

Best Practices for Prevention of Perioperative Ocular Injuries

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### Abstract

Anesthesia providers are entrusted with the responsibility of providing competent health care and maintaining patient safety. This includes minimizing potential injury a patient may face during the perioperative period. Safe standards of practice may be derived from the most current body of research data. A literature review regarding preventative measures of perioperative ocular injury (POI) has demonstrated that, while having a low incidence, these occurrences may inflict devastating and possibly permanent vision impairment and discomfort upon patients. Research varies on which method of ocular protection is superior. Student registered nurse anesthetists (SRNA) have limited experience with management of POIs. The intent of this scholarly project was to increase the knowledge base of a sample size of 48 SRNAs at one nurse anesthesia program about POIs. The fundamental goal of this study was to increase the SRNAs' awareness of evidence-based practice to assist with prevention of future POIs. SRNAs completed a pre-test consisting of 10 questions regarding pertinent POI information immediately prior to receiving education about POIs via a PowerPoint presentation. SRNAs then completed a post-test consisting of the same 10 questions presented in the pre-test. A correlation between scores utilizing statistical software determined an increase in the knowledge base of the SRNAs was achieved. POI education was successfully implemented and resulted in an increase in SRNA knowledge base. POI is relevant to the anesthesia profession. Therefore, a thorough understanding of POI incidence, prevalence, etiology, risk factors, evidence-based prevention and treatment, may be advantageous in possibly reducing its occurrence.

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### **Problem**

According to the National Institute of General Medical Sciences (2016), millions of Americans utilize anesthesia services annually with risks involved. It is the anesthesia provider's role to administer competent care, including minimizing risks during the perioperative period. Therefore, the prevention of perioperative ocular injuries (POI) remains a crucial task for the anesthesia provider and student registered nurse anesthetists (SRNAs) alike. The incidence of ocular injury is 0.1% of general anesthesia cases (Contractor & Hardman, 2006). Risk factors for POI include any patient receiving general anesthesia, low American Society of Anesthesiologist's physical status classification (ASA PS), surgical procedures lasting longer than 90 minutes, head and neck surgeries, lateral or prone position, eye globe prominence, and SRNAs as the main provider (Martin et al., 2009; Moos & Lind, 2006). While a majority of corneal injuries do not cause permanent damage, POIs pose a risk of severe injury and possible permanent blindness (Gild, Posner, Caplan, & Cheney, 1992). Although rare, POIs may inflict immense pain, create discomfort, diminish visual acuity, and potentially alter the course of patients' lives after general anesthesia.

Initially, no preventative measures for POI were taken during general anesthesia. However, research data has demonstrated ocular injury occurs in 44% of patients who have partially open eyes during the course of anesthesia (Batra & Bali, 1977). Additionally, a study by Grover, Kumar, Sharma, Sethi, and Grewal (1998) found 90% of the corneal injury incidences that had occurred, in their sample size of 150 patients, had no POI preventative measures instituted. Both studies are an indication of the necessity for precautions, vigilant care, and undivided attention to maintain the safety and wellbeing of patients undergoing general anesthesia. Over the years, various preventative measures for POI have been implemented by institutions, including provider-patient education and modifying patient risk factors through

various techniques. Some modifiable risk factors include preventing dehydration, ocular lubrication, placement of eye tape, and maintaining a neutral patient head position. Collectively, these measures have a reduced incidence of POI. However, they have not eradicated the complication altogether.

Currently, while various techniques have been implemented for POI, their efficacy has constantly been debated and poorly researched (Martin et al., 2009). The standard of practice regarding prevention of POI is unclear and is often left to the discretion of the anesthesia provider. Whether POIs occur as a result of iatrogenic insult or unknown circumstance, the anesthesia provider is responsible for maintaining patient safety and instituting protective measures throughout the perioperative period. As SRNAs, it is an expectation to ultimately function at the same level of care as certified registered nurse anesthetists (CRNA). SRNAs should be aware of techniques to prevent POI, but more importantly to be able to implement these preventative measures during the perioperative period to maintain patient safety and reduce the risk of injury.

The literature review was guided by two questions, presented in PICOT format. The clinical problem was addressed in the first question: What are identifiable risk factors of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O). The clinical innovation was addressed in the second question: What are the current evidence-based practices for prevention of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O).

## Literature Review

### Background

While having a low incidence of 0.1% of general anesthesia cases, POIs have a significant impact on patients (Contractor & Hardman, 2006). A review of the literature demonstrated POI is associated with corneal abrasions, hemorrhage, vitreous humor loss, conjunctivitis, infectious ulcers, blurred vision, and blindness. Of these, corneal abrasion, in which the epithelial layer of the cornea becomes detached from the basement membrane of the eye, is the most frequent ocular injury to occur during the perioperative period (Moos & Lind, 2006). Additionally, this complication is the most common ocular injury to occur during general anesthesia for nonocular surgeries (Wan, Wang, & Jin, 2014). The cornea is more densely innervated than other tissues in the body, and injury to this region may result in more severe pain than the actual surgery itself (Moos & Lind, 2006). Not only do POIs create immediate pain and discomfort for the patient following general anesthesia, but they may lead to chronic conditions. Such conditions include blindness, persistent epithelial defects, recurrent corneal erosions, corneal opacifications, and visual disturbances resulting days to years after a POI has occurred (Moos & Lind, 2006; Grixti, Sadri, & Watts, 2013). Seventy-eight percent of the closed claims ocular cases and 20% of corneal injury cases had a known mechanism and were highly attributed to the secondary effects of administered anesthesia (Gild et al., 1992). Anesthesia providers assume the responsibility of patient care and safety during the perioperative period. Standard of practice improvement for anesthesia providers is warranted to reduce the incidence of POI and prevent the detrimental impact this complication may inflict upon patients.

An analysis of the American Society of Anesthesiologists (ASA) closed claims database examined all anesthesia related malpractice claims reported over a span of 38 years and found 4% were POI related (Lee & Domino, 2002). A separate analysis of the American Society of

Anesthesiologists (ASA) closed claims database conducted over a span of five years found that of the POI claims, 83% were related to general anesthesia. Additionally, 35% of POI anesthesia related malpractice claims were corneal abrasions, and 16% caused permanent damage (Gild et al., 1992). Paradoxically, while the percentage of POI claims was low, the frequency of payment for settlements was much higher for POIs than for non-ocular injury claims (Gild et al., 1992). The median payout of POI claims was determined to be approximately \$67,500 (Lee & Domino, 2002). Granted the percentage of malpractice claims were small, related settlements were costly and patient harm ensued. Implementing preventative measures may reduce future patient injury and potentially reduce claim amounts.

