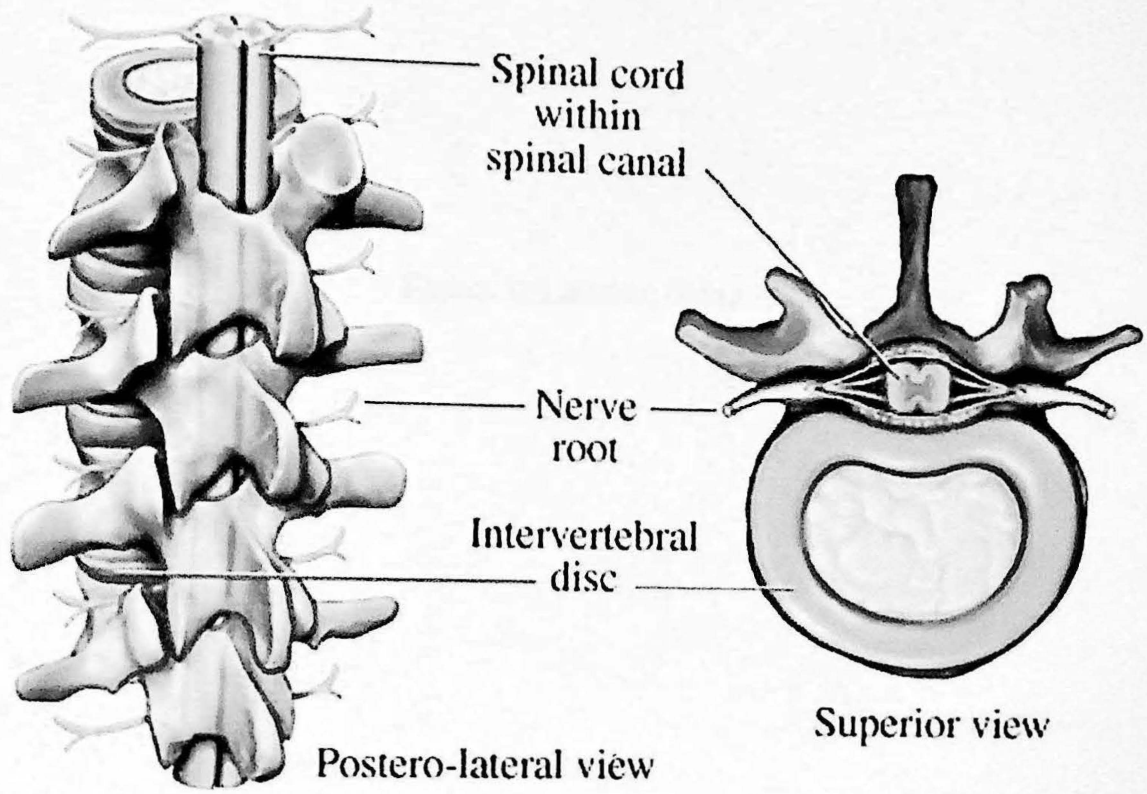

Figure 1: Anatomy of the Spine

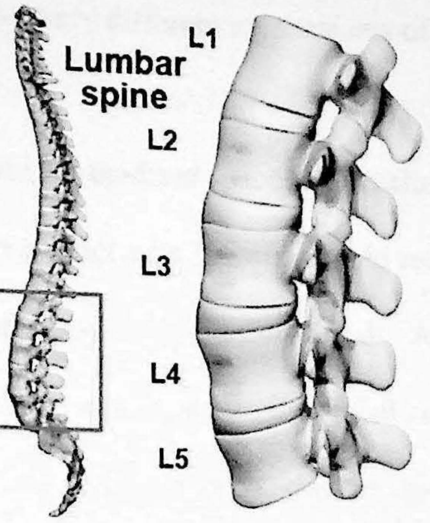

Figure 2: Lumbar Spine

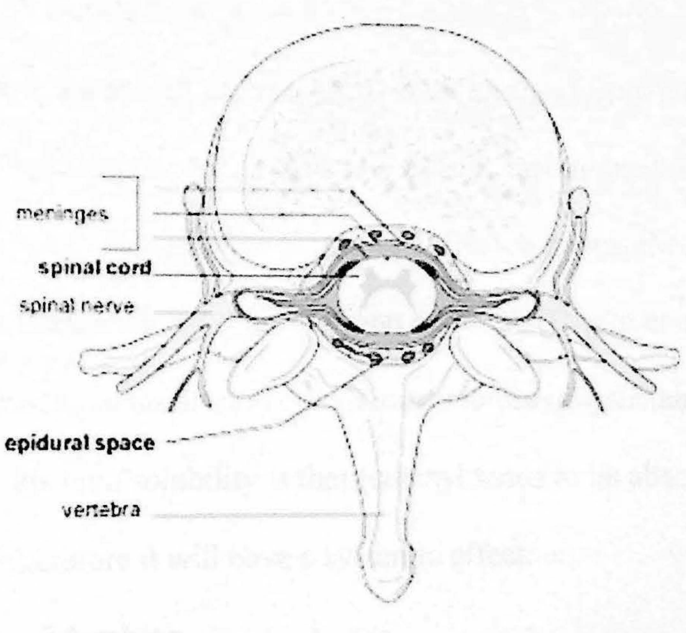

Figure 3: Cross Section of the Spine

Medications Used in Continuous Epidural Infusion

Two groups of agents are commonly used in continuous epidural infusions:

1. Narcotics
2. Local anesthetics

These two groups of agents have very different mechanisms of action.

1. *Narcotics*

Narcotics introduced into the epidural space must diffuse across the dura into the spinal cord where they come in contact with specific opioid receptors in the dosal horn. It is here that they block the transmission of painful stimuli. A number of factors will influence the movement of epidural narcotics into the spinal cord. The most clinically significant is lipid solubility, or the tendency of the drug to dissolve in fat (Dipiro et al., 1999).

a) Fentanyl

Fentanyl is one agent which can be used in continuous epidural infusions. It is a highly lipid soluble agent. This means that it is easy for the medication to diffuse across the dura and CSF to reach the spinal cord. Quick diffusion means that fentanyl will have a rapid onset (4-10 minutes) but a short duration of action (Dipiro et al., 1999). It is for this reason that it must be administered continuously to provide sustained pain control. The other effect of this lipid solubility is that fentanyl tends to be absorbed intravascularly and therefore it will have a systemic effect.

b) Morphine

Morphine, in contrast, is hydrophilic or water soluble. This means that, once it moves into the intrathecal space, morphine will tend to stay dissolved in the CSF for a longer period of time and diffuse very slowly to reach the opioid receptors in the spinal cord. Epidural morphine has a delayed onset of action (10-30 minutes) and an extended duration of action (12-18 hours). A single dose of norphine, given epidurally or spinally, provides effective pain control, supplemented with oral analgesics, for many surgical procedures. The preparation of morphine that is given epidurally or spinally is commonly called "Duramorph". Duramorph is a morphine preparation that is free of preservatives so it can be safely administered into the epidural or intrathecal space (Miller, 2005).

c) Dilaudid

Diluadid (hydromorphone) is a narcotic whose lipid solubility is between that of fentanyl and morphine. It is more lipid soluble than morphine but less than fentanyl. Because it does not dissolve as readily in tissues as fentanyl, there is less systemic absorption and a greater effect on the opioid receptors in the spinal cord. For this reason, it provides effective analgesia when used alone, negating the need to add local anesthetic agents to the epidural infusion (Miller, 2005).

