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# What is the Relationship of Increased Intraocular Pressure and Body Mass Index in Patients Undergoing Robotic Prostatectomy in Sleep Trendelenburg Position?

Seth Parsons

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WHAT IS THE RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE AND  
BODY MASS INDEX IN PATIENTS UNDERGOING ROBOTIC  
PROSTATECTOMY IN STEEP TRENDLENBURG POSITION?

A Research Project submitted to  
the Graduate College of Business  
Marshall University

Final defense submitted in partial fulfillment of requirements for the  
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Charleston Area Medical Center (CAMC) based on a collaborative agreement between  
the MU College of Business and the CAMC School of Nurse Anesthesia

By

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October xx, 2017

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

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RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

**Table of Contents**

ACKNOWLEDGEMENTS .....2

EXECUTIVE SUMMARY ..... 5

LIST OF TABLES .....7

INTRODUCTION AND BACKGROUND

Significance of the Problem and Research Purpose ..... 8

Statement of the Problem and Research Objectives ..... 9

Literature Review .....10

METHODOLOGY

Research Hypothesis .....14

Research Design and Setting ..... 14

Sample Population with Description ..... 14

Data Collection and Instruments .....15

Ethical Implications..... 15

Statistical Design and Analysis .....16

RESULTS

Presentation, Analysis and Interpretation of Data .....16

DISCUSSION

Discussion of Study Results .....19

Study Limitations ..... 21

CONCLUSIONS .....22

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS  
UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG  
POSITION

IMPLICATIONS AND RECOMMENDATIONS

Additional Research Needed .....22

REFERENCES ..... 24

APPENDICES ..... 28

# RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

## EXECUTIVE SUMMARY

**Introduction:** Robotic Prostatectomy is a common procedure performed in surgery centers all over the world, but these procedures can be long and difficult to manage for Anesthesia providers. This study examined the relationship between increased intraocular pressure (IOP) and Body Mass Index (BMI) during Robotic Prostatectomies in Steep Trendelenburg (ST) position. Other variables studied were length of procedure, age, and ASA physical classification.

**Methodology:** The study was a retrospective cross-sectional design of 100 patients with a BMI over 30 and 100 patients with a BMI under 30 who have undergone Robotic Prostatectomies at Charleston Area Medical Center (CAMC) between January 14, 2007 and January 14, 2017.

**Results:** Conjunctival Edema was not found documented in any patient record during data collection.

**Discussion:** Patients with a higher BMI are more likely to be classified as a ASA physical classification III and patients with a lower BMI are more likely to be classified as an ASA physical classification II. Patients with a BMI over 30 were exposed to longer procedure times.

**Conclusions:** No relationship was found between BMI and IOP. However, patients with a higher BMI had a longer procedure time and higher ASA physical classification.

**Implications/Recommendations:** Future researchers can utilize a prospective design to create an assessment form specifically for charting conjunctival edema. Health

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

care professionals could also be taught how to recognize increased IOP as conjunctival edema and treat it appropriately for the benefit of the patient prior to the study.

**Key Words:** Conjunctival Edema, Intraocular Pressure, Body Mass Index, Steep Trendelenburg

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

**LIST OF TABLES**

Table 1. Demographic and Group Statistics of patients who underwent Robotic Prostatectomy and comparison of age and length of procedure between to the two groups. . . . .18

Table 2. Cross Tabulation table comparing number of patients (actual and expected) each BMI group and ASA classification.. . . . 19

Table 3. Linear regression analysis between BMI and Length of Procedure . . . . 20

Table 4. Linear regression analysis between age and ASA Physical Status . . . . .20



# RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

## INTRODUCTION

### *Significance and Research Purpose*

Prostate cancer, the most common cancer in males in the United States, is the third leading cause of cancer death in this population (Klein, Platz & Thompson, 2007). Many surgeries are available to treat prostate cancer, but Robotic Prostatectomy is the latest, most innovative, and being requested increasingly worldwide (Awad et al., 2009). Over 114,000 Robotic Prostatectomies were performed across the world in 2013 (Taketani et al., 2015). This specific procedure requires patients to be positioned in Steep Trendelenburg (ST) for a large portion of the surgery. Molloy (2011) defined ST as a “greater than 30-degree tilt of the operating table below horizontal with the head in the lowest position.” This position uses gravity to assist the surgeon by displacing the abdominal contents for better visualization of the surgical site (Molloy, 2011). These procedures can last over three hours and ST can have substantial unwanted physiological effects when the patients are kept in this position throughout the duration of the surgery (Awad et al., 2009). The main physiologic effect that this study will focus on is increasing Intraocular Pressure (IOP) and its relationship to Body Mass Index (BMI) in the ST position.

