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The Beach Chair Position and Potential Complications Related to Cerebral Perfusion

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THE BEACH CHAIR POSITION AND POTENTIAL COMPLICATIONS RELATED TO CEREBRAL PERFUSION

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ABSTRACT

The complex and dynamic physiological changes that occur when a patient is anesthetized may be further influenced by the surgical positioning of the patient, including that of the beach-chair position. The beach-chair position is often utilized during orthopedic shoulder surgery. The purpose of this review is to identify, utilizing an evidenced-based approach, the potential risks to cerebral and/or spinal cord perfusion when utilizing the beach chair position for surgical procedures under general (and/or regional) anesthesia. Additionally, this review will identify physiological effects on cerebral autoperfusion during anesthesia utilizing the beach-chair position, as well as special considerations or guidelines anesthesia providers should follow when monitoring surgical patients in the beach chair position.

A comprehensive literature review utilizing retrospective reviews, case reviews, prospective studies regarding the beach-chair position and potential complications associated with this position was conducted. A PowerPoint presentation describing the beach-chair position, cerebral autoperfusion, and potential complications associated with this position was developed and presented to Student Registered Nurse Anesthetists at a Midwestern Hospital. This presentation was multi-dimensional with the goal being active participation by the group. Additionally, methodology involved a question/answer session based on relevant patient case scenarios. A post-presentation evaluation tool was used to evaluate the quality of the presentation. The physiological framework of adaption and homeostasis was used as the theoretical basis for this project.

The expected results of this project is to build awareness and knowledge among Certified Registered Nurse Anesthetists regarding the potential for complications when using the beach chair position during anesthesia by providing the current "best evidentiary" research available.

CHAPTER 1

INTRODUCTION

An essential anesthetic objective involves coupling the most efficacious patient position with the surgical procedure. Appropriate patient positioning facilitates the surgical process as well as provides for safe induction and maintenance of anesthesia intraoperatively. Conversely, inappropriate patient positioning can lead to serious complications. In fact, improper positioning is the second most commonly occurring anesthetic complication (Miller, 2005). The two most common manifestations of inappropriate positioning include nerve and brain damage. Peripheral nerve injury, specifically, is the most common injury resulting from improper positioning (Faust, 2002). The upright seated position, or what is commonly referred to as the "beach chair position," has garnered significant controversy of late among the annuals of published anesthesia journals.

A recent controversy has evolved, partially, because in the beach chair position a patient must be elevated anywhere from 30 degrees to 90 degrees upright. A well researched and publicized case series by Pohl and Cullen (2005) titled—*Cerebral Ischemia During Shoulder Surgery in the Upright Position* coupled with a subsequent follow-up article by Cullen and Kirby (2007) titled—*Beach Chair Position May Decrease Cerebral Perfusion* generated interest on this topic. The authors submit that a significant relationship between the beach-chair position, defined in their work as nearly 90 degrees upright, and the propensity for dangerous cerebral and spinal ischemia exists. Additionally they believe that thromboembolic events may also be associated with the

beach chair position. Furthermore the beach position may be a factor in adverse neurologic outcomes. In another recently published work by Rhee and Cho (2008), the authors identify unilateral hypoglossal nerve palsy as being associated with the use of beach-chair position. The scope of this paper involves an analysis of previously described case studies as well as other related studies.

Problem

Regardless of position, anesthetic agents, in general, decrease systemic blood pressure and therefore cerebral perfusion. The beach chair position has become a popular choice for surgical procedures on the shoulder. Specifically, orthopedic surgeons favor the beach-chair position as it does not distort the anatomy of the shoulder and is associated with fewer brachial plexus injuries (Cullen & Kirby, 2008). This position is also routinely used for posterior cervical procedures and posterior fossa craniotomies (Miller, 2005). Although the beach chair position has become a standard position for performing shoulder surgery, recent reports of severe complications warrant an etiological and/or physiological review of the position. The most apparent and serious concern stems from recent reports of cases involving cerebral and spinal cord infarction (Pohl & Cullen, 2005; Cullen & Kirby, 2007; Rhee & Cho, 2008). Apart from these very serious patient complications, the beach chair position is also associated with potential nerve injuries leading to upper arm paralysis or weakness (Miller, 2005). Also of note is the increased frequency of venous air embolism in patients within the beach chair position as compared with those in horizontal positions (Miller, 2005). Additionally, according to Morgan (2006), cardiac output and blood pressure decrease in the beach chair position due to pooling of blood in the lower extremities. This is accompanied by an

increase in heart rate and systemic vascular resistance (SVR). Changes to the respiratory system include increased lung volumes, increased functional residual capacity (FRC), and increased work of breathing (Morgan, 2006). Accordingly, Pohl and Cullen (2005) maintain that the "beach chair position leads to significant hemodynamic changes that have the potential to compromise cerebral circulation" (p. 467).

