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Postoperative Vision Loss Following Spine Surgery and the Implications for Anesthesia Providers

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POSTOPERATIVE VISION LOSS FOLLOWING SPINE SURGERY AND THE IMPLICATIONS FOR ANESTHESIA PROVIDERS

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Abstract

While postoperative vision loss following spine surgery is a rare complication; it has proven to be a devastating problem when it occurs. The American Society of Anesthesiologists compiled a closed-claims study in which only 3% of claims were from eye injuries, however, the patients with these injuries received significantly higher monetary settlements in comparison to patients with other injuries. This statistic alone warrants attention to this surgical complication.

The purpose of this project is to conduct a comprehensive review of the literature regarding postoperative vision loss, specifically following spine surgery, and the anesthesia implications. A poster presentation will be developed to be presented to graduate level students.

The expected results of this comprehensive review will help to provide insight into the complication of postoperative vision loss. It will also help understand the pathophysiology behind postoperative vision loss, as well as help determine guidelines for anesthesia practice to help prevent this complication from occurring

The implications of this research are mainly related to prevention. Current treatment of postoperative vision loss has been largely unsuccessful. Therefore it is important to identify those at risk. A complication of vision loss from a surgery essentially unrelated to the eye is unacceptable to patients. Therefore, more research is needed to attempt to identify exact causes to help guide the anesthetic management of patients undergoing spine procedures.

Chapter I

Introduction

Vision loss following surgery is a rare complication, which recently has caught the attention of anesthesia providers and surgeons as the incidence has increased. Although it remains a rare complication, the exact cause is unclear and treatment options are limited, often providing inadequate recovery of vision. A closer look at contributing factors and possible prevention strategies is imperative in order to avoid this devastating complication.

Statement of Problem

Postoperative vision loss appears to be most common following spinal and cardiac surgeries. With spinal surgeries the most common cause is anterior ischemic neuropathy followed by posterior ischemic optic neuropathy (Rupp-Montpetit & Moody, 2004). Limited research has been done on this topic, as the complication is rare. Due to limited information many anesthesia providers know little if anything about the complication and how to prevent it.

Purpose

The purpose of this project is to review the literature regarding postoperative vision loss, specifically following spinal procedures and the implications for anesthesia providers. The information gained from this research will be used to educate anesthesia providers on preoperative risk factors to screen for as well as steps that need to be taken intraoperatively to help reduce the risk of vision loss.

Conceptual Framework

Malcolm Knowles Theory of Andragogy is best suited for developing a plan for presenting this information to anesthesia providers. Knowles (1985) discusses that with increased knowledge in the general public regarding health care there has been an increase need for health care professionals to continue their education and ensure their competence. Because of this fact, health care institutions have produced a massive amount of continuing education programs. With the clientele of healthcare professionals consisting exclusively of adults these programs need to be based on adult learning (Knowles, 1985). Smith (2002) discusses this theory's set of assumptions regarding how adults learn. Andragogy has six assumptions:

Learner's Need to Know

Unlike children who will learn what they are told to learn, adults need to know why they need to learn something. They need to know how learning about the specific topic will benefit them. Adults need to know that their time will not be wasted learning this new information, that it will be useful in their lives (Smith, 2002).

Self-concept

Adults have a need for autonomy. As adults mature they become more self-directed. Helping learners become more self-directed makes them more responsible for their own learning. Smith (2002) states that Knowles identified reasons for self-directed learning. The reasons are: "people who take the initiative in learning (proactive learners) learn more things, and learn better, than do people who sit at the feet of teachers passively waiting to be taught (reactive learners)." Becoming more responsible for our own learning is a natural progression of our psychological development. Another reason for self-directed learning is related to the fact that education programs require learners to take the initiative for their own learning. Without learning how to be self-directed, learners may struggle with having to take charge of their own learning (Smith, 2002).

Experience

Adults come with an infinite number of experiences. These experiences shape their everyday thoughts, feelings and perceptions. These experiences also provide them with a large knowledge base that they want to be acknowledged for. Using case studies or reflective activities allow them to share their expertise. This engages them in the activity as well as allows others within the group gain from their experience (Smith, 2002).

