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Original Research Article

Acute and Sub Acute Effect of Spinal Subarachnoid Block on Intraocular Pressure: A Comparative Study

Trishna Sahu[1], Aparajita Banerjee[2], Meenakshi Pandey[3], Ambika Prasad Panda[4]

[1,4]Assistant Professor, Department of Anesthesiology, SCB Medical College, Cuttack, Odisha, India
[2]Assistant Professor, Department of Ophthalmology, SCB Medical College, Cuttack, Odisha, India
[3]Assistant Professor, Department of Anesthesiology, Government Medical College, Sundargarh, Odisha, India

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Corresponding author: Dr. Ambika Prasad Panda
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Abstract

Background & Aim: Subarachnoid block is commonly used anesthetic technique for many infraumbilical surgical procedures. It can result in complications like hypotension, bradycardia, local anesthetic toxicity, postdural-puncture headache, backache and nerve damage. Prevention and treatment of these complications were well documented. But its effects on intraocular pressure (IOP) haven't been well studied. The aim of our study was to assess the effects of spinal anesthesia on intraocular pressure.

Material and Methods: Fifty patients posted for infra umbilical surgery under subarachnoid block were included in the study. Intraocular pressure was measured prior to spinal anesthesia (PS), 20 minutes after spinal anesthesia (AS) and finally on the first postoperative day (POD1) and were compared. Both eyes of the patients were included in the study. Hemodynamic and block characteristics were monitored and compared.

Results: Mean intraocular pressure was 17.9± 3.53 mm Hg prior to anesthesia, 15.77± 2.82 mm Hg 20 minutes after spinal anesthesia and 16.83± 3.39 mm Hg on 1st postoperative day,the difference among them being statistically not significant.

Conclusions: Spinal anesthesia can result in decrease in IOP which may result from decrease in mean arterial pressure.

Keywords: Intraocular Pressure, Mean Arterial Pressure, Spinal Anesthesia, Supine Position.

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Introduction

Several factors like the rate of aqueous humour production, vitreous volume, choroidal blood volume, scleral rigidity, orbicularis oculi muscle tension and external pressure determine the intraocular pressure (IOP). The normal intraocular pressure is approximately 15 mmHg (normal range 10-20 mm Hg).[1]Few studies are there in literature regarding changes in IOP that occur during non-ocular surgery under spinal anesthesia.

Though few studies have examined the effects of spinal anesthesia on IOP, the mechanisms remain largely unclear.[2] The relation between body position and IOP has been also investigated and several authors have reported an increase on IOP when body position is changed from sitting to supine which is the most common surgical position.[3]

Spinal anesthesia which is a type of regional anesthesia is commonly used for lower abdomen,infra umbilical, inguinal and lower extremity surgeries. In spinal anesthesia, local anesthetics are injected into subarachnoid space which contains cerebrospinal fluid (CSF).As there is paucity of studies in literature, our aim was to investigate the effect of spinal anesthesia on IOP during spinal anesthesia in infraumbilical surgeries in supine position.

Material and Methods

This prospective study was done in a tertiary care hospital in Odisha which includes patients posted for elective infraumbilical surgery under spinal anesthesia in supine position. Approval from Institutional Ethics Committee and written informed consent was obtained from all patients. Age > 18 years and ASA I or II physical status patient were included. Patients having history of glaucoma, diabetes mellitus, severe hypertension, decompensated heart failure and physical status ASA III/IV were excluded from study. Before administering spinal anesthesia, lactated Ringer solution 10 mL/kg was infused through a 20 Gauge

IV cannula. No premedication was given to any patient. Non-invasive blood pressure, oxygen saturation(SpO2),heart rate and ECG were monitored in peri operative period. Spinal anesthesia was administered in the sitting position under aseptic conditions. In sitting position subarachnoid space was entered at the L3-4 interspace via midline approach using a 25G Quincke spinal needle. Dural tap was performed and after free flow of clear CSF, 15 mg hyperbaric bupivacaine (0.5%) was injected.

