

Lomber Disk Cerrahisinde Genel ve Spinal Anestezinin İntraoküler Basınç Üzerine Etkilerinin Karşılaştırılması

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ÖZ

Perioperatif görme kaybı nadir fakat yıkıcı sonuçları olan bir komplikasyondur. Lomber diskektomi gibi pron pozisyonunda gerçekleştirilen ameliyatlarda sıklığı diğer cerrahilerin 4 katına kadar çıkabilmektedir. En sık nedeni posterior iskemik optik nöropati olarak bildirilse de pron pozisyonun göz içi basıncını arttırması da bir neden olabilir. Çalışmamızda pron pozisyonunda gerçekleştirilen lomber diskektomilerde genel ve spinal anestezinin intraoküler basınç üzerine farklı etki oluşturup oluşturmayacakları araştırıldı. Elektif koşullarda lomber disk herni cerrahisi planlanan 18-65yaş, ASA1-2 risk grubunda hastalar çalışmaya alındı ve Grup GA (Genel Anestezi) ve Grup SA (Spinal Anestezi) olarak ayrıldı. Hastaların demografik ve operatif verileri kaydedildi. İntraoküler basınç ölçümleri preoperatif supin pozisyonunda ve postoperatif pron pozisyon sonrası supin pozisyonun 5.dakikasında ölçüldü. 120 hasta çalışmaya alındı, 77 hastanın verileri analiz edildi. Grup GA'da postoperatif intraoküler basınç değerlerinin preoperatif elde edilen değerlere göre yükseldiği (her iki göz için $p<0.001$); Grup SA'da, pre ve postoperatif intraoküler basınç değerlerinin benzer olduğu saptandı ($p=0.727$ ve 0.699). Arteriyel kan basıncı ve kalp tepe atımı değerlerinde Grup GA'da ekstübasyonla birlikte ani bir artış gözlemlendi. Demografik veriler ve intraoperatif ölçümlerin incelendiği regresyon analizinde sadece vücut kitle indeksi ile her iki intraoküler basınç değeri arasında doğrusal bir ilişki saptandı. Çalışmamızda hemodinaminin stabil seyrettiği, 2 saatten kısa süren disk hernisi operasyonları incelendi. İntraoküler basıncın genel anestezisi sonrası anlamlı düzeyde yükseldiği, spinal anestezisi sonrası ise değişmediği saptandı. İntraoperatif dönemde intraoküler basınç artışı endişe ediliyorsa, spinal anestezinin tercih

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edilmesinin daha uygun olacağı kanaatindeyiz. Bu öneri hemodinaminin minimal etkilendiği, kanama beklenmeyen lomber diskektomi vakalarına yöneliktir. Vücut kitle indeksi yüksek olan hastalarda bu artışın daha yüksek olabileceği göz önünde bulundurulmalıdır.

Anahtar Kelimeler: intraoküler basınç, pron pozisyon, lomber disk hernisi, Genel anestezi, spinal anestezi.

Comparison Of The Effects Of General And Spinal Anesthesia On Introcular Pressure In The Lumbar Disc Surgery

ABSTRACT

Preoperative vision loss is a rare but devastating complication. The frequency of occurrence after operations performed in the prone position, such as lumbar discectomy, can be up to 4 times that of other surgeries. Although the most common cause is reported as posterior ischemic optic neuropathy, increased intraocular pressure from the prone position may also be a cause. In our study, it was investigated whether general and spinal anesthesia would have different effects on intraocular pressure in lumbar discectomies performed in the prone position. Following approval of Local Ethics Committee, Patients aged 18-65 years, ASA1-2 risk group who were scheduled for lumbar disc hernia surgery under elective conditions were included in the study and divided into Group GA (General Anesthesia) and Group SA (Spinal Anesthesia). Demographic and operative data of the patients were recorded. Intraocular pressure measurements were performed in the preoperative supine position and It was measured at the 5th minute of the supine position after the postoperative prone position. 120 patients were included in the study, data of 77 patients were analyzed. In Group GA, postoperative intraocular pressure values increased compared to the values obtained preoperatively ($p<0.001$ for both eyes); Pre- and postoperative intraocular pressure values were found to be similar in Group SA ($p=0.727$ and 0.699). A sudden increase in arterial blood pressure and heart rate values was observed in Group GA with extubation. In the regression analysis examining demographic data and intraoperative measurements, a linear relationship was found between only body mass index and both intraocular pressure values. In our study, disc herniation operations lasting less than 2 hours, with stable hemodynamics, were examined. It was determined that the intraocular pressure increased significantly after general anesthesia and did not change after spinal anesthesia. If there is concern about an increase in intraocular pressure during the intraoperative period, we believe that spinal anesthesia should be preferred. This recommendation is for lumbar discectomy cases where hemodynamics is

