

Original Article

Comparison of Propofol and Isoflurane Effects on Intraocular Pressure among Patients Undergoing Lumbar Disc Surgery

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Abstract

Purpose: Blindness is a catastrophic complication of surgeries performed in prone position which occurs mainly due to hemodynamic alterations and the relevant effects on optic nerve perfusion. In this study, we compared the effects of Propofol and Isoflurane on intraocular pressure among patients undergoing lumbar disk surgery.

Patients and Methods: In this randomized clinical trial, 60 patients who were candidates for lumbar disk surgery were randomly assigned into two groups: Propofol and Isoflurane groups. Intraocular Pressure was measured before and after induction of anesthesia in supine position, immediately after prone positioning of the patient, at the end of operation in prone position, and also after turning the patients back to supine position. Mean arterial pressure, systolic and diastolic blood pressure and heart rates were also assessed.

Result: The baseline Mean Intraocular Pressure among awake patients in supine position in Isoflurane and Propofol groups were 15.8 ± 3.1 and 18.2 ± 5.4 mmHg respectively. At the end of operation intraocular pressure in prone position in these two groups of patients changed to 18 ± 5.8 and 17.2 ± 4.9 mmHg respectively ($P = 0.024$) indicating a statistically significant difference in change. According to mixed analysis, mean arterial pressure, systolic blood pressure, diastolic blood pressure, end tidal Co₂ and heart rate did not show statistically significant difference between the two groups ($P < 0.05$).

Conclusion: Propofol better controls the intraocular pressure compared to Isoflurane in prone position among patients undergoing lumbar disk surgery with no significant difference in hemodynamic responses.

Keywords:

Intraocular pressure

Prone Position

Surgery

Propofol

Isoflurane

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Introduction

Post operative blindness is a rare but devastating complication of surgeries specially when performed in prone position, with the incidence of around 0.01 %^{1,2}. In recent years post operative blindness has been taken into consideration and it has earned the 11th rank among the 53 special considerations related to patients' safety during anesthesia^{3,4}. Perfusion pressure of anterior optic nerve is calculated through the difference between posterior ciliary artery pressure and the venous drainage of eye, which are equal to mean arterial pressure and posterior ciliary pressure respectively⁵. Prone position increases the intra ocular pressure (IOP) in both awake and anesthetized patients⁶. There are some reports about post operative blindness mainly due to hemodynamic alterations affecting optic nerve perfusion rather than direct pressure on the eye globe⁷⁻⁹. In prone position IOP is significantly higher than supine position¹⁰. In the present study we compared the effects of Propofol and Isoflurane on IOP among patients in prone position. This is to our knowledge the first study comparing the effects of these two drugs on IOP under prone position.

Patients and Methods

In this randomized clinical trial, we assessed Sixty ASA physical status I or II patients undergoing surgery due to lumbar disc herniation. This study was approved by the ethics committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran and informed consent was obtained from all participants before entering the study. Exclusion criteria consisted of a history of ophthalmic disorders, anti hypertension drug consumption, blood pressure more than 150/90 mmHg and less than 90/60 mmHg, history of stroke and carotid artery problems. Also, patients with more than 1 liter of bleeding during surgery, time

of operation more than three hours and any respiratory / metabolic abnormalities detected by the End Tidal Co₂ (ETCO₂) or ABG analysis were excluded.

Patients were randomly divided into the Isoflurane (I) and Propofol (P) groups. Intraocular pressure (IOP) was measured in the recovery room before transferring the patient to the operating room using a tonometer (Tono-Pen AVIA, Reichert, USA). Using Tono-Pen is currently the most accurate method for measuring intraocular pressure among outpatients. Hemodynamic status of patients in the operating room was evaluated by recording the blood pressure, pulse oximetry, End Tidal CO₂ and ECG results. Patients received intravenous fentanyl 2 µg/kg and midazolam 0.02 mg/kg as premedication and were anesthetized using Thiopental 5 mg/kg and Atracurium 0.5 mg/kg as muscle relaxant. After 3 minutes of ventilation, appropriate sized spiral endotracheal tube was placed in the trachea. Isoflurane 1 % in group I with O₂ 50 % (3 liters) and NO₂ 50 % (3 liters) and 100-200 µg/kg/min of Propofol intravenously in group P with O₂ 50 % (3 liters) and NO₂ 50 % (3 Litters) were used for maintenance of anesthesia. Cerebral state index value was maintained between 40 and 60 in all patients. IOP was measured immediately after induction of anesthesia in supine position, immediately after turning the patient into prone position, at the end of operation in prone position and after turning the patient back to supine position. The hemodynamic status of patients as systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and End Tidal CO₂ values were all recorded before induction, immediately after induction, after prone positioning, during surgery in minutes 15, 30, 45, 60, 90, 120, 150, 180 and after surgery. To describe the collected data, mean and standard deviation were used. T-test,