Purpose

The scope of this synthesis paper is to examine the physiological ramifications of the beach chair position when used for shoulder surgery. Emphasis will be placed on review of the following potential complications: (a.) compromised cerebral and spinal cord perfusion; (b.) the increased risk of venous air embolism; and (c.) neurological complications. The primary goal of this paper is to inform the anesthesia provider of these risks and to subsequently determine their role in minimizing the potential for these adverse outcomes. Awareness of the potential for and mechanisms of decreased cerebral/spinal perfusion (and other complications) associated with the surgical use of the beach chair position may lead to the establishment of guidelines for further evidence-based analysis. The essential aim of this project, therefore, is to offer an overarching review of complications that may result from the beach chair position during shoulder surgery. Recommendations for preventative anesthesia care will be reviewed as well as recommendations for further study.

Conceptual/Theoretical Framework

Roy's Adaptation Model will be used to examine the complexities associated with the advantages and disadvantages of the beach-chair position. The Roy Adaptation Model is comprised of four distinct areas—physiologic-physical mode, self-concept-

group mode, role function mode, and interdependence mode (McEwen & Willis, 2002). The scope of this paper is limited to the initial adaption mode or to those considerations related to the physiological and chemical processes associated with the beach-chair position. Furthermore, relevant concepts from the Roy Adaptation Model (RAM) to be used include: (a) focal stimuli; (b) contextual stimuli; (c) residual stimuli; and (d) regulator subsystem.

Focal stimuli refers to those stimuli that are proximate causes of the potential complication (McEwen & Willis, 2002). Within the context of this paper, the beach chair position is the focal stimulus. The beach chair position affords the orthopedic surgeon better access to the shoulder, but what seems to be lacking is a quantitative body of research in which a concerted risk-benefit analysis has been implemented to reveal the risks of compromised perfusion. A significant risk of serious complications may be associated with the use of the beach chair position during shoulder surgery, particularly when cerebral blood flow monitoring is not used to verify adequate cerebral perfusion. In contrast, according to a systematic review of the use of the beach chair position in neurosurgery both in the UK and the USA by Porter, Pidgeon, and Cunningham (1999), the authors determined that in most cases the beach chair position is not worth the risk of complications and resulting lawsuits.

A contextual stimulus, within the context of RAM, refers to "all other stimuli in the internal or external environment, which may or may not affect the situation" (McEwen & Willis, 2002, p.188). The notion of a contextual stimulus is critical in understanding the extenuating factors which may or may not affect a compromised patient. It is the need to understand the complex interactions of the beach chair position

and physiological and/or anesthetic induced alterations or "stimuli" that necessitates further quantitative evidence-based study. Contextual factors specifically associated with the beach chair position include: (a.) the use of beta-blocking drugs; (b.) the use of spinal and/or regional anesthesia versus general anesthesia; (c.) the location of the placement of the sphygmomanometer cuff (Sia, 2003); (d.) a change in torso position during the surgical procedure (Rhee & Cho, 2008); (e.) cerebrovascular risk factors; (f.) blood viscosity; (g.) embolic mechanisms; and (h.) head position and/or whether or not the head is appropriately secured.

Residual stimuli are those of which are "immeasurable and unknowable" and yet may exist and therefore may affect the situation. The incidence of severe complications such as cerebral and/or spinal cord ischemia during surgery is very low. According to Pohl and Cullen (2005), the likelihood of a patient experiencing a stroke perioperatively is only 1% to 2.5%. Yet on rare occasions, catastrophic complications occur for no apparent reason. It is, perhaps, the pursuit of attempting to quantify when an "unknowable" serious complication constitutes a pattern or a trend that has become an important catalyst for evidence-based practice (EBP). According to Sackett, Rosenberg, Gray, Haynes, and Richardson (1996), a fundamental aspect of EBP is to apply evidence gained from the scientific method to certain parts of medical practice. It seeks to assess the quality of evidence relevant to the risks and benefits of treatments (including lack of treatment). The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research.

Interestingly, while Roy would certainly concede that one will inevitably encounter residual stimuli, it is a measure of ones commitment to progressive quality

healthcare by which one pursues all available research to understand and therefore mitigate the potential for future residual stimuli. This commitment to integrating clinical expertise with cutting edge research is the embodiment of evidence-based practice.

The regulator subsystem involves a review of the basic type of adaptive processes that respond automatically through neural, chemical, cardiovascular, and/or endocrine coping channels. Essentially, within the RAM, a concerted review of the patho-physiology of the beach chair position is warranted. Twenty percent of overall body oxygen is consumed by the brain. Of that twenty percent, a full sixty percent of the oxygen that goes to the brain is used to make adenosine triphosphate (ATP), which is necessary for the activity of the neurons. The other forty percent of cerebral oxygen is used for cellular biosynthesis (Morgan, 2006, p. 613). Due to this relatively high consumption of oxygen the brain is very dependant on adequate cerebral blood flow (CBF). Therefore, according to Morgan, Mikhail, and Murray (2006), it takes as little as ten seconds for unconsciousness to occur and subsequent irreparable brain damage shortly thereafter.

