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Education of Obstetrical Nursing Staff Regarding Regional Anesthesia and Possible Complications

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EDUCATION OF OBSTETRICAL NURSING STAFF REGARDING REGIONAL ANESTHESIA AND POSSIBLE COMPLICATIONS

By

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Signature Megan Dallman

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Abstract

Spinal and epidural anesthesia have long been a popular choice for anesthesia in the obstetrical population, whether for a laboring patient or a patient undergoing a cesarean delivery. Anesthesia providers carry out the placement and delivery of these blocks. After the block is deemed successful and the patient is considered medically stable, the anesthesia provider may then leave the side of their patient, trusting that the care given by the labor and delivery nurse will be the best possible care available. However, it is a well know fact that risks are present anytime an invasive procedure takes place. Complications can arise with the placement of spinal or epidural anesthetics, and they may occur during, immediately after, hours after or even days after placement of a spinal or epidural anesthetic. If the obstetrical patient does experience complications, the obstetrical nurse must have an adequate knowledge base regarding regional anesthesia in order to provide the most competent care available.

The method used for this independent project was a review of literature utilizing PubMed, CINAHL and SCOPUS databases. Current thoughts on educating labor and delivery nurses on regional anesthesia and possible complications were organized according to a physiological framework. The plan for this independent project was implemented by educating labor and delivery nurses regarding regional anesthesia and possible complications using a Power Point presentation. Main topics of discussion included basics of spinals and epidurals and how they differ, complications that may arise from spinals and epidurals, and appropriate interventions that may either prevent or treat these complications. It was anticipated the nurses would have a better understanding of spinal and epidural anesthesia and possible complications after the Power Point presentation. Results from an evaluation

proved the presentation was successful in increasing the labor and delivery nurses overall comprehension of spinal and epidural anesthesia in the obstetrical population.

INTRODUCTION

Anesthesia for labor has been around since the first anesthetic agent, ether, was dropped onto a cloth providing an inhalational agent to produce analgesia in 1847. Since then, healthcare practices in all fields have grown more multifaceted from decade to decade. Technology is becoming extremely complex and allows advanced monitoring of patients and also for progression in surgical practices. Likewise, research continues to grow and develop leading to new medications and treatments. Because of these never ending changes, everyone in any healthcare profession must be ready to adapt to and accept the complexity the industry offers. As anesthesia providers, it is our responsibility to make sure our patients receive the best care possible at all times. All members involved in a specific patient's case need to work together as a team in order to ensure this.

One area in which multiple members of the healthcare team are involved is obstetrics, specifically laboring woman. Nurse anesthetists place labor epidurals and provide subarachnoid blocks for cesarean deliveries on a regular basis. According to one source, the safety of women whom are undergoing procedures involving an epidural depends "significantly on the competence, attentiveness, and experience of those responsible for their anesthetic management" (Mahlmeister, 2003). This includes the labor and delivery nurse. Labor and delivery nurses must be adequately prepared to care for a patient just receiving regional anesthesia. As a Student Registered Nurse Anesthetist, this topic lead to the clinical question: "What is the evidence for the level of knowledge of regional anesthesia required for obstetrical nurses to provide quality care to obstetrical patients?"

STATEMENT OF THE PROBLEM

Adequate knowledge of obstetrical nurses regarding risks, benefits and techniques of regional anesthesia, specifically subarachnoid and epidural blocks, is an issue of concern for Certified Registered Nurse Anesthetists. Appropriate knowledge of regional anesthesia and analgesia by nurses caring for obstetrical patients at the bedside is vital to patient safety. Certified Registered Nurse Anesthetists have a responsibility to ensure that the nurses who are caring for their patients following placement of a regional block are appropriately informed with the most up to date information regarding potential risks and complications. In particular, they must be aware of the differences between epidural and subarachnoid blocks, hemodynamic instability, anticipated patient responses after administration of regional anesthesia, potential complications and the appropriate treatment of those complications.

PURPOSE OF THE PROJECT

The purpose of this independent project was to thoroughly review the most current evidence-based literature concerning the information and education necessary for nurses to provide safe and effective care to the obstetrical patient undergoing regional anesthesia. This information was then provided to a selected obstetrical nursing staff. The goal of the presentation was to increase the knowledge base of the obstetrical nurse who provides direct care to the obstetrical patient undergoing regional anesthesia, specifically subarachnoid and epidural blocks. It was anticipated that the education provided to these nurses could potentially lead to safer obstetrical nursing care and better patient outcomes.

SIGNIFICANCE OF THE PROJECT

As a nurse anesthesia student in the last six months of my schooling, I have had the opportunity to observe and communicate with many obstetrical nurses while working as a

team taking care for laboring patients. During these interactions, I came to the conclusion that while many of the staff nurses seemed very adequately trained in caring for a patient who had just received a spinal or epidural anesthetic, there were also some nurses who did not seem adequately educated. This is a significant issue because the number of patients receiving labor epidurals or subarachnoid blocks for cesarean delivery is not trivial, and as an individual in the healthcare field, I do not foresee these numbers to decrease anytime in the near future. More than likely, the numbers of labor epidurals and cesarean sections will stay stable or increase. Because of this, the importance of education of obstetrical nursing staff regarding epidural and spinal anesthesia is justified.

CONCEPTUAL FRAMEWORK

As stated in the purpose of this independent project, I would like to share the knowledge learned regarding spinal and epidural anesthesia and possible complications with labor and delivery nurses who routinely care for the obstetric population. It was strongly believed that by educating this population they would be better able to proficiently care for these patients.

This independent project is based on a physiological conceptual framework. Regional anesthesia is a type of anesthesia that produces blockade of neural impulses and includes sensory, motor and autonomic nerve functions. Two types of regional anesthesia exist: neuraxial anesthesia and peripheral nerve blocks. Neuraxial anesthesia is composed of subarachnoid, epidural and caudal anesthesia. The principal side of action for neuraxial nerve blocks is the nerve roots in the spinal canal (Miller, Fleisher, Savarese, Winer-Kronish & Young., 2005; Morgan, Mikhail & Murray, 2006).

The vertebral spinal column is made up of vertebral bones and fibrocartilaginous intervertebral disks. It allows for a certain degree of mobility in several planes and protects the spinal cord and nerves. In all, the vertebral column is comprised of 33 bones, known as the vertebrae. From top to bottom, the verterbrae are divided into 7 cervical, 12 thoracic, 5 lumbar, and 5 sacral (4 of which are paired). The 12 thoracic vertebrae correspond with their matching rib. The body of the lumbar vertebrae has a large anterior cylinder form. A hollow ring is presented anteriorly by the vertebral body, posteriorly by lamina and spinous processes, and laterally by the pedicles. These hollow rings stack vertically and become the spinal canal. The spinal cord and coverings sit within this spinal canal, and the spinal cord extends from the base of the brain and travels through the spinal canal to end approximately at the first lumbar vertebrae (L1) in the average adult. The cervical and lumbar regions are convex in formation. Various ligamentous structures provide structure and support with adjacent muscles. At each vertebral body, nerves exit the spinal cord (Miller et al., 2005; Morgan et al., 2006).

The spinal canal is composed of the spinal cord, the meninges, fatty tissue and a venous plexus. The meninges, which are the coverings of the spinal cord, are composed of three layers. These layers are the pia mater, the arachnoid mater and the dura mater. The pia mater closely adheres to the spinal cord, and the arachnoid mater closely adheres to the thicker, denser, outermost dura mater layer. The "subarachnoid space" is the space between the arachnoid and pia mater. It is here that cerebrospinal fluid (CSF) is contained and constantly bathes the brain and spinal cord and acts as a filtrate of blood that has been filtered through the choroid plexus. About 150 milliliters (mL) of CSF is produced daily, and of this 150 mL, 20 to 35 mL is found in the subarachnoid space. This is also the area where local

anesthetic (LA) is injected into when a subarachnoid block is performed. A subarachnoid block is also commonly referred to as a spinal or an SAB (subarachnoid block). If the LA intended for injection into the subarachnoid space has a narcotic mixed into it, or if the medication planned to be injected into the subarachnoid space is solely a narcotic, it will be called an intrathecal injection. A spinal anesthetic in the obstetric population is commonly utilized for a cesarean section, and it is common in rural areas to place a spinal or intrathecal for laboring women instead of an epidural (Miller et al., 2005; Morgan et al., 2006).

To reaffirm the order of structures of our spinal canal, they are as follows for placement of a spinal: through the skin into the subcutaneous tissue, through the supraspinous ligament, through the interspinous ligament, through the ligamentum flavum into the epidural space, through the dura mater and arachnoid mater into the subarachnoid space. The epidural placement is exactly the same, except the needle stops advancement when it hits the epidural space, characterized by loss of resistance. The epidural space is immediately after the ligamentum flavum and before the dura. The subarachnoid space is the space between the arachnoid mater and the pia mater, and this is where the CSF resides (Miller et al., 2005; Morgan et al., 2006).

Epidural blocks and spinal blocks have several differences and similarities. For the obstetric population, they are both performed routinely in the L2 – L3, L3 – L4, or L4 – L5 interspaces. Injection here provides anesthesia to a specific targeted area and therefore avoids contact with the spinal cord, as discussed earlier (Miller et al., 2005; Morgan et al., 2006).

To perform a spinal blockade, as for a cesarean section, a small spinal needle, often a 22 to 25 gauge, is placed into the subarachnoid space and confirmed with the return of CSF.

Then a small amount, usually about 1 to 2 mL, of a higher concentration of LA is injected. This is a one time injection and the needle and introducer, if used, is completely removed from the back. As the LA immediately enters the CSF and bathes the spinal roots, a quick onset of anesthetic, usually 5 to 15 minutes, with a dense sensory block occurs. A commonly used local anesthetic for a cesarean section is 0.75% bupivacaine. The duration of action for this is approximately 2 hours, which may not be ideal for a laboring woman (Miller et al., 2005; Morgan et al., 2006).

The epidural space is located between the dura mater and a ligament known as the ligamentum flavum. To place an epidural, a larger needle, often an 18 gauge Tuohy needle, is utilized. Once the epidural space is theoretically reached by conferment of loss of resistance (LOR) with the LOR syringe, by no presence of CSF or heme, and also by ease of passage of the catheter through the needle into the epidural space, a test dose of local anesthetic (often 3 mL of 1.5 % lidocaine with 1:200,000 epinephrine) is injected through the catheter. This ensures the catheter was not inadvertently placed into the subarachnoid space and that it did not migrate into a blood vessel. If it is indeed in the epidural space, no unwanted physiological effects will be noted. However, if it is accidentally placed into the subarachnoid space, a very quick onset and dense block will be noted. Also, if it was unintentionally placed into a vessel, the patient will experience symptoms of possible lightheadedness, a "ringing" in the ears, a metallic taste in the mouth, feeling flushed, and will experience about a 20% increase in heart rate (HR) and possibly blood pressure. If either of these conditions occurs, the catheter cannot be used for an epidural anesthetic (Miller et al., 2005; Morgan et al., 2006).

Epidural anesthesia is usually the choice for laboring women. A flexible catheter is threaded into the epidural space and remains there for the entire labor process. Compared to a spinal anesthetic, a larger amount of local anesthetic, usually about 10 to 20 mL, of a lower concentration of local anesthetic is bolused through the catheter. This larger amount of volume is necessary in order for it to diffuse through the layers of the meninges to reach the nerve roots. With an epidural in place, additional pain medicine can be administered at a later point in time if need be, either through an infusion, a bolus, or with a patient controlled device. Epidurals have a slower onset of action as compared to spinal anesthetics and are considered a more hemodynamically stable choice. Blocks with epidurals have a less dense block, which is usually welcomed in the laboring patient. Even though the sensory blockade is not as dense as a spinal anesthetic, a functioning epidural may be bolused with a fast acting LA and used for a cesarean section (Miller, 2005).