Chi-square test and generalized estimating equation (for assessing IOP in both eyes) were used to compare two groups. Comparison of baseline values between two groups was performed using a repeated measures model. To have a power of 80 % in detecting a 3 mmHg difference of IOP change (in prone position) between the two groups when standard deviation of change was assumed to be 4 mmHg, a sample size of 28 in each group was calculated. We entered 30 patients in each group to cover for probable lost to follow up patients. SPSS version 17.0 (SPSS Co, Chicago, IL) was used for statistical analysis.

Results

Baseline information of two groups of patients is shown in Table 1. The mean age of patients

statistically significant ($P = 0.009$). The mean baseline IOP in group P was 18.2 ± 5.4 mmHg and at the end of surgery in prone position it decreased to 17.2 ± 4.9 mmHg. Paired T-test showed that the reduction was not statistically significant ($p = 0.261$). IOP changes in group I and group P were 2.1 ± 6.2 mmHg and -1 ± 6.7 mmHg respectively and the difference was statistically significant ($P = 0.024$). It means that intraocular pressure increased in group I and decreased in group P (Table 2).

According to mixed regression analysis, the heart rate in each group at the end of operation, decreased in comparison with the baseline (time effect was statistically significant, $P = 0.011$). But the difference between heart rates in the two groups was not statistically

Table 1: Baseline characteristics of patients in Propofol and Isoflurane groups

	Total	Isoflurane	Propofol	P
Age	47 ± 11 50 (24 to 60)	47.3 ± 9 49.5 (24 to 60)	46.5 ± 12 50 (24 to 60)	0.783
Sex M/F (M %)	28/32 (46.7)	20/10 (66.7)	8/22 (26.7)	0.002
Bleeding	478 ± 237 450 (100 to 1000)	425 ± 215 375 (100 to 850)	532 ± 250 500 (100 to 1000)	0.0082
HR	83 ± 13 84 (60 to 115)	82 ± 11 84 (60 to 109)	83 ± 15 83 (60 to 115)	0.643
SBP	135 ± 18 135 (96 to 199)	132 ± 17 135 (96 to 171)	138 ± 19 139 (103 to 199)	0.204
DBP	81 ± 12 80 (60 to 111)	80 ± 11 80 (60 to 96)	83 ± 13 80 (67 to 111)	0.271
MAP	117 ± 15 118 (87 to 170)	114 ± 14 117 (87 to 145)	120.12 ± 16.49 119 (92 to 170)	0.189
End Tidal CO₂	32 ± 0.1 31 (29 to 35)	32 ± 0.2 31 (30 to 35)	31 ± 0.3 30 (29 to 34)	0.254
IOP	15 ± 5 16 (10 to 27)	16 ± 3 20 (12 to 21)	18 ± 5 18 (10 to 27)	0.020

was 47 ± 11 . Twenty eight patients were male (46.75 %) and 32 patients were female (53.25 %). Patients were between 20 to 60 years old (Table 1). Mean IOP at baseline in group I was 15.8 ± 3.1 which increased to 18 ± 5.8 mmHg at the end of operation in prone position. This increase was

statistically significant ($P = 0.726$). Also, the time effect was statistically significant in the systolic blood pressure difference between the baseline and the end of operation ($P < 0.001$), but again there was not a statistically significant difference between the two groups ($P = 0.692$).