2. <u>*Local anesthetics*</u>

While the site of action for epidural narcotics is in the spinal cord, local anesthetic agents act primarily on nerve roots (Nagelhout & Zaglaniczny, 1997). Local anesthetic agents act by stopping or "blocking" the transmission of impulses along the nerve fiber. One of the most common local anesthetic agents that is used in continuous epidural infusion is called bupivacaine.

In order to understand the effects of local anesthetic agents it is important to remember that there are three classes of nerve fibers found in nerves:

1. A Fibers: These are myelinated fibers which control sensation and motor functions. A myelin sheath is an outer layer which promotes impulse

transmission down the nerve fiber. The myelin sheath also makes it more difficult to block these nerves (Miller, 2005).

2. B Fibers: Theses are thin fibers that are responsible for autonomic functions, most importantly, vascular smooth muscle tone. When these fibers are blocked they produce a "sympathetic block," which results in vasodilation to the affected area. The blood vessels, whose nerve fibers are blocked, will not constrict in response to normal stimuli such as changes in posture. This vasodilation can be beneficial for some patients, such as those with peripheral vascular disease or tissue grafts. These fibres are the most easily blocked and their function is the last to return (Miller, 2005).

3. C Fibers: These are thin, nonmyelinated fibers that are responsible for transmitting impulses associated with pain and temperature. Because C fibers transmit impulses regarding both pain and temperature, assessing the level at which the patient can detect changes in temperature will also tell you the level at which pain impulses are blocked. This is an important assessment tool used when caring for a patient receiving an epidural infusion. These fibers are blocked easier than A fibers, but not as readily as B fibers (Miller, 2005).

Nerves contain various combinations of these three types of nerve fibers. Since the aim of a continuous epidural infusion is analgesia, as opposed to anesthesia, very low concentrations of local anesthetic are used. Local anesthetics are used in combination with epidural narcotics because they appear to have a synergistic effect (Kumar & Prasanna, 2004). This means that less of each agent is needed to produce the desired analgesic effect.

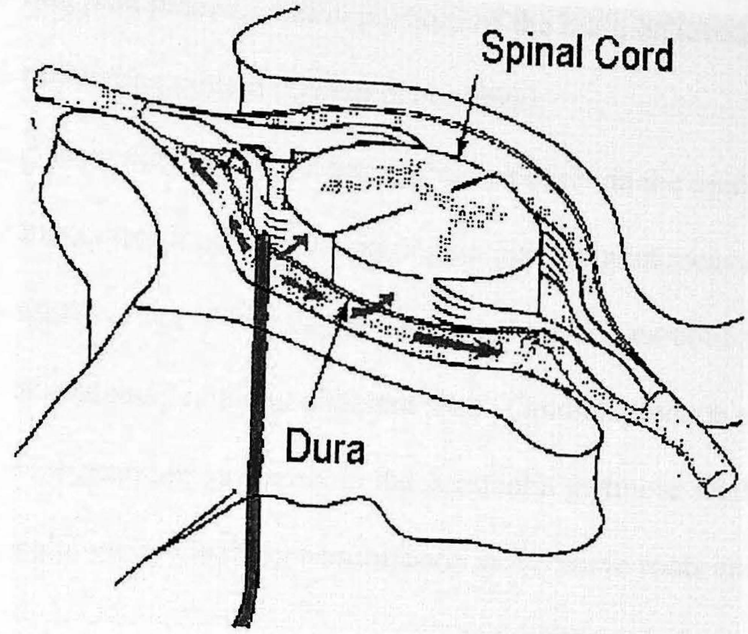

Figure 4: Medications Diffusing Across the Spinal Cord

Physiology of Pain Transmission

The first step leading to the sensation of pain is the stimulation of receptors known as nociceptors. Nociceptive transmission takes place in the A-delta or C afferent nerve fibers. Stimulation of A-delta fibers evokes sharp, acute, well-localized pain, while stimulation of C fibers produces dull, aching, and poorly localized pain. Pain-initiated processes reach the brain through a complex array of ascending spinal cord pathway. The spinothalamic tract is known to have major influence on pain transmission and is divided into lateral and ventral pathways. The lateral pathway is associated with sharp localized pain and is responsible for the spatial and temporal discrimination aspects of nociception. The ventral pathway makes possible the perception of aching, dull, nonlocalized pain. Both pathways eventually merge in the thalamus and connect with the cortex. The modulation of nociceptive input occurs at many sites including the opiate receptors within the central nervous system. These opiate receptors are found in the ascending and decending pain pathway and in portions of the brain believed to be essential to the pain-modulating system (Dipiro et al., 1999).

Continuous infusion with local anesthetics and narcotics via the epidural route for postoperative pain management is superior to other pain management measures. This may be due to a synergistic effect. The analgesia synergy between narcotic and local anesthetic is a result of analgesic action at different sites. Opioids produce analgesia by binding to specific opiate receptors primarily in the substantia geltinosa while local anesthetics produce analgesia by blocking transmission at the nerve roots and dorsal root ganglia. Postoperative pain has two components such as somatic and visceral. Visceral pain is of great clinical importance because most components of postoperative related pain are of visceral origin. Visceral pain pathways have anatomical and electrophysiological features which are different from somatic pathways at the spinal level. The somatic component from the peripheral input can be blocked by local anesthetic while the visceral component is effectively blocked by opiates. Hence, a combination of both opioids and local anesthetics would give better pain relief than either of them alone by acting at different sites (Kumar & Prasanna, 2004).

Pathophysiologic changes due to pain

Adequate postoperative pain management does not only provide comfort for patient, but also promote recovery. It has been shown by many studies that an inadequate postoperative pain management can increase the risk of postoperative complications which involve many organ systems such as respiratory system, cardiovascular system, gastrointestinal system as well as alternation of coagulation.

As to the respiratory system, pain can cause decrease in respiratory function as a reflex response and causes a decrease of pulmonary volume and a depression of the cough reflex. Both these phenomena are responsible of the formation of atelectasis and pneumonia (Nagelhout & Zaglaniczny, 1997), therefore adequate postoperative pain control is essential to prevent these complications.

Paralytic ileus is also a common postoperative complication which is related to poor pain management. With inadequate pain control, patients have no desire to move around; delayed mobilization may contribute to slow gastrointestinal motility which causes paralytic ileus. Pain-induced stress can also alter coagulation and causes hypercoagulable state. Immobility due to poor pain management, in combination with hypercoagulation put postoperative patients in higher risk to develop deep vein thrombolus (Palermo et al., 2005). It is important for nurses to keep these in mind that good pain management is not solely a comfort measure, but also to assist patients to restore their optimal level of wellness.

Insertion of the Epidural Catheter

Although epidural catheters are usually to be inserted in the operating room or the preoperative holding area, it is helpful to understand the insertion procedure. A lumbar epidural is most commonly used because the needle is inserted below the level of termination of the spinal cord. However, the technique for insertion of an epidural catheter is similar in both the lumbar and thoracic regions. Due to anatomic considerations, such as narrower thoracic epidural space and the angulation of the spinous processes, the thoracic approach is more difficult and requires more skill on the part of the anesthetist (Miller, 2005).