Readiness to Learn

When adults feel that they need to learn something in order to deal with problems or real-life situations, they then become ready to learn. This is very important when developing teaching techniques. Smith (2002) discusses that by presenting data in which the lack of information is obvious the learner's need to acquire this new knowledge will be enhanced.

Orientation to Learning

Adults want to know that what they are learning will apply to real life situations. Providing real life examples and allowing learners to bring forth examples will enhance their understanding of the issue at hand. By bringing information forward in this manner learners are able to better grasp the experience and understand how it will affect their job.

Motivation to Learn

As people age external motivators become less important as internal motivators. Adults want to know that this information is going to further them in some way such as, career advancement, increased job satisfaction, quality of life, etc. Providing this information will help learners take ownership of the learning process (Smith, 2002).

The knowledge of these six assumptions can better guide the development of this presentation to attract the adult learner. Anesthesia providers are highly educated and work autonomously; keeping these assumptions in mind will allow these providers to want to learn the key points of this presentation. Using case studies and group discussions will allow these providers to share their experiences as well as allow others to gain from them. Providing statistics and possible consequences will also allow this subject to pertain specifically to their job. Given that, anesthesia providers will be more motivated to learn the specifics of this topic in order to improve their job performance.

Definitions

Postoperative vision loss has gained increased attention in recent years. Ischemic optic neuropathy has been determined to be the leading cause of postoperative vision loss. Since this condition is rare, ischemic optic neuropathy and its categories are defined.

When the blood flow or the oxygen supply to the optic nerve is blocked, ischemic optic neuropathy can result. This ischemia causes scotomatas, or blind spots, to develop in the field of vision. Ischemic optic neuropathies (ION) are categorized as either anterior ischemic optic neuropathy (AION) or posterior optic neuropathy (PION) (Rupp-Montpetit & Moody, 2004).

Anterior ischemic optic neuropathy results when the blood supply and oxygen are diminished at the optic nerve head. The main blood supply for the optic nerve head comes from the posterior ciliary artery (Hayreh, 2000). Anterior ischemic optic neuropathy is further broken down into two types: arteritic and non-arteritic. Arteritic anterior ischemic optic neuropathy (A-AION) is associated with inflammatory processes such as giant cell arteritis, lupus erythematous, hypertension, diabetes, or atherosclerosis. This form of AION is often traced back to thrombotic or embolic lesions (Rupp-Montpetit & Moody, 2004).

Non-arteritic ischemic optic neuropathy (NA-AION) on the other hand is the most common form of optic neuropathy found postoperatively. This form of ION is caused by decreased oxygen to the optic disc which causes swelling, which in turn leads to visual deficits (Rupp-Montpetit & Moody, 2004). Anterior ischemic optic neuropathy has been reported following several conditions with decreased blood pressure such as, hemodialysis, cardiac arrest, intraoperative hypotension, and severe hemorrhage (Rupp-Montpetit & Moody, 2004). Frost (2007) also stated that even sleep that resulted in systemic hypotension has resulted in NA-AION.

Posterior ischemic optic neuropathy (PION) in contrast is related to ischemia of the posterior part of the optic nerve. Posterior ischemic optic neuropathy involves a specific segment of the optic nerve (Hayreh, 2000). Rupp-Montpetit & Moody (2004) define PION specifically as ischemia involving "the area of the optic nerve between the optic foramen at the orbital apex and the area of entry of the central retinal artery". Rupp-Montpetit & Moody (2004) have related PION to decreased partial pressure whether from decreased mean arterial pressure (MAP) or increased intra-ocular pressure or a combination of the two. Frost (2007) stated that PION is possibly due to decreased oxygen delivery to the posterior part of the optic nerve. The posterior portion of the optic nerve is supplied by small vessels that with increased fluid can easily be compressed. Spine procedures that were prolonged and resulted in large amounts of blood loss have been correlated to PION (Frost, 2007).

Significance of Project

As stated previously postoperative vision loss is most common following spinal and cardiac surgeries. Deyo and Mirza (2006) report that in the 1990s spinal fusion procedures tripled in the U.S. They also report that there was a fourfold increase in surgeries for patients over the age of 65. This is of significance as age is a risk factor for diseases such as atherosclerosis and arteriosclerosis; which are believed to be directly related to ischemic optic neuropathy.