Table 2: IOP of patients in Propofol and Isoflurane groups in different times during the surgery

		Isoflurane		Propofol		P
		Mean + SD	Median (Range)	Mean + SD	Median (Range)	
Pre	Value	15.8 ± 3.1	20 (11.9 to 21)	18.2 ± 5.4	18.4 (9.9 to 26.8)	0.020
After induction	Value	13.36 ± 6.5	13.8 (7.9 to 27.9)	17.8 ± 7.8	14.9 (8.8 to 30)	0.027
	Change	-1.6 ± 5.9	-2 (-8 to 17)	-1.2 ± 8.2	-5.5 (-17.8 to 20)	0.834
	Change %	-1 ± 32	-10 (-33 to 80)	-1 ± 39	-16 (-42 to 106)	0.657
	P Within		0.047		0.168	
Early prone position	Value	17.8 ± 7	17.9 (9.8 to 37)	17.8 ± 6.7	17 (8.8 to 17)	0.098
	Change	2 ± 7.5	2.4 (-14.1 to 24)	-1.5 ± 7.6	-1.1 (-16.8 to 15)	0.009
	Change %	12 ± 37	13 (-59 to 93)	-3 ± 31	-7 (-52 to 51)	0.010
	P Within		0.043		0.139	
End of Prone position	Value	18 ± 5.8	22 (15 to 32.8)	17.2 ± 4.9	16.5 (13.8 to 31)	0.763
	Change	2.1 ± 6.2	0.9 (-7 to 19.9)	-1 ± 6.7	-1 (-14.9 to 12)	0.024
	Change %	12 ± 31	4 (-32 to 111)	0 ± 27	-5 (-48 to 52)	0.045
	Within P		0.009		0.261	
After changing to supine position	Value	18.1 ± 7.3	16.8 (10 to 39.9)	± 7.6	15.8 (11 to 39)	0.682
	Change	2.3 ± 7.9	0 (-12 to 27)		-1 (-16 to 27)	0.057
	Change %	13 ± 39	0 (-55 to 81)	-0.2 ± 8.5	-5 (-55 to 83)	0.035
	P Within		0.029	3 ± 40	0.856	

Diastolic blood pressure in both groups did not show any statistically significant decrease at the end of operation compared to the beginning of surgery ($P = 0.092$), and the alterations of diastolic blood pressure did not show a statistically significant difference between the two groups ($P = 0.854$). Mean arterial pressure decreased at the end of surgery compared to the beginning of operation in both groups ($P < 0.001$), but the difference between two groups was not statistically significant ($P = 0.807$). Finally End tidal CO₂ alteration did not show a statistically significant difference between the two groups ($P = 0.325$).

Discussion

In this study, it was observed that IOP of patients who had lumbar disc surgery in prone position and were anesthetized using Propofol was significantly less than those who were anesthetized using Isoflurane. It means that Propofol better protects the eyes compared to Isoflurane against the rise in IOP. It is known that

IOP increases in prone position both in awake and anesthetized patients^{6,10}. In a study comparing the use of Propofol and Sevoflurane in non ophthalmologic surgeries which was performed in supine position the IOP decreased in both groups, but the difference was not statistically significant¹¹. In another study in laparoscopic surgeries, Propofol decreased IOP more than Isoflurane did¹². The mechanism for decreasing intraocular pressure by Propofol is proposed to be by decreasing the ocular centers in the brain. The depression of CNS ocular centers could decrease the intraocular pressure through relaxing extraocular muscle tone or facilitating aqueous drainage, or both^{13,14}. To our knowledge our survey is the first study which compares the effects of Propofol and Isoflurane on IOP among patients undergoing surgeries in prone position. The other point was the effect of Propofol and Isoflurane on hemodynamic stability. In our study the difference in mean heart rate, systolic and diastolic blood pressure, as well as mean arterial changes between

the two groups was not statistically significant. Others have reported that the cardiac output reduction in prone position is more profound in patients who receive Propofol in comparison with those who receive Isoflurane ¹⁵.

Our study had some limitations. Despite the randomization of the patients, two groups showed a statistically significant difference considering the patients' gender. Also our sample

size calculation was based on the effect of drugs on IOP so our sample size might not be suitable to reliably assess the hemodynamic responses.

Conclusion

Propofol better controls the intraocular pressure compared to Isoflurane in prone position among patients undergoing lumbar disk surgery with no significant difference in hemodynamic responses.

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Footnotes and Financial Disclosures

Conflict of Interest:

The authors declare no conflict of interest with the subject matter of the present manuscript.