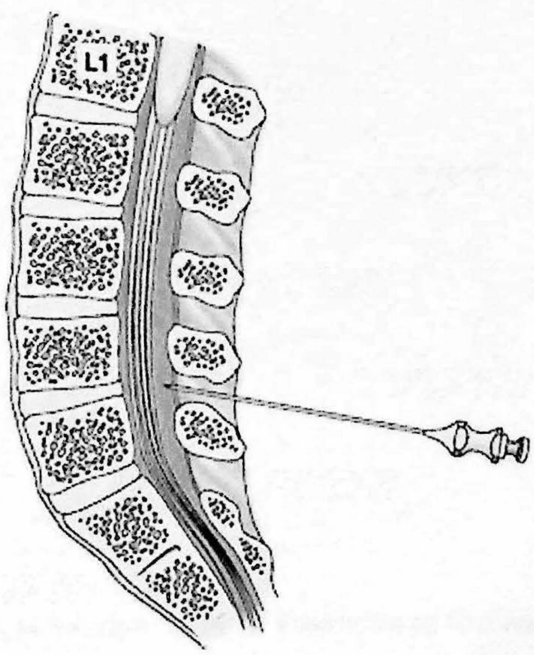

Figure 5: Insertion of Epidural Needle

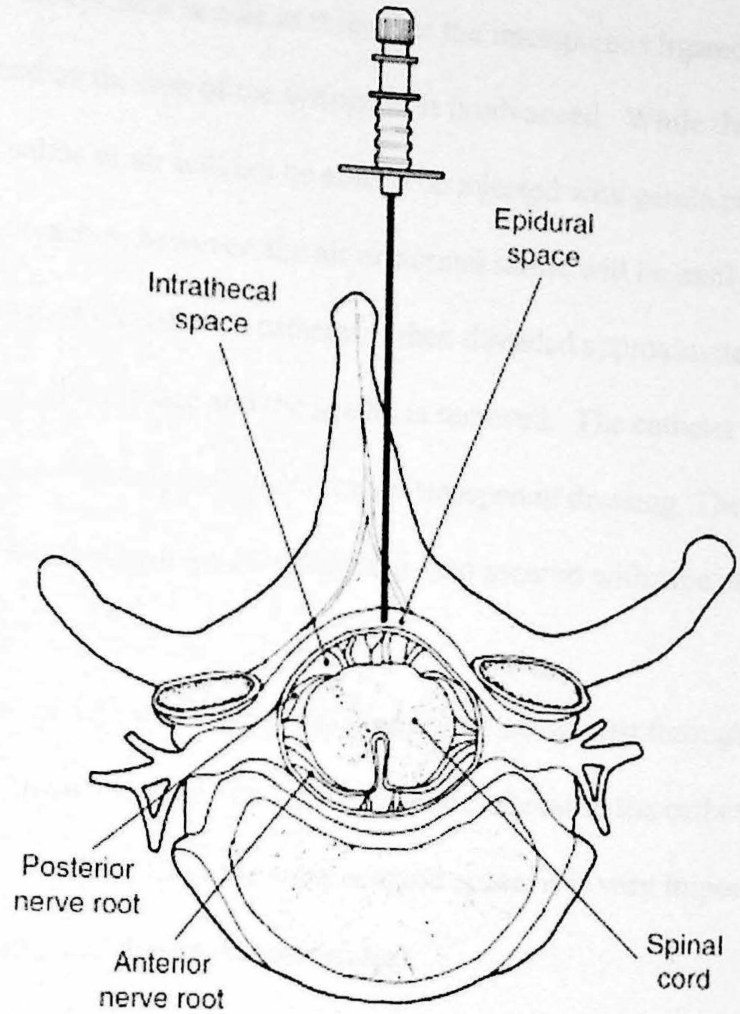

Figure 6: Cross Section View of Insertion of the Epidural Needle

In order to facilitate insertion, the patient is positioned with maximal flextion of the spine in either the lateral (side lying) or sitting position depend on the patient's and the anesthetist's preference. Under aseptic technique, the patient's skin is prepared with antiseptic solution and covered with sterile drape. The loss of resistance technique is most commonly used to identify the epidural space (Mulroy, 2002). This technique derives its name from the fact that the needle encounters resistance from the ligaments as it is advanced toward the epidural space and a loss of resistance is encountered as the space is entered. A syringe, containing a small amount of air or preservative free normal saline is attached to the epidural needle as it reaches the interspinous ligament. Gentle pressure is maintained on the hub of the syringe as it is advanced. While the needle tip is in the ligament, the saline or air will not be able to be injected with gentle pressure. Once the epidural space is reaches, however, the air or normal saline will be easily injected. When the correct space is identified, a catheter is then threaded approximately 2-3 centimeters into the epidural space and the needle is removed. The catheter is then securely taped in place with tape and an occlusive, transparent dressing. The extra length of the catheter is then brought up over the shoulder, and secured with tape along its length.

Proper placement of the catheter is verified by the anesthetist through aspiration of the catheter and a small test dose of a local anesthetic. Because the catheter may inadvertently enter a blood vessel or the subarachnoid space, it is very important to give a test dose to rule out either of these two possibilities.

A syringe is attached to the epidural catheter and can be aspirated to detect the pressure of blood or cerebral spinal fluid (clear or pink fluid). However, the inability to aspirate fluid does not rule out misplacement. A testing dose, which usually consists of 3 ml of local anesthetic, with or with out epinephrine, is given to confirm the placement. The result of the test dose may be summarized as follows:

1. If epinephrine is used in the test dose and the catheter tip lies in a vein, tachycardia, a rise in blood pressure, or both should be seen within 20-40 seconds. These effects are a result of the intravascular injection of epinephrine.
2. If the catheter is in the intrathecal space, the injection of local anesthetic will

produce a loss of motor and sensory function below the block as well as a decrease in blood pressure over a 1-5 minute period.

Because the administration of a test dose is vital in verifying the position of the catheter, the patient must have had a test dose administered by an anesthetist before a continuous epidural infusion is started.

Contraindications for the Use of Epidural Analgesia

Several factors can preclude the use of epidural analgesia. These include:

1. Lack of patient consent.
2. Patient's inability to maintain absolutely still during the needle insertion.
3. Infection at the site of injection or septicemia.

   The epidural catheter may serve as a focus for the spread of infection. Its proximity to the meninges and spinal cord make this especially important (Nagelhout & Zaglaniczny, 1997).

4. Allergies to local anesthetics

   Although true allergies to local anesthetics are rare, some patients are allergic to these agents (Miller, 2005).

5. Hemorrhage or hypovolemia

   If local anesthetic agents are used, they will cause a sympathetic block which will result in vasodilation. In normovolemic patients, reflex vasoconstriction above the block is usually sufficient to maintain blood pressure. If patient is hypovolemic, this vasoconstriction may not be effective in maintaining a normal blood pressure.

6. Bleeding disorders (hemophilia, Von Willebrand's disease, thrombocytopenia).

   The presence of any alteration in normal coagulation will predispose the patient to the development of an epidural hematoma. This is a serious complication which can lead to permanent paralysis.

7. Raised intracranial pressure

8. Technical difficulties such as spinal column abnormalities.

Side Effects and Complications of Epidural Analgesia

Common side effects and complications related to epidural analgesia including respiratory depression, pruritus, nausea and vomiting, epidural hematoma, neural toxicity, as well as cardiac toxicity. Among all these side effects and complications, respiratory depression, epidural hematoma, neurotoxicity and cardiotoxicity are the most severe and life-threatening complications related to epidural infusion.

