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Original Research Article

Intraocular pressure monitoring during prone percutaneous nephrolithotomy, should we pay attention?Elias Sharma¹ and Jaideep Ratkal^{*2}¹Department of Urology, Government Medical College, Jammu, India²Department of Urology, Karnataka Institute of Medical Science, Hubli, India

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***Correspondence Info:**Dr. Jaideep M Ratkal
Associate Professor,
Department of Urology,
Karnataka Institute of Medical Science, Hubli, India***Article History:****Received:** 01/10/2017**Revised:** 25/10/2017**Accepted:** 25/10/2017**DOI:** <https://doi.org/10.7439/ijbr.v8i10.4424>**Abstract****Aims & objectives:** Transitory post-operative visual loss in one of our patients following Percutaneous Nephrolithotomy (PCNL), led us to do a review the available literature on Post Operative Visual Loss (POVL) and to study the intraocular pressure (IOP) changes during prone PCNL.**Introduction:** POVL is a devastating complication in the setting of a non-ophthalmic surgery and can lead to severe legal consequences for the operating surgeon. Raised IOP leading to Ischaemic Optic Nerve Atrophy (ION) is one of the purported factor for POVL.**Method:** We serially measured IOP with a hand-held tonometer in 40 of our patients undergoing PCNL in prone position, at five-time point settings-Baseline; 10 minutes after anaesthesia (Supine 1); 10 minutes after putting the patient in prone position (Prone 1); At the end of the procedure (Prone 2); Before reversal of anaesthesia (Supine 2). Data analysis was done by repeated measures ANOVA and paired *t* tests using NCSS software.**Results:** Out of 40 patients 34(85%) were Males and 6 females (15%); with mean age of 46 years. The duration during which the patient was prone varied was 108.85 ±24.12 minutes. Measured IOP changed significantly in different positions, being highest in Prone 2 position. The rise in IOP had a linear relationship with the duration during which the patient was prone, reducing after anaesthesia reversal in supine position.**Conclusions:** Observing the safety measures in PCNL can go a long way in avoiding POVL, especially in those patients with large & complex stones necessitating the patient to be in prone position for longer durations.**Keywords:** Post operative Visual Loss; POVL; IOP.**1. Introduction**

Post-operative visual loss following a non-ophthalmic surgery is a devastating complication with severe legal consequences for the clinician. The incidence following spine surgeries done in prone position is 0.03%[1]. Apart from hypotension, obesity, peripheral vascular disease [2,3], prone position itself is considered an important risk factor for POVL due raised intraocular pressure resulting in reduced perfusion pressure of optic nerve. Ocular perfusion pressure is defined as the difference between mean arterial pressure (MAP) and intraocular pressure (IOP)[4]. To certain extent MAP can be maintained a normal range in the clinical settings but IOP is difficult to maintain in normal range considering a large

number of factors affecting it. When MAP is maintained in a normal range, any increase in intraocular pressure leads to reduced ocular perfusion pressure (OPP). It has been unequivocally shown by studies in awake patients, that position affects IOP to a great extent [5]. Use of general anaesthesia has also been shown to decrease IOP [6]. So, it can be taken that the balance between the two opposing factors of anaesthesia and prone position is likely to determine the net Ocular Perfusion Pressure. In this study we try to determine the effects of anaesthesia and prone position on IOP and OPP in patients undergoing PCNL in prone position.

2. Materials & methods

The study was conducted over a period of three years (2014-17), after due approval by the institutional approval board. A detailed informed written consent was taken from 40 patients opting to undergo PCNL for renal calculi of varying configurations and size. The patients were in the age group of 22-60 years consisting of 34 males and 6 females, all falling under ASA grades of I-III. Exclusion criteria included those with a BMI of $\geq 30\text{kg/m}^2$, patients of closed angle Glaucoma, on medical therapy with Beta blockers, Cholinesterase inhibitors or Muscarinic drugs. Also excluded were those allergic to topical anaesthetic Proparacaine. Intraocular pressure was measured with a handheld device (Tonopen XL, Reichert Technologies, NY) which uses applanation method to record the IOP. The devices display mean of four IOP recordings along with SD of the measurements as a percentage of the mean. Any recording with SD in excess of 5% was discarded and fresh measurements were recorded.

The protocol was standardised for the study. After instilling Proparacaine, baseline IOP was measured. Anaesthesia protocol was standardised with induction consisting of administration of Propofol (8-10mg/Kg) and maintenance with Isoflurane and Nitrous oxide along with Vecuronium as muscle relaxant. MAP was maintained within 20% of baseline value. Along with MAP, Heart rate, ETCO_2 were monitored with ETCO_2 being maintained at 30-35 mmHg through the intraoperative period. IOP was

again measured 10 minutes after induction with patient being in supine position (Supine 1). The patients were then turned prone with head being maintained in neutral position resting on a Teflon head ring, turned slightly left to avoid direct pressure on the eyes. The IOP was again measured 10 minutes after being positioned prone (Prone 1) and at the end of the procedure (Prone 2). Once the patient was returned to supine position, 10 minutes later the IOP was measured and recorded as Supine 2. The length of the procedure was taken as the period the patient was positioned prone (P1 to P2). The Patients were asked about any visual disturbances in the post-operative period at the recovery.

