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REVIEW ARTICLE

Are you seeing this: the impact of steep Trendelenburg position during robot-assisted laparoscopic radical prostatectomy on intraocular pressure: a brief review of the literature

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Abstract

With the increasing popularity, frequency, and acceptance of the robotic-assisted laparoscopic radical prostatectomy procedure, an awareness of unique intra- and postoperative complications is heightened, including that of increases in intraocular pressure. The steep Trendelenburg positioning required for operative exposure has been shown to increase this value. While the literature is infrequent and undeveloped, certain anesthetic parameters including deep neuromuscular blockade, modified positioning, and the use of dexmedetomidine have been shown to have mild-to-modest decreases in intraocular pressure for baseline. In the four randomized control trials and four observational studies that were found via PubMed/Medline search, the aforementioned techniques demonstrate some preliminary evidence of operative considerations in this unique patient population. These modifications may prove to have even greater significance in patients with pre-existing ophthalmologic pathologies, such as glaucoma, which were excluded from the studies' analyses. This review summarizes the early literature obtained in this subject, with the intent of emphasizing the initial hypotheses and identifying areas for future study.

Keywords Robotics · Anesthesia · Intraocular pressure · Prostatectomy

Introduction

Robot-assisted laparoscopic radical prostatectomy (RALRP) has been increasingly used since 2000 when Menon et al. [1] performed it for the first time in the United States. It has been shown that patients who undergo RALRP rather than open radical prostatectomies have superior adjusted perioperative outcomes, such as decreased likelihood of blood product transfusion and experiencing an intraoperative and postoperative complications [2]. Combining the decreased time and favorable outcomes, RALRP has become the preferred technique for prostate removal, being utilized for 85% of prostatectomies [3].

This procedure requires several different positions and conditions to facilitate operative exposure. After the initial supine position, the patient is placed in the lithotomy position, pneumoperitoneum is created through abdominal insufflation, and then steep Trendelenburg (ST) position for access and visualization of the prostate. This triad of lithotomy, pneumoperitoneum, and ST can cause hemodynamic consequences including increased intraocular pressure which may compromise ocular perfusion.

Intraocular pressure (IOP) is regulated by aqueous humor production, aqueous humor elimination, auto-regulation and control of choroidal blood volume, vitreous humor volume, and extraocular muscle tone [4]. Volatile anesthetic agents cause a reduction in IOP by decreasing aqueous humor production and relaxing the extraocular muscles [4]. This response is counteracted when a patient is in the ST position, leading to increased IOP. Combining this position with

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the possibility of anemia due to significant blood loss, may increase the risk of ischemic optic neuropathy.

In this review we examine the current literature for studies on intraocular pressure in the steep Trendelenburg position.

Methods

We conducted a PubMed/MEDLINE search for studies using the terms "intraocular pressure" and "Trendelenburg". Case reports and editorials were excluded. Attention was given to the literature published in the last 5 years and studies which examined intraocular pressure during RALRP. Of 38 identified studies, 1 was excluded due to unavailability in English language, 2 case reports were excluded, 12 articles were not related to intraocular pressure or Trendelenburg positioning. Due to a variation in degree of Trendelenburg with laparoscopic and gynecologic procedures, these were also excluded. Of the eight studies identified which met the inclusion criteria of patients undergoing RALPR, four were randomized controlled trials [5–8] and four were prospective observational (Fig. 1) [9–12].