Epidural hematoma may cause permanent paralysis if not detected early. If bleeding occurs due to the puncture of a blood vessel, most commonly during catheter insertion or removal, a hematoma may form in the epidural space. Since the hematoma cannot expand outward, it will expand inwards and compress the spinal cord. If this compression is prolonged, permanent paralysis will result. In order to minimize the development of epidural hematoma, The American Society of Regional Anesthesia (Horlocker et al., 2003) has published guidelines for anticoagulant therapy in patients with epidural infusion.

Patients receiving fibrinolytic or thrombolytic agents are at high risk of serious hemorrhagic events, therefore should be cautioned against receiving spinal or epidural anesthetic expect in highly unusual situations. If neuraxial blocks have been combined with fibrinolytic and thrombolytic therapy and ongoing epidural catheter infusion, the infusion should be limited to drugs minimizing sensory and motor block to facilitate assessment of neurologic function. Neurologic assessment should be performed at least every two hours.

There is no contraindication to use of neuraxial techniques with patients on prophylactic subcutaneous heparin therapy. However, heparin administration should be delayed for one hour after needle placement. Indwelling neuraxial catheter should be removed two to four hours after the last heparin dose and re-heparinization should occur one hour after catheter removal.

Patients on low molecular weight heparin (LMWH) may increase the risk of spinal hematoma. Patients on preoperative LMWH thromboprophylaxis can be assumed to have altered coagulation. In these patients, neuraxial needle placement should occur at least 10-12 hours after the last LMWH. Patients receiving treatment doses of LMWH will require delays of at least 24 hours before needle placement. Neuraxial techniques should be avoided in patients administered a dose of LMWH two hours preoperatively because needle placement would occur during peak anticoagulant activity. The first dose of LMWH should be administered no earlier than 24 hours postoperatively. The indwelling neuraxial catheter should be removed prior to initiation of LMWH thromboprophypaxis. If a continuous infusion is needed, the epidural catheter may be left indwelling overnight and removed the following day, with the first dose of LMWH administered at least two hours after catheter removal.

Antiplatelet medications such as NSAIDs appear to have no siginaficant risk for the development of spinal hematoma in patients having epidural or spinal anesthesia. The use of NSAIDs alone does not create a level of risk that will interfere with the performance of neuraxial blocks. At this time, there do not seem to be specific concerns as to the timing of single-dose or catheter techniques in relationship to the dosing of NSAIDs, postoperative monitoring, or the timing of nueraxial catheter removal.

For patients on chronic oral anticoagulation, caution should be used when performing neuraxial techniques. In patients recently discontinued from chronic anticoagulation therapy, the medications must be stopped at least four to five days prior to the planned procedure, and the prothrombin time (INR) should be measured before the initiation of neuraxial block. Neurologic testing of sensory and motor function should be performed routinely during epidural analgesia for patients on warfarin therapy. The type of analgesic solution should be tailored to minimize the degree of sensory and motor blockade. Neurologic checks should be continued after catheter removal for as least 24 hours, and longer if the INR was greater than 105 at the time of catheter removal.

Among all the potential complications related to epidural infusion, neurotoxicity and cardiotoxicity are the most life-threatening complications. Neorotoxicity and cardiotoxicity are toxic reactions to local anesthetics, which added in the epidural analgesic solution, are manifested by a progressive spectrum of neurological symptoms as blood levels rise. Initial symptoms including central nervous system excitation and are often described as a ringing in the ears, a metallic taste in the mouth, or a circumoral tingling. With increasing blood levels of local anesthetics, there is progression to motor twitching in the periphery followed by grand mal seizures. These higher blood levels are associated with coma and eventually respiratory arrest. At extremely high levels, cardiac arrhythmia or hypotension and cardiovascular collapse occur. Most commonly, the blood levels are elevated after unintentional intravenous injected during the performance of epidural anesthesia. The engorgement of veins in the epidural space makes vessel entry easy (Heavner, 2002; Mulroy, 2002). Immediate intervention at the early sign of toxicity will improve chances of successful treatment. Once the toxic reaction is recognized, management requires immediate supportive care, and stop the epidural infusion. Treatment is aimed at correcting contractile depressive and arrhythmia. Hypotension is the main cause of cardiac collapse. Prevention or early treatment of seizure is particular important because seizures produce metabolic acidosis and thereby exacerbate toxicity (Weinberg, 2002).

However, neurotoxicity and cardiotoxicity may also occur because of catheter migration. The epidural catheter may become dislodged and migrate into the subcutaneous tissue, intrathecal space or an epidural vein. Should the epidural catheter migrate into the subcutaneous space, the patient will not be receiving adequate amounts of narcotic to provide analgesia. The patient then will experience increased pain and loss of block if local anesthetic is being used. Catheter migration into the intrathecal space occurs less frequently but will have a more profound effect on the patient. Spinal or intrathecal blocks require far less medication produce effects because of the proximity to the spinal nerves and cord. Therefore, if the epidural catheter migrates into the intrathecal space, the patient will be receiving too much medication thus nerotoxicity and cardiotoxicity may result.

Benefits of Epidural Analgesia

Despite all the potential complications associated with epidural analgesia infusion, there are also many benefits associated with it. According to a meta-analysis, the use of perioperative neuraxial analgesia and anesthesia will improve both traditional clinically oriented and non-traditional patient-oriented outcomes. The results of the analysis revealed that the use of these techniques can decrease mortality by approximately 30%, the odds of developing deep venous thrombosis by 44%, pulmonary embolism by 55%, pneumonia by 39%, respiratory depression by 59%, and the need for transfusion by 55%. Other meta-analyses and more recent randomized trails have also shown that the used of perioperative neuraxial techniques will significantly decrease the incidence of pulmonary, cardiovascular, and coagulation-related complications in high-risk surgical patients. Use of perioperative epidural analgesia facilitates return of gastrointestinal function and generally results in superior analgesia, thus improve patient satisfaction (Bergqvist, Wu, & Neal, 2003).

The reason for the increasingly use of continuous epidural analgesia for postoperative pain control is that epidural analgesia provides excellent pain control allowing patients perform some physical activities such as deep breathing and coughing in their early stage of recovery period. Early mobilization increases the speed of recovering and prevents many postoperative complications.

Many studies have been done to compare the effectiveness of continuous epidural analgesia and intravenous analgesia. A large number of studies have shown that epidural analgesia not only can provide excellent postoperative pain control, but also improves patient's pulmonary function during the recovery period. A group of researchers conducted a prospective study on 48 patients with ASA I or II physical status of either sex between 20 and 70 years of age, undergoing elective major upper abdominal surgery. The patients were randomly grouped into sixteen each. The patients in group one received intravenous analgesic (Group I), the patients in group two received continuous epidural anesthetic (Group II), and the patients in group three received continuous epidural analgesic with local anesthetic (Group III). The scoring systems, visual analogue scale (VAS) and Prince Henry Scale (a verbal differential pain score), were used to score the pain. The VAS was explained to each patient during the preoperative period. The pain evaluation by VAS was at hourly intervals for the first four hours and subsequently at six hourly intervals for the next 36 hours. In addition, a verbal rating score (VRS) was used for subjective assessment of pain. The hemodynamic stability, respiration and saturation were continuously monitored with Nihan Khoden Life Scope 9. Sedation was evaluated by sedation scale as fully awake (0); normal sleep, easily arousable (1); drowsy, arousable on calling (2); drowsy, arousable on shouting and shaking (3); and somnolent, not arousable on shaking violently (4). The data were analyzed by ANOVA at a p-value <0.005 and by Kruskal-Wallis k sample test (Kumar &

Prasanna, 2004).