With pregnancy, multiple, significant physiological changes are present for several body systems. Regarding regional anesthesia, cardiovascular alterations are the main issue of concern. Cardiac changes are in response to the change in metabolic demands of the mother and fetus. Blood volume increases drastically. Specifically, plasma volume increases 45%, red blood cells increase 15 to 30%, blood volume increases 1000 to 1500 mL and total blood volume reaches 90 mL/kg. Hemoglobin usually remains greater than 11 grams/deciliter. All of these changes result in physiological anemia of pregnancy. Cardiac output (CO) increases 30 to 40%, HR increases 15 to 20%, and stroke volume increases 20 to 50%. In the first trimester CO averages 6.7 liters/minute and continues to increase to about 8.7 liters/minute at the end of pregnancy (Miller et al., 2005). An average CO for an adult is typically around 5 liters/minute. This increase is due to an increase principally in stroke volume and to a slight

increase in HR. Systemic vascular resistance is reduced further leading to the increased circulation seen in pregnancy. The heart responds with physical changes including both chamber dilation and hypertrophy. The heart increases in size by about 12%, and it is slightly elevated and rotated to the left. Vascular tone during pregnancy is increasingly sensitive to sympathetic control than when compared with nonpregnant patients. Due to this fact, hypotension is more distinct following spinal and epidural blocks. Complications from incorrect positioning of a parturient can lead to detrimental effects of both mom and baby (Morgan et al., 2006). This complication will be discussed further in the literature review.

Another issue of concern for regional anesthesia in the pregnant patient is musculoskeletal changes. Pregnancy causes an increase in lumbar lordosis and reduces the distance between adjacent lumbar interspaces. This can prevent the woman from adequately flexing. Ligaments can be softened, altering the gritty, identifying feel of the ligamentum flavum. In a nonpregnant woman, the line between the iliac crests is typically the L4 – L5 interspace, but with pregnant women this line shifts to the L3 – L4 interspace. Adipose tissue and interstitial edema can make palpation of the vertebral column difficult (Miller et al., 2005; Morgan et al., 2006).

Many other physiological changes occur in pregnancy, but will be discussed further in the review of literature. Changes in the central nervous system regarding regional anesthesia definitely affect how we administer and prepare patients for regional anesthesia. Pregnancy affects a woman's response to certain medications. It is important to understand why this occurs and what we do to adapt to these conditions. Previously discussed were the major cardiovascular changes with pregnancy. It is crucial to really understand why this is so significant. This is linked to why regional anesthesia is advantageous. Although obstetrical

nurses do not need to fully comprehend specific local anesthetics used during labor and delivery or with cesarean deliveries, it may be beneficial to know the basics of commonly used local anesthetics. Complications discussed in the literature review may include supine hypotensive syndrome/aorto-caval compression, total spinals, high blocks, local anesthetic toxicity, hemodynamic effects due to sympathectomy, neural injuries, hematoma formation, postdural puncture headache, malfunctioning of epidural catheter, cauda equina syndrome and anterior spinal artery stenosis (Cook, Counsel & Wildmith, 2009; Miller et al., 2005; Morgan et al., 2006).

DEFINITIONS

For the purpose of this study, the following definitions are provided to enhance understanding of the content.

Obstetrical nurse refers to a nurse specializing in the care of women and their unborn child/children during pregnancy, childbirth and post-delivery.

Regional anesthesia refers to an anesthetic technique in which a local anesthetic is delivered to a regional area in close proximity to a nerve, thereby disrupting nerve impulse transmissions and providing anesthesia to the region. The sensory, motor and sympathetic blockade depends on the local anesthetic used along with the dose, volume and concentration of that local anesthetic. These factors also determine the duration and level of the block.

Central neuraxial anesthesia refers to a subset of regional anesthesia and includes subarachnoid (spinal), epidural and caudal blocks.

Epidural block refers to a reversible neuraxial block where a catheter is placed into the epidural space in order to inject local anesthetics and/or narcotics to provide pain relief

Epidural space refers to the space between the ligamentum flavum and the dura mater.

Subarachnoid block (SAB) refers to a reversible neuraxial block in which a local anesthetic is injected into the subarachnoid space usually by means of a "one-shot" technique. A SAB is also known as a spinal.

Subarachnoid space refers to the space between the arachnoid mater and the pia mater. This space contains the cerebral spinal fluid.

Cerebrospinal fluid (CSF) refers to the clear, colorless fluid present in the subarachnoid (spinal) space that functions as a buffer to protect the brain and spinal cord. When performing a subarachnoid (spinal) block, the local anesthetic is injected into the spinal space and combines with the CSF.

Local anesthetic (LA) refers to a class of medications used to achieve reversible analgesia and anesthesia by being injected in close proximity to nerve roots and rootlets.

Hemodynamic stability refers to the stability of a patient's overall circulatory status, and can be influenced and altered by medications, certain patient statuses and certain disease processes. A patient is often said to be "unstable" when the blood pressure is low. Main factors influencing hemodynamic status are cardiac output, heart rate, stroke volume, preload, afterload and circulating blood volume.

Certified Registered Nurse Anesthetist refers to an individual who provides and participates in the provision of advanced specialized nursing care in anesthesia, respiratory and cardiopulmonary care.

Intrathecal injection refers to when a local anesthetic intended for a subarachnoid block has a narcotic mixed into it or if the medication planned to be injected into the subarachnoid space is solely a narcotic.

REVIEW OF LITERATURE

Overall Outlook on Education of Obstetrical Nurses Regarding Regional Anesthesia

The literature available regarding education of obstetrical nurses concerning regional anesthesia was unfortunately very limited. Two journal articles, one by Mahlmeister (2003) and one by Balestrieri-Martinez (2009) were the basis for this independent project and provided insight into this topic. They were not studies or actual research projects; they discussed nursing responsibilities in preventing, preparing for and managing epidural emergencies and the nurse's role in anticipating, recognizing and responding to complications in obstetric anesthesia.

Balestrieri-Martinez (2009) addressed the major complications of obstetric anesthesia and how obstetrical nurses need to respond, with the goal of improving patient safety in these possible, but rare high-risk situations. Didactic education recommendations and team communication techniques were also offered in order to possibly help assist hospital educators in achieving the goal of increased patient safety.

Balestrieri-Martinez (2009) confirmed the lack of information in the literature regarding how increased training of obstetrical nursing staff would affect improved obstetric anesthesia outcomes. Major themes found in the literature revolve around the safety of obstetric anesthesia, risk identification, complications and treatment of complications. Minor themes in the literature regarding this topic discuss team communication, overall management of pain/patient satisfaction and pointed out the need for a hospital's duty and commitment in a continual strive to improve patient safety.

Most orientation programs briefly discuss regional anesthesia and potential complications, but leave the amount of information and training insufficient for the nurses to

feel confident in their understanding of the complications and competency to respond. This education need may also extend to experienced staff who may lack the current, most up-to-date knowledge. Education of new staff should be emphasized with a focus on anticipation, recognition, and response to obstetric anesthesia complications, as well as continuing education for all staff (Balestrieri-Martinez, 2009). The American Academy of Pediatrics, American College of Obstetrics and Gynecologists points out that any patient at risk for anesthesia complications needs to be identified prior to anesthesia requests (2006). Skillful communication needs to exist between obstetric and anesthesia providers and be ongoing (Hawkins, 2007). Providing focused instruction regarding the ability to anticipate, recognize, and respond to complications in obstetrical anesthesia will increase the nurse's confidence and competence (Balestrieri-Martinez, 2009). The Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) believes that didactic information coupled with event-specific simulation can help the entire obstetrical team to become involved with the process of patient safety (2001).

Mahlmeister (2003) reviewed significant complications related to obstetrical regional anesthesia, specifically epidurals. Recommendations were also made to assist the nurse in preparing for and managing epidural emergences. In addition, a discussion of specific responsibilities of nurse managers and educators in competency, evaluation and guidance was brought forth. The AWHONN also states that, "the safety of women undergoing procedures, such as the administration of epidural analgesia/anesthesia, depends significantly on the competence, attentiveness, and experience of those responsible for their care" (1998).

Because of the paucity of information about this topic of education of labor and delivery nurses regarding potential complications of regional anesthesia, the remainder of the

paper will focus on what is considered relevant information in the literature regarding this specific topic. Information which will be discussed includes physiological changes of pregnancy relevant to epidural and subarachnoid anesthesia, possible complications of spinal and epidural anesthesia, and general principles of nursing care for potential complications.

Physiological Changes of Pregnancy Relevant to Epidural and Subarachnoid Anesthesia

As previously mentioned in the conceptual framework section, it is vital that the obstetrical nurse fully understands physiological changes endured during pregnancy in relation to epidural and spinal anesthesia. Pregnancy changes the effects of the central nervous system in response to general and regional anesthesia. The minimal alveolar concentration (MAC) decreases during pregnancy, by as much as 40% at term for all general anesthetic agents; pre-pregnancy MAC requirements return by about the third day after delivery. The hormone levels and endogenous opioid levels are involved in how MAC is determined. Also, progesterone levels increase up to 20 times normal. This increases sedating effects, which in turn minimizes the need for normal MAC requirements. Pain thresholds during labor and delivery may also be altered by increased levels of beta-endorphins and dynorphins (Jeong, 2010; Morgan et al., 2006).

Pregnant women also have an enhanced sensitivity to local anesthetics for regional anesthesia, which is due to the engorged and dilated epidural veins. The enlarged epidural veins are also caused by the obstruction of the inferior vena cava and distended epidural venous plexus forcing an increased epidural blood volume. The increased volume causes decreased spinal CSF volume and decreased potential volume of the epidural space. These two effects can cause a more cephalad spread of the LA during spinal and epidural anesthesia. Because of all of these reasons, the normal dose may be reduced by up to 30%.

An increased epidural blood volume also causes an increased epidural space pressure which may cause a higher incidence of a dural puncture with epidural anesthesia. Previous studies have shown this enhanced sensitivity increases the likelihood of systemic toxicity, but more recent studies actually suggest that the likelihood of systemic toxicity is not linked to the sensitivity of local anesthetics. However, because of the engorged and dilated epidural veins, there is a higher chance of placing an epidural catheter into a vein and injecting a large LA dose intravascularly (Morgan et al., 2006).

Dunn, Alston, Baker, Davison, Kwo and Rosow (2007) also confirm that dose requirements for local anesthetics, epidural and spinal, in the pregnant patient may be reduced by up to 30% because the spread and depth of epidural and spinal anesthesia are greater in pregnant women. Reasons for this include distension of epidural veins (compensated by a decrease in CSF), low CSF protein, elevated CSF pH and biochemical changes. Pregnant women are highly dependent upon the sympathetic nervous system for hemodynamic control, which can significantly cause hypotension during regional anesthesia. Therefore, preoperative hydration is vital. Cesarean section requires a T4 sensory level block. Due to the high sympathetic blockade, all patients would benefit from receiving a 1000 to 1500 mL bolus of lactated ringers prior to neural blockade. Smaller volumes of albumin or hetastarch may also be beneficial. Ephedrine, 5 to 10 mg IV, may be given to maintain the systolic blood pressure greater than 100 mmHg or within twenty percent of the patient's normal preoperative blood pressure. Patients undergoing cesarean section with spinal anesthesia need to be cooperative and able to position themselves routinely (Chestnut, 2006; Dunn et al., 2007).

Anesthetics and drugs that cause vasodilation or anesthetic techniques that cause sympathectomy may exacerbate aortocaval compression. Compression of the abdominal aorta will lead to hypotension, and hypotension will then lead to reduced cerebral perfusion and perfusion to the fetus. The autonomic nervous system throughout pregnancy is characterized by sympathetic lability in orthostatic circulatory control and slight reduction in parasympathetic control of heart rate. This can explain the syncope episodes and palpitations some pregnant women experience in the first trimester. However, cerebral hypoperfusion is rare because of the extra blood volume and increased cardiac output throughout pregnancy, but arrhythmias are very common. In the second trimester, there is a marked decrease in parasympathetic responsiveness. The parasympathetic function is partially restored in the third trimester, and fully restored by about the third postpartum day. The activity of the sympathetic division of the autonomic nervous system is shown to increase in the first trimester of pregnancy, progressively rise during the second and third trimesters, and decrease immediately before delivery. This is considered a mechanism of adaptation to pregnancy (Morgan et al., 2006).