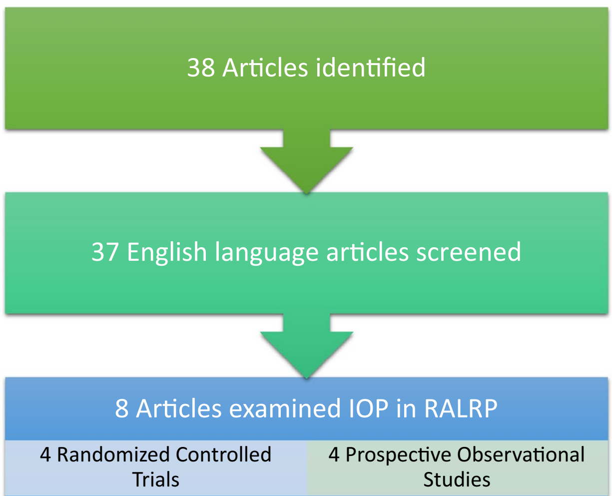

Fig. 1 Study selection. Of the 38 articles identified via PubMed search, only eight were available in the English language and studied intraocular pressure (IOP) in robot-assisted laparoscopic radical prostatectomies (RALRP)

The studies included for review are listed in Table 1 and in the References. All chose patients who were undergoing RALPR. Common exclusion criteria included patient factors independently associated with increased IOP. These criteria included baseline IOP > 30 mmHg, body mass index (BMI) > 30–40 kg/m^2, current ophthalmologic disease including glaucoma, and previous ophthalmologic surgery. BMI was chosen due to its association with increased IOP as shown by Cohen et al. [13] and Wygnanski-Jaffe et al. [14] Uncontrolled hypertension was an exclusion criterion in a few studies [5, 8] possibly due to the association between hypertension and increased IOP [15]. From the studies included for review, mean age of patient ranged between 54.1 and 66.1 years and mean BMI ranged between 23.6 and 29.5 kg/m^2.

All the patients had intraocular pressures taken at baseline while in the supine position, immediately before or after induction of anesthesia (Table 2). Raz was the only study to take the first measurement after induction of anesthesia and consequently has a baseline measurement much lower at 10 mmHg than the rest of the studies which showed an average baseline IOP of 15.6 mm Hg [6].

Table 1 Demographic data

Study	No. of patients	Age (mean)	BMI (mean)
Yoo (moderate NMB-ST) [5]	32	63.9	24.4
Yoo (deep NMB-ST) [5]	34	61.5	23.6
Raz (modified ZT) [6]	29	64.9	27.3
Raz (ST) [6]	21	63.7	27.9
Kim (ST-Precedex) [7]	34	61.6	24.0
Kim (ST) [7]	34	61.9	24.6
Yoo (ST-Sevo) [8]	33	65.1	24.1
Yoo (ST-Propofol) [8]	33	64.7	24.2
Mondzelewski (supine, open) [9]	12	54.1	29.5
Mondzelewski (ST) [9]	18	57.4	26.7
Mondzelewski (supine, laparoscopic) [9]	9	48	27.8
Taketani (observational) [10]	25	64	24
Hoshikawa (ST)-(observational) [11]	31	66.15	[a]
Awad (ST)-(observational) [12]	33	61.5 (med)	28 (med)

Sample size, mean age and body mass index (BMI) for the studies of interest

IOP Intraocular pressure, *ST* steep Trendelenburg, *NMB* neuromuscular blockade, *Sevo* sevoflurane

[a]Unknown

Measurements were conducted with a Tono-Pen hand held tonometer. After baseline data were obtained, measurements were conducted at various time intervals throughout the procedure. We reviewed IOP measurements after 1 h in the ST position during laparoscopy since this was a measurement available in all studies.

Results

The results of the examined studies are seen in Table 2 and represented graphically in Fig. 2. All eight studies showed that ST position led to a statistically significant increase in IOP after 1 h. The four randomized controlled trials showed that increased IOP was attenuated using specific medication and position interventions. Yoo demonstrated that propofol-based total intravenous anesthetic causes an attenuation of IOP when compared to a sevoflurane-based inhaled anesthetic [8]. The propofol group received a remifentanil