Despite anesthesia providers implementing the accepted standard of practice of taping the patient's eyes closed immediately after the loss of consciousness, POIs continue to occur (Yu, Chou, Yang, & Chang, 2010). Clinically, preventative POI practices vary amongst providers as do their accompanying rationales. It would be advantageous to explore and implement best practices for prevention of POIs based on current literature to improve the standard of practice. Research has shown an increase in POI has been observed in patients when SRNAs are the anesthesia providers (Martin et al., 2009). Given this data, increasing the knowledge base of SRNAs regarding best practices for POI prevention may further reduce risk and improve patient safety.

### **Impact on Practice**

Many studies evaluating the effectiveness of preventative measures of POI exist which assist in determining best practice. Identified patient risks for POI consist of non-modifiable and modifiable factors. Non-modifiable factors, in which an increased incidence of POI has been shown, include receiving general anesthesia, belonging to ASA PS class I or II, male gender, enlarged eye prominence, receiving head or neck surgery, being in lateral or prone surgical

position, and having a surgical procedure lasting longer than 90 minutes (Kara-Junior, Espindola, Valverde-Filho, & Rosa, 2015; Grixti, Sadri, & Watts, 2013). Although studies have found the etiology of POI to be multifactorial, patients have been found to sustain ocular injuries of unknown origin (O'Driscoll & White, 2016; Gild et al., 1992). A study conducted by Roth, Thisted, Erickson, Black and Schreider (1996) reviewed 60,965 non-ocular surgical cases and reported the mechanism of injury for POIs recorded was only identifiable in 10% of cases. While the anesthesia provider is unable to alter non-modifiable factors, it is important for the provider to be educated on modifiable risk factors and capable of identifying the patient's predisposition to POI. Expanding a provider's knowledge base regarding POIs has been shown to modify the provider's standard of practice (Martin et al., 2009). By expanding the knowledge base, providers may become more vigilant and more apt to implement preventative POI measures, leading to improved patient outcomes.

Numerous studies regarding POIs focus on interventions related to patient factors that can be manipulated. The most notable modifiable factor demonstrating an increased incidence of POI is corneal compromise. General anesthesia reduces a patient's pain perception and eliminates protective mechanisms of the eye. Anesthetic medications decrease basal tear production, induce mechanical failure of the eyelids to close, abolish the corneal reflex, and reduce Bell's phenomenon leading to corneal exposure and drying. Collectively these factors increase the risk of ocular injury (Wan et al., 2014; O'Driscoll & White, 2016). Studies have shown that general anesthesia significantly reduces tear production in populations across the lifespan as early as 10 minutes after induction (Cross & Krupin, 1977). Additionally, pre-existing ocular dryness conditions, anticholinergic medications, deliberate hypotension, and anemia contribute to decreased tear production and corneal hypoxia (Yu et al., 2010). The cornea does not have a



primary blood supply and is sensitive to fluctuations in oxygen supply. Therefore, actions disrupting blood flow to the corneal region compromise ocular integrity, such as positive pressure ventilation increasing intraocular pressure, neck flexion decreasing venous return, and hypotension reducing perfusion (Moos & Lind, 2006).

A highly randomized quantitative study of 4652 subjects receiving general anesthesia examined the efficacy of lid taping versus a combination of lid taping and eye ointment application to prevent corneal injury. Both interventions were reported to be equally effective in corneal protection, and the post-surgical prevalence of corneal injury was 0.17% (Cucchiara & Black, 1988). Similarly, a study of 200 ASA PS 1 and 2 subjects undergoing general anesthesia evaluated the effectiveness of tape, ointments, and artificial tears in preventing corneal abrasion. All interventions were found to be equally efficacious in corneal protection, and prevalence for corneal injury post surgically was 9% (Ganidagli, Cengiz, Becerik, Oguz, & Kilic, 2004). Despite implementing equally effective corneal protection practices, ocular injury still ensued. This brings into question the significance of other modifiable factors with regard to preventing POI.

Other modifiable factors demonstrating an increased incidence of POI include direct mechanical trauma and chemical injury (Kara-Junior et al., 2015). Direct mechanical trauma accounts for 8% of the ocular injury closed claims cases (Gild et al., 1992). This trauma occurs when the ocular structure comes in direct contact with an object. Aforementioned objects include the face mask, surgical drapes, provider's identification badge, or the laryngoscope blade grazing or piercing the ocular surface. An object such as a surgical instrument, exerting constant pressure on the ocular globe is also considered direct mechanical trauma (Grixti et al., 2013). Chemical injury accounts for 13% of the ocular injury closed claims cases (Gild et al., 1992). Chemical

injury occurs when a chemical compound comes in direct contact with the ocular structure. These compounds can include skin preparation, anesthetic gas, or lubricant with preservatives having direct contact with the ocular surface (O'Driscoll & White, 2016). To summarize, multiple variables play a role in the incidence of POI.

A retrospective study examined 1028 surgical prostatectomy cases over a 27-month span where standard of practice was changed from utilizing a combination of tape and ointment to transparent bio-occlusive dressing. Incidence decreased from 2.3% with the tape and ointment to 0% incidence with the bio-occlusive dressing (Laverv, Samadi, & Gainsburg, 2010). Bio-occlusive dressings provide a complete peripheral seal, creating a mechanical barrier and providing protection from chemical injury and infection. Additionally, these dressings preserve corneal protection by creating a uniform lid closure, maintaining a moist environment and reducing tear film evaporation (Grixti et al., 2013). A quantitative study conducted by Wan et al. (2014), evaluated the superiority of a hydrogel patch over taping eyes in regards to corneal protection in 76 patients. The hydrogel patch was found to be the most effective intervention. The patch targeted multiple preventative measures of POI including reducing corneal exposure, ensuring uniform lid closure, maintaining the protective tear film, and providing chemical and mechanical protective barriers (Wan et al., 2014). Anesthesia provider attentiveness is warranted to protect patients from direct mechanical trauma, globe compression, and chemical injury.