The incidence of postoperative vision loss varies from 0.05% (Roth, Thisted, Erickson, Black, Schreider, 1996) to 0.2% (Lee et al., 2006). The variation in incidence may be due to anesthesiologists' lack of reporting the complication related to concerns of litigation (Williams, Hart, & Tempelhoff, 1995). Their concern may be justified as Roth et al. (1996) stated in the ASA Closed Claims Study eye injuries only accounted for 3% of cases, however, they received significantly higher monetary settlements when compared with other settlements. Because of this fact anesthesia providers need to be further educated on this complication in order to reduce the incidence of it. ION has very limited treatment options and many of those options show minimal improvement in the patient's vision (Williams, Hart & Tempelhoff, 1995). Knowing this, it is imperative that anesthesia providers take the necessary steps to prevent this complication from occurring.

Assumptions/Limitations

One assumption made by this author is that this information is intended to be presented to practicing anesthesia providers. Therefore a basic knowledge of anesthesia practices is assumed. Limitations to this topic are related to the rarity of this complication. There were limited amount of studies done specifically on this subject and most of those done were retrospective in approach.

Chapter Summary

Ischemic optic neuropathy is a rare but devastating complication with limited treatment options. Williams, Hart, & Temelhoff (1995) discuss the fact that anesthesia texts have limited their discussion regarding postoperative vision loss to positioning errors. However, more recent research has reported the vision loss to be related to ischemic optic neuropathy. There is limited research done on this topic, as the complication is rare, however, with such a poor prognosis of visual recovery it is imperative to determine preventative strategies. Using Knowles Theory of Andragogy a presentation will be developed for anesthesia providers to increase their knowledge of this complication and understand the necessary steps to be taken to help prevent it.

Chapter II

Literature Review

Anesthesia, surgical, and ophthalmic literature have all documented postoperative vision loss following non-ophthalmic surgery. The exact cause of postoperative vision loss continues to be a mystery. The proposed risk factors for ION include; patients positioned in the prone position, deliberate hypotension, hemodilution, long operative times and preexisting health conditions.

Positioning

Most anesthesia texts discuss the implications of improper positioning. It is the responsibility of both the anesthesia team as well as the surgical team to ensure that the patient is correctly positioned for the procedure and protect them from injury (Langen, Jellish & Ghanayem, 2006). Vision loss is one of the complications related to positioning problems, specifically with the prone position.

Warner, Butterworth & Gross (2006) discuss that perioperative blindness as a result of direct globe pressure has rarely been reported. However, it is also stated that prone-positioned patients have higher intra-ocular pressure (IOP), a direct risk factor for ischemic optic neuropathy. Cheng et al. (2001) looked at the intra-ocular pressure of 20 anesthetized patients in the prone position. Baseline IOPs were obtained in the supine position and again after the patient was anesthetized but still in the supine position. Interestingly, the measurement after induction resulted in lower IOPs than baseline. However, after ten minutes in the prone position IOPs were significantly higher. Intra-ocular pressures were also obtained at the end of the surgical case before reversal of anesthesia was done and these measurements proved to be the highest (Cheng, et al., 2001).

Hunt, et al. (2004) also completed a similar study looking at IOP in anesthetized prone patients. Their study measured IOP of 20 patients undergoing spinal surgeries. They measured IOP at three different times; prior to intubation, immediately after pronation, and at the end of the surgery while the patient was still prone. This study also found that the prone measurements were significantly higher than the supine measurements. Hunt, et al. (2004) also compared the IOPs between patients whose heads were placed on pillows versus those whose heads were positioned in pins. The IOPs of the patients whose heads were positioned on pillows did prove to be higher. One limitation of both Hunt's and Cheng's study is that they did not measure central venous pressure (CVP). It would be interesting to determine if there is a correlation between elevated CVPs and IOPs.