Table 2 Perioperative outcomes

	Baseline IOP (mmHg)	IOP after 1 h in ST	EBL cc (mean)	Operation time (mean)	Fluids (ml)
Yoo (moderate NMB) [5]	15	23.3 (ss)	467	115	1210
Yoo (deep NMB) [5]	15	19.8 (ss)	416	111	1316
Mondzelewski (supine, open) [9]	15.3	19.04	291 (ss)	[a]	[a]
Mondzelewski (ST) [9]	13.7	30.1	617 (ss)	[a]	[a]
Mondzelewski (supine, laparoscopic) [9]	14.1	22.7	112 (ss)	[a]	[a]
Taketani (observational) [10]	14.9	25	267	318	1733
Raz (modified ZT) [6]	10.8	19.5 (means were SS)	260.7	184	1487.5
Raz (ST) [6]	10.0	23.5	297.1	187	1454.8
Kim (ST-Precedex) [24]	15	19.9 (ss)	338	126	1646
Kim (ST) [7]	15	25.7 (ss)	388	137	1753
Yoo (ST-Sevo) [8]	17.5	23.5 (ss) after 30 min	431	105 (med)	1558
Yoo (ST-Propofol) [8]	17.9	19.9 (ss)-after 30 min	415	92 (med)	1485
Hoshikawa (ST)-(observational) [11]	17.94	21.55 (ss)	364	274.2	[a]
Awad (ST)-(observational) [12]	15.7	25.2 (ss)	80 (med)	68 (time in ST) med	2000 (med)

Summarized baseline intraocular pressures with comparisons to values 1 h after steep Trendelenburg positioning. Operative outcomes are included

IOP intraocular pressure, *ST* steep Trendelenburg, *EBL* estimated blood loss, *NMB* neuromuscular blockade, *Sevo* sevoflurane, *ss* statistically significant

[a]Unknown

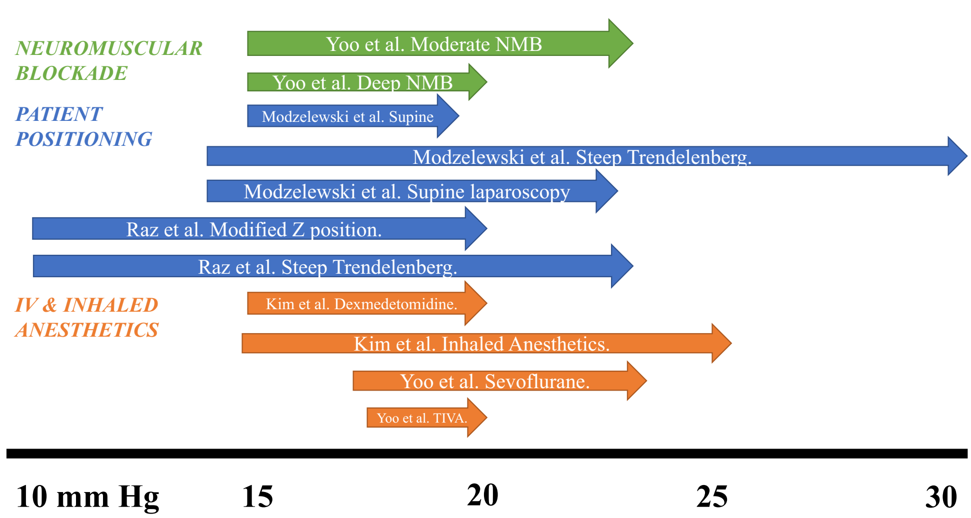

Fig. 2 Schematic of mean differences. In relative configurations, the increase in mean intraocular pressure at 1 h of steep Trendelenburg position compared to baseline is shown. TIVA = total intravenous anesthetic. The studies are divided based on anesthetic variables of interest

infusion and a propofol infusion using a target-controlled infusion system to maintain an effect site concentration of 2–5 µg/ml. The sevoflurane group used a remifentanil infusion and sevoflurane with the concentration maintained at 1.5–2.5%.

A similar medication-related attenuation in IOP was found in the study by Kim which found that patients treated with dexmedetomidine had an attenuation in IOP [7]. The experimental group had a dexmedetomidine infusion running at 0.4 µg/kg/h in addition to the inhaled anesthetic that was used in the control group. After 1 h in ST position the group receiving dexmedetomidine had an average IOP of 6 mm Hg less than the control group.