Normal CBF is 45 to 65 mL/100 g/min. Normal cerebral metabolic rate for oxygen (CMRO2) is 3.0 to 3.8 mL/100 g/min. It is important to note that CBF and CMRO2 are linked in that the brain requires "a constant supply of substrate to meet its relatively high metabolic demands" (Dunn, 2007, p. 442). According to Dunn (2007), several factors affect and/or regulate CBF.

Cerebral perfusion pressure (CPP) is the difference between the mean arterial pressure (MAP) and the intracranial pressure (ICP) and is represented as CPP=MAP – ICP. Normally ICP is less than 10 mm Hg, therefore, CPP is significantly dependent on

MAP (Morgan, 2006). A less than normal MAP potentially could result in decreased CPP.

Definitions

The following definitions explain key terms and concepts used within the paper.

1. *Air embolism*: The abnormal presence of air in the cardiovascular system resulting in obstruction of the flow of blood through the vessel.
2. *Beach chair position* (also referred to as the barber's chair position): Generically defined as a semi-recumbent position. The beach chair position was developed in the 1980s. Patients are placed upright as if sitting in a reclining 'beach chair' at angles varying from 30-90% above the horizontal plane with appropriate padding and with the head secured in a headrest. The patient's legs are allowed to rest upon padded extensions.
3. *Brachial Plexus:* The brachial plexus is an arrangement of nerve fibers, running from the spine, formed by the ventral rami of the lower cervical and upper thoracic nerve roots, specifically from above the fifth cervical vertebra to underneath the first thoracic vertebra (C5-T1). It proceeds through the neck, the axilla (armpit region) and into the arm.
4. *Cerebral autoregulation*: The ability of the brain to maintain constant cerebral blood flow despite changes in systemic arterial pressure. Autoregulation of cerebral blood flow is efficient within a MAP range of approximately 60 to 140 mm Hg.
5. *Cerebral perfusion pressure (CPP):* Cerebral perfusion (CPP) is a measure of the amount of blood flow to the brain. It is calculated by subtracting the

intracranial pressure from the mean systemic arterial blood pressure. Normal CPP ranges from 70 to 100 mm Hg.

6. *Ischemia:* A decreased supply of oxygenated blood to a body organ or part, usually due to functional constriction or actual obstruction of a blood vessel.

Significance

While the beach chair position is routinely used in orthopedic shoulder surgery, scientific literature regarding the risks and benefits of this procedure for shoulder surgery is in the early stages. A case series by Pohl and Cullen (2005) and a follow-up case series by Cullen and Kirby (2007) represent a significant component of the existing body of work dedicated to this topic. In contrast, given the fact that the sitting position has been implemented in neurosurgery for more than eighty years, the risk-benefit equation of using the sitting position for use in neurosurgery is well documented (Porter, Pigeon, & Cunningham, 1999; Leonard & Cunningham, 2002). There was a lack of statistical data related to complications and the orthopedic use of the beach chair position in the past. Consequently there was also a lack of awareness among anesthetic providers as to the potential for complications. According to Smith and Osborn (2001), complications can occur with the beach chair position when proper understanding and subsequent monitoring of the physiological dynamics of cerebral and spinal perfusion are absent. Smith (2001) further submits that while appropriate guidelines for providing anesthesia in the beach chair position during neurosurgery is well known and documented among the neurosurgical community, these principals have not been transferred over to the orthopedic community. It is this lack of transfer that evidence-based medicine is tasked with overcoming. A renewed effort is afoot to make anesthesia providers more cognizant

of the importance of vigilant monitoring and awareness of pre-op BP baselines, maintenance of BP perioperatively, and the effect of potent intravenous and inhalational drugs on BP.

Assumptions

For the purpose of this project, the following assumptions were made.

1. The healthcare community would be served by promoting a thorough evidence-based review of the concerns raised by recent publications related to the beach chair position and orthopedic shoulder surgery.
2. The author assumes that the retrospective literature, medico-legal reports, case studies, and clinical explanations are valid and reliable.
3. The author assumes that the retrospective literature, medico-legal reports, case studies, and clinical explanations reviewed was appropriately collected, described, and represents an accurate portrayal of currently available academic literature on the beach chair position regarding cerebral and ischemia perfusion.
4. Participants associated with the in-service have an advanced understanding of anesthesia and physiology.

Limitations

Given the limited information available and the inability to conduct clinical trials or randomized studies, the sources used in this paper were confined to retrospective reviews, case reports and, medico-legal reviews.