Pressure that determines the shape of an eyeball is called IOP. Normal IOP is 10 to 20 millimeters of mercury [mmHg] (Molloy, 2012). This pressure is determined by resistance to outflow of the fluid. Healthy patients with no eye abnormalities maintain a constant IOP with autoregulation. Autoregulation means

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

as IOP increases, flow of fluid out of the eye will increase to maintain constant ocular perfusion pressure [OPP] (Guyton & Hall, 2011). Unhealthy patients may not have the capability to autoregulate pressures and as a result, they will experience increased IOP. Increased IOP will decrease the OPP. Perfusion to the optic nerve (OPP) is measured by mean arterial pressure (MAP) minus IOP. Healthy patients can also experience this as IOP reaches extremely high levels and autoregulation gets disrupted.

There are a wide variety of reasons as to why IOP can increase. Recent studies have suggested acute venous congestion and optic nerve compartment syndrome (Alwon & Hower, 2016). Venous congestion occurs due to ST position. This position causes venous pressure to rise because intra-abdominal and intra-thoracic pressures are increased, creating increased IOP (Lee, 2012). Rising venous pressures in head and neck start a cascade of events that involve higher hydrostatic pressures that cause capillary beds to leak. The leaking capillaries cause accumulation of interstitial fluids to compress veins and decrease venous return (Lee, 2012). The end result to these events is decreased perfusion to the optic nerve due to increased IOP (Lee, 2012).

### *Problem Statement and Research Objectives*

ST position has shown to have higher incidence of conjunctival edema even though the exact cause is unknown. Increased IOP can cause potential life-altering complications such as Postoperative Vision Loss [POVL] (Molloy & Cong, 2014).

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

The purpose of this retrospective study was to determine the relationship between conjunctival edema and BMI in patients who underwent robotic prostatectomy in ST position. The objective is to identify patients who are at increased risk for experiencing increased IOP during this procedure. The hypothesis was that patient's with a BMI over 30 had an increased incidence of conjunctival edema postoperatively.

### *Literature Review*

Several studies have been performed to evaluate the effects of increased IOP in ST procedures. However, many of the studies focus on procedures that involve other patient positions such as prone. After reviewing multiple articles, ST position appears to be linked to increased IOP during surgery and complications such as POVL following surgery.

Awad et al. (2009) prospectively studied the changes in IOP in 33 patients undergoing robotic-assisted prostatectomy. The researchers measured IOP while the patients were placed in different positions that included supine and awake, supine and asleep, and ST. Peak levels of IOP were reached following ST position when compared to supine (Awad et al, 2009). Duration of surgery and end tidal carbon dioxide (ETCO<sub>2</sub>) were shown to be the significant predictors of IOP increase during ST position (Awad et al, 2009).

Recently, Molloy, Cong, and Watson (2016), conducted a prospective study to examine the effects of administering Dorzolamide-Timolol following induction. This medication reduces IOP and may prevent an increased during ST positioning. The researchers used 90 patients with 46 receiving the intervention and 44 receiving a

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

placebo (Molloy, Cong, & Watson, 2016). The authors measured a baseline IOP and again every 30 minutes following administration of Dorzolamide-Timolol. The study found that prophylactic therapy with Dorzolamide-Timolol notably decreased IOP compared the control group (Molloy, Cong, & Watson, 2016).