Uterine blood flow progressively increases during pregnancy until it reaches a mean value of 500 to 700 mL by term. Since uterine blood flow lacks autoregulation, uterine blood flow is dependent on maternal blood pressure and cardiac output (Miller et al., 2005). Uterine blood flow comprises about 10% of CO. Approximately 80% of uterine blood flow supplies the placenta, while the rest supplies the myometrium. The fetus is dependent on the placenta for respiratory gas exchange, nutrition, and waste elimination. Therefore, any change to uterine blood flow adversely affects fetal blood supply (Morgan et al., 2006). The

formula used to determine uterine blood flow is: Uterine blood flow = (uterine arterial pressure – uterine venous pressure)/uterine vascular resistance (Miller et al., 2005).

The three major factors which decrease uterine blood flow during pregnancy include: (1) systemic hypotension, (2) uterine vasoconstriction, and (3) uterine contractions. Typical causes of hypotension include: aortocaval compression, hypovolemia, and sympathetic blockade post regional anesthesia. Uterine vasoconstriction can be caused by stress-induced release of endogenous catecholamines during labor. Uterine vasoconstriction can occur with the use of high doses of alpha adrenergic medications as they have the potential to decrease uterine blood flow through vasoconstriction. Hypertensive disorders cause decreased uterine blood flow as a result of generalized vasoconstriction. Finally, uterine contractions also decrease uterine blood flow by elevating uterine venous pressure and compressing arterial vessels as they traverse the myometrium (Morgan et al., 2006).

The Choice of a Spinal or Epidural

The question may come up regarding what type of anesthesia for a cesarean section is most beneficial for the parturient and the fetus. Regional anesthesia is currently the most popular form of anesthesia provided to laboring women and is generally considered the safest form of analgesia for labor for both the parturient and fetus (Birnbach & Ranasinghe, 2008). Advantages of regional anesthesia over general anesthesia include a decreased risk of aspiration, honoring the mother's wishes to remain awake, avoidance of fetal depressant drugs, and reduced blood loss associated with surgery (Bowman-Howard, 2007). There are many different successful regional techniques utilized today to provide anesthesia and analgesia to laboring women. Such techniques include epidurals, spinals, combined spinal-epidurals, paravertebral blocks, paracervical blocks and pudendal blocks. Of these, epidurals

and spinals are the most commonly used techniques, with combined spinal-epidurals gaining popularity (Faust, 2003).

An epidural catheter is rarely placed for a planned cesarean section due to the better option of a spinal anesthetic. First, an epidural has a more likely chance of being "patchy" compared to a spinal anesthetic. Second, both the concentration and volume of the LA needed in order to provide adequate surgical anesthesia with an epidural is high. Therefore, should the local anesthetic enter the subarachnoid space or a vessel, the patient would most likely have devastating outcomes such as a total spinal or systemic toxicity. The only potential benefit of the epidural versus a spinal would be the opportunity for post-operative pain control. However, the pain associated with a cesarean section rarely requires more than minimal intravenous toradol or oral anti-inflammatory medications or opioids (Miller et al., 2005; Morgan et al., 2006).

A spinal is the ideal anesthetic for a planned cesarean section. This method allows for the fast onset of a solid sensory and motor block required for the abdominal surgery. However, due to the sympathetic block that occurs with a spinal, the anesthetist must expect and be prepared to treat hypotension. Moreover, the SAB is ideal for the planned cesarean section because of the small doses and volumes used leading to a lesser risk of LA toxicity and minimal transfer of the drug to the fetus (Miller et al., 2005). In addition, failures, including incomplete or "patchy" blocks, are very infrequent with spinal anesthesia (Miller et al., 2005). Potential disadvantages to a SAB for the planned cesarean section include the limited duration of the block and higher incidence of hypotension from sympathectomy.

An epidural may be a good choice for regional anesthesia in the event of needing an emergent cesarean section after the epidural is already in place for a laboring woman.

However, it is imperative there is sufficient time to both redose the epidural with a larger volume and concentration of the LA to allow it to set up prior to making the incision in order to ensure adequate surgical anesthesia. This may be a disadvantage when time is of the essence. When there are only minutes to deliver the baby via cesarean section, an epidural is not the optimal choice due to the variable length of time required for the redosing and setting up of the local anesthetic. Also, epidurals can be associated with "patchy" blocks which can lead to further delay of incision. If there is no time to perform a SAB or induce general anesthesia, "patchy" anesthesia prior to the delivery of the baby can be treated with intravenous ketamine or inhaled nitrous oxide. Pain that remains intolerable in spite of recommended interventions necessitates general anesthesia with endotracheal intubation (Morgan et al., 2006).

Spinal anesthesia is preferred over epidural anesthesia for an emergent cesarean section for many reasons. It is easy to perform, has a more rapid, predictable onset, is associated with a decreased risk for systemic toxicity, and produces a more intense, complete block. Due to the fast set up of the spinal block, time from the injection of the anesthetic into the subarachnoid space to incision time is merely minutes. This allows for as close to immediate incision as possible and, therefore, delivery of the fetus (Morgan et al., 2006).

Possible Complications of Spinal and Epidural Anesthesia

Hypotension, by far, is the most common complication of spinal and epidural blockade. Obstetrical nurses need to have an understanding of physiological changes with pregnancy and why hypotension is a common finding after regional anesthesia in this patient population. They must have good judgment on intravenous fluid bolus administration, vasopressor administration and when they do need to call anesthesia for help or questions. It

is important to follow protocols/standing orders (Mahlmeister, 2003). Hypotension, defined as a 20 to 30% drop in blood pressure or a systolic pressure less than 100 mmHg, is the most common side effect of regional anesthesia (Cook et al., 2009; Faccenda & Finucane, 2001; Morgan et al., 2006; Wedel-Jones, Mandala, Barron, Bernstein & Osol, 2009). Hypotension is caused by decreased sympathetic tone that occurs with spinal and epidural anesthesia. The drop in blood pressure is more exaggerated when there is aortocaval compression and/or when the patient is in a semi-upright position. Hypotension should be expected with the initiation of regional anesthesia, and the anesthetist must have treatment options planned, prepared, and at the bedside. A full set of vital signs should be obtained prior to the procedure, and the patient should be monitored during and after the placement of a subarachnoid or epidural blockade. Before placing an epidural catheter or performing a subarachnoid block, the patient should receive a crystalloid fluid bolus in order to offset the expected decrease in sympathetic tone and, therefore, hypotension. Also, prior to initiating regional anesthesia, the patient should be given supplemental oxygen and positioned appropriately to allow for the ideal placement of the catheter or needle. After the local anesthetic is administered into the epidural or subarachnoid spaces, intravenous (IV) vasopressor treatment options for hypotension consist of ephedrine (5 to15 mg) or phenylephrine (25 to 100 mcg). Once the procedure is complete, the patient may lay down in the left uterine displacement position. Keep in mind, however, the trendelenburg position is contraindicated in the pregnant, laboring woman due to its potentially detrimental effects on pulmonary gas exchange. Treatment of hypotension should be aggressive to ensure adequate perfusion to the fetus (Cook et al., 2009; Faccenda & Finucane, 2001; Morgan et al., 2006; Wedel-Jones et al., 2009).

Supine hypotension syndrome (also known as aorto-caval compression/syndrome) is a complication of pregnancy that can develop in 10 to 20% of patients at term when placed in the supine position. The enlarging uterus creates a pressure that compresses the inferior vena cava resulting in a degree of occlusion. This occlusion decreases venous return to the heart, and therefore, decreases CO, ultimately leading to systemic hypotension. The aorta is also compressed producing decreased blood flow to the lower extremities, uterus, and placenta (Faccenda & Finucane, 2001; Morgan et al., 2006; Wedel-Jones et al., 2009).

Hypotension associated with pallor, diaphoresis, vertigo, nausea, or vomiting are signs of supine hypotension syndrome. Tachycardia is noted from the response of the baroreceptors and sympathetic system to a decreased CO. Obstruction of the vena cava can show signs of venous stasis, phlebitis, or edema in the legs and feet (Faccenda & Finucane, 2001; Morgan et al., 2006). Increased collateral venous drainage is seen with the distended paravertebral venous plexus and other vessels to the abdominal wall. Depending on the severity of the compression and the patient's ability to compensate for the decrease in CO, changes in level of consciousness may be noted (Faccenda & Finucane, 2001; Miller et al., 2005; Wedel-Jones et al., 2009). Fetal distress occurs as result of the maternal hypotension, increased uterine venous pressure from occlusion of the vena cava, and decreased perfusion to the placenta from the aortic compression (Cook et al., 2009; Faccenda & Finucane, 2001; Morgan et al., 2006; Wedel-Jones et al., 2009).

Treatment for supine hypotensive syndrome consists of proper positioning to prevent this occurrence. Avoidance of the supine position unless care is taken to displace the uterus should be a priority. A wedge, greater than fifteen degrees, can be used under the right hip to shift the uterus to the left preventing compression of the vena cava and aorta. Slight tilt of

the OR table can also be used to relieve some of the pressure (Miller et al., 2005). If the patient develops hypotension she can also be positioned to the left lateral side; this may restore the venous return and improve the hypotension. Supplemental oxygen should be applied to increase oxygenation to both mother and baby since cardiac output is insufficient. Intravenous fluids and ephedrine should be used to support decreased blood pressure (Cook et al., 2009; Faccenda & Finucane, 2001; Morgan et al., 2006; Wedel-Jones et al., 2009).

Overall, the consensus of the literature states that possible complications (and treatment of these complications) of epidural and spinal blocks for obstetrical patients has been the same for the past several decades from an anesthesia standpoint. A multitude of information is available concerning possible complications of spinal and epidural anesthesia. Serious, but rare complications may include high blocks, total spinals, systemic toxicity, neural injury (nerve root damage, spinal cord damage, cauda equina syndrome), hematoma formation, true local anesthetic allergy, abscess formation and infection. More common, but less severe complications include trauma (backache, dural puncture or leak), post-dural puncture headache, catheter/needle misplacement (ineffective block, patchy/inadequate anesthesia), transient neurological symptoms, pruritis and nausea (Birnbach & Ranasinghe, 2008; Cook et al., 2009; Faccenda & Finucane, 2001; Jenkins, 2004; Moen & Irestedt, 2008; Pool, 2003; Pool, 2001).

Many complications exist that are directly associated with epidural placement and administration. According to Bethune, Harper, Lucas, Robinson, Cox, Lilley and Yentis (2004), the following list shows these complications and the rate of occurrence:

> "(a) difficulty moving legs, 1:10; (b) itching, 1:10; (c) difficulty passing urine, 1:10; (d) failure of epidural, 1:100; (e) headache, 1:200; (f) severe fall in blood pressure,

1:1,000; (g) intravascular injection of local anesthetic, 1:10,000; (h) total spinal, 1: 10,000; (i) nerve damage 1:13,000; (j) meningitis, 1:100,000; (k) being paralyzed, 1:1,000,000, and (l) backache and needing instrumental delivery, unchanged" (p. 31).