Yoo et al. found the depth of neuromuscular blockade (NMB) made a difference in intraoperative IOP [5]. The moderate NMB group received an atracurium infusion to maintain a train of four count of 1–2. The deep NMB group utilized a rocuronium infusion to maintain a post-tetanic count of 1–2. The moderate NMB group had a higher IOP when compared to the deep NMB group after 1 h in ST position.

Of the randomized controlled trials, Raz et al. investigated a modification of head position while in ST [6]. The modified Z position consisted of placing the patient in ST and then positioning the head and shoulders horizontally. This change in position of the head and shoulders showed statistically significant decrease in IOP when compared to patients in standard ST position.

Among the four observational studies, Mondzelewski was the only prospective observational study with multiple cohorts: anesthetized patients in the supine position, anesthetized patients in the ST position, and anesthetized patients undergoing laparoscopy in the supine position [9]. This three-arm study demonstrated the isolated contribution to increased IOP due to laparoscopy alone. This finding indicates that the increase in IOP seen in patients undergoing RALPR has a contribution from the ST position as well as from the laparoscopic component of the procedure.

There were only two studies which correlated intraoperative changes in IOP with postoperative ophthalmologic clinical outcomes. Taketani showed of 25 patients who underwent RALRP, all had a statistically significant increase in IOP after 1 h in the ST position [10]. Of the 25 patients, seven subjects had local visual field defects in the lower hemi-field when taking the Glaucoma Hemifield Test. Interestingly, the subjects were not aware of any deficits and they all resolved when tested again 3 months after surgery. Hoshikawa also examined visual acuity using a Snellen chart [11]. Despite all 31 patients exhibiting an increase in intraoperative IOP, no visual changes were detected.

Total estimated blood loss and intravenous fluids administration were recorded in almost all the studies to account for changes in venous pressure due to volume status. These data were important to control for since venous pressure is directly correlated with intraocular pressure. Only Taketani reported the mean arterial pressure which is also a risk factor for posterior ischemic optic neuropathy [10]. The only study to examine end tidal carbon dioxide ($ETCO_2$) and its relationship to IOP was Awad et al. [12]. Awad used univariate mixed effect models to show that $ETCO_2$ and surgical duration were the only significant predictors of increased IOP while in ST position.

Discussion

Patients undergoing RALRP are at risk for increased intracranial pressure [16, 17], mean arterial pressure [18], central venous pressure [18], and expiratory airway pressure [19] which can occur during laparoscopy and positioning in the ST position. While the some of these variables can be managed with medications and ventilator settings, intraocular pressure is not routinely measured and can lead to sequelae which are undetected until after emergence from anesthesia [20]. Laparoscopy alone is a risk factor for increased IOP due to increased intraabdominal pressure [21]. When combined with the ST position, IOP can rise to levels which may compromise ocular perfusion and cause postoperative visual loss [22]. Use of vasopressors to maintain OPP in the setting of increased IOP is not ideal since these medications can cause a reduction in blood flow in the capillary bed of the optic nerves, thereby causing ischemic injury [23]. Due to this limitation, it is important to find ways to lower the IOP.

Some of the most commonly reported complications from RALRP are ileus, abdominal distension, and nausea vomiting, with an incidence of less than 2% at some of the busier surgical centers for this procedure. Corneal abrasions were the most common anesthesia-related complication in a review of 1500 cases [25].

The existing literature suggests several variables that can attenuate the IOP response that occurs with ST. Even though Yoo [8] showed the increase in IOP to be less with propofol rather than sevoflurane, Gofman et al. [24] and Sator-Katzenschlager et al. [26] showed no change in intraocular pressure in supine patients undergoing propofol or sevoflurane. This suggests that choice of anesthetic agents when a patient is supine may not be as pertinent as when the patient is in ST. Further research is needed to confirm the impact of anesthetic agents on IOP while in ST.