minimally affected and bleeding is not expected. It should be considered that this increase may be higher in patients with a high body mass index.

Keywords: intraocular pressure, prone position, lumbar discectomy, general anesthesia, spinal anesthesia.

INTRODUCTION

It has been reported that the frequency of complications resulting in loss of vision in spinal surgeries performed in the prone position is high, and the highest risk is in the long hours of spinal fusion and scoliosis operations (Epstein, 2016). It has been reported that these complications are developed due to ischemia of the optic nerve and that the time of the operation, bleeding, hypotension, excessive fluid resuscitation, as well as pressure on the eye, are effective factors (Park et al., 2019; Wang, Brewer, & Sadun, 2020). All of these are the problems that can arise due to bleeding on a difficult patient to perform surgery. Therefore, the contributions of the anesthesiologist to prevent peri-operative vision loss in spinal surgeries performed in the prone position has not yet been adequately clarified (SA, 2020). After the prone positioning, an instant increase occurs in IOP (Cheng et al., 2001). It has been reported that the pressure reflected on the face of the patient who is turned to the prone position and supported with routine adjuvants has increased to 30 mmHg during anesthesia (Leibovitch, Casson, Laforest, & Selva, 2006). For these reasons, it is stated that the prone position can significantly increase the risk of ischemic optical neuropathy (Stambough, Dolan, Werner, & Godfrey, 2007). We thought the preferred anesthesia method might affect the IOP, therefore, the right choice could be useful in preventing ischemic optical neuropathy and similar complications. To test this hypothesis, we aimed to measure the peri-operative intracular pressure in patients who were performed general anesthesia and spinal anesthesia on an elective lumbar disc hernia surgery in the prone position. In order to avoid the potential effects of the risk factors described above, we limited our work to short and medium-term, lumbar surgeries where bleeding is not expected.

MATERIAL METHOD

After receiving the permit from the Local Ethics Council of Recep Tayyip Erdogan University with the date 24.10.2018 and decision no. 142, adult patients who were planned to have lumbar disc hernia surgery were included in the study at elective conditions by the Department of Brain and Nerve Surgery, between the dates of December 2018 - November 2019. Patients whose American Anesthesiology Association risk score is 3 or above, those who are pregnant, patients who were

taken into operation with an urgent indication; since it will affect the intracocular pressure measurement, those who have an eye disease history such as eye surgery, glaucoma, cataract, tumor, infection, trauma, etc.; because of the peri-operative vision loss risk factors, patients with diabetes mellitus, uncontrolled hypertension, peripheral vein disease, morbid obesity; patients who have hypersensitivity to the anesthetic medications used in the study; patients who were detected to have dura tearing during the surgery, those who were performed vasopressor adjustment, liquid or blood resuscitation were excluded from the study.

In this prospective study, no formal randomization was performed. We prospectively enrolled consecutive cases in the order they presented and, because the attending anesthesiologist independently selected the anesthesia modality, we alternately included one spinal-anesthesia patient and the next general-anesthesia patient, thereby achieving balanced cohorts without investigator-driven allocation. The type of anesthesia to be administered to the patients who were admitted to the operating room was standardized for all patients. All patients were monitored with electrocardiogram, noninvasive blood pressure, pulse oximetry; and basal measurements were obtained. 7 ml/kg of iv hydration was administered by 0.09% isotonic in 15 minutes, and premedication was provided by 0.02 mg/kg of iv midazolam.