Systemic toxicity is due to excessive plasma and tissue concentrations of local anesthetic. Accidental intravascular injection during epidural anesthesia is the most common cause of this. Detrimental effects involve mainly the central nervous system (CNS) and the cardiovascular (CV) system. The degree of systemic absorption depends on the dose administered, the vascularity of the injection site, physiochemical properties of the LA and presence of epinephrine in the solution. The addition of 5 mcg of epinephrine to every 1 mL of LA to make a concentration of 1:200,000 decreases systemic absorption by about one-third (Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

CNS toxicity is a very rare, but very serious complication. Low plasma concentrations with CNS toxicity may produce tinnitus and numbness of the tongue and lips due to the high vascularity of these tissues. As the concentration increases, the local anesthetic readily crosses the blood brain barrier to cause further CNS effects. Progression occurs in the following order: (1) dizziness and numbness of tongue and lips; (2) tinnitus and blurred vision; (3) restlessness, agitation and nervousness; (4) slurred speech, drowsiness and skeletal muscle twitching; (5) tonic-clonic seizures; (6) CNS depression with hypotension and apnea; and (7) CV collapse. Once a nurse or provider recognizes the progression of CNS toxicity occurring, it is imperative to administer a benzodiazepine, such as Midazolam, to the patient. Specific plasma concentrations with correlating effects include analgesia at 1 to 5 microgram/milliliter (mcg/mL), lightheadedness and tinnitus at 5 to 10 mcg/mL, seizures and unconsciousness at 10 to 15 mcg/mL, respiratory arrest and coma at 15-25 mcg/mL and CV

collapse at greater than 25 mcg/mL (Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

CV system toxicity is first manifested by hypotension due to relaxation of arteriolar vascular smooth muscle and direct myocardial depression. This reflects decreases in systemic vascular resistance and CO. At low plasma concentrations, the local anesthetic effects cardiac sodium channels and contributes to the antidysrhythmic properties of these drugs. Accidental intravenous bupivacaine injections may result in rapid hypotension, cardiac dysrhythmias and an atrioventricular heart block. The electrocardiogram changes very little before it progresses to ventricular tachycardia or ventricular fibrillation. Threshold for cardiotoxicity may be decreased in patients taking drugs to inhibit cardiac impulse propagation, such as beta-blockers, digitalis or calcium channel blockers. Cardiac complications are often refractory to standard treatment options. Bupivacaine for epidurals should be limited to 0.25% or 0.5% due to the volumes used in these situations. Bupivacaine for spinals is usually 0.75% since a denser block is usually desired. Bupivacaine 0.75% is no longer approved for epidural use in the obstetrical population since the majority of deaths from CV collapse have occurred in this population with this concentration. (Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Treatment for CNS or CV toxicity includes the basic airway, breathing and circulation (ABC's) treatments for basic life support measures. Supplemental oxygen is required at the earliest signs of toxicity. Adequate respiratory ventilation is necessary to prevent hypoxemia and acidosis. It will likely be required to establish an airway by intubation. Circulation should be managed by using IV fluid, colloids and vasopressors. Medications such as IV benzodiazepines, thiopental and propofol are effective in suppressing

local anesthetic induced seizures. Advanced cardiac life support measures should be followed. Prevention is accomplished by being familiar with safe dosages, always aspirating before each injection and reinjection, proper monitoring, adequate preparation for possible resuscitation, careful selection of a LA for a specific purpose with attention paid to the concentration, using fractionated doses (no more than 5 mL at a time) and by the use of a vasoconstrictor if not contraindicated (Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Neurotoxicity results from local anesthetic being injected into the epidural and subarachnoid spaces. Effects may be seen as patchy groin numbness, persistent muscle weakness, transient radicular irritation and cauda equina syndrome. With transient radicular irritation, moderate to severe low back pain radiating down legs may be seen and appears within 24 hours after complete recovery from a spinal anesthetic (usually lidocaine). It is also associated with the lithotomy position. Symptoms subside within one week, and it is thought to be related to a neuroinflammatory process. Cauda equine syndrome occurs after infusion of local anesthetic through microcatheters used in continuous lidocaine spinal anesthesia. It is associated with high concentrations of lidocaine with pooling of the drug around the cauda equina. Effects include sensory and motor deficits, bowel and bladder dysfunction and paraplegia. Anterior spinal artery syndrome is another possible complication. With only one artery supplying this area, problems can arise as a result of severe hypotension, venous congestion or outflow obstruction. Permanent paralysis of the lower extremities can occur due to anterior spinal artery syndrome, and it occurs with prolonged periods of hypotension. Symptoms are sudden, and flaccid paralysis is the main sign (Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Moen and Irestedt (2008) discussed neurological complications following central neuraxial blockades in the obstetric population. These authors discussed neurological complications from a more in-depth standpoint focusing on specific disease processes in relation to central neuraxial blockade. While many complications discussed fit in well with my independent study, such as an epidural abscess, the authors focused more on diseases such as multiple sclerosis, spina bifida, myasthesnia gravis, Von Willebrand disease and coagulations disorders.

It is known that monitoring, assessment and care of women receiving epidural anesthesia during the intrapartum period continues to remain the responsibility of the labor and delivery nurse. According to Mahlmeister (2003), it is estimated that more than half of women in labor do receive labor epidurals. However, even with this high percentage and the reality that all anesthetic procedures carry risks, the rate of significant adverse outcomes from epidurals has been reduced by safer drugs, protocols, guidelines and biomedical equipment. Yet, the labor and delivery nurse must be ready to appropriately anticipate and respond to life-threatening complications.

Complications from epidural and spinal anesthesia are considered either minor or major. Minor complications are issues that are usually self-limiting and are often a result of concomitant use of intrathecal narcotics. These problems can include nausea, vomiting, pruritis and urinary retention. Other minor problems that usually do not comprise physiological integrity of the mother include transient hypotension, maternal temperature elevation, unintentional dural puncture leading to a spinal headache and backache/back pain (sometimes lasting up to a few weeks after catheter removal) (Leighton & Halpern, 2002).

Epidural and subarachnoid hematomas require immediate surgical intervention. If a block lasts significantly longer than expected, a hematoma should be ruled out. Severe back pain and lower extremity paresthesia require immediate attention. The occurrence of epidural hematomas is less than 1 in 150,000. Often, patients may have an underlying/undiagnosed coagulation disorder. Symptoms are lower extremity weakness/numbness/paraplegia which may be masked by the local anesthetic. Treatment is early detection and spinal decompression within six to twelve hours. Hematomas may occur during labor or delivery or may begin at the time of epidural catheter removal. Literature stresses that epidural/spinal hematomas should be suspected when there is a long lasting dense motor block after discontinuation of anesthetic (Cook et al., 2009; Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Neurological complications are rare but often are the patient's greatest level of concern. Nerve damage, having a 0.03 to 0.1 % chance of occurrence, may manifest as persistent paresthesia or limited motor weakness. Transient paresthesias and residual neuropathies usually resolve spontaneously in one to six months (Cook et al., 2009; Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Respiratory problems are usually a result of a high spinal or total spinal. The phrenic nerve (C3 to C5) controls the diaphragm. With a high spinal, blocking the phrenic nerve can lead to an inability to cough and to feel respirations even though the patient is still able to maintain adequate tidal volumes. Total spinals are life-threatening and will lead to diaphragmatic paralysis and an inability to breath, leading to further necessary resuscitation measures. A total spinal is due to local anesthetic depression of the cervical spinal cord and brain stem, and results from an accidental injection of an epidural dose of local anesthetic

into the subarachnoid space. This potentially could occur with migration of an epidural catheter or by accidentally placing an epidural catheter into the subarachnoid space and dosing it as an epidural. Again, this stresses the importance of test doses and aspiration before each reinjection of LA. A total spinal is characterized by sinus bradycardia, profound hypotension, respiratory arrest and unconsciousness. The drug of choice for treatment is epinephrine along with advanced cardiac life support protocols. An isotonic intravenous solution should be administered and infused at a rapid rate and left uterine displacement should be maintained. If narcotics were combined with the anesthetic agent, a reversal agent, such as naloxone, should be administered. An adequate airway must be established and maintained, and positive pressure ventilation with 100% oxygen is initiated with an anesthesia bag and mask until a qualified provider can intubate the trachea. These actions should be carried out with all life-threatening complications that may arise (Cook et al., 2009; Faccenda & Finucane, 2001; Mahlmeister, 2003; Miller et al., 2005; Morgan et al., 2006).

Post dural puncture headache (PDPH) is a topic that has been covered thoroughly in the anesthesia field. The chance of causing a PDPH is about 1%, and according to the literature, the level of experience of the CRNA is related to this percentage. A PDPH is more common in young females, when there have been several attempts at placing an epidural, and when large, cutting needles are used. The hallmark sign is that it is postural in nature, with the headache mild to gone in the supine position and the headache mild to severe when the patient is sitting or standing up. The location of the headache is usually occipital to fronto-occipital, and the patient may occasionally complain of diplopia, seeing "spots", tinnitus, a buzzing or roaring sound, and nausea and vomiting. Treatment consists of administration of

IV fluids, caffeine, supine position, rest, possibly epidural saline (30-50 mL) or a blood patch, with the latter two being completed by an anesthesia provider. The "gold standard" for treatment is the blood patch. The cause for a PDPH is due the loss of CSF through a needle puncture, resulting in decreased brain buoyancy. The PDPH can occur immediately after the procedure or as late as five days after the procedure, but is most commonly one to two days after the dural puncture. Generally, the earlier the presentation, the more severe the symptoms present. The blood patch usually works best if given after the first 24 hours, and it works by increasing subarachnoid and epidural pressure and forming a "patch" of clotted blood which seals the dural tear. The success rate is 95% with the first blood patch. It may be repeated a second time only, and this must be done 24 hours after the first blood patch. If a second blood patch is necessary, the success rate is then 99%. Possible complications which may present with a blood patch placement consist of back, buttocks and leg pain/pressure, and a mild temperature elevation. These symptoms may be treated with acetaminophen and usually resolve rather quickly (Canidido & Stevens, 2003; Cook et al., 2009; Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

General Principles of Nursing Care When Complications Occur

The development of a major epidural or spinal complication, such as a high spinal, total spinal, allergic reactions or epidural hematoma, requires prompt initiation of life support measures. Any nurse caring for the woman who has received an epidural or SAB should be well-versed in the correct sequence of the steps when an emergency arises. First, the emergency call system should be activated while a clear and concise report about the situation is conveyed to the floor staff, anesthesia providers and obstetricians. A patent airway must be maintained with positive pressure ventilation with 100% oxygen via bag-

valve-mask if respiratory compromise is evident. Preparations should be made for full cardiopulmonary resuscitation, if necessary, and may include cardiac compressions and intubation. IV fluids administered should be wide open and left uterine displacement is implemented. The nurse must be familiar with possible medication requests per the physician if pharmacy services are not currently present. If a seizure occurs due to a total spinal, attention must be paid to help prevent injury. The nurse must anticipate the orders for an anticonvulsant (Canidido & Stevens, 2003; Cook et al., 2009; Faccenda & Finucane, 2001; Miller et al., 2005; Morgan et al., 2006).

Not all high spinal blocks occur with the initiation of an epidural. Catheters can migrate. The woman may begin to exhibit gradual signs of a rising level of motor and sensory blockade. The nurse must perform frequent respiratory assessments, along with vital signs documented and assessed every 5 to 15 minutes. To adequately measure the level of the block, obstetrical nurses need to be competent in assessing dermatome levels and should be familiar with which nerve fibers are being blocked. Nerve fibers are categorized into A, B and C fibers. The A fibers are further divided into alpha, beta, gamma and delta fibers. A-delta and C fibers carry pain sensation. A-delta fibers, being myelinated, conduct at a very rapid rate and carry "first pain" signals. Only the C fibers are completely unmyelinated. They are slower and carry "second pain," which is dull and aching in nature. The primary objective of the SAB is to block the A-delta (sharp) and C fibers (dull). However, we also block the A-alpha/beta (proprioceptive and motor functions), A-gamma (muscle tone) and B-fibers (sympathetic) simultaneously (Faccenda & Finucane, 2001; Moen & Irestedt, 2008; Morgan et al., 2006; Wedel-Jones et al., 2009).

The order of nerve blockade is important in assessing neuraxial blockade. First B

fibers (preganglionic sympathetic fibers) are blocked. With this, venodilation occurs and typical low blood pressure may occur. Next, C and A-delta fibers are blocked, which are associated with pain, temperature and touch sensation. A-gamma fibers are blocked next, and these are associated with the loss of muscle tone. Then A-beta fibers are blocked, and this leads to the loss of motor function and proprioception. Last, the A-alpha fibers are blocked, which also causes loss of motor function and proprioception. The progression of the order of sensory loss is (1) pain; (2) heat/cold (temperature); (3) touch; and (4) pressure. The order of these senses being restored occurs in the reverse order. Touch, proprioception, and motor function may (and often do) remain intact, especially with the use of certain concentrations of local anesthetics being utilized for epidural blockade (Miller et al., 2005; Moen & Irestedt, 2008; Morgan et al., 2006).