Although neither Hunt's nor Cheng's study resulted in postoperative vision loss it does prove that the prone position places patients at increased risk for ION. Kasodekar & Chen (2006) define ocular perfusion pressure as mean arterial pressure minus IOP. Therefore, even a modest drop in blood pressure of the prone patient, who may already have elevated IOP, would then severely decrease the blood supply to the optic nerve potentially leading to ischemic optic neuropathy. While reports of direct pressure on the globe are minimal it does still have to be taken into consideration. Care must be taken to ensure that the position of the head has not inadvertently been changed and that there is no direct pressure placed on the globes.

A study performed by Walick, et al. (2007) looked at differences in IOP in patients that were placed in the prone position and left flat and those in the prone position with -7 degrees trendelenburg. In their article they stated evidence that showed that there was adequate blood flow to the optic nerve until IOPs reached 40mmHg. This study showed that patients in the trendelenburg position had significantly higher IOPs as well as more facial discomfort, complaints of headaches, nasal congestion and pressure behind the eyes. One disadvantage of this study, however, is that these were healthy patients not needing to undergo any surgery. The patients were also not anesthetized which may have helped decreased the IOPs in this population (Walick, et al., 2007). Never the less this study did show the significance of adding the trendelenburg position to the prone position and the potential for increased risk of optic nerve ischemia.

Another study performed by Ozcan, et al (2004) looked at IOPs in awake patients in the prone position. Like Walik, et al. (2007) they found that the trendelenburg position along with prone position resulted in significantly elevated IOPs. Of interest is that the authors did not find any difference in IOPs when different OR table setups were used. They did also find that putting the patients in reverse trendelenburg helped to significantly decrease the IOPs of patients while still in the prone position (Ozcan, et al., 2004). This does provide evidence that if trendelenburg position is needed while in the prone position that when possible placing the patient in reverse trendelenburg throughout the case may help maintain adequate blood flow to the optic nerve.

The American Society of Anesthesiologists Task Force (2006) also discussed the prone position as placing a patient at higher risk for vision loss. They recommended patients that were determined to be high risk, those undergoing prolonged operations and/or those with substantial blood loss, be placed in a slight reverse Trendelenberg position during the procedure.

Warner, et al. (2001) performed a review of all patients with new onset vision loss after noncardiac surgical procedures performed at Mayo Clinic from January 1986 to December 1998. There were 410,189 patients who underwent 501,342 procedures. Of those patients 405 had new onset vision loss. Only 189 of those had vision loss that lasted longer than 30 days. There were 9285 patients who underwent spinal procedures in the prone position. None of those patients developed vision loss lasting longer than 30 days. However, the authors determined that the overall frequency of postoperative vision loss to be 1 per 125,234 procedures; meaning that anesthesia providers will inevitably come across one or more vision loss cases during their career.

Hypotension

Controlled hypotension has been used during spinal anesthesia since the 1970s. It is employed in attempt to reduce blood loss and reduce the number of blood transfusions required. A study done by Mandel, Brown, McCollough, Pallares, & Varlotta in 1980 defined controlled hypotension as a decrease in systolic blood pressure of more than 20mmHg. They reviewed records for 145 patients undergoing spinal surgeries over a 4-year period. Their study found that blood loss was reduced as well as shorter operative times for the hypotensive group. Although the optic nerve has a degree of autoregulation to help preserve perfusion pressure during these hypotensive episodes it does however, operate on a small range, putting it at increased risk for ischemic injury (Hunt et al., 2004).

surgery receive an arterial catheter unless there is a contraindication. This allows for accurate and reliable pressure readings and easy access to blood for monitoring of hemoglobin and hematocrit.

As stated previously, ION is a very complex condition in which one causative factor has yet to be determined. Most cases of postoperative ION have documented periods of hypotension; therefore controlled hypotension remains something that should be employed only after careful consideration of all factors.