General anesthesia application:

Through iv, 2 mcg/kg of fentanyl and 2 mg/kg of propofol were given to provide anesthesia, 0.6 mg/kg of rocuronium was given for muscle relaxation, and the intubation was performed. The mechanical ventilation settings of the post-prone position anesthesia device are set to the frequency with end-expiratory pressure of 5 cmH₂O, tidal volume to 7 ml/kg, end-tidal carbon dioxide pressure to 33-37 mmHg. At the end of the operation, 0.5 mg of atropine through iv was given, and after 30 seconds, 0.07 mg/kg of neostigmine was performed; they were extubated after sufficient spontaneous ventilation.

Spinal anesthesia application:

Bupivacaine (Heavy Marcaine, Astra Zeneca, Turkey) to be applied for spinal anesthesia was modified and calculated to standardize according to the patient's height and weight (Harten, Boyne, Hannah, Varveris, & Brown, 2005). During the case, the isotonic fluid replacement was maintained at a speed of at least 4 ml/kg/hour.

Surgical positioning:

After the patient was turned into a prone position, the bilateral breast pads,

cushions under legs and arms, and finally the head pad was placed in the most suitable position for the surgery. In patients with general anesthesia, it was paid attention that the head is at heart level and there is no pressure on the eyes. Patients undergoing spinal anesthesia were reminded that they can turn their heads wherever they want during the surgery.

Measurements:

Intracocular pressures of all patients were measured 2 times. The first of the measurements were performed in the supine position before anesthesia application. After the measurement, anesthesia was applied and the patient turned to prone position. The second measurement, on the other hand, was taken after the surgery and the patient was turned to a supine position. In the patients with general anesthesia, 5 minutes were waited for the measurement after the procedures so that the extubation does not cause a false increase in the measurement.

All the measurements were performed by an Ophthalmologist with the TonoPen XL device (Reichert, Buffalo, New York, United States of America) in the supine position. Proparacaine drop (Alcaine 0.5%, Novartis, Switzerland) was dripped into the eye before both measurements, and local anesthesia was provided.

During the surgery, arterial blood pressure, heart apex rate, peripheral oxygen saturation, end-tidal carbon dioxide pressure, amount of liquid given, amount of bleeding, amount of urine was measured and recorded at intervals of 5 minutes until the patient was returned to the prone position, then to the supine position.

Statistical analysis:

Data were analyzed with IBM SPSS Statistics (Version 12). The conformation of data to the normal distribution was examined with the Kolmogorov-Smirnov test and Q-Q graphic. Normally distributed data (age, height, weight, body mass index) and measurements (IOP values, arterial blood pressure, heart rate, peripheral oxygen saturation, end-tidal carbon dioxide pressure, duration of operation, amount of bleeding, and amount of intravenous fluids infused) were presented as mean $\pm$ standard deviation. Between-group comparisons were performed with a t-test.

Categorical data (gender, ASA score, surgical indication, surgical procedure) were presented as count (percentage%). Intergroup comparisons was carried out with chi-square test.

Intergroup comparisons of demographic data and measurements were carried out. Pre-operative and post-operative IOP values were compared separately for

each eye, treating each eye as an independent observation. A linear regression model was built to test the effects of demographic and measured variables on IOP. Variables found to be statistically significant in the regression analysis were further examined using correlation tests to assess the strength and direction of their relationship with IOP. Throughout the analysis, a p value < 0.05 was considered as statistical significance.

Because no published data were available to support a priori effect-size assumptions, we adopted a pragmatic approach and simply included every consecutive eligible patient who presented during the 12-month recruitment window (December 2018 – November 2019). This convenience strategy yielded 77 analysable cases, which a post-hoc calculation showed provides $>80\%$ power to detect a ≥ 3 mmHg between-group difference in postoperative intra-ocular pressure at $\alpha = 0.05$.