Increasing provider knowledge base regarding ocular anatomy, physiology, etiology of POI, and protective measures may be considered another method to reduce incidence of POI (O'Driscoll & White, 2016). A performance improvement initiative to lessen the incidence of corneal injury was implemented by increasing the awareness of anesthesia providers each time a corneal injury was sustained through e-mail notification. Formal education regarding factors that

can lead to corneal injury and preventative measures of corneal injury was then provided to all anesthesia providers. After pre-initiative and initiative periods had been analyzed, data presented a reduction of perioperative corneal injuries from a baseline of 1.51 per 1,000 to 0.79 per 1,000 ( $P= 0.008$ ) (Martin et al., 2009). This performance initiative demonstrates the need to increase anesthesia provider awareness of POIs and knowledge of patient risk factors using formal education. By emphasizing the procedural risk factors and preventative measures of corneal injury, anesthesia providers modified their standard of practice and reduced the incidence of corneal injury. Another significant data point from this performance improvement study is that the odds ratio (OR) for being the anesthesia provider and incidence of perioperative corneal injury for the SRNA group was 2.97 compared to the CRNA OR of 1.00 and resident OR of 1.09. This indicates more perioperative ocular injury occurred under the care of an SRNA, and an SRNA as the anesthesia provider is a higher risk factor for the occurrence of POIs compared to CRNAs and residents. While biases may be present, as the study was published in an American Society of Anesthesiologists journal and limitations of a small sample size ( $n=117$ ) make data difficult to generalize, the data is an indication that further anesthesia provider education is warranted.

Based on research evidence, the primary focus of preventing POI is to maintain ocular integrity by ensuring lid closure and performing frequent eye checks to ensure lids remain closed from immediately after induction until just before emergence (Batra & Bali, 1977; Grixti et al., 2013). Research evidence demonstrates that taping the eyelids closed is the generally accepted practice and an effective protective intervention, but no single measure that entirely prevents POI has been determined (O'Driscoll & White, 2016). Utilization of ointment, artificial tears, hydrogel, or bio-occlusive dressings may provide additional protection to reduce POI risk. While

research evidence has demonstrated other interventions as having equivalent effectiveness to tape, further current research with larger sample sizes is necessary to determine validity of these preventative measures accurately. Through implementation of performance improvement initiatives, a reduction in incidence of perioperative corneal injury has been observed. Ultimately, by increasing anesthesia provider knowledge and vigilance regarding perioperative ocular care and POI prevention, patient risk of experiencing these potentially detrimental complications may be reduced.

### **Project Description**

SRNAs have limited experience regarding POI management. As future anesthesia providers, it is imperative that SRNAs have an understanding of the incidence of POI and various preventative measures for ocular protection during general anesthesia. Since numerous methods of ocular protection exist, a thorough literature review was conducted to examine which methods are considered best practice. This project intends to educate Adventist University of Health Sciences (ADU) SRNAs on the current evidence-based best practices to prevent POI in their patients. The information was gathered via a literature review of perioperative ocular injuries and methods of protecting the eyes under general anesthesia for nonocular surgeries. Topic presentation occurred on October 19, 2017 during the Clinical Conference IV course for the SRNA 2018 cohort and Clinical Conference I course for the SRNA 2019 cohort. The ADU SRNAs received a pre-test (See Appendix B) to obtain a baseline of the knowledge deficit. A PowerPoint constructed to present current POI literature was then presented to the SRNAs, followed by a post-test (See Appendix B) to evaluate the effectiveness of the teaching methods. The post-test contained identical questions as the pre-test, to accurately assess the amount of information retained.

The aim of this scholarly project was to enhance the knowledge of a specific group of

future anesthesia providers (ADU SRNAs) regarding best evidence-based practice to reduce POI risk and increase patient safety. Their knowledge was assessed immediately after administration of the educational PowerPoint presentation (See appendix E) in their Fall 2017 trimester during the Clinical Conference I and IV classes. An increase in post-test scores when compared with pre-test scores would indicate an increase in knowledge of the ADU SRNAs occurred. Initially, POI was identified as a problem, then formulated into a problem statement. This problem statement helped to guide the literature review and the creation of the educational PowerPoint. The teaching evaluation was based on scores from a pre- and post-test of the ADU SRNAs. A correlation between scores utilizing the IBM Statistical Package for the Social Sciences (SSPS) software determined whether an increase in the knowledge base of the SRNAs was achieved.

### **Methods**

After Scientific Review Committee (SRC) feedback and Institutional Review Board (IRB) approval from ADU was granted, the implementation process of the project ensued. During the Fall trimester on October 19, 2017, an educational PowerPoint was presented to a convenience sample of 48 SRNAs at ADU in a classroom setting. Only the SRNAs of the 2018 and 2019 cohort were included in this project. SRNAs of the 2018 cohort had completed five of the seven trimesters of the nurse anesthesia program at ADU. SRNAs of the 2019 cohort had completed two of the seven trimesters of the nurse anesthesia program at ADU. Additionally, only pre- and post-test scores of SRNAs who signed the informed consent form were utilized for analysis. Students who did not complete both the pre- and post-test were excluded from data collection and analysis. Professors and other personnel were not included in the statistical data collection. Through a review of the literature, the educational PowerPoint consisted of information gathered from the current body of research. The pre- and post-tests were correlated to a student based on numbering of each test. Each pre- and post-test were given to the SRNAs in

an envelope with a number written on the outside. The tests did not contain any SRNA personal information. Having a number system ensured each SRNA's right to privacy and maintained anonymity.

Signed paper consents (See Appendix A) were collected from the ADU SRNAs first. Next, pre-tests (See Appendix B) were administered to the SRNAs and collected prior to the PowerPoint presentation. After collection of the completed pre-tests, the educational PowerPoint consisting of POI information gathered from the current body of research (See Appendix E) was presented to the SRNAs. After the presentation, the post-tests (See Appendix B) were administered to the SRNAs and collected. All information was collected and stored securely by the researchers. Scores from the pre- and post-tests were entered into an Excel spreadsheet, according to each student number. These scores were then statistically evaluated by ADU's statistician (See Appendix D). Results and conclusions were formulated after the statistical analysis of the data. The goal of this project was to increase the knowledge about POI amongst the SRNAs who participated in the PowerPoint presentation education. Data was stored securely by the researchers and was only accessible to pertinent parties, including the project mentor, project chair, the researchers, and the ADU statistician.

### **Timeline**

The research and literature review for this project began in the Summer 2017 trimester. As information was collected, the scholarly project paper and proposal were outlined. Requirements were met according to the timeline and syllabus. Project implementation, data collection, and analysis occurred in Fall 2017 during the Clinical Conference IV course for the SRNA 2018 cohort and Clinical Conference I course for the SRNA 2019 cohort. There was participation of 48 SRNAs.