Results of this study demonstrated that the mean pain scores on VAS at the end of one hour were lower in all groups. From the first to tenth hour, there was significant decrease in the means pain scores in Group I and Group III, and not in Group II. The difference was statistically significant (P<0.05) between Group II and Group III only. From the sixteenth hour, the mean pain score was less in all groups. It was statistically significant between Group I and III as well as between Group II and III (P<0.05). The ANOVA test showed statistical significant (<0.01) in all groups except the zero, third tenth, and sixteenth hour. The mean pain scores on VRS were also lower in all the three groups at the end of one hour of infusion. There was no significant difference from one hour to the sixteenth hour except the fourth hour where the mean pain scores were less in Group I and III, compared to Group II. From the twenty second hour onwards, the mean pain score were less in all groups, the differences were statistically significant between Group I and III, as well as between Group II and III (P<0.05). The total analysis by the Kruskal Wallis test showed that all hours are significant except the zero and second hour. This study showed that analgesic (morphine) in combination with local anesthetic (bupivacaine) administered as a continuous epidural infusion provided a better quality of analgesia with fewer side effects in the postoperative period after upper abdominal surgery, compared to either local anesthetic or narcotic alone (Kumar & Prasanna, 2004).

Another group of researchers also conducted a similar study to compare the effectiveness of epidural analgesia and intravenous opioids analgesia on pulmonary function during the postoperative period. A group of 84 obese female patients (BMI>30) having elective laparotomy for gynecological procedures. The patients were given a free choice between epidural analgesia (n=42) or the intravenous opioids analgesia (n=42) for postoperative pain control. The researches performed a spirometry test to measure the vital capacity, forced vital capacity, and forced expiratory volume in one second (FEV_1) at preoperative assessment, then 20 minutes, 1 hour, 3 hour and 6 hour after the procedures. The data were analyzed by the unpaired t-test and 5% level of significant and 80% power of test were used for the test. The baseline valves were all within the normal range. The results of this study showed that all postoperative spirometric valves decreased significantly. The greatest reduction in vital capacity occurred directly after extubation, but was less in the epidural analgesia group than in the intravenous opioid analgesia group, mean of 23% (SD=8) versus -30% (SD=12). The results showed a statistical significant between the two groups (P<0.001). Recovery of spirometric valves was also significantly quicker in patients receiving epidural analgesia than those receiving intravenous opioid analgesia (Ungern-Sternberg, Regli, Schneider & Reber, 2005).

Epidural analgesia not only can be used in adult populations, but is also becoming very commonly used in pediatric patients. In comparing the effectiveness of epidural analgesia to traditional intravenous analgesia in the pediatric population, similar results were found. According to a research conducted by Bai and colleagues (Bai et al., 2004), the research studied 91 male and female children, ASA I or II, between 1 to 14 years old who were undergoing elective lower extremity surgery. The children were randomly divided into two groups, the epidural fentanyl group (Group E, n=61) and the intravenous fentanyl group (Group I, n=30). The degrees of pain, using the Parent Visual Analog Scale (PVAS) and the Objective Pain Score (OPS), were assessed immediately, six hours and twenty-four hours after the patient's arrival at the ward. Complications such as nausea and vomiting, dysuria, pruritus, and respiratory depression were identified. All the results were expressed as mean ± SD. The demographic data between the two groups and postoperative nausea and vomiting (PONV) were compared by chi-square test, while OPS and PVAS was compared by Mann-Whitney U-test. A probability valve of <0.05 was considered significant. The results of this study showed the postoperative PVAS of Group E was 3.8 ± 2.6 immediately after arrival, 2.7 ± 2.2 on the sixth hour, and 1.6 ± 2.0 on the twenty-fourth hour after arrival, while that of Group I was 4.9 ± 2.2, 4.3 ± 2.1, and 2.2 ± 1.5 respectively. The postoperative PVAS was significant lower in Group E than Group I ($p<0.05$). The frequency of PONV was 16.4% in Group E and 30% in Group I. Although the percentage of Group I was higher than Group E, there was no statistical significance. The results of this study demonstrated continuous epidural analgesia reduce postoperative pain scores significantly more than continuous intravenous fentanyl analgesia without any serious complications in pediatric lower extremity surgery.

Nursing Assessment and Interventions of Side Effects and Complications

Nursing care of a patient receiving a continuous epidural infusion is based on knowledge of the expected benefits of this therapy along with possible side effects. Nurses take care of patients receiving continuous epidural analgesia have to realize that side effects and complications may occur due to the effects of the:

1. Narcotic
2. Local anesthetic
3. Epidural catheter

1. Side effects due to narcotics

a) Respiratory depression

Just as for other forms of analgesia, respiratory depression is a rare but serious complication. When narcotics are infused epidurally, two types of respiratory depression can be seen. Early respiratory depression is usually due to intravascular absorption of the agent and occurs shortly after the narcotic is administered. However, when narcotics are given epidurally or intrathecally, they will circulate with CSF and eventually will come into direct contact with the respiratory conters in the brain stem. When this occurs, respiratory depression may result. As this process takes time to develop, it is described as late respiratory depression. Late respiratory depression has a gradual onset and is typically accompanied by increasing sedation (Nagelhout & Zaglaniczny, 1997). It may occur at anytime during a continuous epidural infusion and for several hours after the infusion is discontinued. It is for this reason that respiratory rate has to be monitored closely. Since increasing sedation is an early sign of respiratory depression, somnolence or sedation scales are also monitored. The somnolence scale consists of five levels of sedation with a numeric score assigned to each.

0 (none):	wide awake and alert
1 (mild):	frequently drowsy, easy to rouse
2 (moderate):	drowsy, easy to rouse
3 (severe):	drowsy, difficult to rouse
S (sleep):	normal sleep

The patient's level of sedation should be checked every one hour along with respiratory rate. **When patients are sleeping, they do not have to be awakened to check their level of sedation as long as their respiratory rate does not decrease.**

Assessment of respiratory function should include observation of the quality of respiration. Significant respiratory depression may occur if the patient experiences an upper airway obstruction. In these cases, the patient may have an adequate respiratory rate, as evidenced by chest movement, but is not moving enough air to provide for adequate air exchange. Similarly, patients may have an adequate respiratory rate with a low tidal volume causing respiratory failure due to inadequate elimination of carbon dioxide. For these reasons, it is important to assess both the rate and quality of respiration. In addition, the use of pulse oximetry would be helpful to assess patients' respiratory function.

The incidence of respiratory depression from epidural narcotics is increased in elderly patients, particularly those with pre-existing respiratory disease, those with thoracic epidural, and patients who receive any parenteral CNS depressants, including narcotics (Cousins & Bridenbaugh, 1999). Treatment of respiratory depression involves the administration of a drug called naloxone (Narcan). Naloxone is an antagonist which is specific to narcotics. It will reverse the effects of the epidural narcotic and, therefore, is the treatment of choice for respiratory depression. Naloxone has a relatively short half life in comparison to epidural narcotics. Therefore, it is likely that respiratory depression may recur as the effects of the naloxone will wear off before the effects of the narcotic. Frequent and repeated respiratory assessments are essential as Narcan may need to be repeated.