Then all patients were made supine. Pinprick test was used to determine the dermatomal level of sensory block after which surgery was allowed. Early complications of neuraxial anesthesia, like hypotension and bradycardia, were treated with ephedrine 5 mg in increments and atropine 0.5 mg, respectively. Hypotension was regarded as systolic arterial pressure less than 90 mm Hg or ≥ 25% fall from its baseline value.

Bradycardia was regarded as heart rate < 60/min. IOP was measured by tonometer prior to spinal anesthesia (PS), 20 min after spinal anesthesia (AS) and on the first postoperative day (POD1). All IOP measurements were taken in supine position and by the same ophthalmologist. The patients were asked to look straight ahead to a far point while the ophthalmologist brought the tonometer near to the patient's eye. Once the tonometer was correctly adjusted, 6 IOP readings for each eye were recorded from the central cornea by lightly pressing the tonometer button. The instrument automatically averaged the six measurements, so the mean IOP was shown on the display. Statistical analysis was performed with SPSS 25 (Statistical Package for the Social Sciences, Chicago, Illinois) and p values < 0.05 were considered statistically significant. Quantitative variables are expressed as mean values ± SD. The analysis of repeated measure ANOVA was used to compare the results of the three IOP measurement methods. Post hoc comparisons were made using the Bonferroni test.

Result

All the patients completed the study. Table 1shows demographic data of the patients.Mean age was 35±9.7years.Gender ratio was 28:22(M:F). 32 patient developed hypotension and 12 patients developed bradycardia which was managed by fluid, ephedrine and atropine respectively.

Table 1: Demographic variables of the patients

Variables		Data(±/n)
Age in years		35±9.7
Sex(M:F)		28:22
Type of surgery		
	LSCS	16
	Inguinal hernia	14
	Skin grafting	9
	Lower limb orthopedic surgery	6
	Hysterectomy	5
No of patient having hypotension		32
No of patient having bradycardia		12

Mean intraocular pressure was 17.9± 3.53 mm Hg prior to anesthesia, 15.77± 2.82 mm Hg 20 min after spinal anesthesia and 16.83± 3.39 mm Hg on 1st postoperative day, the difference among them being statistically not significant.

There was no difference between right and left eyes with respect to IOP measurement before spinal anesthesia, 20 minutes after spinal anesthesia and on 1st postoperative day. (p>0.05)(Table 2) No other acute complications were observed regarding anesthesia and surgery.

7 cases developed postdural puncture headache on the first postoperative day and were managed conservatively.

Table 2: IOP measurements (Mean±SD) before and after spinal anesthesia

Time point	IOP (right eyes)	IOP (left eyes)	IOP (Both eyes)
Prior to spinal anesthesia	17.91± 3.45	17.89± 3.61	17.9± 3.53
20 minutes after spinal anesthesia	15.74± 2.84	15.80± 2.81	15.77± 2.82
Post-operative day 1	16.88 ±3.38	16.79± 3.41	16.83± 3.39

Discussion

In our study, we concluded that spinal anesthesia had no significant effect on IOP. Both immediate and postoperative IOP values had not been affected compared to baseline IOP. The effects of many anesthetic drugs on intraocular pressure are well studied during general anesthesia.[4] But there were few studies available in literature regarding the relationship between IOP and spinal anesthesia.

The hypothesis of the study was based on the relationship between CSF pressure and IOP.[5] Marek et al. have concluded that increased trans-lamina cribrosa pressure difference (TLCPD) may be a possible risk factor in the pathogenesis of glaucoma.[6] Increased translaminar pressure difference will occur with a relative increase in intraocular pressure or a reduction in CSF pressure.[7].