Alwon and Hwer (2016) wrote an article to investigate theories on what causes POVL, risk factors associated with POVL, preventative measures to decrease POVL, and interventions that providers can use to avoid the postoperative complication. The two authors found the cause of IOP to be interstitial fluid accumulation, which causes congestion and compartment syndrome around the optic nerve (Alwon & Hwer, 2016). Multiple risk factors were shown to increase IOP. The risk factors included length of surgery greater than six hours, excessive blood loss greater than one liter, ST position, male gender, and obesity (Alwon & Hwer, 2016). Numerous interventions were discussed to prevent the increase in IOP. These interventions include using colloids instead of crystalloids to replace fluids, protecting the eyes from direct pressure, implementing a five minute supine rest period during ST procedures, and administration of dorzolamide-timolol (Alwon & Hwer, 2016). Even though the authors mention these interventions, Alwon and Hwer (2016) concluded that more research is needed to determine best practice in eliminating POVL following surgery.

Molloy (2012) developed a study to link IOP measurements to a scale that providers could utilize to determine the best time to institute interventions that optimize ocular perfusion. IOP measurements and visual assessments using the

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

Molloy/Bridgeport Anesthesia Associates Observation Scale (MBOS) were done at beginning of surgery, in 30-minute intervals, and at the end of surgery (Molloy, 2012). The MBOS compared baseline IOP and conjunctival edema (chemosis) to determine the probability of IOP reaching over 40 millimeters of mercury (mmHg). Molloy (2012) found that baseline IOP provides a probability of when IOP may exceed 40 mmHg, and also found the presence of chemosis to be suggestive of the same level of IOP being reached. These results advocate for a change in practice so that every patient undergoing ST procedures get a recorded baseline IOP (Molloy, 2012).

A study by Molloy (2011) was prompted a case of POVL following long procedure performed in ST position. This study was done was completed over three years to determine the relationship between IOP, OPP, and length of time in ST position. OPP was determined by mean arterial pressure (MAP) and IOP (Molloy, 2011). 37 patients were included in the study that measured IOP and OPP during supine position and in 30-minute intervals during ST position. The author revealed that IOP increased and OPP decreased significantly in relation to position change (Molloy, 2011). The findings imply a relationship between increased time in ST position and OPP, which contests the accepted view that auto regulation prevents increased compartment pressures and reductions in perfusion (Molloy, 2011).

Taketani et al. (2015) conducted a recent study to prospectively evaluate visual field defects following robotic-assisted laparoscopic radical prostatectomy (RALP) in ST position. The authors studied 25 male patients who had uneventful

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

surgery. Variables measured included visual field tests, IOP, and ophthalmologic examinations at various times before and after the procedure (Taketani et al, 2015).

Taketani et al. (2015) found RALP significantly increased IOP which led to transient unilateral visual field defects that subsided three months after surgery.

Ophthalmologic assessments can detect increased IOP and altered perfusion; therefore this study strongly urges this examination to be completed before and after this type of surgery (Taketani et al, 2015).

Yoo et al. (2014) piloted a study designed to compare propofol's effects with sevoflurane's effects on IOP in 66 patients undergoing RALP while in the trendelenburg position. The patients were assigned to either receive general anesthesia with propofol and remifentanyl (Propofol Group) or with sevoflurane and remifentanyl (Sevoflurane Group). The authors measured IOP at nine different time periods that were predetermined prior to beginning the study (Yoo et al, 2014). The researchers found that IOP increased with ST position and inflation of the stomach with carbon dioxide, but the propofol group experienced less of an increase when compared with the sevoflurane group (Yoo et al, 2014).

In 2014, Molloy and Cong, directed a quasi-experimental study to assess the effects of dorzolamide hydrochloride and timolol maleate (Cosopt) eyedrops on IOP during laparoscopic surgery while in ST position. The researchers included 63 patients to receive the medication when IOP was measured to be around 38 to 40 mmHg perioperatively (Molloy & Cong, 2014). Following administration of the eyedrops, IOP was measured at multiple different times. The research showed a

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

significant decrease in elevated IOP for those patients who are undergoing laparoscopic surgery in ST position (Molloy & Cong, 2014).

Lee (2012) developed a study to determine risk factors associated with ischemic optic neuropathy (ION) in patients undergoing spinal fusion surgery. The author used 17 different institutions to compare 80 patients without ION and 315 patients with ION following spinal fusion surgery. Lee (2012) found many different risk factors that were significantly and independently linked to ION which include obesity, male gender, lengthy anesthetic time, higher estimated blood loss, and reduced colloid administration.