Anemia/Hemodilution

Large blood losses are common with spinal surgeries. With spinal procedures the exposed cancellous bone surfaces, friable epidural veins, and vessels with in the subcutaneous tissues make the risk of increased bleeding high with these procedures. Hemodilution is a common practice in large spine surgeries. It is frequently used in order to reduce the number of allogenic blood transfusions (ABT). Shander and Rijhwani (2004) list the risks of ABT as transmission of viral diseases, transfusion reactions, immunomodulation, transfusion-associated graft-versus-host disease and transfusion related acute lung injury. They also discuss the value of hemodilution as reduced blood loss, avoidance of ABT, reduction or elimination of blood transfusions, decreased morbidity and mortality. Raw, Beattie, & Hunter (2003) also discuss that blood loss is associated with longer time in the operating room, more wound infections resulting in delayed wound healing, and an increased need for blood transfusions.

Hemodilution for spine surgery is typically defined as normovolemic hemodilution (NH). Epstein et al (2006) defined NH as the removal of 1 to 2 units of blood replaced with 2 to 4mL per milliliter of blood harvested with crystalloid. Epstein

(2008) discussed a goal of reducing the intraoperative hematocrit to 28%. More specifically, Epstein (2008) discussed removing 1 unit of blood for hematocrit 36-38%, 2 units of blood for hematocrit 39-43%, and 3 units of blood for hematocrit >44%. Moderate NH is achieved with a hemoglobin average of 9g/dL. Epstein et al (2006) found little hemodynamic risk with NH as well as improvement in cardiac function. They did, however, not recommend hypotensive anesthesia along with NH. Epstein (2008) found 86% of patients in her study who did not undergo NH required homologous transfusions. While only 3.4% of those undergoing NH required transfusions. Due to the potential for large blood loss during spine surgery and the risk of infection from blood transfusion NH has proved useful in the these procedures.

Williams, Hart, & Tempelhoff (1995) do discuss that with a lower hematocrit blood flow increases, however that only affects the vessels at the precapillary level. They discuss the fact that at the capillary level where oxygen exchange is taking place the blood viscosity is not a factor. Katz & Karlin (2005) also discuss the decreased oxygen delivery capability when anemia is present. In spite of this, Lee et al. (2006) point out one case in which the patient had a diagnosis of ION yet had a hematocrit of 40%, demonstrating that ION can occur in the absence of anemia.

Lee et al. (2006) analyzed 93 cases of postoperative vision loss from 1987 to 2004. They found that the majority of the cases involved moderate anemia. They were unable, however, to determine if the amount of anemia was a result of the larger spinal procedures or if it could be directly linked to ION. Eighty-two percent of patients had an estimated blood loss of 1,000 mL or greater.

In the study done by Myers, et al. (1997) as previously mentioned discussed the difficulty in determining whether anemia is directly related to ION since it is often found in addition to hypotension. They did, however find 5 of the 37 cases they reviewed had ION without experiencing hypotension. These patients were found to have an estimated blood loss of 5 liters.

There is no one set guideline for a hemoglobin threshold. Langen, Jellish, & Ghanayem (2006) suggest maintaining the hemoglobin level at or above 10g/dL, whereas Rupp-Montpetit & Moody (2004) report that The National Institutes of Health Consensus Conference on Perioperative Blood Transfusion didn't recommend transfusing patients until their hemoglobin reaches less than 7g/dL. The Task Force (2006) recommended initiating transfusions whenever the hematocrit reaches 26%. This varying degree of standards in practice leads one to question if a critical level at which blood should be transfused exists and what that is.

For major spine procedures it is recommended that both crystalloid and colloid therapy be utilized when substantial blood loss occurs. The Task Force (2006) believes that excessive volume of crystalloid may be a major cause of ION. The excessive amounts of crystalloids that need to be infused to replace blood loss and maintain blood pressure in major spine procedures can lead to facial and orbital edema; this volume may cause a compartment syndrome of the eyes, leading to ischemia of the optic nerve. The Task Force (2006) also recommended limiting crystalloid therapy to 40ml/kg, regardless of the duration of the surgery. The rest of the fluid therapy can be managed with colloids (hetastarch, albumin or blood). They also discussed if blood pressure is not adequate with these volumes infusions of dopamine or phenylephrine should then be used.