### **Data Collection**

Data from this project was obtained from a convenience sample of SRNAs (N=48) at ADU from the 2018 and 2019 cohorts. After informed consent was obtained, a pre-test with a corresponding student number was administered to assess prior knowledge base. These questions aimed to assess the knowledge base of ocular anatomy, POI incidence and prevalence, cost of POI settlements, types of POIs, and evidence-based methods for preventing POI. Student identities were kept anonymous by utilizing this number system. After pre-tests were collected, an educational PowerPoint constructed of current POI literature regarding ocular anatomy, POI incidence and prevalence, cost of POI settlements, types of POIs, and methods for preventing POI was presented to the SRNAs. At the conclusion of the PowerPoint presentation, a post-test was administered to the SRNAs. The post-test consisted of the same questions as the pre-test. However, the SRNAs had no knowledge that the post-test contained the same questions and did not have access to the post-test until after the presentation. The presentation and pre- and post-tests constituted as one exchange over the span of approximately 45 minutes.

### **Evaluation plan**

Data collected from the pre- and post-tests were statistically analyzed by ADU's statistician (See Appendix D). Current software utilized by ADU is IBM Statistical Package for the Social Sciences (SPSS). Pre- and post-test data were compared to gauge if an increase in knowledge had occurred. This statistical information was then compiled into different graphical representations including an Excel spreadsheet of the scores from pre- and post-tests, a paired samples statistics table, and a paired samples test table. The successful completion of this scholarly project was determined by evidence of enhanced knowledge of SRNAs. Evidence of enhanced knowledge of the information presented was provided by the results of the tests.

### **Results and Findings**

A paired sample t-test was utilized to analyze the data (See Appendix D). The calculated t value was -9.624 with a p value of  $< .0001$ . This value is considered statistically significant. From these values, it can be concluded that there was a significant difference between the pre-test and post-test mean percentage scores. The negative sign of the t value indicates that the mean post-test percentage scores increased significantly from the mean pre-test percentage scores.

### **Conclusion and Limitations**

Pre- and post-test questionnaires (see Appendix B) were administered to the ADU SRNA 2018 and 2019 cohorts. Forty-eight responses (N=48) were evaluated. The data obtained from the pre-tests demonstrated that initial knowledge base of POIs was limited, with a mean pre-test correct score percentage of 29.17%. POI is relevant to the anesthesia profession and may have an immense impact on patients, therefore this is a subject that requires anesthesia provider attention. Providing an evidenced-based PowerPoint presentation regarding POIs to the ADU SRNAs enhanced their knowledge base of POIs. The mean percentage pre-test score of 29.1667% and the post-test mean percentage score of 68.3333%, demonstrate a significant increase in test scores after the PowerPoint presentation was administered ( $p < .0001$ ). The outcome of this scholarly project was an increase in awareness and knowledge of current POI literature among SRNAs. Therefore, regarding the aim of the study to increase SRNA knowledge base of POIs, the scholarly project was relevant and successful. ADU SRNAs from the 2018 and 2019 cohorts benefitted from this scholarly project as evidenced by the statistical analysis of the data.

Limitations to the scholarly project including potentials for error and potential biases were present. The scholarly project was conducted at a single site: ADU. Additionally, the inherent nature of a convenience sample already subjected the project to bias. The sample size



was small (N=48), decreasing validity of the scholarly project. Additionally, the sample was homogenous, consisting entirely of ADU SRNAs. Therefore, the data was not representative of the entire SRNA population and cannot be used to generalize results to other populations. A prominent limitation of this research project was that it only accommodated the evaluation of an immediate increase in knowledge. Retention of knowledge may be better assessed by administration of a post test at later date instead of immediately after the educational PowerPoint presentation. Additional studies consisting of larger varied sample sizes may be beneficial for practice and knowledge expansion.

Ultimately, this presentation may aid in the education of SRNAs in different programs, other students in healthcare programs, and licensed anesthesia providers. While the scholarly project demonstrated a statistically significant increase in SRNA knowledge base, ongoing education may be beneficial to continue to increase POI awareness and maintain POI knowledge base. A thorough understanding of POI incidence, prevalence, etiology, risk factors, evidence-based prevention, and treatment, may be advantageous in reducing its occurrence. A poster (Appendix F) of this scholarly project will be presented to ADU faculty and students upon completion in April 2018.

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## Appendix A

### ADU NAP CAPSTONE PROJECT – INFORMED CONSENT

Our names are Amy Best and Amy Engelhardt and we are MSNA students in the Nurse Anesthesia Program (NAP) at Adventist University of Health Sciences (ADU). We are doing a Capstone Project called *Best Practices for Prevention of Perioperative Ocular Injuries*. This project is being supervised by Alescia L. DeVasher Bethea, PhD, CRNA. We would like to invite you to participate in this project. The main purpose of this form is to provide information about the project so you can make a decision about whether you want to participate.

#### **WHAT IS THE PROJECT ABOUT?**

The purpose of this project is to enhance the knowledge of a specific group of student registered nurse anesthetists attending Adventist University of Health Sciences regarding best evidence-based practice to prevent perioperative ocular injury occurrences and reduce perioperative ocular injury risk in order to increase patient safety.

#### **WHAT DOES PARTICIPATION IN THIS PROJECT INVOLVE?**

If you decide to participate in this project, you will be asked to complete an anonymous pre-assessment, attend a classroom presentation, and then complete an anonymous post-assessment. The assessment will address ocular anatomy, perioperative ocular injury incidence, perioperative ocular injury malpractice claims, corneal abrasion, and methods for preventing POI. Your participation by attendance at the presentation and completion of the survey is anticipated to take approximately 45 minutes.

#### **WHY ARE YOU BEING ASKED TO PARTICIPATE?**

You have been invited to participate as part of a convenience sample of students currently enrolled in the ADU NAP. Participation in this project is voluntary. If you choose not to participate or to withdraw from the project, you may do so at any time.

#### **WHAT ARE THE RISKS INVOLVED IN THIS PROJECT?**

Although no project is completely risk-free, we don't anticipate that you will be harmed or distressed by participating in this project.

#### **ARE THERE ANY BENEFITS TO PARTICIPATION?**

We don't expect any direct benefits to you from participation in this project. The possible indirect benefit of participation in the project is the opportunity to gain additional knowledge about perioperative ocular injuries and methods of protecting the eyes under general anesthesia for nonocular surgeries.

#### **HOW WILL THE INVESTIGATORS PROTECT PARTICIPANTS' CONFIDENTIALITY?**

The results of the project will be published, but your name or identity will not be revealed. To maintain confidentiality of assessments, the investigators will conduct this project in such a way to ensure that information is submitted without participants' identification. Participant identities will be kept anonymous by utilizing a number system. All information will be collected and stored securely by the researchers and will only be accessible to pertinent parties including the project mentor, project chair, the researchers, and the ADU statistician. Data will be destroyed upon completion of the project. Thus, the investigators will not have access to any participants' identities.