### METHODOLOGY

#### *Research Hypothesis*

There was one hypothesis for this study: Patients with a BMI over 30 had an increased incidence of conjunctival edema. Conjunctival edema, swelling of the white outer coating of the eye, is an indication for significantly increased IOP as defined by Malloy/Bridgeport Anesthesia Associates Observation Scale (Alwon & Hewer, 2016).

#### *Design and Setting*

This study used a retrospective cross sectional design. A cross sectional design was chosen because data could be collected at Charleston Area Medical Center (CAMC) where patient records could be accessed. The cross sectional design allows for identification of patient demographics and clinical characteristics that can

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

determine the relationship of conjunctival edema and BMI in the ST position during Robotic Prostatectomy surgery.

### *Sample Population with Description*

The sample population was patients who underwent Robotic Prostatectomy in the ST position from 14, 2007 to January 14, 2017. The subjects were identified by The International Classification of Diseases 9<sup>th</sup> revision and 10<sup>th</sup> revision. The Clinical Modification (ICD-9-CM) codes are 60.5 (Radical Prostatectomy) and 17.42 (Laparoscopic robotic assisted procedure), The Clinical Modification (ICD-10-CM) procedure code is 0VB08ZZ (Excision of prostate, via natural or artificial opening endoscopic.) Inclusion Criteria was classified as age over 18 and less than age 65, ASA physical class I-IV, BMI less than 45, and Robotic Prostatectomy in ST position. The exclusion criterion was any patient who presented with documented glaucoma.

### *Data Collection and Instruments*

Each patient's Electronic Medical Record (EMR) was accessed to obtain data. Specific data was collected using the preoperative evaluation record, perioperative evaluation record, and postoperative evaluation record.

Information was collected and organized by the researcher using data collection worksheets. Data collection sheet 1 (Appendix B) was used to assign a study number to each patient. Data collection sheet 2 (Appendix C) was used to collect and organize patient demographic data including age, ASA physical status, BMI, length of procedure, and conjunctival edema.

### *Ethical Considerations*



## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

Any identifying patient data will be maintained on a password-encrypted computer. All written data will be stored in a locked cabinet in the investigator's office that only the investigators have access to. During data collection, each patient will be given an identification number for research purposes only. This number will link the patient's medical record number and the account number and will allow further data collection and analysis without providing identifiable information and compromising patient's privacy. All data will be destroyed upon completion of the study and graduation of DMPNA program.

### *Statistical Design and Analysis*

The purpose of this research was to determine the relationship between increased IOP and ST position in patients undergoing Robotic Prostatectomy. The dependent variable was the presence of conjunctival edema postoperatively. The main independent variable was BMI. Other independent variables included age, ASA physical status, and length of procedure. A t-test was done to determine if the BMI over 30 group (Group 1) and BMI under 30 group (Group 0) shared similarities in age and length of procedure. A Chi Square was done to determine if ASA is similar between the two groups. A logistical regression was used to determine the relationship between the independent variables of ASA physical status, BMI, age, and length of procedure and the dependent variable of eyelid edema. A p-value of  $<.05$  was considered statistically significant. The data was analyzed using SPSS version 21 (SPSS IBM Company, 2013).

# RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

## RESULTS

### *Presentation, Analysis, and Interpretation of Data*

The total study sample consisted of 200 male patients presenting to CAMC Hospitals for Robotic Prostatectomy ages 18-65. The patients were separated into two groups of 100 patients each. Group 1 was patients with a BMI of more than 30, and group 0 was patients with a BMI of less than 30. The main dependent variable of Conjunctival Edema was not found documented in any patient record during data collection. The following tests were performed to determine any relationships between BMI, age, ASA Physical Status and length of procedure.

A t-Test was performed to compare the age and length of procedure between the two groups. The mean age of Group 1 was found to be  $57.90 \pm (5.364)$ , the mean age of Group 0 was found to be  $58.34 \pm (4.513)$ . Length of procedure was also compared between the two BMI groups. The procedure for Group 1 lasted an average of  $222.98 \text{ minutes} \pm (63.840)$ , while Group 0 lasted an average of  $199.36 \text{ minutes} \pm (79.158)$  [Table 1].