Intraoperative Time

Large spinal procedures are known for lengthy operative times. Lee, et al. (2006) found in their analysis of 93 postoperative vision loss cases that 94% of the cases had an anesthesia time of 6 hours or greater. Roth, Thisted, Erickson, Black & Schreider (1996) also found in their study of 60,965 eye injury cases that the duration of those with resulting eye injury had anesthetic times of 4.7 +/- 3.0 hours versus those without eye injuries reported times of 2.0 +/- 2.6 hours. Cheng, et al. (2001) found in their study that the more hours a patient was in the prone position the higher the intraocular pressure. However, in a similar study done by Hunt, et al. (2004) there was no correlation between length of time prone and increased IOPs. Although they did not find a correlation between the two as did Cheng, et al. (2001) their operative times were less than that of Cheng, et al. (2001) (90-155min versus 320 +/- 107 min). This leads one to question, had there been longer procedures in the study done by Hunt, et al. (2004) would a correlation been found?

Preexisting Conditions

Almost all studies related to postoperative vision loss identify similar preexisting conditions. The conditions that seem to be consistent throughout the literature are chronic hypertension, diabetes, smoking, and coronary artery disease. Dunker, Hsu, Sebag, & Sadun (2002) stated that these disease processes disrupt the normal autoregulation by causing damage to the vascular endothelium. Rupp-Montpetit & Moody (2004) also list peripheral vascular disease, arteriosclerosis, and vasculitis due to the fact that they cause more resistance to blood flow. Monteiro (2006) found in their study of 24 patients diagnosed with NA-AION 40% end up with involvement of their unaffected eye within months to years after the initial insult. They also found that most of those patients had hypertension, diabetes mellitus and arteriosclerosis. Buono & Foroozan (2005) found in their review of 83 cases of perioperative posterior ischemic optic neuropathy that one study had 20 out of 28 patients diagnosed with PION had one or more risk factors. In this same review, however, they did find a study in which no difference was found between the groups in relation to the number of risk factors. These preexisting conditions do, however, seem to be the only reoccurring factor in patients that develop ION, so screening for them is of most importance.

Treatment

Unfortunately there is not an established treatment for ischemic optic neuropathy (Hayreh, 2000). Hayreh (2000) found that a small number of patients did have improvement following treatment with steroids. Williams, Hart, & Tempelhoff (1995) make note that therapies such as retrobulbar steroid injections, antiplatelet therapy, anticoagulants, phenytoin, norepinephrine infusion and adequate blood replacement have all proven to be inconsistent in recovery of vision. Remigio & Wertenbaker (2000) along with Hayreh (2000) found that high doses of corticosteroids did provide some recovery of vision in those patients diagnosed with posterior ischemic optic neuropathy.

Manheimer (2006) found in his Cochrane review that there is no surgery that has improved outcomes for those diagnosed with NA-AION. He also found that patients undergoing optic nerve decompression were at an increase risk of worsening the condition. Optic nerve decompression involves making two or more slits in the tissue surrounding the optic nerve. The slits allow for cerebral spinal fluid to drain from around the optic nerve, in theory decreasing pressure on the nerve. Manheimer (2006) also found that those diagnosed with NA-AION were 14.7% more likely to develop the same condition in the nonaffected eye.

Kasodekar & Chen (2006) along with Myers, et al. (1997) listed considerations that should be taken intraoperatively. Both authors stated caution should be taken with hypotensive anesthesia. The risks must outweigh the benefits in patients with preexisting risk factors for developing postoperative vision loss. Limits should be set preoperatively at what level they will maintain the patient's blood pressure and then ensure that it does not drift beyond that point. Lower thresholds should be held for replacement of blood loss with blood products in patients with risk factors. Attention to eye care during the procedures is also important. Ensuring that there is no direct pressure on the globe of the eye as well as assessing for increased edema of the face. Joyce (2006) noted that sudden, unexplained dysrhythmias should alert the anesthesia provider to the potential of ocular pressure that could be resulting in retinal artery occlusion that could eventually lead to post operative vision loss. Kasodekar & Chen (2006) even recommend using a Mayfield Headrest or Gardner Wells Tongs in an attempt to prevent any direct pressure on the eyes. Both articles also discuss the importance of monitoring for visual complications immediately in the recovery room.