Reduction of CSF pressure after spinal anesthesia is a well-known phenomenon and this plays a major role in the development of postdural puncture headache. So spinal anesthesia can result in the formation of glaucoma, increasing TLCPD by decreasing CSF pressure, i.e. normal tension glaucoma. But this condition cannot be evaluated by IOP measurements alone, because the main problem here is not in the intraocular pressure elevation, but the decrease in CSF pressure. Furthermore, some studies have shown hypotension to be associated with decrease in IOP. [8] Patients receiving spinal anesthesia are prone to hypotension resulting decrease of IOP. Sekeryapan et al. [9] have investigated IOP changes in patients receiving spinal anesthesia and found a relationship between IOP and blood pressure, such that decreased blood pressure had a significant effect on lowering IOP.

They have stated that a decrease in mean arterial blood pressure as a result of spinal anesthesia may have an effect on IOP, probably by decreasing ciliary body blood flow They excluded patients receiving sympathomimetics like ephedrine to increase blood pressure after spinal anesthesia not to intervene in IOP changes related to hypotension, and found a direct relation between blood pressure and IOP. Gherezghiher et al. [10] have reported that aqueous humor production in monkeys was associated with mean arterial pressure. These findings indicate that aqueous humor production is in close relationship with mean arterial pressure, which regulates ciliary blood flow.

In our study, fall in SBP > 25% of the baseline were immediately treated with fluid and ephedrine. CSF pressure is dependent on cerebral perfusion pressure. Hypotension causes a decrease of cerebral perfusion pressure and so a decrease in CSF pressure.[11] Also there is a relationship between intraocular and CSF pressures.

The optic nerve traverses the eye through the lamina cribrosa and obtains an arachnoid membrane contiguous with the arachnoid of the intracranial space that contains CSF. Lamina cribrosa stabilizes the IOP by forming a barrier between the intraocular and extraocular spaces and prevents leakage of aqueous humor from the intraocular space into the retrobulbar CSF space. Because of this anatomical relationship, the association between CSF pressure and IOP has been investigated recently, and a correlation between CSF pressure and IOP has been postulated in various studies. [12]. Elevated CSF pressure has shown an association with elevated IOP, and the use of IOP measurement has been suggested as an indicator of intracranial pressure. CSF is located in a closed compartment in the intracranial and spinal subarachnoid spaces. Its daily production is approximately 450–500 mL, which exceeds its total volume by a factor of three in the subarachnoid space. Spinal anesthesia can also result in a drop of CSF pressure by another mechanism, simply by loss of CSF through the puncture site. If the loss of CSF from the dural hole is more than its production rate, this can result in a decrease of CSF pressure. This is an important especially with the use of thicker spinal puncture needles that result in more CSF loss.A disproportionate loss of CSF through the puncture site also leads to headache, named postdural puncture headache, a common complication of spinal anesthesia, especially when thicker spinal needles are used. Body position was shown to change IOP. A rise of 2–6 mm Hg was reported previously when changing from sitting to supine position.[13]

Spinal anesthesia may decrease this response of IOP, but more studies are needed in this respect. Saquib et al in their study concluded that patients with glaucoma, uveitis, and cardiovascular diseases should have intraocular pressure monitoring prior to deciding the type of anesthesia and after anesthesia for lower-limb and abdominal surgeries.[14] Hatipoglu S et al in their study concluded that spinal anesthesia alone has no acute or subacute effects on intraocular pressure.

Further studies can be made to evaluate the chronic effects and must focus on the relationship between postdural puncture headache and intraocular pressure changes after spinal anesthesia.[15] The main limitation of our study was that, we followed the patients for only one day postoperatively. Patients might have developed postdural puncture headache later and intraocular pressure changes in them might have been observed later. So, we suggest that further studies must be carried out with longer follow-up periods.

Conclusion

We concluded that spinal subarachnoid anesthesia has no acute and subacute effects on intraocular pressure. Further studies must be done to find out relationship between postdural puncture headache and intraocular pressure changes after spinal anesthesia.

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