A separate t-Test was performed to determine statistically significant differences in age or length of procedure between Group 1 and Group 0. Statistically significant is defined as a P value of  $<0.05$ . Between the two groups, age was found to have no significant difference ( $p = .531$ ) with a mean difference of  $-.440$  years.

Length of Procedure, however, showed a statistically significant difference between Group 1 and Group 0 ( $p = .021$ ) with a mean difference of  $23.620$  minutes (Table 1).

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

	BMI (1=over 30, 0=under 30)	N	Mean	SD	p
Age	1	100	57.90	5.364	.531
	0	100	58.34	4.513	.531
Length of Procedure (minutes)	1	100	222.98	63.840	.021
	0	100	199.36	79.158	.021

Table 1: Demographic and Group Statistics of patients who underwent Robotic Prostatectomy and comparison of age and length of procedure between to the two groups.

N=Total number of patients. SD = Standard Deviation.

A Cross Tabulation table was used to analyze the relationship between ASA and the two BMI groups. Patients that were categorized as an ASA II equaled 43. Group 1 totaled 30 with an expected value of 21.5 and Group 0 totaled 13 with an expected value of 21.5. Patients that were categorized as ASA III equaled 152. Group 1 totaled 67 with an expected value of 76 and Group 0 totaled 85 with an expected value of 76. Patients categorized as an ASA IV totaled 5. Group 1 totaled 3 with an expected value of 2.5 and Group 1 totaled 2 with an expected value of 2.5 (Table 2). A Pearson Chi Square test was completed to determine if there was a statistically significant relationship between ASA physical status and the two BMI groups. This test revealed a significant relationship between ASA physical status and BMI (p=.011). There were more ASA II patients in Group 0 than expected and more ASA III patients in the Group 1 than expected (Table 2).

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

			BMI (1=over 30, 0=under 30)		Total
			0	1	
ASA	II	Count	30	13	43
		Expected Count	21.5	21.5	43.0
		Std. Residual	1.8	-1.8	
	III	Count	67	85	152
		Expected Count	76.0	76.0	152.0
		Std. Residual	-1.0	1.0	
	IV	Count	3	2	5
		Expected Count	2.5	2.5	5.0
		Std. Residual	.3	-.3	
Total	Count	100	100	200	
	Expected Count	100.0	100.0	200.0	

Table 2: Cross Tabulation table comparing number of patients (actual and expected) in each BMI group and ASA classification.

A stepwise linear regression was conducted between BMI and length of procedure. BMI was found to be the only important variable. Group 1, BMI over 30, length of procedure took 23.620 minutes longer ( $p = .021$ ) [Table 3]. This was the same result as seen when the two groups were compared. The mean length of procedure for Group 1 was 222.98 minutes and the mean length of procedure for Group 0 was 199.36 minutes. ASA Physical status and age were showed no statistical significance (Table 4.)

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

Model	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics	
					Tolerance	
1	Age	.058 <sup>b</sup>	.831	.407	.059	.998
	ASAI	-.026 <sup>b</sup>	-.355	.723	-.025	.957
	ASAI	-.005 <sup>b</sup>	-.064	.949	-.005	.956

Table 3: Linear regression analysis between BMI and Length of Procedure in patients who underwent Robotic Prostatectomy.

Model	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
1 LOP	199.360	7.191		27.724	.000
	23.620	10.169	.163	2.323	.021

Table 4: Linear regression analysis between age and ASA Physical Status

ASA = American Society of Anesthesiologist physical status classification. Statistical Significance at  $p < .05$

## DISCUSSION

### *Discussion of Study Results*

A total of 200 patients undergoing Robotic Prostatectomy in ST position were chosen randomly to determine the relationship between BMI and increased IOP via documented conjunctival edema. After reviewing all 200 patient charts, zero patients had documented conjunctival edema.

Statistical tests were done to determine the relationship between age and BMI. The 200 patients were divided into two groups based on BMI, Group 1 was BMI over 30 and Group 2 was BMI under 30. No significant findings regarding age and

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

BMI were discovered. The difference in age between to two groups totaled 0.44 years.

The relationship between ASA physical classification and BMI was also determined using a cross tabulations table. Both groups had an expected count and total count in each of the ASA physical classifications. Group 0 totaled more ASA physical classification II patients than expected. Group 1 had more totaled ASA physical classification III patients than expected. There was no relationship between either Group 1 or Group 0 and ASA classification IV. These results showed that patients with a higher BMI are more likely to be classified as a ASA physical classification III and patients with a lower BMI are more likely to be classified as an ASA physical classification II.