RESULTS

A total of 120 patients were included in the study. A total of 18 patients were excluded from the study since they did not meet the inclusion criteria. These patients were excluded from the study because eight of them were taken into operation with urgent indication, four of them had morbid obesity diagnosis, uncontrolled hypertension was detected in three of them, and three patients had glaucoma diagnosis. The data of 77 patients were analyzed in total. Consort chart is shown in Figure 1.

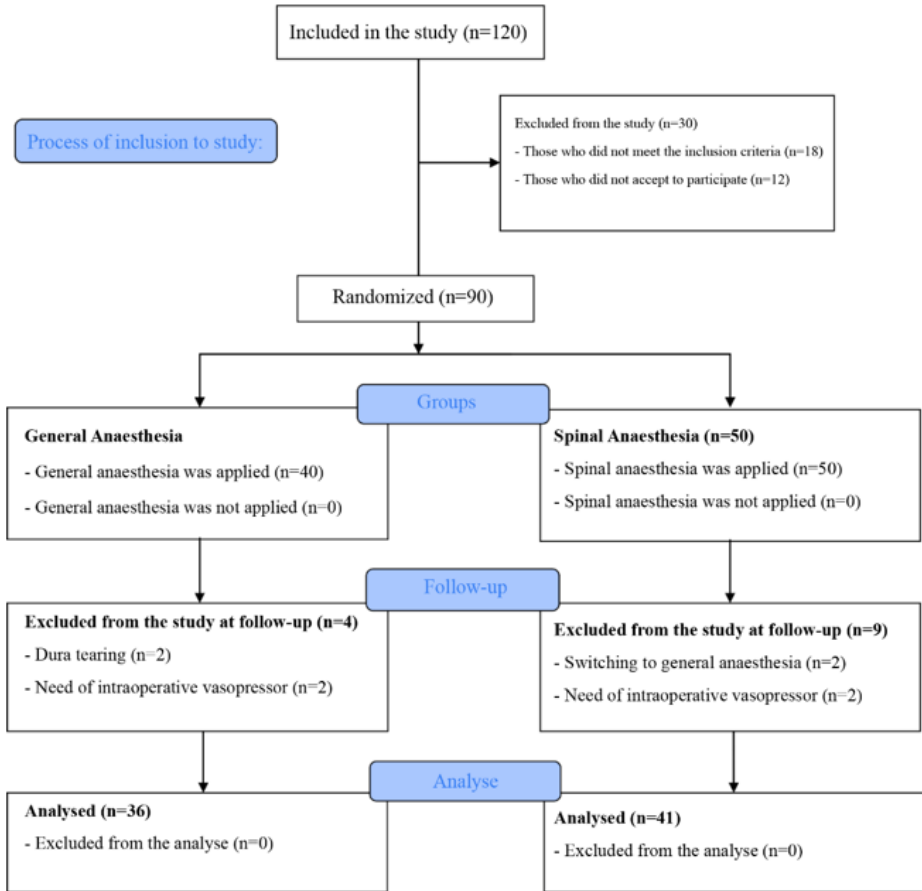


Figure 1. Consort flow chart of the study.

The characteristics of the patients included in the study are given in Table 1. In brief, the groups were similar in terms of age, female and male gender distribution. Only the height of the anthropometric characteristics was higher in the group with spinal anesthesia. Weights and body mass indexes were similar. The most frequent surgical indication was detected as the lumbar disc hernia.

Table 1. Patient Characteristics

	General Anesthesia (n=36)	Spinal Anesthesia (n=41)	p
Age, years	49.9±10.0	51.1±11.8	0.674
Gender, n (%)			0.879
Female	16 (44%)	20 (49%)	
Male	20 (56%)	21 (51%)	
Height, cm	161.5±8.9	167.4±9.7	0.015
Weight, kg	82.3±13.1	84.8±14.7	0.399
BMI, kg/cm ²	31.7±4.9	30.3±4.9	0.233
Surgical indication, n (%)			
Extrudate disc	31 (86.1%)	35 (85.4%)	0.969
Protrusive disc	3 (8.3%)	4 (9.7%)	
Sequestrum disc	2 (5.6%)	2 (4.9%)	
ASA score			0.185
1	12 (33%)	18 (44%)	
2	24 (67%)	23 (56%)	
Right intracular pressure, mmHg	18.5±3.7	18.4±4.1	0.707
Left intracular pressure, mmHg	18.8±4.0	19.1±4.4	0.718

Data of the patients recorded during the operation was given in Table 2. In brief, operation times and bleeding amounts were similar. However, the intravenous liquid amount given during the operation was significantly higher in the group with spinal anesthesia ($p<0.001$). Pathology was not found in any of the patients whose data were analyzed.