#### **WILL IT COST ANYTHING OR WILL I GET PAID TO PARTICIPATE IN THE PROJECT?**

Your participation will cost approximately 45 minutes of your time, but will require no monetary cost on your part. You will not be paid to participate.

#### **VOLUNTARY CONSENT**

By signing this form, you are saying that you have read this form, you understand the risks and benefits of this project, and you know what you are being asked to do. The investigators will be happy to answer any

questions you have about the project. If you have any questions, please feel free to contact Amy Best at Amy.Best@my.edu.edu or Amy Engelhardt at Amy.Engelhardt@my.adu.edu. If you have concerns about the project process or the investigators, please contact the Nurse Anesthesia Program at (407) 303-9331.

\_\_\_\_\_  
**Participant Signature/ Participant Name (PRINTED LEGIBLY)**

**Date** \_\_\_\_\_

\_\_\_\_\_  
**Participant Name (PRINTED LEGIBLY)**

**Appendix B****Pre-Test and Post-Test Questionnaire**

1. The incidence of ocular injury is what percentage of general anesthesia cases?
  - a. 0.1%
  - b. 1%
  - c. 10%
  - d. 11%
  - e. 100%
  
2. Which of the following describe the pathophysiology behind ischemic optic neuropathy?  
Select all that apply.
  - a. Hyperperfusion of the optic nerve
  - b. Hypoperfusion of optic nerve
  - c. Increased intraocular pressure
  - d. Decreased intraocular pressure
  - e. Optic nerve is in a watershed region and more prone to ischemia
  
3. What are the risk factors for perioperative ocular injury? Select all that apply.
  - a. Receiving general anesthesia
  - b. High American Society of Anesthesiologist's physical status classification
  - c. Being of male gender
  - d. Having a surgical procedure lasting longer than 10 minutes
  - e. Being in lateral or prone position for surgery
  
4. Which one of the following is the most common type of perioperative ocular injury for non-ocular surgeries?
  - a. corneal abrasion
  - b. hemorrhage
  - c. conjunctivitis
  - d. blurred vision
  - e. blindness
  
5. What are potential chronic conditions to which perioperative ocular injuries may lead?  
Select all that apply.
  - a. blindness
  - b. persistent epithelial defects
  - c. recurrent corneal erosions
  - d. improved vision
  - e. corneal tumors
  
6. As of 2002, what was the median payout for perioperative ocular injury claims?
  - a. Approximately \$10,000
  - b. Approximately \$23,500
  - c. Approximately \$67,500
  - d. Approximately \$101,000

- e. Approximately \$127,500
7. Which one of the following is not an anesthetic effect on the ocular system?
- a. Decreased basal tear production
  - b. Induce mechanical failure of the eyelids to close
  - c. Abolished the corneal reflex
  - d. Increased lash reflex
  - e. Reduced Bell's phenomenon
8. Which one of the following statements is true?
- a. Based on research evidence, the primary focus of preventing POI is to maintain ocular integrity by ensuring lid closure and performing frequent eye checks to ensure lids remain closed from immediately after induction until just before emergence
  - b. Based on research evidence, POI can be prevented 100% of the time by taping eyes closed
  - c. Based on research evidence, the primary focus of preventing POI is to use as many prevention methods as possible
  - d. Based on research evidence, POIs can never be prevented, therefore no interventions are required
  - e. All statements are false
9. Which are preventative measures for perioperative ocular injury? Select all that apply.
- a. Taping eyes
  - b. Eye ointment
  - c. Artificial tears
  - d. Hydrogel patches
  - e. Opening lids
  - f. Bio-occlusive dressings
  - g. Constant ocular pressure
10. Which of the following correctly explains the pathophysiology of central retinal arterial occlusion?
- a. Emboli from the lower extremities can migrate to the optic artery and cause bilateral blindness
  - b. Emboli from the ipsilateral carotid may travel to the central retinal artery and induce unilateral blindness
  - c. Emboli from the lungs may travel to the central retinal vein and induce unilateral blindness
  - d. Emboli from the contralateral carotid may travel to the central retinal artery and cause bilateral blindness
  - e. The pathophysiology of central retinal arterial occlusion is unknown.



**Appendix C**

**Pre-Test and Post-Answer Key**

1. A
2. B, C, E
3. A, C, E
4. A
5. A, B, C
6. C
7. D
8. A
9. A, B, C, D, F
10. B

**Appendix D  
Data Collection**

**Table 1. Pre-Test Scores**

Pre-Test #	Correct	Incorrect	Grade (%)
1	3	7	30
2	4	6	40
3	4	6	40
4	4	6	40
5	5	5	50
6	5	5	50
7	1	9	10
8	3	7	30
9	3	7	30
10	1	9	10
11	6	4	60
12	3	7	30
13	1	9	10
14	2	8	20
15	5	5	50
16	5	5	50
17	1	9	10
18	7	3	70
19	3	7	30
20	4	6	40
21	3	7	30
22	4	6	40
23	3	7	30
24	2	8	20
25	1	9	10
27	2	8	20
28	4	6	40
29	2	8	20
30	3	7	30
31	6	4	60
32	1	9	10
33	1	9	10
34	3	7	30
35	3	7	30
36	0	10	0
37	1	9	10
38	2	8	20
39	2	8	20
40	3	7	30
48	2	8	20
49	5	5	50
50	2	8	20
51	3	7	30
52	0	10	0
53	5	5	50
54	3	7	30
55	3	7	30
56	1	9	10
Average % correct:			29.16666667

**Table 2 Post-Test Scores**

Post-Test #	Correct	Incorrect	Grade (%)
1	7	3	70
2	9	1	90
3	5	5	50
4	4	6	40
5	6	4	60
6	5	5	50
7	8	2	80
8	4	6	40
9	7	3	70
10	3	7	30
11	9	1	90
12	7	3	70
13	6	4	60
14	8	2	80
15	8	2	80
16	6	4	60
17	5	5	50
18	2	8	20
19	9	1	90
20	6	4	60
21	7	3	70
22	9	1	90
23	9	1	90
24	8	2	80
25	10	0	100
27	10	0	100
28	8	2	80
29	7	3	70
30	8	2	80
31	7	3	70
32	8	2	80
33	1	9	10
34	10	0	100
35	10	0	100
36	0	10	0
37	9	1	90
38	9	1	90
39	8	2	80
40	9	1	90
48	5	5	50
49	7	3	70
50	4	6	40
51	7	3	70
52	6	4	60
53	7	3	70
54	4	6	40
55	8	2	80
56	9	1	90
Average % Correct:			68.33333333