Summary

The beach chair position in orthopedic shoulder surgery improves visibility and access for the surgeon. This position, however, has been linked to serious complications including compromised cerebral and/or spinal perfusion, air emboli, sciatic neuropathy, and brachial plexopathy. The benefits of the position may not outweigh the risks. This independent project aims to review these risks and benefits.

CHAPTER II

LITERATURE REVIEW

Introduction

The beach chair position is utilized for orthopedic shoulder surgery because it allows for improving visualization and surgical access while also minimizing changes in the intra-articular anatomy. It includes placing the patient in an elevated-sitting position ranging from angles of 30 to 90 degrees above the horizontal plane. The beach chair position is often requested by surgeons because of its noted benefits, however, it is also associated with significant complications of which anesthesia providers must be made aware. This paper investigates the beach chair position, including its risks and benefits using current research.

Review and Critique of Related Studies

Cerebral blood flow

Normal cerebral blood in an adult patient is approximately 50 to 65 ml per 100 grams of brain tissue per minute or 750 to 900 ml/min. This is equivalent to 15% of resting cardiac output. Cerebral blood flow (CBF) is closely related to the metabolic rate of the tissue. Carbon dioxide concentration, hydrogen ion concentration, and oxygen concentration are the metabolic factors associated with the control of CBF (Guyton & Hall, 2006).

The oxygen mechanism for local regulation of CBF is a protective response against diminished neuronal activity. The rate of utilization of oxygen by the brain remains within narrow parameters at approximately 3.5 ml of oxygen per 100 grams of brain tissue per minute. Insufficient blood flow to the brain causes immediate compensatory cerebral vasodilation, therefore returning or attempting to return CBF and transportation of oxygen to the brain to normal. A decrease in cerebral oxygen (O2) tension below 30 mm Hg immediately increases CBF (Guyton & Hall, 2006).

Frizzel, et al. (2005) identified extrinsic and intrinsic factors that affect the autoregulation of CBF. The extrinsic factors altering CBF are related primarily to the cardiovascular system and include MAP, cardiovascular function, and blood viscosity. CBF is autoregulated between MAP limits of 60 and 140 mm Hg. This means the MAP can be decreased acutely to as low as 60 mm Hg or increased to 140 mm Hg without a significant change in CBF. If the MAP drops below this range, the brain will initially attempt to compensate by extracting more oxygen from the available blood supply. If this compensation is ineffective, cerebral ischemia will occur. Alterations in cardiovascular function that affect cardiac output may also reduce CBF. If the cardiac output is reduced by more than one third, CBF will decrease.

The intrinsic factors, according to Frizzel et al. (2005) are related to cerebral perfusion pressure (CPP) and intracranial pressure (ICP). Cerebral perfusion pressure is the difference between MAP and ICP. The normal range is between 60 and 80 mm Hg. The goal is for CPP to remain constant when there are changes in MAP. Cerebral vascular resistance increases or decreases in response to MAP to maintain a constant flow to the brain (Frizzel, et al., 2005).

Benefits associated with the beach chair position

The efficacy of the sitting position (of which the beach chair position is included) in neurosurgery has been well documented in the past. Currently, issues related to the beach chair position are predominately explored within the context of orthopedic shoulder surgery. However, there were several recent and noteworthy studies pertaining specifically to the beach chair position, but outside the scope of orthopedic shoulder surgery. Notably, the quantitative study conducted by Valenza, et al. (2007) involved a research study of 20 obese patients. The authors were seeking to compare respiratory function in morbidly obese patients in supine versus beach chair positions. They found that the beach position outperformed the supine position in terms of measured elastance of the respiratory system (Valenza, et al., 2007). Yet, Valenza, et al, did not offer any commentary on practical applications. In 1988, Skybar, Altchek, Warren, Wickiewicz, and O'Brien published a qualitative work that touted the benefits of the beach-chair position in performing shoulder arthroscopy. At the time, shoulder arthroscopy was routinely completed with the patient in the lateral decubitus position, yet this position could lead to compromises in neurological problems or injuries to the brachial plexus. Their conclusions were based on a review of fifty patients who underwent shoulder surgery while in the beach-chair position. The authors reported excellent results with no operative or anesthetic complications or nerve palsies. It is unclear from their report as to which method of anesthesia was used other than a reference to "light sedation with an interscalene block" (Skybar, et al., 1988, p. 258). Essentially the authors concluded that the beach-chair position for shoulder surgery was a better alternative to the traditional lateral decubitus position in the following ways: (a) faster and more efficacious in patient

positioning set-up; (b) beach-chair does not require traction, while the lateral decubitus required traction; (c) more physiologic in terms of all types of anesthesia techniques; (d) more mobility options perioperatively; and (e) ergonomically advantageous for the surgical team (Skybar, et al. 1988).

Complications associated with the beach chair position.