Naloxone is administered intravenously in 0.1 mg increments every two minutes until the patient's respiratory rate is twelve or greater. Naloxone is titrated in these small doses to prevent the patient from experiencing extreme pain, which may result in significant changes in heart rate and blood pressure, as the effects of the narcotic are reversed. The aim is to relieve the respiratory depression while preserving analgesia.

Clinically significant respiratory depression occurs when the patient's respiratory rate falls below 10 breaths per minute. Because the respiratory rate is monitored every one hour, any gradual decrease in respiratory rate should be considered an early warning sign, especially if this is accompanied by increasing sedation. If respiratory depression occurs (i.e. patient's respiratory rate is <10/minute), emergency care will include:

1. stopping epidural infusion
2. stimulating the patient by waking them and asking them to take deep breaths

3. if the patient is not receiving oxygen, begin oxygen by nasal prongs at 4 L/minute. If the patient is receiving oxygen therapy, change it to a nonrebreath mask at 10 L/minute

4. assess oxygen saturation as soon as possible

5. administer naloxone 0.1 mg IV every two minutes until respiratory rate is twelve

6. monitor vital signs every five minutes

7. notify anesthesiologist on call and surgical service

Although the incidence of respiratory depression is low, it is imperative that IV access be maintained should the need to give naloxone arises. **A saline lock is <u>NOT</u> sufficient for this purpose.**

b) Prunitus

Pruritus is a frequently occurring side effect of epidural narcotics. This symptom can vary from mildly irritating to severely distressing. The patient should be assessed for other causes of itching such as the presence of hives. If itching is noticed, comfort measures, cool cloths, creams and lotions should be offered. Benadryl (diphenhydramine) is an antihistamine which some patients find effective. A standing order for Benadryl will be left on the patient's chart. It is important to keep in mind that Benadryl has significant sedating effects. If the pruritus is severe, narcan may be ordered. As discussed earlier, this medication will reverse the effects of the narcotic thus relieving the itching.

c) Nausea and vomiting

Nausea occurs in a significant number of patients receiving narcotics with many requiring treatment. Although the exact mechanism is unknown, some researchers have suggested that the nausea induced by epidural narcotic is similar to motion sickness (Nagelhout & Zaglaniczny, 1997). Instructing patients to move slowly may be effective for preventing nausea. Antiemetics such as Zofran may be administered as required.

d) Urinary retention

Epidural narcotics and local anesthetics can cause urinary retention. Foley catheters are **NOT** required for patients receiving epidural analgesia. Urine output should be monitored closely on all patients who do not have urinary catheters in place. If urinary retention does develop, the anesthesiologist should be notified and an order for catheterization may be needed.

3. *Side effects due to local anesthetics*

a) Hypotension

Hypotension in a patient receiving epidural analgesia is most common when local anesthetics are used. The local anesthetic agent produces a sympathetic block. This causes vasodilation which increases the vascular space producing a relative hypovolemia. This condition will be exacerbated if the patient has received inadequate fluid replacement perioperatively. Hypotension in patients in patients receving only narcotic in their epidural infusion may also occur, but is most likely **NOT** related to the epidural infusion. Therefore, other possible causes of the hypotension should be investigated.

In order to detect hypotension, the following nursing interventions will occur:

- ♦ a registered nurse will remain in constant attendance of the patient for the first 15 minutes after the infusion is established. Epidural infusions will be started only in PACU or SICU.
- ♦ Vital signs will be assessed at the following intervals:
  - every 5 minute for the first 15 minutes
  - every 10 minutes for the next 30 munites
  - every 30 minutes for 1 hour
  - every 1 hour for 2 hours then;
  - every 2 hours for the first 24 hours then every 4 hours
  - respiration rate and somnolence scale every I hour for the duration of therapy
  - pain scale every 1 hour when awake
  - dermatome levels (see Appendix A) and bromage scale (see Appendix B) every 4 hours

If hypotension develops, other causes such as bleeding or septic shock should be thoroughly investigated as well as an assessment of epidural function including dermatome level, bromage scale and pain intensity. The following measures are appropriate for treating hypotension:

- ♦ stopping the epidural infusion
- ♦ notifying the physician

- raise the patient's legs to or above the level of the heart. This is best accomplished using pillows. Placing the bed in trendelenberg position is not recommended.
- administer 500 mL of Normal Saline intravenously
- administering oxygen per nasal prongs at 5 L/min or nonbrebreath mask at 10 L/min if the patient is already receiving oxygen therapy
- assess oxygen saturation as soon as possible
- assess vital signs every 5 minutes until they have return to normal
- have Ephedrine 50 mg/ml, a 10cc syringe with needle, and a vial of normal saline at bedside

Ephedrine is the drug of choice for treating severe hypotension. Usual IV dosage is 5-10 mg. Ephedrine is a sympathomimetic (mimics the sympathetic nervous system) agent which causes vasoconstriction. It has a rapid onset of action, but a short duration of action (Dipiro et al., 1999).

b) Paresthesia

The term paresthesia refers to any unusual sensation, but is usually described as numbness or tingling (Miller, 2005). In patients receiving epidural analgesia, paresthesia may be due to a number of causes including:

- administration of local anesthetic agents
- pressure from the epidural catheter on neural tissue
- administration of substances toxic to neural tissue
- catheter migration into the intrathecal space

- spinal cord compression (Miller, 2005)

If a patient, with an epidural catheter in place, complains of, or exhibits, any signs of neurologic impairment such as numbness, leg or back pain, notify an anesthesiologist immediately and take the following actions:

- stop the infusion
- assess blood pressure every 30 minutes or more often as necessary

For patients receiving local anesthetics, the level of block will be assessed every 4 hours for the duration of the infusion. Patients may be ambulated, if their condition permits, but they must be supervised closely.

3. *Complications related to the epidural catheter*

a) Catheter migration

As mentioned previously, the epidural catheter may become dislodged and migrate into the subcutaneous tissue, intrathecal space or an epidural vein. To prevent inadvertent removal of the catheter, it is important **NOT** to change the epidural catheter dressing. The catheter should be securely taped along the length of the spine (see Appendix C). It is common to have a scant amount of serosanguineous draining on the dressing.

As the epidural catheter migrates into the **subcutaneous space**, there will be less medication infused into epidural space. The patient will not be receiving adequate amounts of narcotic to provide analgesia. Signs and symptoms that would occur include:

- loss of analgesia (increased pain)
- loss of block if local anesthetic is being used

- puffiness or leaking of fluid at the insertion site may or may not be present

If this occurs, the epidural catheter will have to be removed by an anesthesiologist.

Epidural catheter migration into the **intrathecal space** may also occurs and will produce a more profound effect on the patient. Spinal or intrathecal blocks require far less medication to produce effects. If the epidural catheter migrates into the intrathecal space, the patient will be receiving too much medication and will develop signs and symptoms to reflect this. These include:

- respiratory depression
- increasing motor and sensory block which can proceed to complete motor and sensory block with respiratory arrest and circulatory collapse

Because of the low doses of local anesthetic being used in continuous epidural infusions, the effects from the local anesthetic should be minimal. If these symptoms occur, the infusion should be stopped, anesthesiologist should be notified, and resuscitation instituted if necessary.