**Table 3. Paired Samples Test**

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Pre-Test - Post-Test	-39.16667	28.19637	4.06980	-47.35404	-30.97929	-9.624	47	.000

**Table 4. Paired Samples Statistics**

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test	29.1667	48	16.35163	2.36015
	Post-Test	68.3333	48	23.64033	3.41219

## Appendix E

## Educational POI Powerpoint Presentation

# Best Practices for Prevention of Perioperative Ocular Injuries

AMY BEST, BSN, RN  
AMY ENGELHARDT, BSN, RN  
PROJECT MENTOR: ADAM SIMPSON, MSNA, CRNA, USAF-FLORIDA  
PROJECT CHAIR: ALBIOA L. DEVASHER BETHGA, PhD, CRNA  
NURSE ANESTHESIA PROGRAM, ADVENTIST UNIVERSITY OF HEALTH SCIENCES

1

## Objectives

- Describe ocular physiology and pathophysiology
- Identify impact of anesthesia on ocular system
- Recognize potential causes of perioperative ocular injury (POI)
- Identify risk factors of POI
- Identify surgeries with high risk of POI
- Discuss techniques for POI prevention

2

## Case Study

- Patient: 30-year-old male
- Diagnosis: Prostate cancer
- Surgical Procedure: Robotic radical prostatectomy
- Perioperative Considerations: ASA class I, NPO for 8 hours, patient complaints of dry mouth and sore throat, requires general anesthesia, extreme head-tilting position, patient involvement in care (SRNA), long surgical procedure, pulse oximeter on index finger
- Postoperative Complaint: Experiencing blurry vision, pain and foreign body sensation to right eye 20 minutes patient after arrival in PACU
- Interventions: Urgent ophthalmology consultation
- Findings: Severe ocular irritation, performed in PACU remarkable for a moderate sized, linear, corneal epithelial defect in the central cornea
- Diagnosis: Corneal Abrasion
- Treatment: Prescribed erythromycin ointment, apply to right eye three times a day for five days, and instructed to follow up in the eye clinic in 3 to 5 days

3

## Problem Identification

Ocular injury is emotionally taxing, painful, uncomfortable, and costly for patients

Could this have been prevented?



4

## Problem Statement

- Determine what identifiable risk factors of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O).
- Determine what the current evidence-based practices for prevention of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O).



5

## What is Perioperative Ocular Injury (POI)?

- Insult to ocular structures during the perioperative period resulting in ocular conditions such as corneal abrasions, hemorrhage, vitreous humor loss, conjunctivitis, infectious ulcers, blurred vision, and/or vision loss, among others
- May lead to chronic conditions such as **blindness, persistent epithelial defects, recurrent corneal erosions, corneal opacifications, and/or visual disturbances** resulting days to years after POI occurrence
- Incidence of POI is **0.1%** of general anesthesia cases

6

### Anesthesia Effects on Ocular System: Anatomy of Pre-corneal tear film

- ▶ Pre-corneal tear film
  - ▶ Regenerated by blinking
  - ▶ 3 Main Layers:
    - ▶ Lipid: prevent evaporation of aqueous layer, lubricates eye
    - ▶ Aqueous: created by lacrimal glands, oxygenates corneal epithelium, irrigates from debris, host defense (IgA, IgG, complement factors, lysozymes)
    - ▶ Mucin: converts corneal epithelium from hydrophobic to hydrophilic



7

### Effects of General Anesthesia on Ocular System

- ▶ Induces lagophthalmos (**mechanical failure of the eyelids to close**)
- ▶ **Abolishes corneal reflex and lash reflex** (unable to blink and replenish protective pre-corneal tear film)
- ▶ **Decreases basal tear production** and pre-corneal tear film stability
- ▶ **Reduces Bell's Phenomenon** (eye rolling upward during sleep)

Culminating effects of general anesthesia lead to corneal drying, increased risk for ocular damage, and susceptibility to infection

8

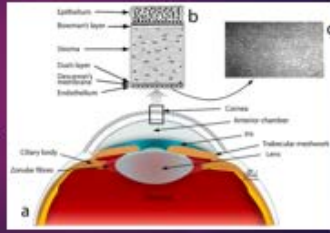
### Leading POIs

- 1) Corneal Abrasion
- 2) Direct Ocular Trauma
- 3) Vision Loss
  - ▶ Ischemic optic neuropathy (ION)
  - ▶ Central Retinal Artery Occlusion (CRAO)

9

### Corneal Abrasion: Anatomy of Cornea

- ▶ 1/6 of outer coat of eye
- ▶ Avascular, delicate epithelium, continuous with conjunctiva
- ▶ Densely innervated
- ▶ Protected by pre-corneal tear film
- ▶ Cornea is extremely sensitive to hypoxia
  - ▶ Central cornea receives atmospheric oxygen that is dissolved in pre-corneal tear film
  - ▶ Peripheral cornea receives oxygen that diffuses from surrounding choriocapillary blood vessels
- ▶ 6 layers: Epithelium, Bowman's Layer, Stroma, Duct's layer, Descemet's membrane, Endothelium



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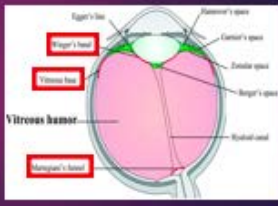
### Corneal Abrasion

- ▶ **The most common type of POI for non-ocular surgeries**
- ▶ Pathophysiology:
  - ▶ Corneal drying in combination with reduced oxygen delivery to cornea leads to edema
  - ▶ Creates favorable environment for desquamation of the epithelial layer from the basal membrane
- ▶ Causes:
  - ▶ Exact mechanism remains unknown
  - ▶ Mechanism of injury was identified in 20% of American Society of Anesthesiologists (ASA) closed claims related to corneal abrasion
    - ▶ Direct Contact-Facemask, anesthesiologist's hand/watch/badge, laryngoscope, surgical drapes or instruments, pressure to globe, patient scratching eye with pulse ox on index finger, positioning foam, patient repositioning
    - ▶ Chemical injury-Surgical prep solutions, clearing solution on facemask, direct instill of inhalational agents
- ▶ Symptoms:
  - ▶ Ocular pain, foreign body sensation, blurred vision, tearing, redness, photophobia

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### Direct Ocular Trauma: Vitreous Anatomy