Yoo et al. showed that deep NMB causes less of an increase in IOP when compared to moderate NMB [5]. This finding can be explained by greater relaxation of extraocular muscles which facilitates aqueous humor drainage [4], and better surgical conditions [27, 28] which may correlate with decreased insufflation pressure requirements.

Taketani et al. showed all the patients had objective findings including increased IOP and visual field defects, yet none of the subjects reported subjective effects such as visual field loss or ocular symptoms [10]. This suggests that patients undergoing RALRP may sustain transient visual field loss without symptoms.

Awad et al. notably showed not only an increased in IOP with ST, but also a direct correlation between IOP and $ETCO_2$ [12]. It is postulated that this is due to choroid plexus vasodilation from increased arterial CO_2. This mechanism may also be responsible for the increased IOP seen in the supine, laparoscopic cohort of the prospective findings of Mondzelewski [9].

No formal guidelines or strategies exist regarding pre-operative vision screening, perioperative medication, etc., for those undergoing RALRP with a known increased IOP from baseline or normal range, especially for patients expected to be in Trendelenburg position for an extended period [29]. It has been suggested that patients with pre-existing ophthalmologic conditions presenting for robotic prostatectomy should obtain ophthalmology consultation and likely optical coherence tomography to evaluate retinal thickness. A more thorough assessment of pre-operative visual function and anatomy should yield safer and more informed risk assessment pre-operative and pre-anesthesia evaluations [30].

In addition, though not specific to RALRP, some features of general anesthesia have been linked to changes in intraocular pressure. While induction agents such as propofol, thiopental, and etomidate can reduce IOP by 25–40%, maintenance agents such as sevoflurane can also do so. Short-acting opioids can decrease IOP, though succinylcholine can increase IOP by 10 mmHg [31]. Some of the respiratory/airway factors that can influence intraocular pressure include direct laryngoscopy, coughing on an endotracheal tube, an increase in partial pressure of carbon dioxide or decrease in partial pressure of oxygen, as well as positive end-expiratory pressure greater than 15 cm H_2O [32]. Another factor to consider is the relationship between age and IOP. The association between IOP and age has not been well-established with some studies indicating an increase of IOP with age [33] and some studies indicating no change [34]. Consequently, it is unknown if management of IOP while in ST would change based on age. While younger patients may be able to autoregulate ocular perfusion pressure better than older patients, we still recommend the same concerns and precautions that would be instituted in the older patient population.

The Anesthesia Patient Safety Foundation in 2013 developed general consensus guidelines and principles to minimize the risk of perioperative visual loss including minimizing surgery duration, keeping the head above the level of the heart, including colloid in fluid replacement, though some risk factors are harder or impossible to alter male gender, obesity, intraoperative exposures and positioning, etc. [35]. Periodic hemoglobin measurements are recommended. It may be difficult to best optimize arterial pressure and intraocular pressure given patients' comorbidities, most significantly diabetes mellitus, atherosclerosis, hypertension, and glaucoma [36].

The Foundation also emphasized the need for more detailed and thorough informed consents [33], something of which can be extracted to the ophthalmologic complications of RALRP. The risk of orbital pain and periorbital edema postoperatively should also be explained to the patient as part of the informed consent process [29].

Beyond the discussion of the literature, the limitations of the analysis include the limited number of studies which we found in this review. Of the eight studies, only four were conducted in a randomized controlled trial. Each study had a small population. Other than the study by Taketani, none of the other studies measured accompanying variables such as mean arterial pressure which might contribute to alterations in IOP.