Frost (2007) also identified factors that should alert the anesthesia provider to the potential increased risk for postoperative vision loss. Patients undergoing repeat spinal surgery in the prone position are at increased risk due to the likelihood of a prolonged procedure as well as extensive instrumentation. These patients are also at an increased risk for large amount of intraoperative blood loss, which has been identified as a direct risk factor for postoperative vision loss. Frost (2007) stated that disc disease associated with obesity and a sedentary life style is also at increased risk. These patients are more likely to experience hypoxia, which in turn decreases oxygen delivery to the optic nerve.

Chapter Summary

The exact cause of postoperative vision loss is not well understood. It appears to be multifaceted. It does seem that direct globe pressure is rarely the cause. The prone position has been shown to increase intraocular pressure in patients, which is a risk factor for ischemic optic neuropathy. It has also been demonstrated that the trendelenburg position worsens IOPs while reverse trendelenburg position can help promote blood flow to the optic nerve. Hypotension and blood loss also appear to be contributing factors, however they cannot be isolated so it is difficult to determine exactly what role they play. It was shown that patients with postoperative vision loss did undergo lengthier surgical procedures as well. Preexisting patient conditions seem to give us the best look at who may be at risk for postoperative vision loss. Those with vascular disease, diabetes, and chronic hypertension emerge as being most at risk. Treatment is very limited with few patients regaining any vision. Guidelines were given to help prevent the development of vision loss. Most of the preventative strategies pertain to identifying those at increased risk for vision loss and minimizing their risk in the operating room by decreasing the degree of hypotension used, aggressive blood replacement, and special care given in regards to the positioning of the patient.

Chapter III

Methodology of the Independent Project

The methodology of this independent project included a thorough review of the literature and a presentation of an educational lecture regarding potential causes, treatments and preventative strategies for postoperative vision loss. The lecture included a 10-question pretest, PowerPoint presentation, question and answer period, and a posttest.

Population

The target population for this independent project involved graduate level nursing students pursuing a degree in nurse anesthesia. This population was selected to help educate them about this complication as they are beginning their careers in the field of anesthesia.

Methodology

At the start of the presentation twelve first year anesthesia students were given a ten-question pretest. A twenty-minute PowerPoint was presented that provided information regarding diagnosis of postoperative vision loss, potential causes, treatments, and preventative strategies. Following the presentation the students were given the ten-question posttest.

After the pre and posttests were analyzed it was noted that there was improvement following the presentation. On the pretest the students got an average of 4.42 questions wrong; the posttest showed only an average of 1.67 questions wrong.

Chapter IV

Anesthesia Considerations

The incidence of postoperative vision loss has been reported as frequently as 1:100 among orthopedists, specifically spine surgeons (Frost, 2007). This is an alarming statistic when considering the fact that there is no known treatment for this complication. With the increasing number of spine procedures being done in the United States coupled with the increasing complexity of the patients undergoing these procedures it is paramount for the anesthesia profession to become informed of this condition and learn how to prevent it.

Although this complication is still somewhat rare it has gained increase attention in anesthesia practice. One important point with this complication is to inform patients undergoing spine procedures of its possibility. Dr. Anthony Lehner (2008), a retired anesthesiologist, suffered this complication following his fifth back surgery. In his article he discusses the fact that while he had discussed this complication with his anesthesiologist his surgeon never mentioned the risk of vision loss. He goes on to state that the surgeon actually tried to blame the anesthesiologist postoperatively. This complication needs to be presented as a risk to all patients undergoing spine surgeries preoperatively, by both the anesthesia team and the surgeon. It needs to be presented so that the patient understands that it is a complication of the surgery and positioning and not an "anesthetic complication" (Lehner, 2008).

Further implications for anesthesia practice include identifying patients at risk. While it is still not understood exactly what leads to the optic nerve ischemia experienced in patients undergoing spine surgery there have been some commonalities among patients. Patients with underlying vascular pathologies such as peripheral vascular disease, hypertension, coronary artery disease, diabetes and vasculitis have disruptions in their autoregulation capabilities. Therefore, they are unable to compensate for swings in blood pressure and increases in intraocular pressure. The anesthesia provider needs to recognize that when patients with these preexisting conditions present for spine surgery extra care needs to be taken in the management of their anesthesia to decrease the risk of optic nerve ischemia.