Table 2. Intraoperative Measurements

	General Anesthesia (n=36)	Spinal Anesthesia (n=41)	p
Operative time, min	72.2±12.3	72.2±11.6	0.926
Surgical procedure, n (%)			1
Single-level discectomy	29 (81%)	33 (83%)	
Two-levels discectomy	7 (19%)	8 (17%)	
Amount of bleeding, ml	50±4.9	55±6.8	
Intravenous fluid, ml	1067.1±313.6	1576.8±470.7	<0.001

IOP values measured after the operation was shown in Figure 2 comparatively with the values measured before the operation. In brief, it was determined that after general anesthesia application, IOP values were higher than the values obtained before the surgery ($p < 0.001$ for both eyes); and that after spinal anesthesia application, they were similar to the values obtained before the surgery ($p = 0.727$ ve 0.699).

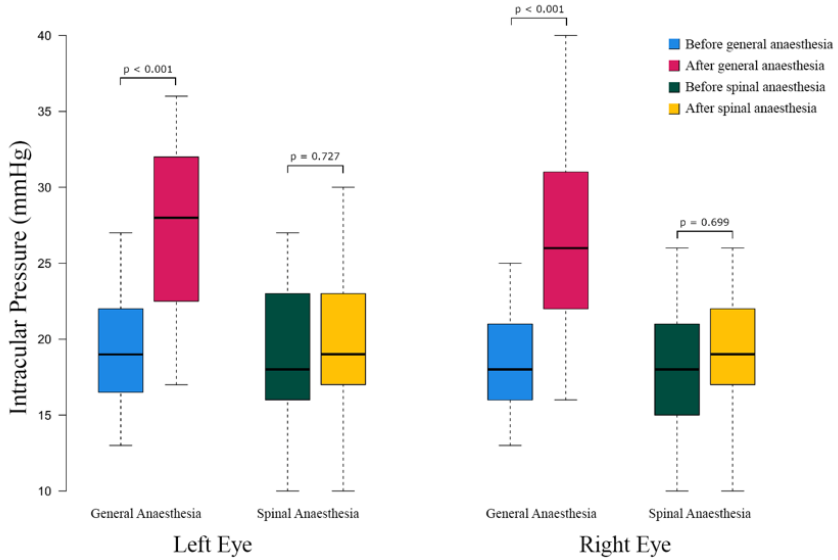


Figure 2. Intraocular pressure measurements.

For ease of evaluation, the measurements from the left eye are given on the left side, the measurements from the right side are given on the right side. In both graphs, there are the measurements for the general anesthesia group on the left, and measurements for the spinal anesthesia group on the right.

The systolic, diastolic and mean arterial blood pressure with pulse values measured during the intraoperative period were significantly decreased with the start of anesthesia in all patients, remained fairly stable during the operation, and converged to the basal values at the end of the operation. There was an instant increase in the general anesthesia group along with the extubation, and there was no significant change in the spinal anesthesia group.

When the factors affecting IOP from the patient characteristics and intraoperative measurements were analyzed with multiple regression analysis, body mass index was found to give significant results. The linear relationship between the body mass index and IOP is shown in Figure 3.