B-fibers are small and more permeable to local anesthetics than the larger fibers, therefore sympathetic blockade (assessed via temperature) is two dermatomes above the sensory level block (assessed via pinprick/pain). The sensory block is two dermatomes above the motor block. For example, if the sensory block is at the T6 level, the sympathetic block will be at the T4 level, and the motor block will be at the T8 level. A dermatome is an area of skin that is mainly supplied by a single spinal nerve root. Immediately after leaving the spinal cord, spinal nerves divide into ventral and dorsal branches. Each spinal segment supplies a unique distribution to the skin (dermatome) and a specific number of muscles. This is how anesthesia providers and labor and delivery nurses assess the level of a block. A few specific dermatome levels are as follows: L1 – the genitalia area , T10 – the umbilical area, T6 – the xiphoid process, T4 – the nipple line and C8 – the 5th digit (Miller et al., 2005; Moen & Irestedt, 2008; Morgan et al., 2006).

Allergic reaction to local anesthetics can present in various ways. Even though true local anesthetic reactions are extremely rare, reactions may range from mild urticaria to laryngeal edema, bronchospasm and anaphylaxis with profound hypotension and severe respiratory compromise. Again, care is directed at maintaining the airway and preventing cardiovascular collapse. Depending on the severity of the reaction, an antihistamine, epinephrine and steroids may be ordered (Miller et al., 2005; Moen & Irestedt, 2008; Morgan et al., 2006).

Labor and delivery nurses must be aware of possible contraindications for the placement of a neuraxial block in the pregnant woman. The only actual absolute contraindication is patient refusal. However, there are some other certain patient situations where the placement of an epidural or spinal block may be considered an absolute contraindication. These instances include severe hypovolemia, an elevated intracranial pressure, an infection at the injection site, a major coagulopathy disorder (such as extremely low platelets or disseminated intravascular coagulation), any aortic stenosis or moderate to severe mitral stenosis. Subarachnoid blocks result in decreased afterload (vascular resistance) and preload which can cause catastrophic cardiovascular decompensation. These patients really rely on adequate afterload and preload in order to adequately maintain perfusion to the fetus and the parturient (Miller et al., 2005; Moen & Irestedt, 2008; Morgan et al., 2006).

It is vital to be prepared at all times. Vigilance and prevention is the key. All staff should know where all emergency equipment is. If the labor and delivery nurse questions any kind of action a provider is performing, they should not be afraid to address the situation. Dermatome levels and patient status should be assessed frequently. In general, IV fluids are beneficial. According to Mahlmeister (2003), the number of pregnant women receiving

epidurals during labor and birth will only continue to increase. Even though the incidence of complications remains very low, the potential for life-threatening adverse reactions still does exist.

While it is not necessary for the labor and delivery nurse to be fully educated on how exactly local anesthetics work for spinals and epidurals or to be completely well versed with specific local anesthetics, it is important they do know the basics of commonly used local anesthetics. Bupivacaine is very commonly used for both labor epidurals and spinal anesthesia for cesarean delivery. Bupivacaine provides a more potent sensory blockade than motor blockade. It also has high protein binding properties, therefore very little of the drug crosses the placental. The concentration for a spinal block is 0.75% to 0.5% of about 1 to 2 mL. Overall, it has a very quick onset of just minutes, with a duration of 120 to150 minutes. Epinephrine can be mixed with bupivacaine in spinals. This extends the duration of the LA by causing the area to vasoconstrict, therefore producing slower systemic absorption rate. By decreasing the absorption rate, the risk of systemic toxicity is lower. This is important because bupivacaine has a high affinity for cardiac receptors (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

The concentration of bupivacaine for an epidural is less at 0.0625% to 0.25% depending on the exact technique used. Onset is about 10 to 20 minutes, with a duration of about 120 to 240 minutes. In general, the higher the concentration of a local anesthetic is, the denser the block is. For example, the spinal concentration is 0.75%, providing a denser block, which is appreciated for a cesarean delivery. It should also be noted that bupivacaine 0.75% is no longer approved for epidural use. The majority of deaths from cardiovascular

collapse in this population were attributed to this concentration of bupivacaine in epidurals (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

Lidocaine in the obstetric population is not seen as frequently as in years past. It provides a dense motor blockade, which is not ideal for labor. Another reason for this is the prevalence of transient neurologic symptoms and cauda equina syndrome that has been attributed to the use of lidocaine. However it is still used by some practitioners. Lidocaine 0.25% to 2.0% is used in epidurals with a duration of 75 to 120 minutes with a fast set up. Spinal administration is done with a 1.5% to 2.0% concentration. This has a very fast setup and a duration of 60 to 90 minutes. Because of the very fast onset of lidocaine, it still is frequently used for cesarean sections when the patient comes to the operating room with a functioning labor epidural (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

Ropivacaine is an isomer of bupivacaine. It is less potent with a lower risk of potential systemic toxicity. It is a great local anesthetic for epidurals since it is less potent and has less systemic and cardiac risks than bupivacaine. It is a long lasting and dense sensory block, which makes it ideal for epidural blockade. The concentration for spinals and epidurals is 0.2 to 1.0%. The duration of action is 1.5 to 2.5 hours for spinals and 1.5 to 4.0 hours for epidurals. It is often used with fentanyl, which significantly reduces the amount of LA needed to provide full and lasting comfort to the patient while decreasing risks of toxicity (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

Intrathecal narcotics are frequently used in both epidural and spinal anesthesia. Fentanyl, 15 to 25 mcg, may be used in spinal anesthetics. It has a fast onset of 5 to 10 minutes, but has a limited duration of 2 to 4 hours. Duramorph, 0.15 to 0.5 mg, may be utilized and must be preservative free. It has a slow onset of 60 to 90 minutes but has a

duration of 18 to 24 hours. Since it is not lipid soluble, it tends to drift throughout the CSF. Because of this, it could reach respiratory centers in the medulla in 6 to 24 hours which could potentially lead to respiratory depression. Since this is a possibility, it is of utmost important to check respiratory status frequently until 24 hours post administration. Not only do opiods provide prolonged pain control, but they also have a synergistic effect when used with a LA in subarachnoid and epidural blockade, therefore less LA may be necessary. The need for less LA contributes to a lesser risk of toxicity. Side effects of intrathecal use include itching, urinary retention, respiratory depression and possible nausea and vomiting. These effects can be treated with naloxone, nalbuphine, diphenhydramine and ondansetron (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

Epinephrine can also be mixed with certain local anesthetics in spinals. The presence of epinephrine in the solution, specifically an addition of 5 micrograms of epinephrine to every 1 mL of LA (making a 1:200,000 epinephrine: LA mixture) decreases systemic absorption of local by about one-third. Epinephrine has been shown to extend the duration of certain local anesthetics by causing the area to vasoconstrict, therefore producing slower systemic absorption rate. By decreasing the absorption rate, the risk of systemic toxicity is lessened (Katzung, 2006; Miller et al., 2005; Morgan et al., 2006).

METHODOLOGY

The methodology for this independent project started with a thorough review of the literature. Specific databases utilized included PubMed, CINAHL and SCOPUS. All searches included a time-frame of 1985 to current. The search strategy used the key words "epidural block," "subarachnoid block," "spinal block," "complication," "labor and delivery," "nurse," "education," "pregnancy" and "obstetrics." A nurse educator on a labor and delivery unit at

hospital facility was contacted, and it was explained to her that the intended presentation was specifically an educational presentation for labor and delivery nurses regarding spinal and epidural anesthesia and potential complications. Plans were made to present during a specific time and date. An educational presentation using current literature and anesthesia textbooks was then developed and was titled, "Spinal and Epidural Anesthesia in the Obstetrical Population." The educational session included a Power Point presentation, a discussion and a question and answer period. Specific planned topics of discussion for the labor and delivery nurses included an anatomy review, physiological considerations regarding regional anesthesia in obstetrical patients, a discussion of how local anesthetics work, and lastly complications of spinals and epidurals (refer to appendix). When the Power Point presentation was finished, an evaluation form was added to aid in the evaluation of the educational materials (refer to appendix). The presentation in the complete form was provided to the labor and delivery educator for the unit for complete review prior to the presentation.

On the day of the scheduled presentation, I provided the information to seven labor and delivery nurses (one of which was the nurse educator for the labor and delivery unit), which was the targeted population. The topics, as previously listed, were presented in a matter of about 40 minutes, and at the end of the presentation, the nurses had several questions for me. Following the question and answer session, the group evaluated the course. They rated the course on a scale from one to five, with one signifying they "strongly disagree" with the given statement, and five signifying they "strongly agree" with the given statement.

Table 1 – Scaled Results from the Evaluation

Question	Individual Results	Averaged Results
1. The objectives were clearly presented.	5, 4, 4, 4, 4, 4, 5	4.29
2. The content of the speakers talk met my expectations.	5, 5, 3, 3, 3, 5, 4	4.0
3. The speaker presented the material in a clear manner.	5, 4, 4, 4, 4, 5, 2	4.0
4. The speaker spent appropriate time on the presentation.	5, 5, 5, 4, 4, 2, 4	4.14
5. I would recommend this presentation to other nurses.	5, 5, 3, 4, 4, 4, 3,	4.0
6. I feel I did learn some new information regarding regional anesthesia in the obstetrical patient population.	5, 5, 3, 5, 4, 5, 4	4.43

The success of the presentation was evident as the results all leaned towards a positive outcome. All statements included in the evaluation form received results of a 4.0 or above on the aforementioned 1 to 5 scale. The labor and delivery nurses were interested in the topic presented and asked many questions, mostly concerning anatomy and the exact placement of epidurals and spinals. They also asked several questions regarding complications of spinals and epidurals. It was noted by the presenter that most of the questions asked were from nurses with less than three years of clinical experience. Since this presentation was deemed a success, it may be assumed that it would be beneficial to provide educational material in the same manner in the future.

DISCUSSION AND IMPLICATIONS FOR NURSING

Recommendations for Practice, Research, Education and Policy

Limited literature was available regarding the necessary education and competency of labor and delivery nurses concerning regional anesthesia in the obstetrical patient. However, the information that was available certainly did reach a consensus. In concurrence with my beliefs prior to the start of this project, the literature showed that most orientation programs

briefly discuss regional anesthesia and potential complications, but leave the amount of information and training insufficient for the nurses to feel confident in their understanding of the complications and competency to respond. Extra emphasis should be provided to new staff with a focus on anticipation, recognition, and response to obstetric anesthesia complications, as well as continuing education for all staff. By providing this focused instruction regarding the ability to anticipate, recognize, and respond to complications in obstetrical anesthesia, the nurses' confidence and competence will increase. Didactic information coupled with event-specific simulation can help the entire obstetrical team to become involved with the process of patient safety.

Through this independent project it was my intention that certified registered nurse anesthetists work collaboratively with the labor and delivery nursing staff. Skillful communication needs to exist between obstetric and anesthesia providers and be ongoing. Patients at risk for anesthesia complications need to be identified. It is important that as practitioners we are able to adequately explain risks and benefits of spinals or epidurals. Likewise, it is the responsibility of the bedside nurse to be able to explain common complications from spinals and epidurals, but they must also be aware of more serious complications and how to appropriately respond to these occurrences. Nurses must be familiar with the most serious complications, even though they are much less common. It is of the utmost importance that nurses be ready for all resuscitation measures at any given time, and this must include knowing where emergency equipment is located, how to use this equipment and to anticipate what providers will request.

Further research needs to be carried out regarding the topic at hand. It will not be until all of previously mentioned recommended interventions take place in order to fully

educate our nation's labor and delivery nurses regarding regional anesthesia in the obstetrical patient that we will be able to assess the effectiveness of the education. Once there is an ongoing, specific intended action plan in place for epidural and spinal education intended for labor and delivery nurses, further studies will be necessary to research the positive outcomes of patient care due to the increased awareness and competencies of the nurses.

Many other possible studies could add to this project. It may be beneficial to complete research specifically targeting labor and delivery nurses and how they feel about their spinal and epidural education and competencies before and after undergoing educational in-services and partaking in an approved research study. Another study could look at the communication between staff nurses and anesthesia providers and how this communication is linked to patient outcomes. Likewise, another could focus on the hospital policy aspect of the topic. Every hospital has policies and standing orders which must be followed. It would be interesting to see through a study of differing hospitals to ascertain what commonalities of policies and standing orders lead to a strong orientation process for labor and delivery nurses.