Conclusion

The studies reviewed showed a direct association between ST and increased IOP. More work is needed to look at whether an increase in intraocular pressure is correlated with adverse clinical outcomes, especially in patients which pre-existing elevated IOP. Until this is done, patients with pre-existing ophthalmologic disease may benefit from pre-operative ophthalmologic consultation, modifying anesthetic agents, and position during RALRP. These interventions include using propofol-based total intravenous anesthetic, deep NMB, use of dexmedetomidine, and a modified ST position.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

References

1. Menon M, Shrivastava A, Tewari A et al (2002) Laparoscopic and robot assisted radical prostatectomy: establishment of a structured program and preliminary analysis of outcomes. J Urol 168(3):945–949
2. Trinh QD et al (2012) Perioperative outcomes of robot-assisted radical prostatectomy compared with open radical prostatectomy:

results from the nationwide inpatient sample. Eur Urol 61(4):679–685
3. Oberlin DT, Flum AS, Lai JD, Meeks JJ (2016) The effect of minimally invasive prostatectomy on practice patterns of American urologists. Urol Oncol 34(6):255
4. Cunningham AJ, Barry P (1986) Intra-ocular pressure—physiology and implications for anaesthetic management. Can Anaesth Soc J 33(2):195–208
5. Yoo YC, Kim NY, Shin S, Choi YD, Hong JH, Kim CY, Park H, Bai SJ (2015) The intraocular pressure under deep versus moderate neuromuscular blockade during low-pressure robot assisted laparoscopic radical prostatectomy in a randomized trial. PLoS One 10(8):e0135412
6. Raz O, Boesel TW, Arianayagam M, Lau H, Vass J, Huynh CC, Graham SL, Varol C (2015) The effect of the modified Z trendelenburg position on intraocular pressure during robotic assisted laparoscopic radical prostatectomy: a randomized controlled study. J Urol 193(4):1213–1219
7. Kim NY, Yoo YC, Park H, Choi YD, Kim CY, Bai SJ (2015) The effect of dexmedetomidine on intraocular pressure increase in patients during robot-assisted laparoscopic radical prostatectomy in the steep Trendelenburg position. J Endourol 29(3):310–316
8. Yoo YC, Shin S, Choi EK, Kim CY, Choi YD, Bai SJ (2014) Increase in intraocular pressure is less with propofol than with sevoflurane during laparoscopic surgery in steep Trendelenburg position. Can J Anaesth 61(4):322–329
9. Mondzelewski RJ, Schmitz JW, Chistman MS, Davis KD, Lujan E, L'Esperance JO, Auge BK (2015) Intraocular pressure during robotic-assisted laparoscopic procedures utilizing steep Trendelenburg positioning. J Glaucoma 24(6):399–404
10. Taketani Y, Mayama C (2015) Transient but significant visual field defects after robot-assisted laparoscopic radical prostatectomy in deep Trendelenburg position. PLOS One 10(4):e0123361
11. Hoshikawa Y, Tsutsumi N, Ohkoshi K, Serizawa S, Hamada M, Inagaki K, Tsuzuki K, Koshimizu J, Echizen N, Fujitani S, Takahashi O, Deshpande GA (2014) The effect of steep Trendelenburg positioning on intraocular pressure and visual function during robotic-assisted radical prostatectomy. Br J Ophthalmol 98(3):305–308
12. Awad H, Santilli S, Ohr M, Roth A, Yan W, Fernandez S, Roth S, Patel V (2009) The effects of steep Trendelenburg positioning on intraocular pressure during robotic radical prostatectomy. Anesth Analg 109(2):473–478
13. Cohen E, Kramer M, Shochat T, Goldberg E, Garty M, Krause I (2016) Relationship between body mass index and intraocular pressure in men and women: a population-based study. J Glaucoma 25(5):e509–e513
14. Wygnanski-Jaffe T (2015) Metabolic syndrome: a risk factor for high intraocular pressure in the Israeli population. Int J Ophthalmol 8(2):403–406