It is important to note that although the beach-chair position has become a standard for surgical procedures of the shoulder and to a much lesser extent, for some neurological procedures (craniotomy), the fact is that the beach chair is a relatively new orthopedic position, stemming from the late 1980s. Reports of potential complications involving the beach chair position are rare and until the recent Pohl and Cullen (2005) and Cullen and Kirby (2007) reports was universally considered to be safe. One particular concern associated with the beach chair position is the potential for a decrease in cerebral profusion. Additionally, thromboebolic events, hypoglossal nerve injury, improper head placement and nerve compression have all been associated with the intraoperative use of the beach chair position. According to Faust (220), nerve injury is the most common complication resulting from improper patient positioning during surgery. Additionally, according to Warner (2005), during the intraoperative period inadequate positioning is a leading cause of nerve compression or stretch (p.5).

Mullins, Drez, and Cooper (1992) published a case report titled, "Hypoglossal nerve palsy after arthroscopy of the shoulder and open operation with the patient in the beach-chair position" in which they cautioned practitioners to be aware of changes in the position of a patient's neck while undergoing surgery in the beach-chair position. Specifically, Mullins, et al. (1992) reported on a case involving a shoulder arthroscopy

that required general anesthesia and endotracheal intubation. The patient was positioned in the beach-chair position with the neck secured in the neutral position. The duration of the anesthesia was seventy minutes. Upon awakening, the patient experienced a feeling of having a "thick tongue" which manifested as slurred speech. The ultimate diagnosis by a neurological consultant was isolated palsy of the hypoglossal nerve. Upon reflection, the authors concluded that the cause of the palsy was most likely a result of a change in the position of the neck causing "the nerve to be compressed beneath the angle of the mandible" (p. 139). Essentially, the authors concluded that at some point during the arthroscopic procedure, the patient's neck moved therefore causing the hypoglossal nerve to be compromised. It was not clear from the published account which neck immobilization techniques, if any, were used. However, apparently, Mullins', et al. cautionary note about the importance of diligence in checking the position of the patient's head while in the beach chair position was well heeded, in that the symptoms of hypoglossal nerve palsy within the context of this position did not appear again in print until 2008 in another case report by Rhee and Cho.

Rhee and Cho (2008) detail two cases of postoperative unilateral hypoglossal nerve palsy following shoulder surgery involving the beach chair position. While Rhee and Cho (2008) conceded that arthroscopy for the treatment of shoulder problems is standard, complications, although rare, do occur and are well documented (Berjano, Gonzalez, Olemdo, Perez-Espana, & Munilla, 1998). The authors contend that during arthroscopic shoulder surgery proper immobilization techniques to ensure the integrity of patients' head is paramount. Dissimilar to the Mullins, et al. report (1992), Rhee and Cho (2008) maintained that the hypoglossal nerve palsies in their cases came about not as a

result of the neck being inadvertently turned from the neutral position, but as a result of a change in trunk flexion from 70 degrees to 30 degrees.

Even more rare than hypoglossal nerve palsy in regards to the beach chair position during shoulder arthroscopic surgery, is visual loss and ophthalmopelia (Bhatti & Enneking 2003). Bhatti and Enneking (2003) reported on a case involving a routine arthroscopic shoulder surgery in which the patient was placed in a 90 degree beach chair position and subsequently suffered postoperative visual loss. The authors were unsure as to the etiopathogensis of the ocular complications, but positioning may have been a contributing factor. Interestingly, Bhatti and Enneking (2003), and Salvatore (2003) maintained that the most likely cause of the loss of sight was a severe and prolonged cerebral hypoperfusion. The gravitational effect of the patient's position (90 degrees upright) physiologically decreased CPP. Furthermore, the authors noted that the patient's head was at least 60 cm above the noninvasive blood pressure cuff [NiBP] which was placed at the ankle. The vertical distance between MAP at the brain decreases by 0.77 mm Hg per cm for each centimeter of gradient (Morgan 2006). Therefore, while the MAP according to the NiBP may have appeared adequate, the actual MAP at the brain may have been compromised.

A slight decrease in cerebral blood flow (CBF) during surgery and anesthesia can have devastating implications for the patient. According to Smith (2007), the beach chair position causes a reduction in central venous pressure, cardiac output, and MAP. With these changes in the non-anesthetized patient, the body naturally compensates by increasing its systemic vascular resistance. With induction of anesthetic drugs, this physiological mechanism is blocked. Vasodilation and reduction in venous return occurs

which further decreases MAP and therefore CPP. Smith (2007) states that there is approximately a 15% decrease in CPP in the non-anesthetized patient when placed in the beach chair position.

The beach chair position requires that the patient be placed in an upright position while under anesthesia, therefore raising concerns regarding the effect on cerebral blood flow. MAP and CPP are further impacted by pharmacological agents commonly used for induction and maintenance of anesthesia. Stoelting and Miller (2007) submit that a decrease in MAP occurs with increasing concentrations of isoflurane, sevoflurane, and desflurane in a dose dependent manner. These volatile agents have direct cerebral vasodilating effects resulting in an increase in cerebral blood flow. If MAP is decreased beyond the lower limit of cerebral autoregulation, cerebral blood flow becomes dependent upon systemic blood pressure.