CONCLUSION/SUMMARY

In conclusion, epidural and spinal anesthesia numbers in the obstetrical population will either remain stable or continue to rise. Even if the incidence of adverse reactions remains very low, the potential for life-threatening complication still remains. Multiple physiological changes during pregnancy are important to understand in order to provide the most competent care to these patients. It is vital that labor and delivery nurses receive a certain degree of didactic education, a suitable period of supervised clinical experience/orientation and complete various forms of skills verification before taking responsibility for a pregnant woman receiving regional anesthesia.

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APPENDIX

SPINAL AND EPIDURAL ANESTHESIA IN THE OBSTETRICAL POPULATION

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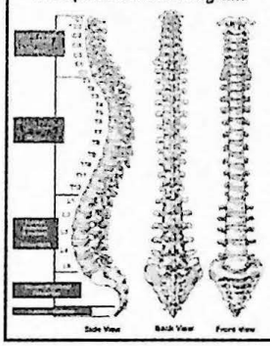
April 12, 2010

Topics To Be Discussed

- Review of Anatomy
- Physiological Considerations Regarding Regional Anesthesia in OB Patients
- How Do Local Anesthetics Work?
  - -Discussion of Commonly Used Local Anesthetics
- Spinal and Epidural Complications
- Any Questions?

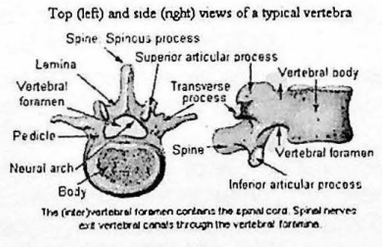
Anatomy

The Spinal Column Diagram



- Vertebral column formed by the sequential interconnectivity of 33 vertebrae
- Vertebral column extends from base of skull and foramen magnum to tip of coccyx
  - 7 cervical, 12 thoracic, 5 lumbar, 5 fused sacral, 4 fused coccygeal

- Lumbar vertebra are shortest and least angled
- Vertebrae
  - Transverse process
  - Pedicle
  - Vertebrae body
  - Lamina
  - Spinous process – "landmarks"



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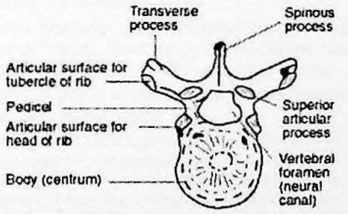


Vertebral Ligaments

- The supraspinous ligaments, interspinous ligaments, and ligamentum flavum act as landmarks that assist in identification of and access to the epidural and subarachnoid spaces
  - Skin: we inject a small bleb of LA into the skin before inserting needle
  - Subcutaneous fat: Variable thickness
  - Supraspinous ligament: joins the tips of the spinous process
  - Interspinous ligament: thin, flat band of ligament running b/w the spinous processes
  - Ligamentum flavum: quite thick, up to 1 cm, composed of elastic tissue. Connects lamina to lamina
    - particularly important with epidurals (located right before entering the epidural space)
    - When the needle is within the ligaments, it will feel gripped and a distinct give can often be felt as it passes through the LF and into the epidural space
    - Feels "gritty" or "sandy"
    - Strongest of the posterior ligaments

Spinal Cord Facts

- Spinal cord extends from medulla oblongata through spinal foramen to the level of the lumbar vertebra
  - At birth, spinal cord ends at L3 and gradually moves cephalad to L1
  - Ends at L1 in most adults
  - Ends at T12 in 30% of adults
  - Extends to L3 in 10% of adults
- Flexion of the vertebral column causes the tip of the spinal cord to move slightly cephalad
- Each spinal nerve contains motor, sensory and autonomic nerve fibers

Meninges

- Meninges are protective layers of tissue that directly cover the spinal cord
- 1. Pia mater – surrounds spinal cord directly and covers spinal roots/nerves
- 2. Arachnoid mater – cobweb like membrane covers brain and spinal cord
- 3. Dura mater – also covers brain and spinal cord
  - Invests the roots of the spinal cord
  - Tough outer membrane
- Arachnoid and dura are VERY close together that when doing a spinal, it is almost impossible to penetrate the dura without also penetrating the arachnoid

Order of Structures

- For Spinal : Skin→ Subcutaneous tissue → Supraspinous ligament → Interspinous ligament→ligamentum flavum→ into epidural space → through dura mater and arachnoid mater into the subarachnoid space. The epidural placement is exactly the same, except the needle stops advancement when it hits the epidural space (have LOR).

- Epidural space: space immediately after the LF and before the dura
- Subarachnoid space: space b/w the arachnoid mater and the pia mater. Contains CSF
- Spinal cord tapers to the conus medullaris and nerve pathways, which run more vertically, in a collection of rootlets call the cauda equina ("horses tail")

Anatomy of Epidural Space

- Epidural space is a potential space outside the dural sac but inside the vertebral canal
- Bounded cranially by the foramen magnum, caudally by the sacral hiatus, laterally by the pedicles, posteriorly by the ligamentum flavum and vertebral lamina
- Contains epidural veins, fat, lymphatics, segmental arteries and nerve roots
  - Rich plexus of veins is primarily on anterior and lateral side
  - Blood supply to the spinal cord and nerve roots is derived from a single anterior artery and paired posterior spinal arteries
    - Artery of Adamkiewicz arises from the aorta, typically unilateral providing the major blood supply to the anterior, lower 2/3 of the spinal cord

Anatomy of Epidural Space

- Fat is the most ubiquitous material in the epidural space
  - Epidural fat can hold onto lipid soluble drugs (fentanyl), reducing bioavailability
- Distance from the skin to the lumbar epidural space varies w/ individuals
  - 2.5 to 8 cm
  - Varies w/ vertebral level and often assoc. w/ patient weight

Epidural Anesthesia

- Slower onset as compared to a spinal
- Usually not as dense of a block as compared to a spinal
- Utilizes larger volume of a very dilute concentration of LA, often combined w/ opiate to specifically target small sympathetic and sensory fibers, sparing motor fibers
- Results in:
  - Sympathetic block
  - Sensory block
  - Motor blockade

Spinal Anesthesia

- Blocks nerve roots as they course through the subarachnoid space and CSF
- Performance of block below L1 avoids needle trauma (usually try to go below level L2)
- AKA
  - Subarachnoid blocks
  - SAB
  - Intrathecal (opiods w/ or s/ LA)
    - Excellent in helping w/ postop pain (duramorph frequently)

Spinal Anesthesia

- Usually a denser block
- Provides profound sympathetic, sensory and motor block
- Very rapid onset
- Small volume of LA (1-2 mL)
- Needles much smaller than epidural needle
  - Usually 25 gauge in the OB population, versus 17-18 gauge for epidural

Generalizations for SAB

- Sensory: bupivicaine>lidocaine>tetracaine
- Motor: tetracaine>lidocaine>bupivacaine
- Dosage: the greater the dose
  - Faster onset
  - Longer duration
  - Denser block
  - Increased spread
  - Too few milligrams
    - Spotty and poor block
- Duration: tetracaine> bupivicaine> lidocaine

Additives to Spinal Anesthesia

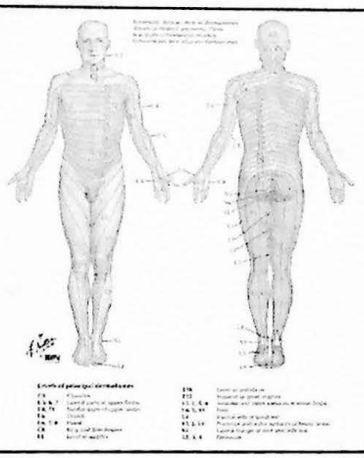
- Epinephrine
  - Use as a wash
  - Markedly prolongs tetracaine (has been shown in research to not prolong bupivicaine)
  - May add quality
- Fentanyl
  - Adds quality
  - May add to duration because of quality
  - Duration 2-4 hours
  - Minimal short term side effects
  - Effects gone after 4 hours

Spinals

- Spinal anesthsia is the temporary chemical interruption of sensory, autonomic and motor nerve fiber transmission
  - Thought to take place in the anterior and posterior nerve roots as they pass through the CSF
- 3 classes of nerves: motor, sensory, and autonomic
  - Stimulation of motor nerves (blocked 3rd) causes muscles to contract and when they are blocked, muscle paralysis results
  - Sensory nerves (blocked 2nd) transmit sensations such as touch and pain to the spinal cord and from there to the brain
  - Autonomic nerves (blocked 1ST) control the blood vessels, heart rate, gut contraction and other fxns not under conscious control

Dermatomes

- Cutaneous area innervated primarily by a single nerve root
- Immediately after leaving the spinal cord, spinal nerves divide into ventral and dorsal branches
- Each spinal segment supplies a unique distribution to the skin (dermatome) and a specific number of muscles
- How we measure our block



SAB Contraindications

- Absolute:
  - Patient refusal (THE ONLY ACTUAL ABSOLUTE)
  - Severe hypovolemia
  - Elevated ICP
  - Infection at the injection site
  - Major Coagulopathy (ex. DIC)
  - AS or MS (outflow obstructions)
    - SAB results in decreased afterload (vascular resistance) and preload which can cause catastrophic cardiovascular decompensation
    - These pts really rely on adequate afterload and preload

What Nerve Fibers are Blocked?

- Categorized into A,B,and C
- A is further divided into alpha, beta, gamma and delta
  - A-delta and C fibers carry pain sensation. A-delta fibers, being myelinated, conduct at a very rapid rate and carry "first pain" signals
  - Only the C fibers are completely unmyelinated. They are slower and carry "second pain," which is dull and aching in nature. Local anesthesia will act along all C fibers, but only at the breaks in the myelin.

- Primary objective of the SAB is to block the A-delta (sharp) and C fibers (dull)
- However, we also block the A-alpha/beta (propriocptive and motor fxns), A-gamma (muscle tone) and B-fibers (sympathetic) at the same time

Assessing the SAB

- B-fibers are small and more permeable to LA than the larger fibers, therefore sympathetic blockade (assessed via temperature) is 2-4 dermatomes above the sensory level block (assessed via pinprick/pain)
- The sensory block is 2 dermatomes above the motor block
  - Ex. If sensory block is at the T6 level, then the sympathetic block will be at the T4 level, and the motor block will be at the T8 level
- Order in which nerve fibers are blocked: B fibers> C & A delta> A gamma> A beta > A alpha
- Estimating dermatome level:
  - L1 – genitalia
  - T10 – umbilicus
  - T6- xiphoid process
  - T4 – nipple line
  - C8 – 5th digit

Factors Influencing Level and Duration of SAB

- Baricity (ratio of density of a solution to the density of CSF)
- Position
- Drug concentration
- Drug volume
- Speed of injection
- Needle/bevel direction
- Pt age and ht
- Intraabdominal pressure
- Use of vasoconstrictors

- Increased intraabdominal pressure
  - Pregnancy and obesity can cause engorgement of the venous plexus which decreases the size of the subarachnoid space and possibly decreases CSF volume
    - Increases chances of dural puncture
    - Increases chances of contact with engorged veins
    - This lessened size/volume will result in a higher spread of the block
    - Because of this, the normal dose may be reduced by 30% for pregnant women, even more so with obese pts and if carrying more than one baby
      - This is opposite of what we are accustomed to doing with many of our other patients

Intrathecal Narcotics

- Fentanyl (15-25 mcg) – fast onset (5-10 min) but limited duration (2-4 hours)
- Duramorph (0.24 – 0.5 mg) must be preservative free. Slow onset (60-90 minutes) but has a duration for 18-27 hours. Since it is not lipid soluble, it tends to drift throughout the CSF. Could reach respiratory centers in the medulla in 6-12 hours (→ resp. depression)
- Not only do opiods provide prolonged pain control, but also has a synergistic effect on LA (SAB and epidural)
  - Need less of the LA→ less chances for toxicity
- Side effects: itching, urinary retention, resp depression
  - Tx. w/ narcan, nubain, benadryl, and zofran