15. Klein BEK, Klein R, Knudtson MD (2015) Intraocular pressure and systemic blood pressure: longitudinal perspective: the Beaver Dam Eye Study. Br J Ophthalmol 89(3):284–287
16. Mavrocordatos P, Bissonnnette B, Ravussin P (2000) Effects of neck position and head elevation on intracranial pressure in anaesthetized neurosurgical patients. J Neurosurg Anesthesiol 12:10–14
17. Halverson A, Buchanan R, Jacobs L et al (1998) Evaluation of mechanism of increased intracranial pressure with insufflation. Surg Endosc 12:266–269
18. Kalmar AF, Foubert L, Hendrickx JF et al (2010) Influence of steep Trendelenburg position and CO_2 pneumoperitoneum on cardiovascular, cerebrovascular, and respiratory homeostasis during robotic prostatectomy. Br J Anaesth 104:433–439
19. Wiltz AL, Shikanov S, Eggener SE et al (2009) Robotic radical prostatectomy in overweight and obese patients: oncological and validated-functional outcomes. Urology 73:316–322
20. Nuzzi R, Tridico F (2015) Ocular complications in laparoscopic surgery: review of existing literature and possible prevention and treatment. Semin Ophthalmol 19:1–9
21. Ece I, Vatansev C, Kucukkartallar T, Tekin A, Karal A, Okka M (2015) The increase of intra-abdominal pressure can affect intraocular pressure. Biomed Res Int 2015:986895
22. Walick KS, Kragh JE, Ward JA (2007) Changes in intraocular pressure due to surgical positions: studying potential risk for postoperative vision loss. Spine 32:2591–2595
23. Hayreh SS (2004) Posterior ischaemic optic neuropathy: clinical features, pathogenesis, and management. Eye 18:1188–1206
24. Gofman N, Cohen B, Matot I, Cattan A, Dotan G, Stolovitch C, Ela-Dalman N (2015) Do intraocular pressure measurements under anesthesia reflect the awake condition? J Glaucoma 26:299–302 **(PMID 26561424)**
25. Danic MJ, Chow M, Alexander G, Bhandari A, Menon M, Brown M (2007) Anesthesia considerations for robotic-assisted laparoscopic prostatectomy: a review of 1500 cases. J Robot Surg 1:119–123
26. Sator-Katzenschlager S, Deusch E, Dolezal S, Michalek-Sauberer A, Grubmuller R, Heinze G, Wedrich A (2002) Sevoflurane and propofol decrease intraocular pressure equally during non-ophthalmic surgery and recovery. Br J Anaesth 89(5):764–766
27. Madsen MV, Staehr-Rye AK, Gatke MR, Claudius C (2015) Neuromuscular blockade for optimizing surgical conditions during abdominal and gynaecological surgery: a systematic review. Acta Anaesthesiol Scand 59:1–16
28. Martini CH, Boon M, Bevers RF, Aarts LP, Dahan A (2014) Evaluation of surgical conditions during laparoscopic surgery in patients with moderate vs deep neuromuscular block. Br J Anaesth 112:498–505
29. Awad H, Walker CM, Shaikh M, Dimitrova GT, Abaza R, O'Hara J (2012) Anesthetic considerations for robotic prostatectomy: a review of the literature. J Clin Anesth 24:494–504
30. Awad H, Malik OS, Cloud AR, Weber PA (2013) Images in anesthesiology: robotic surgeries in patients with advanced glaucoma. Anesthesiology 119:954
31. Kelly DJ, Farrell SM (2018) Physiology and role of intraocular pressure in contemporary anesthesia. Anesth Analg 126:1551–1562
32. Nathan N (2018) The eyes have it: factors that influence intraocular pressure (IOP). Anesth Analg 126:1431
33. Rotchtchina E, Mitchell P, Wang J (2002) Relationship between age and intraocular pressure: the Blue Mountains Eye Study. Clin Exp Ophthal 30:173–175
34. Wong TT, Wong TY, Foster PJ et al (2009) The relationship of intraocular pressure with age, systolic blood pressure and central corneal thickness in an Asian population. Invest Ophthalmol Vis Sci 50:4097–4102
35. Lee LA, Stoelting RK (2013) APSF-sponsored conference on perioperative visual loss develops consensus conclusions. Anesth Patient Saf Found Newsl 27:52–53
36. Epstein NE (2016) Perioperative visual loss following prone spinal surgery: a review. Surg Neurol Int 7:S347–S360