Controlled hypotension is a technique frequently used during spine surgery. With controlled hypotension there is a decrease in blood loss that provides for a better surgical field resulting in shorter procedure times. However the perfusion pressure of the eye is defined by Joyce (2006) as "the difference between the mean arterial pressure and the intraocular pressure: PP (eye) = MAP – IOP" (p. 188). Ischemia to the optic nerve results when the intraocular pressure exceeds the MAP. Thus with a MAP <60mmHg without increasing intraocular pressure already sets the patient up for decreased blood flow to the optic nerve. Add the prone position and often the trendelenburg position to this equation and now there is increase IOP as well as decreased MAP. Arterial catheters should be placed in all patients undergoing major spine procedures in the prone position. This allows for accurate pressure readings and easy access to blood for laboratory monitoring (ASA, 2006).

Anesthesia providers need to be familiar with this condition as well as signs that optic nerve ischemia may be taking place. While NA-AION has not been found due to direct pressure on the eyes it is imperative that anesthesia providers are constantly checking on the position of the face. Not only should they be checking for direct pressure on the eyes but also evaluating the swelling in the face. Excessive swelling should alert the provider to increased venous congestion in the head, which could affect the blood flow to the optic nerve. Joyce (2006) stated any sudden dysrhythmias, specifically bradycardia, without an identifiable cause should alert the provider to potential "direct external ocular pressure that can produce central retinal artery occlusion and post operative vision loss" (p. 188). Prompt evaluation in the immediate postoperative period should also take place. Specifically asking patients about their vision in the recovery room is important. Often patients do not voice a change in their vision thinking it is just from the anesthesia and it will wear off as they wake up. This further delays the treatment. Should a patient complain of vision loss, immediate ophthalmologic consultation should be requested. Further treatment should be focused on restoring perfusion to the optic nerve. Ensure that there is an adequate blood pressure, treating hypovolemia with fluids and administering a diuretic to reduce IOP (Frost, 2007).

Normovolemic hemodilution is also commonly used in large spine procedures. As defined previously by Epstein (2008), NH is achieved with a hemoglobin average of 9g/dL or a hematocrit of 28%. While this technique has proven to reduce the amount of blood transfusions patients require as well as potentially improving cardiac function, it also decreases the amount of oxygen carried and delivered in the blood (Katz & Karlin, 2005). Epstein et al. (2006) also mentioned that NH should not be used with hypotensive anesthesia. In fact, Myers et al. (1997) found that frequently anemia as well as hypotension was present in cases of ION. Therefore it is important for anesthesia

Chapter V

Discussion and Recommendations

The purpose of this project was to educate anesthesia providers about postoperative ischemic optic neuropathy and its incidence in the patients undergoing lumbar spine procedures. This study further discussed potential causes, treatments, preventative strategies as well as implications for anesthesia providers. Utilization of this information by anesthesia providers may result in decreased incidence in postoperative vision loss following spine surgery.

Recommendations for Practice

Results from this research show that little is known about this complication and a need for further improvement in preventative measures. Anesthesia providers need to utilize this information in their practice during spine procedures to help decrease the incidence of this complication. Accurate knowledge of this complication as well as diligent care to help prevent it must be implemented.

Recommendations for Education

As stated previously this complication is a rare but devastating complication. More education is needed for those providing anesthesia to patients undergoing spine procedures in the prone position. The ASA task force has emphasized the need for education on this topic to help prevent it. With the number of spine procedures tripling since the 1990s and a four-fold increase in those over the age of 65 undergoing surgery it is imperative that anesthesia providers are educated on this potential complication (Deyo & Mirza, 2006).

Recommendations for Further Studies

There are several opportunities for further study regarding this topic. First it is still somewhat unclear as to the exact cause of postoperative vision loss following spine surgery. There are a small number of studies done regarding this complication and those done are mostly retrospective in nature. Exact causes as well as treatments for postoperative vision loss are still unknown. More research needs to be done to attempt to find the cause so that preventative measures can be taken.

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