Ischemia refers to a marked decrease in blood supply to the brain or spinal cord and may result from utilization of the beach chair position. According to Miller (2005), the spinal cord receives its blood supply from two posterior arteries and one anterior spinal artery. According to Hart and Hindman (1982), cerebral infarction perioperatively is a rare phenomena occurring in less than 1% of patients undergoing general surgical procedures. Perhaps, therefore, it is the rarity of cerebral infarction in general surgery that has lead to the widespread interest by Pohl and Cullen (2005) and Cullen and Kirby (2007) as they detail the tragic results of four patients who suffered intraoperative stroke during routine shoulder surgery in the beach chair position.

In their case series, Pohl and Cullen (2005) established a link between the use of the beach chair position during shoulder surgery and certain complications. These

associated complications included both cerebral and spinal cord ischemia. Pohl and Cullen (2005) describe four cases involving the beach chair position and negative outcomes. Indications are that all of the described cases of intraopertive stroke were attributable to postural hypotension and/or head and neck manipulation leading to compromised cerebral or spinal blood flow. For example, one case involved a 47 year old otherwise healthy female who suffered cerebral ischemia following shoulder surgery in the beach chair position. This case appeared routine as the arthroscopy procedure was unremarkable. Although her BP was 113/60 mm upon arrival to the post-anesthesia care unit (PACU) she did not awaken. She remained intubated and well oxygenated during her stay in the PACU. She was initially administered naloxone and subsequently physostigmine to aid in wakeup. Eventually, a computed axial tomographic (CAT) scan combined later with magnetic resonance imaging (MRI) indicated cortical infarcts.

Another case reviewed was similar in that a healthy 57 year old male also experienced a posterior circulation infarct involving various regions of the brain following shoulder surgery in the beach chair position. A more recent and related case study article by Cullen and Kirby (2007) also describes two cases linking the beach chair position with the potential for decreased cerebral/spinal perfusion. Fundamentally, as stated above, Pohl and Cullen (2005) base their conclusions on secondary case reports and medico-legal reviews. The authors reported on four instances whereby routine shoulder surgery culminated in severe complications, including permanent brain/spinal damage and death. The case reviews are primarily concerned with issues related to the beach chair position, cardiovascular risk factors, and cerebral ischemic complications" (Pohl & Cullen, 2005). The four patients described were in their late 40s' to mid 50s',

two women and two men, all undergoing shoulder surgery in the beach chair position. None of the patients exhibited historical indications that would put them at a high-risk for stroke.

Pohl and Cullen (2005) identify standard risk factors associated with stroke including hypertension, diabetes, and smoking. The authors delineated aspects of the cases into five distinct yet related components or risk factors: (a) cerebrovascular risk factors; (b) patient positioning; (c) hypotension & related contributing factors; (d) head position; and (e) embolic mechanisms. Apart from one patient's family history of stroke and one with hyperlipidemia, the four as a group did not display any potential signs of cerebrovascular risk.

> Pohl and Cullen (2005) conclude that— The most likely factor contributing to the reduction of cerebral perfusion in our case series is the patient's position. All patients underwent shoulder surgery in the beach chair/barbershop position (nearly 90 degrees upright)…Compared with the lateral decubitus position, the beach chair position facilitates anesthesia. Yet, this position in neurosurgical procedures is highly controversial because of the incidence of adverse events and outcomes, including air embolism, postural hypotension, quadripelegia, and injury to the sciatic, peroneal, and brachial plexus nerves, as well as obstruction of the internal jugular vein (p. 466).

Pohl and Cullen (2005) concluded that the beach chair position's potential to decrease cerebral perfusion pressure (CPP), combined with vasopressor agents' effect of compromising autoregulation may be one of the key cofactors in understanding the cause

behind the severe complications associated with their case series. Yet, as stated above, Pohl and Cullen (2005) contend that while cerebrovascular risk factors can be intensified by placing a patient in the beach chair position, there are three other factors as well that can lead to seriously compromised cerebral/spinal blood flow. The three factors include: (a) a patient's blood viscosity; (b) the position of the head and whether or not the head is appropriately secured; and (c) the potential for an embolic event in the form of an air or fat thromboembolus (Pohl & Cullen, 2005).