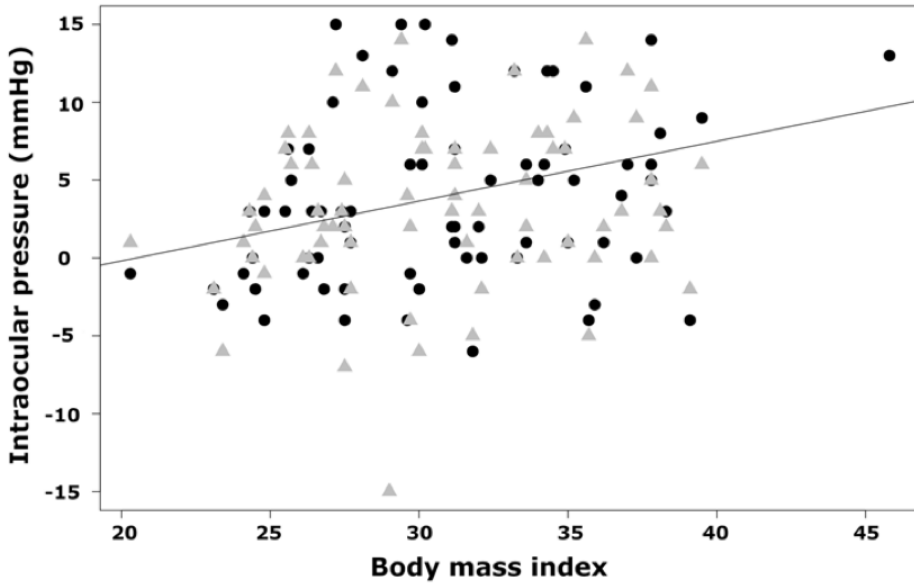


Figure 3. The linear relationship between the body mass index and intraocular pressure

DISCUSSION

In this study, it was determined that hemodynamic was stable, the IOP value increases measured 5 minutes after the general anesthesia in the short-term lumbar disc hernia operations, and did not change after the spinal anesthesia. Body mass index was detected as an independent factor increasing IOP.

The strengths of this study are that the number of patients is high in comparison with similar studies, and measurements were performed before and after the anesthesia from both eyes.

Extended operational time, excessive fluid resuscitation, venous congestion, arterial hypotension come forward in the pathophysiology of perioperative ischemic optic neuropathy (Park et al., 2019). All of these are the problems that can arise due to bleeding on a difficult patient to perform surgery. General anesthesia can cause ischemic optic neuropathy in the induction and maintenance phases by presenting arterial hypotension (Newman, 2008).

In the literature, the effect of general anesthesia that increases IOP is supported by the study of Pinar et.al which they examined 40 patients who have undertaken a lumbar disk hernia operation in the low ASA risk group. Pinar et.al did not

detect a difference 10 minutes after the anesthesia in the supine position, saw an increase only in the general anesthesia group 10 minutes after prone positioning, detected an increase in both groups at prone position at the end of the operation, and determined that the increase was more distinct in the anesthesia group (Pinar et al., 2018).

Our results in the general anesthesia group are similar to the results of Pinar et.al; however, in our study, no increase was detected on any of the measurements in the spinal anesthesia group. This may be because Pinar et.al have taken the measurements in prone position.

It is possible that the increase in the general anesthesia group is caused by stress due to extubation (Hassanein, Zekry, & Moharram, 2016). It was stated that IOP increased to 13-15 mmHg in the 5th minute, and to 11-14 mmHg in the 10th minute after extubation. Given that basal values are at the level of 9-14 mmHg, performing post-study measurements 5 minutes after the extubation in our study cannot explain the increase in the general anesthesia group alone.

Another possibility is that the increase depends on the neostigmine used to reverse the effect of the muscle relaxant. In a study where neostigmine-atropine combination and sugammadex, IOP values were stated to be at 18-35 mmHg after the neostigmine application and to be at 10-30 mmHg in the 5. minute (Yagan et al., 2015). The basal measurements being at the 10-27 mmHg range in the same group shows that 5 minutes after the extubation is a sufficient time for the measurement.