A stepwise linear regression was also performed to determine the relationship between BMI and length of procedure. A relationship was found between these two variables. Patients in Group 1 had a longer length of procedure than patients in Group 0. Group 1 patients' length of procedure lasted an average of 23.620 minutes longer than patients in Group 0. This result signifies that patients with a higher BMI could potentially be exposed to longer times in ST position. As previously stated, longer ST position time correlates with an increased IOP (Molloy & Cong, 2014).

### *Study Limitations*

This study has several limitations. First, the fact that this study was done at only one hospital is a limitation. Generalization to other facilities may not produce

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

the same result. Also, diverse surgical experience and technique and varied anesthesia technique may provide different outcomes.

One major limitation to the present study was the unexpected omission of notation or charting of conjunctival edema, periorbital edema, or any type of edema around the eyes or entire face. That is to say, no edema of any type was in the written reports during the perioperative period. Consequently, it was impossible to prove or disprove the hypothesis for the study. While it is not beyond the bounds of possibility, it is implausible that edema did not occur, given the extreme position of the patients for this procedure and the long duration of this type of surgery. Another indicator of the occurrence of edema is the administration of a diuretic medication perioperatively. Use of diuretics can decrease edema that the patient has by excretion of the excess fluid via the kidneys. These medications are given on an as needed basis during this type of surgery, which would have been an indicator for some type of edema. This was not accounted for when collecting patient data and could cause the patients conjunctiva to appear non edematous when the PACU nurse did an assessment.

Assessment forms and varying levels of experience of the PACU nurses were another limitation. No check box or space to document periorbital or conjunctival edema was included. Baseline IOP is imperative to determine to assess if a critical level of pressure was obtained (Molloy, 2012). The facility does not have the capability to assess IOP, but does have the ability to assess conjunctival appearance preoperatively. This assessment is subjective and not completed by PACU nurses.

## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

The sample size was another limitation. The years of patients studied ranged ten years and yielded a little over 300 total patients who met inclusion criteria. A larger number of patients could have ensured a representation of the population and potentially produced a relationship between BMI and conjunctival edema.

### CONCLUSIONS

In summary, there was no relationship between BMI and IOP. Conjunctival edema was not found documented in any patient charts during the research. However, length of procedure and ASA physical classification was shown to have a relationship with BMI. Patients with a higher BMI had a longer procedure time and higher ASA physical classification. Further studies at this facility should be completed using a prospective method involving the use of an assessment form with information on identifying conjunctival edema and possible effects of increased IOP. This study could be of value to future patients undergoing the same procedure in the same position. It could be of most value to patients with undiagnosed increased IOP who would benefit from the interventions mentioned in the literature review.

### IMPLICATIONS AND RECOMMENDATIONS

#### *Additional Research Needed*

Future research on this subject could potentially find a relationship between BMI and IOP during Robotic Prostatectomy in ST position. Future researchers can utilize a prospective design to create an assessment form specifically for charting conjunctival edema. Health care professionals could also be taught how to recognize increased IOP as conjunctival edema and treat it appropriately for the benefit of the



## RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

patient prior to the study. These professionals can then accurately determine if the patients experienced increased IOP and have a specific place to chart the symptom.

Additional research can also include more variables such as fluid administration, diuretic usage, and total time in ST position. These factors could potentially play an important role in the development of increased IOP.

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDLENBURG POSITION

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RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

APPENDICES

**Appendix A**

Data Collection Tool 1

Study Number	Medical Record Number
1	
2	
3	
4	
5	
...	
200	

RELATIONSHIP OF INCREASED INTRAOCULAR PRESSURE IN PATIENTS UNDERGOING ROBOTIC PROSTATECTOMY IN STEEP TRENDELENBURG POSITION

**Appendix B**

Data Collection Tool 2

Study Number	IV - BMI (>30[1]/<30[0])	Age (years)	Length of Procedure	ASA Classification	Eyelid Edema (Y[1]/N[0])
1					
2					
3					
4					
5					
...					
200					