Lowe, Lee, Rumley, Price, and Fowkes (1997) also determined that "increased blood viscosity may be one plausible biological mechanism through which increases in hematocrit and fibrinogen may promote ischaemic heart disease and stroke" (p. 173). Pohl and Cullen (2005) asserted that the measure of a patient's blood viscosity as determined in part by one's hematocrit (Hct) reading is an important factor in influencing both cerebral and spinal blood flow. None of the four patients in the Pohl and Cullen (2005) case review had their Hct or hemoglobin levels checked pre-operatively and while the authors are not necessarily calling for such measures in regard to shoulder surgery in general, they did assert that a relatively high viscous blood flow for whatever reason can lead to a decreased CBF. Routine checks of hematocrit levels may be warranted for patients undergoing surgery and anesthesia involving the beach chair position. Therefore if the potential exists for such a phenomenon to occur, the anesthesia provider should consider obtaining a pre-operative hematocrit level.

The position of the head and/or ensuring that the patient's head is secure is of paramount importance for the surgical team. Wilder (1982) describes a case in which a patient in the beach chair position sustained a serious midcervical injury after a posterior

fossa craniotomy. Observations and experimental evidence was presented to support the theory that stretch of the cervical spinal cord associated with neck flexion may be sufficient to impair the autoregulation of spinal blood flow such that the reduced hemodynamic parameters associated with general anesthesia in the sitting position contributes to the risk of spinal cord infarction. Pohl and Cullen (2005) report similar conclusions regarding the beach chair position citing issues related to a relative fall in blood pressure at brain level when compared to other positions, air emboli, and anterior spinal artery syndrome from excess neck flexion.

Cullen and Kirby (2007) revisit the case earlier described by Pohl and Cullen (2005) involving a healthy 47 year old woman who suffered a fatal brain infarction during routine shoulder surgery in the beach chair position. The central theme behind the publication was to submit that "significant changes" occur when a patient is elevated to the beach chair position. Among the concerns associated with this position is autoregulation. Autoregulation in the presence of vasodilating anesthetics is compromised leading to significant decreases in cerebral perfusion (Cullen & Kirby, 2007). The authors, furthermore, advocate that a "critical variable" includes an understanding of the potential for miscalculation of MAP by relying on a standard BP cuff. Cullen and Kirby (2007) submit that given the beach chair position, MAP at the brain is very different when compared to the site at which the BP is actually measured, usually the arm.

Regarding the beach chair position as a factor in the potential for cerebral ischemia, Pranevicius and Pranevicius (2008) submit that at present a consensus does not

exist as to safe arterial blood pressure parameters. The authors also state that agreement on how blood pressure should be calculated and the role of beta-blockers is lacking.

Autoregulation refers to the brain's capacity to regulate blood flow based on metabolic requirements. Cerebral perfusion pressure (CPP) is autoregulated by the body's ability to modify the diameter of blood vessels. Pranevicius and Pranevicius (2008) contend that the potential for complications arise when anesthesia providers assume that an arterial pressure measurement is essentially the same as a corresponding CPP measurement. In the beach chair position, arterial pressure is contingent upon where on the body the measurement is obtained. Conversely, CPP, being a pressure difference between perfusion inflow and outflow, remains the same (CPP = MAP – CVP) and is not dependent on regional measurement. To minimize the potential for unknown factors leading to cerebral or spinal ischemia, Pranevicius and Pranevicius (2008) recommended several factors. Clinicians must be cognizant of the potential for cervical stenosis and position the patient accordingly. The establishment and maintenance of an initial BP baseline measurement while the patient is in the beach chair position should be used as a guide. Location of the BP monitoring site is not significant, yet the authors caution that the anesthesia provider should not move the measurement site during the case and if they do, they must document it on the patient record, as well as any change in the patient's position. The clinician must then reevaluate CPP. Furthermore, clinicians must have access to the patient for evaluation of visual signs of jugular venous collapse. The authors also suggest that volume loading may prevent collapse of the jugular veins by increasing CVP (~18 mmHg).

According to Bhatti and Enneking (2003) research regarding the relationship between the beach chair position, arthroscopic visualization, and systolic blood pressure is lacking. One central tenet is clear; maintaining appropriate cerebral perfusion is paramount and therefore, the correlation between arterial blood pressure at the head level (when a patient is seated upright at 70 to 90 degrees) and the location of the blood pressure cuff is a critical variant that the anesthesia provider must bear in mind. Accordingly, gravitational effects, especially when a patient is elevated to 80 to 90 degrees in the beach chair position, can influence arterial blood pressure.

Casti, Fanelli, Putzu, and Fanelli (2006) contend that monitoring of the central nervous system during anesthesia is underutilized. With the availability of cerebral oximetry, the authors conclude that monitoring cerebral oxygen saturation is improved and thus the potential for complications related to cerebral perfusion is decreased. There is a need for continued research in this area.

Summary of the review of literature

The beach chair position has been implicated in negative outcomes for several patients undergoing shoulder surgery and craniotomy. Although the beach chair is often the position of choice for surgeons due to improved visualization and access to the surgical site, the potential for complications do exist requiring vigilant monitoring and positioning. These complications cannot be overlooked and anesthesia providers must be aware of the further impact that anesthetic drugs and techniques may have on the patient.