- ▶ 80% of eye consists of the vitreous space
- ▶ Vitreous membrane (hyaloid membrane) is a layer of collagen that is attached to the retina in 3 places
  - ▶ Anterior vitreous attachment (Wieger's band)
  - ▶ Anterior vitreous base at Ora serrata
  - ▶ Posterior vitreous at optic disk margins
- ▶ Vitreous humor is 99% water and 1% collagen and hyaluronic acid



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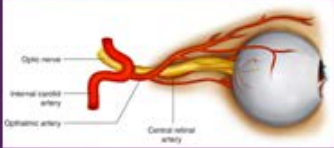
### Direct Ocular Trauma

- ▶ Pathophysiology:
  - ▶ Ocular globe experiences direct insult from foreign object leading to globe puncture (vitreous humor loss) and/or rupture of retinal vessels (hemorrhage, hematoma, bleeding)
- ▶ Causes:
  - ▶ Patient movement (coughing, bucking, restlessness)
  - ▶ Accidental contact between foreign object and globe (surgical instruments, laryngoscope, ET)
- ▶ Symptoms:
  - ▶ Visual disturbance, blindness, floaters, cobwebs, haze, shadows, red flare

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### Perioperative Vision Loss

- ▶ Incidence of Perioperative vision loss is 0.0008% of general anesthesia cases
- ▶ ION and CRAO consist of 81% of postoperative vision loss cases



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### Perioperative Vision Loss: ION Vs CRAO

	ION	CRAO
<b>Etiology</b>	<u>Optic nerve is in a watershed region and may come to ischemia, increased intracranial or systemic pressure, retinal hypoxemia, increased resistance to flow, and decreased oxygen delivery cause hypoxiation of optic nerve eventually leading to nerve damage</u> Posterior portion of optic nerve more vulnerable than anterior portion	Prolonged interruption of retinal arterial blood flow leading to damage usually by embolus <u>Ischemia from the posterior carotid may travel to the central retinal artery and induce unilateral blindness</u>
<b>Presentation on Fundoscopy</b>	Rapid onset, Pale swollen disc with surrounding hemorrhage	Instantaneous onset, Characteristic red spot, pale retina
<b>Signs &amp; Symptoms</b>	Sudden vision loss without pain, Headache, usually unilateral	Sudden vision loss without pain, usually unilateral
<b>Treatment</b>	Corticosteroids	Medical emergency, Reduce IOP, (timolol)


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### American Society of Anesthesiologists Closed Claims

- ▶ 4% of closed claims cases over a span of the past 38 years were PCI related
- ▶ 83% of PCI claims were related to general anesthesia
- ▶ 78% of PCI claims had a known mechanism and were highly attributed to the secondary effects of administered anesthesia
- ▶ 61% of PCI closed claims resulted in permanent ocular damage
- ▶ 35% of PCI closed claims were corneal abrasions

**As of 2002, payout for PCI claims**

- ▶ Range: \$25-\$2,900,000
- ▶ Median: **\$67,500**



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### Literature Review Findings



17

### Risk Factors

- ▶ According to Kara, Epsztejn, Valverde, & Rosa (2015), the most common non-modifiable risk factors included, "receiving general anesthesia, belonging to ASA P5 class I or II, male gender, enlarged eye prominence, receiving head or neck surgery, being in lateral or prone surgical position and having a surgical procedure lasting longer than 90 minutes."
- ▶ GA alone, decreases tear production and abolishes corneal reflexes (O'Donogh & White, 2016).
- ▶ Research by Martin et al., (2007) included SRNAs and residents as providers as putting patients at an increased risk of PCI as well as surgeries performed on Monday
- ▶ Important to be mindful of environmental hazards: such as stethoscopes, badges, laryngoscope blades, nasogastric tubes, surgical drapes, face masks, skin prep (Crichton et al., 1992; Kara et al., 2015)

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### Interventions

- A study conducted by Wan et al. (2014) found hydrogel patches to be a more effective intervention than taping the eyes. The patch targeted multiple preventative measures of POI including reducing corneal exposure, ensuring uniform lid closure, maintaining the protective tear film, and providing chemical and mechanical protective barriers.
- Findings from Cross & Krupin's study (1977) demonstrate mechanical protection by taping eyes and augmentation of tears with a topical bland, nonionic, petroleum-base ophthalmic ointment are the most effective preventative measures for POI.
- Quacchio & Black (1988) found the efficacy of lid taping versus a combination of lid taping and eye ointment application to prevent corneal injury to be equally effective in corneal protection.
- POI preventative measures during general anesthesia were evaluated. Tapes, ointments and artificial tears were found to be equally efficacious in corneal protection (Garddoglu, Cengiz, Seceki, Oguz, & Kirci, 2004).
- Meticulous attention is required by the anesthesia provider to prevent POI (Moos & Lind, 2006). The provider should ensure contacts are removed, eyes are taped closed, perform frequent eye checks to make sure eyes are fully closed, prevent eye pressure, maintain neutral head position, prevent patient eye rubbing, prevent foreign objects from contacting cornea (NC, Face mask, pulse ox).

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### Provider Education

- Importance of provider education in reducing the incidence of POI

**Martin et al., 2009**

- Performance improvement initiative
- Two phases-
  - Phase 1: send e-mail if patient received POI
  - Phase 2: formal teaching module related to POI with emphasis on prevention
- Statistically significant decrease in injury rate after educational module

**O'Discoli & White, 2016**

- Literature review module with objectives:
  - Understanding etiology of POI
  - Understanding anatomy of ocular structures
  - Identify which patients are at increased risk of POI
  - Understand preventative measures to reduce POI
- \*Emphasis is made on taping the eyes fully closed immediately after induction of anesthesia, before airway management.