Physiological Considerations Regarding Regional Anesthesia in OB Patients

- Regarding regional anesthesia, cardiovascular alterations are the main issue of concern.
- Cardiac changes are in response to the change in metabolic demands of the mother and fetus.
- Blood volume increases drastically
  - plasma volume increases 45%
  - red blood cells increase 15 to 30%
  - blood volume increases 1000 to 1500 mL
  - total blood volume reaches 90 mL/kg

- Cardiac output (CO) increases 30 to 40 %
- HR increases 15 to 20 %
- stroke volume increases 20 to 50 %
- In the first trimester CO averages 6.7 L/minute and continues to increase to about 8.7 L/minute at the end of pregnancy
- Systemic vascular resistance is reduced further leading to the increased circulation

- The heart responds with physical changes including both chamber dilation and hypertrophy
- The heart increases in size by about 12%, and it is slightly elevated and rotated to the left
- Vascular tone during pregnancy is increasingly sensitive to sympathetic control
  - Due to this fact, hypotension is more distinct following spinal and epidural blocks
  - Complications from incorrect positioning of a parturient can lead to detrimental effects of both mom and baby

- Musculoskeletal changes
  - Pregnancy causes an increase in lumbar lordosis and reduces the distance between adjacent lumbar interspaces
    - can prevent the woman from adequately flexing
  - Ligaments can be softened, altering the gritty feel of the ligamentum flavum
  - In a non-pregnant woman, the line between the iliac crests is typically the L4 – L5 interspace, but with pregnant women this line shifts to the L3 – L4 interspace
  - Adipose tissue and interstitial edema can make palpation of the vertebral column difficult

Supine Hypotensive Syndrome

- Aka Aorto-Caval Compression Syndrome
  - Decrease in CO can occur in supine positions after 28 wks
  - SB and low BP occurs, SB is preceded by period of ST
  - Other s/sx: pallor, diaphoresis, vertigo, N/V
  - d/t complete or near complete occlusion of the IVF and aorta by the gravid uterus
    - Venous stasis, phlebitis, LE edema, LOC changes
  - Profound decrease in venous return
  - Trendelenberg position may exacerbate caval compression

Aorto-Caval Compression Syndrome cont'd

- Combo of systemic hypotension, increased uterine venous pressure, and uterine arterial hypoperfusion → comprosmies uterine and placental blood flow
  - Compression of maternal aorta and IVC by gravid uterus
  - Depends on maternal position
  - Decreases maternal BP
  - Decreases uterine perfusion
- Correct with:
  - LUD 15 degrees in left lateral position
  - Fluid loading
  - Supplemental O2

Effects of IVC Compression

- Decreased venous return, CO and uterine blood flow
- Results in pooling of venous blood and increased uterine and LE venous pressures
  - Increased venous pressures = decreased uterine blood flow
- Compression of IVC below diaphragm distends and increases blood flow through collateral venous drainage→epidural vein engorgement even more

Regional Anesthesia and Physiological Alterations

- Directly blocks the SNS
- Remember, the sympathetic blockade can be 2-4 dermatomes higher than the sensory level
- Hypotension is the most common complication
  - Can occur w/in 3-5 min (w/ SABs) and is r/t venodilation → decreased CO
  - Main clue to impending hypotension is nausea
  - More pronounced in hypovolemic and pregnant pts
  - The higher the block, the more venous capacitances (pooling) and therefore less blood return to the heart

- SB can be associated w/ the blockade of T2-4 because these are the cardioaccelerators
- Decreased venous return causes decreased stretch of the RA → SB
- SB can also occur bc of surgical manipulatoin (C-section)
- How should we treat pts w/ HTN who experience hypotension
  - Keep within 20 % of their norm. SBP of 100 is the "magic number", but with many pts an SBP of 100 may still not be high enough

How Do Local Anesthetics Work?

- Regional Anesthesia
  - Peripheral = Extremities (nerve block)
  - Central = Neuraxial
    - Includes spinals, epidurals and caudal
- Principal site of action
  - The nerve root
  - Local anesthetic injected into the CSF or epidural space bathes the nerve roots
  - Effects of LA on nerve fibers varies according to the nerve size, myelination, the concentration achieved and duration of contact

How Do Local Anesthetics Work?

- No one MOA explains all of the physiological effects of all of the LAs
- Newest research focuses on a specific binding site or receptor within Na channels

How Do Local Anesthetics Work?

- Chronology of Events
- 1. Solutions of LA deposited near nerve. Diffusion of LA molecules away from this site occurs as result of tissue binding, removal by circulation, and local hydrolysis. What is left of LA will penetrate the nerve sheath
- 2. LA molecules permeate the nerve's axon membraines and reside there.

- 3. Binding of LA to sites on voltage-gated Na+ channels prevents opening by inhibiting the conformational changes that underlie channel activation. LA's bind in the channel's pore and also occlude the path of Na+ ions
- 4. During onset and recovery from LA, impulse blockade is incomplete so partially blocked fibers are further inhibited by repetitive stimulation, producing additional, use-dependent binding to Na+ channels
  - LA just hanging around will bind to these Na+ channels that begin to "move"

How Do Local Anesthetics Work?

- 5.One LA binding site on the Na+ channel might be sufficient to account for the drugs resting and use-dependent actions. Access to this site may potentially involve multiple pathways.
- 6. The rate of onset and recovery are governed by the relatively slow diffusion of LA molecules into and out of the whole nerve

- In a nutshell:
  - 1.Diffusion of LA base portion through nerve sheath
  - 2. Binding of cationic (charged) portion of LA to membrane receptor site (inside of nerve)
  - 3. Blockade of sodium channels
  - 4. Decrease in sodium conductance
  - 5. Depression of rate of electrical depolarization
  - 6. Failure to achieve threshold potential level
  - 7. Lack of development of propagated action potential
  - 8. Conduction blockade

Order of Nerve Blockade

- Order of nerve blockade:
  - B fibers (preganglionic sympathetic fibers)
    - venodilation, low BP
  - C and A-delta fibers (pain, temp, touch)
  - A-gamma fibers (loss of muscle tone)
  - A-beta fibers (loss of motor and proprioception)
  - A-alpha (loss of motor and proprioception

Order of Sensory Loss

- 1. pain
- 2. heat/cold
- 3. touch
- 4. pressure

4. restored
3. in
2. reverse
1. order

- Occurs in progression
- Touch, proprioceptin, and motor function may (and often) remain intact

Bupivacaine

- The concentration for a spinal block is 0.75%-0.5% of 1-2ml
  - Very quick onset – minutes, duration 120-150 minutes
  - Epinephrine can be mixed with bupivacaine in spinals
    - extends duration of the LA by causing area to vasoconstriction - producing slower systemic absorption rate. By decreasing the absorption rate, the risk of systemic toxicity is lower
    - This is important because bupivacaine has a high affinity for cardiac receptors
- The concentration of bupivacaine for an epidural is less at 0.0625% to 0.25% depending on exact technique used
  - Onset 10-20 minutes, duration 120-240 minutes
- Bupivacaine provides a more potent sensory blockade then motor blockade
- High protein binding – very little drug crosses the placental

Lidocaine

- Not seen in the obstetric population today like it was in years past
  - dense motor blockade – not ideal for labor
  - transient neurologic symptoms, CES
- Lidocaine 0.25%-2.0% is used in epidurals w/ duration of 75-120 minutes
- Spinal administration, 1.5% to 2.0% -duration of 60-90 minutes
- Fast onset – still used for c-sections when pt comes in w/ functioning labor epidural

Ropivacaine

- Isomer of Bupivacaine
- Less potent - lower risk of potential systemic toxicity
- Great LA for epidurals:
  - Less potent –less systemic/ cardic risks than bupivacaine
  - Long lasting
  - Dense sensory block
- Spinals and epidurals is 0.2%-1.0%
- DOA 1.5-2.5 hours for spinals
- DOA 1.5-4.0 hours for epidurals
- Often used w/ fentanyl - significantly reduces amount of LA needed to provide full and lasting comfort to pt while decreasing risks of toxicity

Spinal and Epidural Complications

- Allergic rxns – rare, less than 1% of all adverse rxns to LA are d/t this
- Systemic toxicity – d/t excessive plasma and tissue concentrations of LA
  - Accidental intravascular injection during epidural anesthesia is most common mechanism (also seen w/ PNBs)
  - Involves mainly the CNS and CV system
  - Degree of systemic absorption depends on
    - Dose administered
    - Vascularity of the injection site
    - Presence of epi in the solution – addition of 5 mcg of epi to every mL of local (1:200,000) decreases systemic absorption of local by about 1/3
    - Physiochemical properties of the LA

CNS Toxicity

- Low plasma concentrations
  - Produces numbness of the tongue and lips d/t high vascularity of these tissues
  - Tinnitus
- As concentration increase, LA readily crosses the BBB to cause further CNS effects
- Progression
  - Tongue and lips numb, dizzy
  - Tinnitus and blurred vision
  - Restlessness, agitation, nervousness
  - Slurred speech, drowsiness, skeletal muscle twitching
  - Tonic-clonic seisures
  - CNS depression w/ hypotension, apnea
- What to do? Get some midazolam in your pt.(As PaCO2 levels increase, the seizure threshold decreases)

Plasma Concentration mcg/mL

• 1-5 mcg/ml	Analgesia
• 5-10	Lightheadedness,tinnitus
• 10-15	Seizures, unconscious
• 15-25	Coma, resp arrest
• >25	CV collapse

CV System Toxicity

- Hypotension
  - Relaxation of arteriolar vascular smooth muscle
  - Direct myocardial depression
  - Reflects decreases in SVR and CO
- At low plasma concentrations
  - LA effect cardiac sodium channels and contributes to the anti-dysrhythmic properties of these drugs

- With excessive plasma concentrations
  - Sufficient cardiac Na+ channels become blocked so conduction and automaticity become adversely depressed
- With excessive Lidocaine
  - Slow Conduction rates manifest as prolonged P-R interval and QRS complexes
  - Gives you some warming if you have an ECG on your pt

- Accidental IV bupivicaine injections
  - May result in rapid hypotension, cardiac dysrhythmias and AV heart block
  - EKG changes very little before it progresses to VT and VF
- Threshold for cardiotoxicity
  - May be decreased in pts taking drugs to inhibit cardiac impulse propagation like beta-blockers, digitalis or calcium channel blockers
- Cardiac complications are often refractory to standard treatment options

- Bupivicaine
  - For epidurals should be limited to 0.25% or 0.5% d/t the volumes used in these situations
- Bupivicaine for spinals is usually 0.75% (want a denser block)
- Bupivicaine 0.75% no longer approved for epidural use in OB population. Majority of deaths from CV collapse in this pop. attributed to this concentration

Treatment for CNS or CV Toxicity

- ABCs
- Airway
  - Adequate respiratory ventilation to prevent hypoxemis and acidosis
  - Hyperventilation if pt able to
  - Intubation
- Breathing
  - Supplemental O2 at earliest sign of toxicity

- Circulation
- Drugs
  - IV benzos, thiopental, and propofol are effective in suppressing local anesthetic induced seizures
  - Epinephrine is drug of choice
  - Follow ACLS guidelines

Prevention

- Be familiar with safe dosages
- If not contraindicated consider use of vasoconstrictor
- Always aspirate and test dose before each injection and re-injection
- Fractionated dose
  - No more that 5 mL at a time
- Adequate preparation for possible resusciation
- Proper monitoring
- Careful selection of LA for specific purpose, and attenction to concentration required and dosing guidelines

Neurotoxicity

- Results from LA injection into epidural and subarachnoid spaces
- May be seen as patchy groing numbess, persistent muscle weakness, transient radicular irritation or cauda equina syndrome

Transient Radicular Irritation

- Moderate to severe low back pain radiating down legs that appears within 24 hours after complete recovery from spinal anesthetic w/ lidocaine (usually)
- Associated w/ lithotomy position
- Symptoms subside within 1 wk
- Related to neuro-inflammatory process

Cauda Equina Syndrome (CES)

- Neurotoxicity after infusion through microcatheters used in continuous lidocaine spinal anesthesia
  - Pooling of drug (assoc w/ Lidocaine) around the cauda equina
    - Is now recommended to mix lidocaine w/ equal parts of CSF (making it more isobaric)
  - High concentrations
  - Sensory and motor deficits
  - Bowel and bladder dysfunction
  - Paraplegia

Anterior Spinal Artery Syndrome

- w/ only one artery supplying this area, problems can arise as a result of severe hypotension, venous congestion or outflow obstruction
- Permanent paralysis can occur d/t ASAS. Occurs w/ prolonged periods of hypotension and may result in permanent paralysis of the LE
- Sx are sudden. Flaccid paralysis is the main sign

Other Complications

- #1 – Hypotensoin
  - From sympathetic blockade
  - Tx w/ IVF and vasoactive meds (ephedrine, phenylephrine)
  - Pre-tx w/ IVF

- Neurological complications are rare but often are the pts greatest level of concern
  - Nerve damage (0.03 -0.1 %)
    - Persistent parasthesia or limited motor weakness
- Transient parasthesias and residual neuropathies resolve spontaneously in 1-6 months usually
- Epidural and subarachnoid hematomas require immediate surgical intervention
- A hematoma should be ruled out if the block lasts significantly longer than expected. Severe back pain and LE parasthesia require immediate attention.