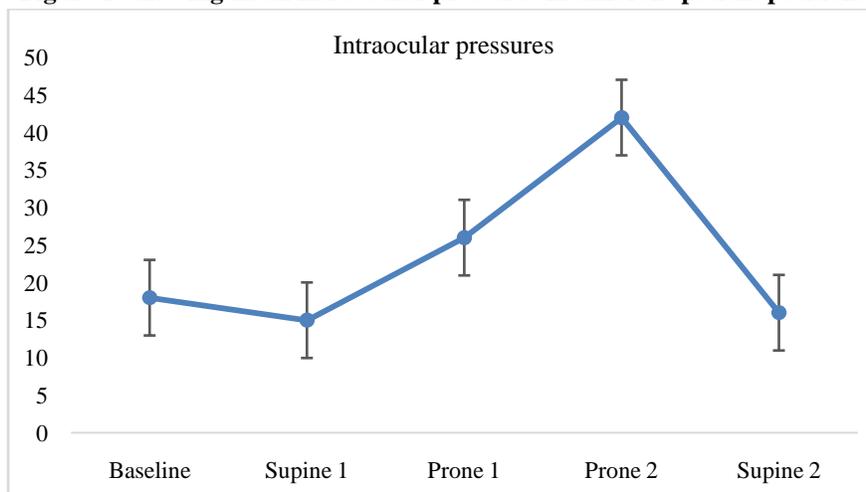
3. Results

As there was no statistical difference was found between the right and left eyes, and since the head was turned to left in prone position (left eye uppermost), IOP measurements of only left eye was included in the data analysis. There was a statistically significant fall in IOP in Supine 1 position from baseline (18 ± 1 mmHg v/s 15 ± 1 mmHg; $P < 0.05$). IOP showed a statistically significant rise in Prone 1 from Supine 1 recording (26 ± 1 mmHg V/s 15 ± 1 mmHg; $P < 0.05$). Prone 2, measured at the end of procedure was significantly higher compared to all other recordings at 42 ± 1 mmHg with P value < 0.05 . Prone2 IOP demonstrated a linear association with the duration of surgery measured as P1 to P2.

Table 1: showing the mean intraocular pressures in five patient positions

	Mean IOP (Range) mm Hg	SD	95% CI of mean
Baseline	18.00 (15.23-19.45)	0.892	17.43 To 18.45
Supine 1	15.00(13.66 – 16.12)	0.512	14.50 To 15.47
Prone 1	26.00(24.12-28.40)	1.12	25.76 To 26.38
Prone 2	42.00(40.02 -44.00)	0.988	41.67 To 42.34
Supine 2	16.00(14.22-18.20)	0.487	15.73 To 16.44

Figure 1: showing mean intraocular pressures in different patient positions



4. Discussion

The present study reiterates the measurement of IOP and reaffirms, the changes that take place in Intraocular pressures in relation to differing patient positions and the linear association between IOP & duration of surgery. The most accurate method of measuring IOP continuously is invasive which was reported by Hoh H *et al* in two patients using anterior chamber probe [7]. But for obvious reasons such a method is not realistic to be used in prone position. Tonopen XL, used in the present study, has been validated in rabbits against intraocular probes by Setogawa *et al* [8] and is used widely by ophthalmologists for their clinical use. A contact lens with embedded transducer for continuous IOP monitoring is under development [9]. Since the MAP is maintained in a narrow range from normal, any increase in intraocular pressure adversely affects the ocular perfusion pressure and hence increasing the chance of Post-Operative Visual Loss. Lam *et al* reported IOP changes in awake volunteers recording a rise in IOP in prone position just 8 minutes after change of posture [5]. Ozcan *et al* in a similar study in healthy volunteers in awake state added a reverse Trendelenburg position and showed that there was a distinct improvement in IOP with just 10-degree rise [10]. General anaesthesia reduces the IOP and rise in ETCO₂ raises the IOP. Cheng *et al* were the first to study the changes in IOP in anaesthetised patients undergoing spine surgery in prone position [11]. They noticed a marked rise in IOP in prone position which demonstrated a linear association between the rises in IOP with duration of surgery. Our study corroborates their findings but in those patients undergoing PCNL in prone position. PCNL is the preferred surgery for renal stones larger than 2.5 cm and duration of the procedure increases as the size and complexity of stones change.

IOP has been shown to increase in those patients undergoing laparoscopic procedures in Trendelenburg position which improved with resumption of supine and even more with reverse Trendelenburg positions. Should one put the patient in reverse Trendelenburg position once PCNL procedure extend beyond two hrs? We believe so! Nuri Deniz *et al* measured IOP in patients undergoing Prone PCNL in a randomized fashion in dependent and non-dependent eyes and reported a statistically significant difference between the two [12].

IOP assumes a significance in intraoperative settings as MAP lowers due to blood loss or is deliberately reduced to keep the blood loss to minimum. Viability of anterior optic nerve is dependent on increased minimum blood flow, with fall in haematocrit. When both MAP and haematocrit are low IOP becomes even more critical factor influencing blood supply to anterior optic nerve. Another factor which influences the changes in IOP

with positional is episcleral venous pressure (EVP) [13]. Any increase in CVP with changes in body position increases EVP and EVP has a positive correlation with IOP [14-15]. Increasing orbital blood flow in prone and Trendelenburg positions leads to congestion of choroid plexus and hence orbital blood volume, to increase in IOP [16]. As already premised, perfusion pressure of anterior optic nerve is the difference between MAP and IOP. To certain extent the blood flow to anterior optic nerve is autoregulated and disease states such as hypertension, diabetes, atherosclerosis derange the autoregulation leaving it susceptible to ischaemia [17].

5. Conclusions

Post-Operative Visual Loss is a rare but a devastating complication of non-ophthalmic surgeries performed in prone position including PCNL. Adequate safeguards need to be put in place to avoid the complication including frequent measurement of Intra-ocular pressures especially in those with Glaucoma. Continuous IOP measurement using contact lens probes is definitely a way forward.

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