The role of regional techniques in spinal surgery is increasing (Pierce et al., 2017). There are some differences between general anesthesia and spinal anesthesia management in terms of ocular perfusion pressure. For example, the neuro-axial block resulting from single dose of local anesthetic in spinal anesthesia is often encountered with hypothermia that requires intervention. However, the risk of hypotension in general anesthesia practice is immediately only in the induction phase. This situation can be controlled with the titration of anesthetic medications. Therefore, a decrease in the secondary ocular perfusion pressure can be expected in the case of spinal anesthesia (Ho, Newman, Song, Ksiazek, & Roth, 2005). In contrast to this, if the appropriate position was not provided for the head of the patient at the start of the operation in general anesthesia, it has been reported that the eye stays under the pressure during the surgery or venous congestion occurs in the orbital compartment (Amorim Correa & Acioly, 2018). This allows the risk of low ocular perfusion pressure to be expected throughout the entire operation.

This risk is minimal in spinal anesthesia since the patient can prevent the eye-getting pressure by adjusting his/her own head position. Thus, the risk caused by the hypotension of spinal anesthesia is balanced with the pressure to the eye in general anesthesia.

Hatipoglu et.al examined the effects of spinal anesthesia on IOP on 38 patients who underwent periumbilical or subumbilical surgery in the ASA risk group and stated that it did not produce an effect (Hatipoglu et al.). The study of Hatipoglu has been published recently, and supported by another study comparing TIVA and spinal anesthesia (Lyzohub et al., 2020). In contrast to this, Sekeryapan et.al argued that the decrease in the arterial blood pressure after spinal anesthesia causes a decrease in IOP (Şekeryapan B, 2013). Although the results of Sekeryapan et.al appear to contradict our study, at first sight, we believe that the systemic arterial blood pressure of patients we have been administering spinal anesthesia is closely maintained by the values of IOP in this group. Given a higher amount of liquid in these patients with no vasopressor, it may have prevented a possible decrease in IOP. However, our study does not have a design to reveal this relationship. For the same reason, we were unable to assess the potential effects of general and spinal anesthesia on the sympathetic system to IOP.

We have determined that only the body mass index can be associated with IOP from the perioperative parameters examined. Obesity was reported among the risk factors of ischemic optic neuropathy after spinal fusion surgery ("Risk factors associated with ischemic optic neuropathy after spinal fusion surgery," 2012). In the study of Panon et.al conducted on normal weighted and overweight volunteers, they studied a number of ocular parameters to compare the relationship between IOP and body mass index, and they found that IOP values in the overweight group be significant than the normal weighted group (Panon et al., 2019). In our study, body mass index was determined to be increasing as IOP increases. Based on these findings, it should be taken into account that the basal IOP values of patients with high body mass index and undergoing spinal surgery in the prone position will be high. In the perioperative period, obese patients should be approached more carefully in terms of loss of perioperative vision, and in the intraoperative period, we believe that if there is no contraindication, spinal anesthesia would be more appropriate.

Our study's design has some limitations. After spinal anesthesia was performed, especially due to the limitations of the tonometry method, another measurement could be performed following the formation of sufficient sensory and motor block in patients who were placed in the supine position (Okafor & Brandt,

2015). In most studies, including our study, support cushions are used; and we chose to take our measurements in supine positions since we would have to make changes in the position of the head for the measurements in prone position. In our study, the given liquid amount was significantly higher in the patients who were administered spinal anesthesia than the patients who were applied general anesthesia with. This may have created a bias in the analysis of the data. Although the treatments of hemodynamic adverse cases were tried to be standardized, we did not have a design to prevent the bias created by the hemodynamic differences and fluid treatment.

CONCLUSION

We believe that spinal anesthesia may be preferred to prevent an increase in intraocular pressure in lumbar discectomy cases where there is no hemodynamic compromise or bleeding.

Ethical Committee Approval: Local Ethics Council of Recep Tayyip Erdogan University with the date 24.10.2018 and decision no. 142

Conflict of Interest Declaration: The authors declare no conflict of interest. Informed consent was received from all patients.

Author Contributions:

HK conceptualized the hypothesis, designed the methodology, supervised the project and reviewed the draft. EK performed data collection, statistical analysis, visualization, and wrote the main manuscript. All authors contributed in the revision, read and approved the final manuscript.

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