- Epidural hematoma (<1 in 150,000)
  - Often have underlying disorder/coag defects primary cause
  - LE weakness/numbness/paraplegia
  - May be masked by LA use for pain control
  - Tx – early detection and spinal decompression (within 6-12 hours)
  - May occur during labor or delivery, may begin at time of epidural catheter removal
  - Suspect when there is a long lasting dense motor block after discontinuation of anesthetic

Complications Cont'd

- Meningitis or epidural abscess is avoided by aseptic technique
  - Sx arise 1-3 day post procedure
  - Back pain, tenderness, fever, WBCs up
- Other neurologic injuries are r/t positioning, ischemic events and preexisting conditions

- Respiratory problems usually result of a high spinal or total spinal
- Phrenic nerve (C3-5) controls the diaphragm. Blocking the phrenic nerve can lead to inability to cough, feel respirations, but are able to maintain TVs. Anxiety!- Reassure
- Total spinals can lead to diaphragmatic paralysis – inability to breath – need to intubate
  - Local anesthetic depression of the cervical spinal cord and brain stem

- Total spinals
  - Result of accidentally injecting an epidural dose of LA into the SA space
  - Also can occur with migration of catheter
  - Important: test doses, and aspiration before each re-injection of
  - Patient complains of numbness to fingers and thumb – indicates level of C6,7,8
  - Characterized by SB, profound hypotension, respiratory arrest and unconsciousness
  - DOC is epinephrine
  - Treat as Code Blue/Code 99

PDPH

- 1-2 % w/ epidural attempt
- Common in young females, multiple attempts, and large, cutting needles
- Hallmark sign : postural in nature (H/A mild to gone in supine position, H/A mild to severe when pt sitting/standing)
  - Usually occipital to fronto-occipital
  - Occasionally diplopia, "spots", tinnitus, buzzing, roaring, N/V
- Tx: IVF, caffeine, supine, rest, epidural saline (30-50 mL) or blood patch
- Etiology: loss of CSF through needle puncture results in decreased brain buoyancy

PDPH

- Usually 1-2 days after dural puncture
- Can occur immediately or as late as 5 day post
- The earlier the presentation, the more severe the sx
- Epidural blood patch – "gold standard"
  - Usually works best after 1st 24 hrs
  - Mechanism – blood increases subarachnoid and epidural pressure and forms "patch" of clotted blood and seals dural tear
  - Success rate – 95% first blood patch
  - May need repeating – OK to do 24 after later and success rate – 99%

- Blood patch
  - Complications – back, buttocks, leg pain (especially if >20 mL injected)
  - 35% mild back pain, temp elevation – tx tylenol, usually resolves 24-48 hrs

Lastly

- Be prepared
- Vigilance is the key! – Prevention!
- Know where all emergency equipment is!
- If you question something that a provider is doing, don't be afraid to address it
  - Ex. not aspirating
- Assess dermatome levels and pt status frequently
- In general – IVFs are your friends ☺

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University of North Dakota
College of Nursing
Nurse Anesthesia Specialization

GUEST SPEAKER EVALUATION FORM

Name of Guest Speaker **Megan Dallman, SRNA**

Topic **Spinal & Epidural Anesthesia in the OB population**

Date of presentation **April 12, 2010**

(1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree					
Please place an X in the appropriate boxes	**1**	**2**	**3**	**4**	**5**
1. The objectives were clearly presented.					
2. The content of the speakers talk met my expectations.					
3. The speaker presented the material in a clear manner.					
4. The speaker spent appropriate time on the presentation.					
5. I would recommend this presentation to other nurses.					
6. I feel I did learn some new information regarding regional anesthesia in the obstetrical patient population.					

Speaker and presentation strengths:

Suggestions for improvement:

Additional Comments:

Education of Obstetrical Nursing Staff Regarding Regional Anesthesia and Possible Complications

Megan Dallman, SRNA

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Introduction

- Complications can arise with the placement of spinal or epidural anesthetics and may occur during, immediately after, hours after and even days after placement of a spinal or epidural anesthetic.
- If the obstetrical patient does experience complications, the obstetrical nurse must have an adequate knowledge base regarding regional anesthesia in order to provide the most competent care possible.

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Statement of Problem

- Adequate knowledge of obstetrical nurses regarding risks, benefits and techniques of regional anesthesia, specifically subarachnoid and epidural blocks, is an issue of concern for Certified Registered Nurse Anesthetists.

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Purpose of the Study

- The purpose of this independent project is to thoroughly review the most current evidence-based literature concerning the information and education necessary for obstetrical nurses to provide safe and effective care to the obstetrical patient undergoing regional anesthesia.
- This information will then be provided to a selected obstetrical nursing staff.

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Goal

- The goal of the presentation will be to increase the knowledge base of the obstetrical nurse who provides direct care to the obstetrical patient undergoing regional anesthesia, specifically subarachnoid and epidural blocks. It is anticipated that the education provided to these nurses will lead to safer obstetrical nursing care, which could potentially lead to better patient outcomes.

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Significance of the Study

- Appropriate knowledge of regional anesthesia and analgesia by nurses caring for obstetrical patients at the bedside is vital to patient safety.
- CRNAs have a responsibility to ensure that the nurses who are caring for their patients following placement of a regional block are appropriately informed with the most up to date information regarding potential risks and complications.
- In particular, they must be aware of:
  - differences between epidurals and subarachnoid blocks
  - physiological changes/considerations regarding regional anesthesia in OB patients
  - hemodynamic instability in relation to physiological considerations
  - patient responses after administration of regional anesthesia
  - potential complications and appropriate treatment

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Areas of Inquiry

- Being an SRNA in the last 4 months of my schooling, I have had the opportunity to observe and communicate with many OB nurses while providing anesthesia for laboring patients.
- During these interactions, I came to the conclusion that while many of the staff nurses seemed very adequately trained in caring for a patient who had received a spinal or epidural anesthetic, there were also nurses who did not seem adequately educated.

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Areas of Inquiry

- This observation lead to a few questions:
  - What is the evidence for the level of knowledge of regional anesthesia required for obstetrical nurses to provide quality care to obstetrical patients?
  - What can I do, as an SRNA and future CRNA, to help educate OB nurses to ensure appropriate, competent care for obstetrical patients receiving regional anesthesia?

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Literature Review

- Review of literature was done using PubMed, SCOPUS and CINAHL databases
- Abundance of information regarding complications of epidurals and spinals in relation to the obstetric population
- Slightly limited research regarding appropriate competency of labor and delivery nurses in relation to complications of regional anesthesia for the obstetric population

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Literature Review

- Overall, the consensus of possible complications (and treatment of these complications) of epidural and spinal blocks for OB patients has been the same for the past several decades from an anesthesia standpoint.
  - Serious, but rare: High block, total spinal, systemic toxicity, neural injury (nerve root damage, spinal cord damage, cauda equina syndrome), hematoma formation, LA allergy, abscess formation, infection

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- Cont'd
  - More common: trauma (backache, dural puncture or leak), PDPH, catheter/needle misplacement (ineffective block, patchy/inadequate anesthesia), transient neurological symptoms, pruritis
  - The most common complication by far: hypotension d/t effects from sympathectomy
    - treated with IVF and vasopressors

(Jenkins, 2004)

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Literature Review (Regarding OB Nurses)

- Most orientation programs briefly discuss regional anesthesia and potential complications, but leave the amount of information and training insufficient for the nurses to feel confident in their understanding of the complications and competency to respond
- Extra emphasis should be provided to new staff w/ a focus on anticipation, recognition, and response to obstetric anesthesia complications, as well as continuing education for all staff.

(Balestrieri-Martinez, 2009)

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Literature Review (Regarding OB Nurses)

- Patients at risk for anesthesia complications need to be identified
- Skillful communication needs to exist between obstetric and anesthesia providers and be ongoing

(Balestrieri-Martinez, 2009)

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Literature Review (Regarding OB Nurses)

- Nurses MUST be familiar with the most serious complications (even though they are more rare).
- For example: Systemic toxicity
  - Need to know sx: blurred vision, dizziness, tinnitus, metallic taste, tongue numbness
  - Worsening sx: restlessness, incoherent speech, seizures
  - Cardiovascular collapse: initially may see HTN and ST, soon followed by low BP, arrhythmias and arrest
  - Nursing interventions: raise HOB, apply oxygen, IVF wide open, maintain patent airway, get help
    - Nurses must be ready for all resuscitation measures (know where equipment is and anticipate what providers will request, including medications)

(Malmeister, 2003)

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Literature Review (Regarding OB Nurses)

- The most common complication:
  - Hypotension
    - OB nurses need to have an understanding of physiological changes w/ pregnancy and why hypotension is a common finding after RA in this patient population
    - Need to have good judgment on IVF boluses and vasopressor administration, and when they do need to call anesthesia
    - Important to follow protocols/standing orders

(Malmeister, 2003)

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Literature Review (Regarding OB Nurses)

- Providing focused instruction regarding the ability to anticipate, recognize, and respond to complications in obstetrical anesthesia will increase the nurse's confidence and competence (Balestrieri-Martinez 2009).
- Didactic information coupled w/ event-specific simulation can help the entire OB team to become involved w/ the process of patient safety (Birch et al, 2007).

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Overview of Methods

- Presentation to OB nurses (7) at Meritcare
- Included:
  - Overview of basic anatomy and physiology
    - Vertebral column and structures
    - Physiological changes in a pregnant woman (and how this is relevant to RA)
  - What is a subarachnoid block?
  - What is an epidural block?
  - Basic principals of how local anesthetics work

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Overview of Methods

- What are contraindications to central blockade?
- What are factors that affect central blockade?
- What emergency equipment needs to be available prior to administering a central blockade?
- Possible complications associated with RA in the laboring woman
- How to anticipate and respond to these complications and how to possibly even prevent them

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Evaluation

- A basic questionnaire regarding the educational inservice was provided
- It was anticipated that after the powerpoint presentation the labor and delivery nurses would:
  - have a better comprehension of spinal and epidural anesthesia
  - understand physiological considerations for regional anesthesia in the OB patient
  - understand possible complications from RA
  - comprehend how to prevent, anticipate and respond to these complications

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Evaluation Results

(1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

- 1. The objectives were clearly presented.
  - Averaged 4.29
- 2. The content of the speakers talk met my expectations.
  - Averaged 4.0
- 3. The speaker presented the material in a clear manner.
  - Averaged 4.0
- 4. The speaker spent appropriate time on the presentation.
  - Averaged 4.14
- 5. I would recommend this presentation to other nurses.
  - Averaged 4.0
- 6. I feel I did learn some new information regarding regional anesthesia in the obstetrical patient population.
  - Averaged 4.43

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Questions???

Thank you for listening!

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