Catheter migration into an **epidural vein** will cause systemic absorption of the agents in the infusion. The most significant sign that will be evident will be a loss of analgesia and block. Should the catheter migrate into the epidural vein, signs and symptoms that could occur include:

- increasing sedation
- signs of systemic toxicity
  - cicumoral numbness (numbness around lips and tongue)
  - visual and auditory disturbances such as difficulty focusing and

- tintinus
- disorientation
- drowsiness
- shivering
- skeletal muscle twitching and tremors involving face and distal extremities first
- convulsions
- cardiovascular collapse
- respiratory depression/arrest

These effects are dose related and, because the concentration of local anesthetic being used in epidural infusion is low, they should be minimized. However, if the signs and symptoms of systemic toxicity have occurred, the epidural infusion should be stopped immediately, the anesthesiologist should be notified, and resuscitation instituted if necessary.

b) Infection

Infection can occur at the site of entry or more significantly further up the catheter. Strict aseptic technique should be used when preparing epidural medications. The area around the insertion site should be monitored for signs of tenderness, redness, swelling, and drainage every 4 hours. Epidural catheter should only be left in place for the maximum of 72 hours, and have to be removed by an anesthesiologist after 72 hours. Because of the possibility of catheter dislodgement, the dressing should not be changed to inspect the site.

c) Spinal headache

Inadvertently entering the intrathecal space during insertion of an epidural catheter may result in the development of a spinal headache. A spinal headache develops because CSF escapes through the puncture site into the epidural space. When the patient is upright, the deficit of CSF causes a shift in the brain relative to the meninges and results in tension on these structures. A typical spinal headache will be the one that appears or worsens when the patient is upright and may be accompanied by a feeling of pressure in the ears. If the headache is severe, and does not respond to conservative treatment, it can be treated with an epidural blood patch (Miller, 2005).

d) Neural toxicity

Pharmaceutical preservatives and alcohol are extremely toxic to neural tissue. For this reason, it is important that infusions prepared for epidural injection be preservative free. Toxic substances include **alcohol** and other **bacteriostatic agents**. It is necessary to prepare solutions quickly, aseptically, and to avoid the use of alcohol swabs. If the infusion set becomes disconnected, cover the exposed ends with sterile dressings, and call the Anesthesia Department for assistance.

Conclusion

Nursing care for the patient receiving a continuous epidural infusion is aimed at prevention and early detection of the effects and side effects of the treatment. Although this may seem to be a difficult task at first, the ability to provide a superior form of sustained pain control makes the effort worthwhile. Not only do continuous epidural onfusion provide consistent pain relief, they require far less narcotic to do so. As a result, sedative and possible disorientation are lessened. Effective pain relief allows patients to mobilize earlier, reducing the incidence of deep vein thrombosis complications. The ability to deep breath and cough more effectively also reduces morbidly due to pulmonary complications. Finally, and perhaps most importantly, the psychological benefits of effective pain control cannot be overemphasized.

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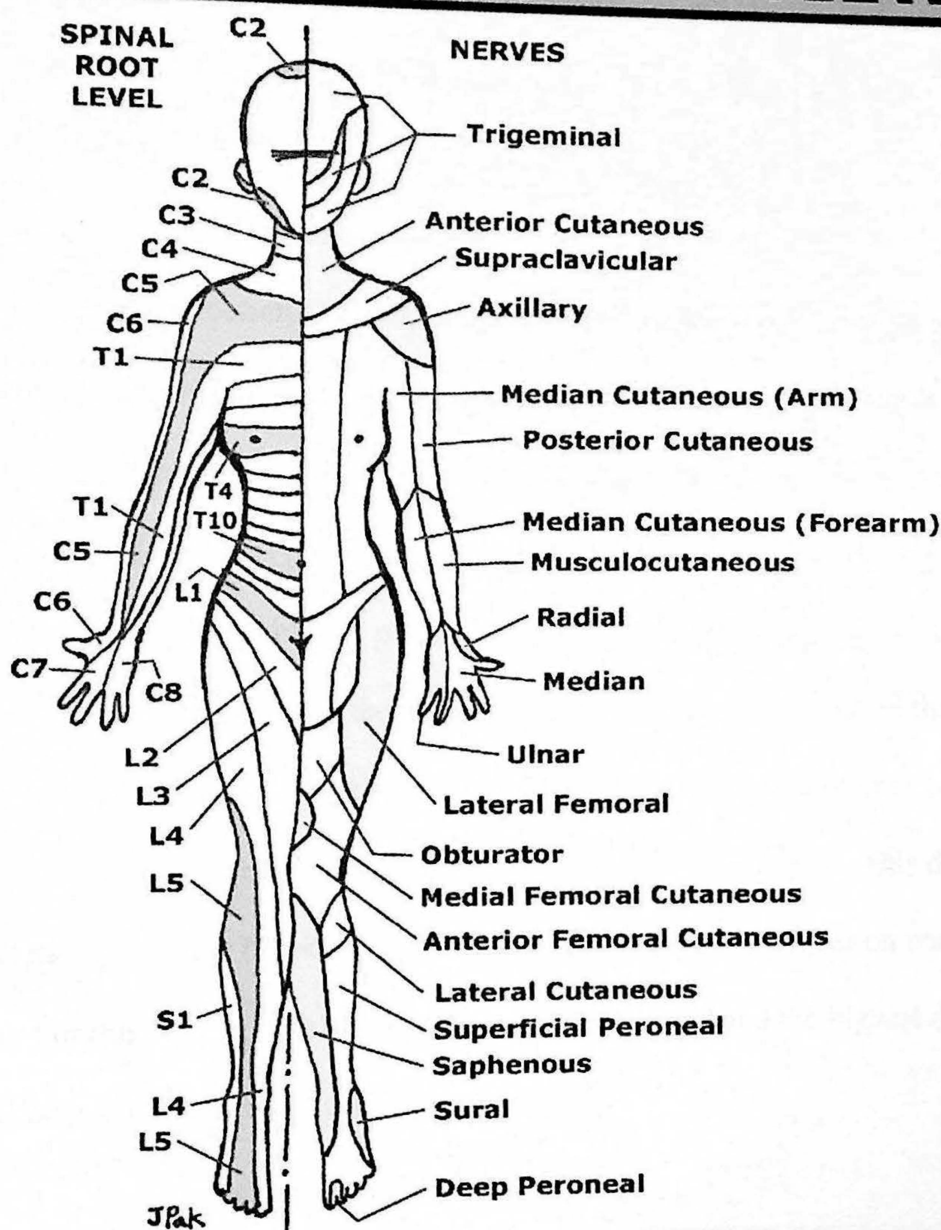
APPENDIX A

DERMATOME(ANT. VIEW)



NERVE	MOTOR ACTION	SENSATION
Axillary	Shoulder abduction	Lateral shoulder
Musculocutaneous	Elbow flexion	Lateral forearm
Median	Thumb opposition	Lateral palm
Radial	Finger extension	Dorsolateral hand
Ulnar	Finger ab/adduction	Medial hand

ROOT	MOTOR ACTION	SENSATION	REFLEX
C5	Shoulder abduction, Elbow Flection	Lateral arm	Biceps
C6	Wrist extension, Shoulder Adduction	Thumb, index finger	Brachioradialis
C7	Wrist flexion, Finger Extension	Middle finger	Triceps
C8	Finger flexion, Elbow Extension	Ring, small finger	---
T1	Finger ab/adduction	Medial arm	---