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### POI Risk Factors

- General anesthesia
- Gender (Male)
- Facial and ocular shape, extreme horizontal/oblique
- Low ASA classification (I or II)
- Standard of care of facility not met by anesthesia provider and medical team
- Large eye globe prominence
- SPMA in the anesthesia provider
- Surgery on Monday
- Prolonged hypotension
- Dehydration
- Multiple blood loss/multiple transfusions
- Ageless
- Tube or placed on index finger
- Advanced age
- Decreased body temperature
- Vascular cage



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### POI Risk Factors Continued: Comorbidities

- Hypertension
- Obesity
- Smoker
- Diabetes
- Anemia
- Cardiac disease
- Dry eye conditions
- Renal failure
- Gastrointestinal ulcer
- Narrow-angle glaucoma
- Vascular occlusive disease
- Arteriosclerosis
- Polycythemia vera
- Collagen vascular disorders

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### Surgeries Associated with POI

**Surgical procedures lasting longer than 90 minutes**

- Surgery to eye or in close proximity to eye
- Head and neck surgeries
- Knee arthroplasty
- Spinal fusion
- Laminectomy without fusion
- Appendectomy
- Colectomy resection
- Cholecystectomy
- Coronary artery bypass grafting
- Hip/femur surgery
- Cardiac valve



23

### Recommendations

- Evidence based recommendations for preventative measures of POI
  - Provider vigilance
  - Mechanical/Chemical protection
    - Taping eyes immediately after induction, eye contact lubrication, artificial tears, hydrogel patches or Bio-occlusive dressings
  - Optimizing fluid status
  - Maintaining a neutral patient head position



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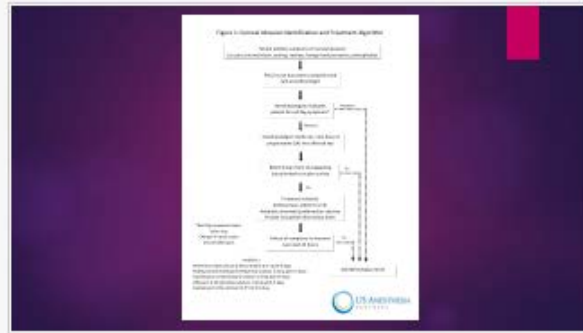
### Standard of care for US Anesthesia Partners

**CORNEAL ABRASION PREVENTION**

<p><b>ALL PATIENTS</b></p> <ul style="list-style-type: none"> <li>• Perform immediate post induction eye protection for all patients, or before or in the treatment room</li> <li>• Perform eye protection, gently remove tape immediately and apply eye tape to each hand</li> <li>• Immediate closure of eyes and then place small bio adhesive dressing (e.g. Tegaderm™ "Tape occluder")</li> <li>• Non-stick tape placement of ocular occluder</li> </ul>	<p><b>PATIENTS AT INCREASED RISK (ALL SURGICAL)</b></p> <ul style="list-style-type: none"> <li>• Use number of post-induction foot movement along with "no movement or change" or "no touch" verbal cue</li> <li>• Use of cover body or under body warming device as appropriate</li> <li>• Place eye safety goggles, occlude or support of upper hand below and bio adhesive dressing</li> </ul>
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26

### Case Study

- Patient: 33-year-old male
- Diagnosis: Prostate cancer
- Surgical Procedure: Robotic radical prostatectomy
- Perioperative Considerations: ASA class I, NPO for 8 hours, patient complaints of dry mouth and being unable to open general anesthesia, bilateral horizontal double vision, patient involvement in care (BRIEF), long surgical procedure, acute occlusion on water trigger
- Preoperative Complaint: Experiencing blurry vision, pain and foreign body sensation to right eye 20 minutes prior to the start of PACU
- Intervention: Ophthalmology consultation
- Findings: Reddish ocular exam was performed in PACU remarkable for a moderate sized, linear, corneal epithelial defect in the central cornea
- Diagnosis: Corneal Abrasion
- Treatment: Prescribed tetracycline ointment, apply to right eye three times a day for five days, and instructed to follow up in the eye clinic in 2 to 3 days

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### Summary

► **Based on research evidence, the primary focus of preventing POI is to maintain ocular integrity by ensuring lid closure and performing frequent eye checks to ensure lids remain closed from immediately after induction until just before emergence**

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### Questions?

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## Appendix F Poster Presentation

### Best Practices for Prevention of Perioperative Ocular Injuries

Amy Best, BSN, RN and Amy Engelhardt, BSN, RN  
**Project Mentor:** Adam Simpson, MSNA, CRNA US Anesthesia Partners – Florida  
**Committee Chair:** Alescia DeVasher Bethea, PhD, CRNA  
**Adventist University of Health Sciences: Department of Nurse Anesthesia**






#### Problem

- What are **identifiable risk factors** of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O)
- What are the **current evidence-based practices** for prevention of POI in patients undergoing general anesthesia for non-ocular related surgeries that SRNAs with limited experience with management of POI (P) may be educated about (I) to increase SRNA knowledge base (O)

#### Methods

- With SRC and IRB approval, an educational PowerPoint presentation based on current literature presented to the 2016 and 2019 ADU SRNA cohorts
- Pre-tests utilized as a knowledge baseline
- After informative PowerPoint, identical post-tests administered
- Data analyzed by ADU statistician




#### Findings

- Recommendations for preventative measures of POI based on current literature
  - **Provider vigilance**
  - **Mechanical/Chemical protection**
    - Taping eyes immediately after induction, Eye ointment/lubrication, Artificial tears, Hydrogel patches or Bio-occlusive dressings
  - Optimizing fluid status
  - Maintaining a neutral patient head position

#### Literature Review

- Corneal abrasion most common POI
- Median POI payout: \$67,500
- Risk Factors
  - GA alone decreases tear production, male gender, head or neck surgery, lateral or prone positioning, dehydration, duration >90 minutes
  - Environmental hazards: stethoscope, badges, laryngoscopes, prep solutions
- Interventions
  - Variations on ensuring complete lid closure with tape or hydrogel patches
  - With / without artificial tears or lubricant
- Provider Education
  - Performance improvement initiatives
  - Literature review modules with completion tests
  - Education improves awareness of POI.



#### Analysis and Conclusions

- When comparing pre- and post-test mean percentage scores, the post-test scores increased significantly ( $p < .0001$ ).
- The outcome of this scholarly project was an increase in awareness and knowledge of current POI literature among SRNAs.
- Therefore, regarding the aim of the study to increase SRNA knowledge base of POIs, the scholarly project was relevant and successful.

Table 1. Mean Knowledge Score		Pre-Test		Post-Test	
Year	Mean	SD	Year	Mean	SD
2016	24.24	4.88	2019	34.24	4.88
2017	24.24	4.88	2019	34.24	4.88

Table 2. Annual Safety Incidents		Year	No. Incidents	Total Hours
2016	POI	24	24	24
2017	POI	24	24	24

CORNEAL ABRASION PREVENTION

ALL W/RS

- Avoidance of eye contact with equipment
- Avoidance of eye contact with personnel
- Avoidance of eye contact with patient
- Avoidance of eye contact with patient
- Avoidance of eye contact with patient

PROVIDER KNOWLEDGE

- Education improves awareness of POI
- Education improves awareness of POI
- Education improves awareness of POI
- Education improves awareness of POI

Courtesy USAP-J.R. 2017

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