The literature available on the correlation between the use of the beach chair position during surgical procedures, especially in the area of shoulder surgery, and the potential for serious complications is in the early stages of refinement and development.

A concerted effort to transfer relevant documentation and research gleaned from decades of using the beach chair position during neurosurgical procedures to the orthopedics may be beneficial.

CHAPTER III

METHODS

Introduction

After completing clinical rotations with anesthetic providers at a variety of Midwestern health care facilities, it was discovered that there existed concern about the potential for compromised cerebral perfusion in the beach chair position. After a review of literature was completed it became apparent that a clear understanding of the cerebral physiological changes that occur in the anesthetized patient in the beach chair position was necessary in order to prevent complications. Findings from the literature review were presented to students in training.

Target Audience

This project was presented to Student Registered Nurse Anesthetists (SRNAs) and Nurse Anesthesia Specialization faculty. A thirty minute power point presentation (see Appendix) was delivered to twelve SRNAs and one faculty member at a Nurse Anesthesia program located in the Midwest.

Procedure

With the assistance of the program director of a Nurse Anesthesia Specialization program in the Midwest, a thirty minute educational in-service, addressing first year nurse anesthesia students, was scheduled. A power point presentation was developed to

present the key components of the study to the target audience (see Appendix A). Important variables pertaining to the beach chair position were presented and discussed.

Evaluation and Expected Results

An evaluation form was developed and distributed amongst the audience. Issues related to the potential risk for compromised perfusion to the brain and/or spinal cord when utilizing the beach chair position under general anesthesia was presented to a group of SRNAs with the goal being to build awareness and to discuss the physiological implications of this position. Upon completion of the power point presentation and the question/answer session, the target audience was afforded the opportunity to fill out the evaluation form. It is expected that the target audience will have a better understanding of the cerebral autoregulation and other related topics within the context of the beach chair position post presentation.

Nursing Practice

The complex and dynamic physiological changes that occur when a patient is anesthetized are further influenced by positioning. A review of the potential risks to compromised perfusion to the brain/spinal cord when using the beach chair position is of benefit to the practice of nursing.

Nursing Research

Further study in this area is warranted as the increased popularity of the beach chair position could potentially lead to increased anesthetic complications. Much is known about neuro-anesthesia and the up-right position, using best practices frameworks would increase the sharing of this knowledge to the benefit of the surgical orthopedic community. To date all that is available in terms of research are case reviews, so

thorough research is warranted. With the advent of research, conclusive guidelines when employing the beach chair position could be developed to further decrease the risk for compromised cerebral perfusion. Areas of research could include a comprehensive statistical assessment pertaining to the rate of complications associated with the beach chair position and the efficacy of cerebral oximetry.

Nursing Education

To ensure safe and reliable care for patients, education must be ongoing. Continuing education will allow anesthesia providers to learn more about the risks associated with the beach chair position and how these risks can be minimized. Anesthesia providers should commit to perusing current literature and attending in-services to further increase their knowledge of the subject matter.

Nursing Policy

An establishment of a standardized protocol for measuring cerebral and spinal perfusion when using the beach chair position would be beneficial. Also, a thorough understanding of the complex and dynamic physiological changes that occur as a result of various surgical positions is needed and therefore should be promoted and remediated on a consistent basis.

Summary

While surgery inherently involves risk for complication, the anesthetic provider is committed to minimizing risk. As its use continues to increase, it is of paramount importance that the anesthesia provider stays current on issues related to the beach chair position. Important tools for minimization of risk include; ongoing research, educational in-services, and continuing education opportunities.

CHAPTER IV

Results

The presentation went smoothly and the students appeared to appreciate the information provided. The results from the evaluation were overwhelmingly positive; the fact that I consistently received top scores on the Guest Speaker Evaluation Form (see Appendix B) bear this out. The twelve students were attentive and furthermore their many interesting and relevant post-presentation questions indicated solid understanding of the topic. Topics covered during the question-answer session dealt mainly with what I had encountered during my personal clinical experiences in terms of issues related to the beach chair position. Overall, the experience was both positive and beneficial for all involved.

Appendix B

University of North Dakota
College of Nursing
Nurse Anesthesia Specialization

GUEST SPEAKER EVALUATION FORM

Name of Guest Speaker Crystal Farrow

Topic: Beach Chair Position

Date of presentation June 1, 2009

	Strongly Agree - Disagree				
Please place an X in the appropriate boxes	**5**	**4**	**3**	**2**	**1**
1. The topic was applicable and relevant.					
2. The content of the speaker's talk met my expectations.					
3. The speaker(s) presented the material in a clear and logical manner.					
4. The presentation's length was appropriate for the subject matter.					
5. I would recommend this presentation to other students.					
6. Overall quality of presentation					

Speaker and presentation strengths:

Suggestions for improvement:

Additional Comments:

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