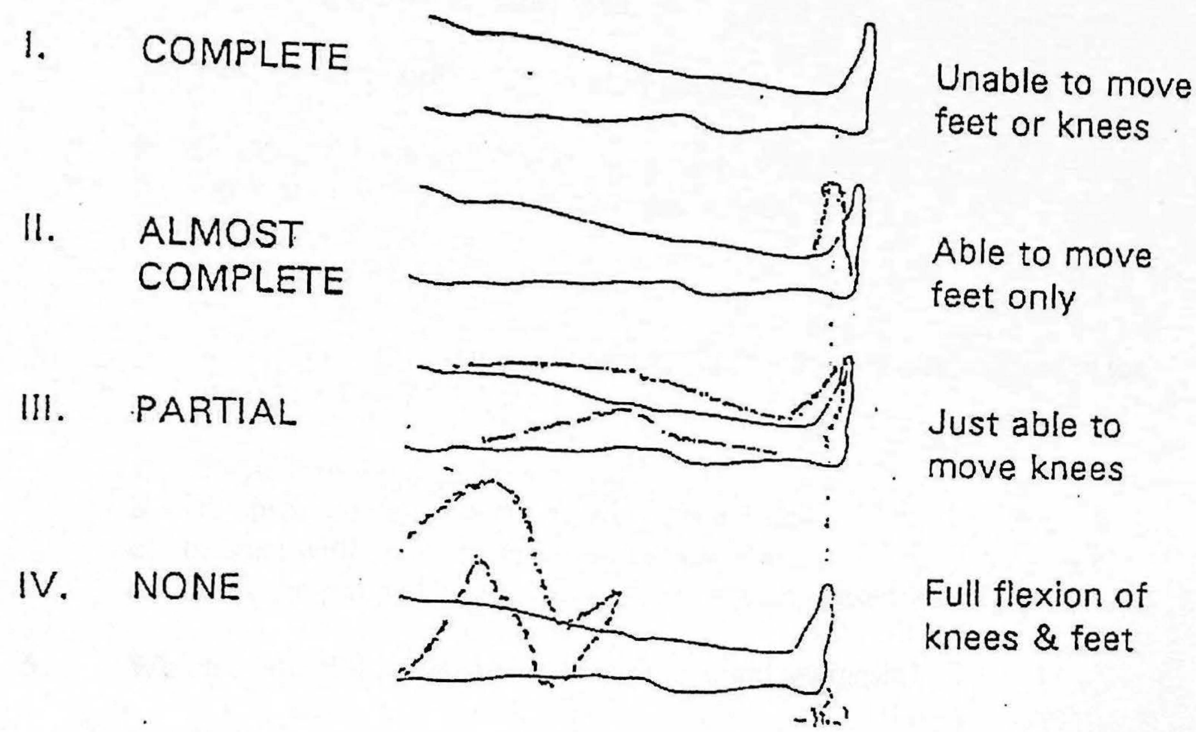
Some of the most commonly used landmarks for assessing the level of block include:

T_4	Nipple line
T_6	Xyphoid
T_{10}	Umbilicus
L_1	Inguinal Ligament

As discussed earlier, C fibers are responsible for transmission of pain and temperature impulses. We use this information to assist us in determining the level of the block. This is accomplished by using a cold stimulus, either an alcohol swab or a glove filled with ice. The cold is applied to an area which is known not to be blocked, such as the arm or the neck, to enable the patient to identify the sensation. Then it is moved down each side of the body and the patient is asked to acknowledge when they can no longer perceive the sensation as being cold. The change in perception may be slight, that is the patient may state that the ice is not as cold as it was previously. This dermatome is noted as the level of the block. Blocks may be unequal, that is, higher on one side then another. For this reason, both sides of the patient are tested and the highest dermatome level is considered to be the level of the block.

APPENDIX B

A bromage scale is used to describe the patient's motor function. The patient is asked to move their lower limbs and a number value is assigned based on their ability to move. If the patient has full leg movement, they receive a score of 4; only knee movement means a score of 3; only foot movement is a score of 2, and a score of 1 means the patients are unable to move their legs at all.



<u>If the bloc is unequal, the limb with the least amount of movement will be charted.</u> As the concentration of local anesthetic being used will be low, patients should not have a significant motor block. If the patient has a complete block , the infusion should be stopped and anesthesiologist should be notified.

APPENDIX C

Posttest for Epidural Analgesia Care

1. A Bromage Scale is used to assess the level of motor block.

True False

2. All of the following are true statements about the epidural space **except** that it:

a. is a potential space
b. is located just outside the dural mater of the spinal cord
c. contains fat and blood vessels
d. is filled with cerebrospinal fluid

3. Epidural narcotics effectively control pain by:

a. blocking the autonomic and motor nerve fibers
b. interacting with opiate receptors in the spinal cord
c. causing sedation
d. stabilizing the nerve membrane

4. All of the following are true statements about narcotics administered in the epidural space **except** they:

a. diffuse through the meninges and CSF
b. are absorbed intravascularly via epidural veins
c. interact with opiate receptors in the spinal cord
d. block the sympathetic nervous system causing vasodilation

5. Which of the following are benefits of epidural analgesia?

1. less sedation
2. more effective coughing
3. early ambulation
4. improved pain relief

a. 1 and 3
b. 4 only
c. 1, 3 and 4
d. All of the above

6. Dilaudid:

1. is the narcotic most frequently used in continuous epidural infusions
2. penetrates the dura rapidly
3. is slow to clear from CSF
4. has a rapid onset of action
5. has a short duration of action

a. 1 only
b. 1 and 3
c. 3 and 5
d. 2, 4 and 5

7. The following are <u>potential</u> side effects of epidural analgesia **expect:**

a. pruritus
b. respiratory depression
c. sensory and motor block
d. seizures

8. Which of the following factors increases the risk of respiratory depression due to epidural narcotics?

1. older age
2. high opioid doses
3. concurrent use of sedatives
4. respiratory function and drug clearance compromise

a. 2 and 4
b. 1, 3, and 4
c. 1 and 3
d. All of the above

9. The infusion should be stopped and treatment instituted when:

a. the patient is alert and the RR>14
b. the patient is occasionally drowsy and RR=12
c. the patienthas become increasingly drowsy and the RR has decreased to 8 over the past two hours
d. the patient is awake and alert and RR=10

10. Naloxone (Narcan):

a. is a narcotic antagonist
b. should be administered in doses of 0.1mg IV until the respiratory rate >12
c. must only be given by a physician
d. a and b

11. All of the following statement are true **except**:

a. alcohol and preservatives are toxic to neural tissue and must be avoided in the preparation of epidural medications
b. a top up may be used to treat break through pain
c. increasing sedation and decreasing respiratory rates are an indication for more frequent nursing assessments
d. metoclopromide (Reglan) may be given for prurtus to all patients receiving epidural analgesia

12. If one increases the rate at which an epidural narcotics are infused, one also increases the risk of respiratory depression.

True False

13. Patients who have an epidural catheter in place can receive any form of anticoagulation.

True False

14. The maximum concentration of bupivacaine to be used either alone, or on combination with an opioid is 0.06% (0.6mg/ml).

True False

15. Patients who are receiving epidural analgesia must have a peripheral IV infusion in situ.

True False

16. Analgesia preparations containing stabilizing agents, preservatives, antioxdants or neurolytic agents must not be administered through epidural catheters.

True False