Effect of Mannitol on Intraocular Pressure in Vitrectomized and Nonvitrectomized Eyes: A Prospective Comparative Study

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Purpose: To compare the effect of mannitol in reducing intraocular pressure (IOP) in vitrectomized and nonvitrectomized eyes.

Materials and Methods: Prospective comparative case study. Eyes with IOP ≥ 40 mm Hg were included. Eyes which are vitrectomized and silicon oil filled were classified as group 1, and nonvitrectomized open-angle eyes were classified as group 2. Mannitol (20%, 1 g/kg) was administered intravenously over 30 minutes, and IOP was recorded at 30 minutes interval till 2 hours and at the third and fourth hour from the start of mannitol.

Results: Thirty eyes (patients) were recruited in each group. Mean (SD) IOP reduced from 48.5 ± 5.2 to 43.7 ± 8 at 30 minutes, 40.7 ± 8.4 at 60 minutes, 37.3 ± 9.6 at 90 minutes, 35.6 ± 10.4 at 2 hours, 34 ± 10.7 at 3 hours, and 33 ± 11.2 mm Hg at 4 hours in group 1, and from 48.9 ± 6.5 to 43.2 ± 6.6 at 30 minutes, 40.2 ± 7.8 at 60 minutes, 36.7 ± 7.3 at 90 minutes, 35.1 ± 7.7 at 2 hours, 34.2 ± 8.8 at 3 hours, and 35.7 ± 9.4 mm Hg at 4 hours in group 2. There was a significant reduction in IOP at each time point compared with baseline in both the groups (P < 0.001). There was no significant difference in IOP between the 2 groups at each time point.

Conclusion: Mannitol reduces IOP significantly in both vitrectomized and nonvitrectomized eyes.

Key Words: intraocular pressure, mannitol, Vitreous

ORIGINAL STUDY

S ilicon oil has been widely used for internal tamponade in retinal detachment surgeries for many years, owing to its high surface tension and buoyancy. Prevalence of raised intraocular pressure (IOP) following silicone oil tamponade in vitreoretinal surgery ranges between 8% and 48%. Various established mechanisms of elevated IOP were pupillary block, inflammation, migration of silicone oil into the anterior chamber, overfilling of the eye, emulsified silicon oil bubbles in the angle and idiopathic.

Hyperosmotic agents like mannitol are used for reducing the IOP in a short period of time. Mannitol acts by increasing the osmolality of the plasma and thereby drawing water from the vitreous into the circulation thus causing vitreous dehydration. However, there is no established mechanism of IOP reduction in vitrectomized eyes. The present study was conducted to evaluate the efficacy of mannitol in reducing IOP in silicon oil–filled vitrectomized eyes and to compare it with nonvitrectomized eyes.

MATERIALS AND METHODS

A prospective comparative case study conducted at Aravind eye hospital, Coimbatore from May 2017 to April 2018. The study was initiated after the Institutional Review Board and Ethics Committee approval and the study adheres to the tenants of the Declaration of Helsinki. Eyes with IOP ≥ 40 mm Hg and open angles on gonioscopy were included. Mannitol was given to these subjects for acute pain relief and to prevent vascular occlusion from happening due to very high IOP. Consecutive patients who had elevated IOP after vitrectomy with silicone oil injection were classified as group 1, and patients with open-angle glaucoma and nonvitrectomized eyes were classified as group 2. Patients with angle-closure glaucoma, history of glaucoma surgery, cardiac or renal disease, and eyes with overfilled silicon oil were excluded from the study.

Data recorded were age, sex, visual acuity, IOP, gonioscopy, corneal edema, optic disc changes, diagnosis, details of vitreoretinal surgery, number of antiglaucoma medications, if any, and pain score. Corneal edema was graded as grade 0: clear cornea; grade 1: corneal edema, iris details clearly seen; grade 2: microcystic corneal edema, iris details hazily seen; grade 3: microcystic corneal edema, iris seen details not visible; and grade 4: microcystic corneal edema, iris not visible. The pain was scored from 0 to 10 based on the Wong-Baker Faces Pain Rating scale.

All patients were administered 20% mannitol intravenously at a dosage of 1 g/kg body weight over 30 minutes. IOP was checked with Goldman applanation tonometer before mannitol infusion and at 30, 60, 90 minutes and 2, 3, and 4 hours from the initiation of mannitol. Other data reevaluated after mannitol infusion were corneal edema and pain score. During the study period, patients were not prescribed other forms (topical or oral) of antiglaucoma medication.

Statistical Analysis

Mean and SD was used to assess continuous variables. Paired t test was used to compare the IOP, and Wilcoxon signed-rank test was used to compare the corneal edema and pain score before and after mannitol infusion. P-value < 0.05 was considered to be statistically significant. Statistical analysis was performed using commercial software (Stata version 13.1; StataCorp, College Station, TX).

RESULTS

Thirty patients (eyes) were recruited in each group with a mean age ± SD of 48.5 ± 15 in group 1 and 54 ± 14 in group 2. Table 1 shows the baseline demographic characteristics of the
Mean corneal edema decreased from 0.6 ± 0.9 to 0.2 ± 0.4 in group 1 (P = 0.005) and 0.6 ± 1 to 0.2 ± 0.5 in group 2 (P = 0.003). Mean pain score decreased from 0.6 ± 1.4 to 0.2 ± 0.8 in group 1 (P = 0.026) and 0.2 ± 0.8 to 0 in group 2 (P = 0.083).

### DISCUSSION

Mannitol reduces IOP by dehydrating the vitreous along an osmotic gradient. Studies have shown decreased IOP response after water drinking in human eyes with the damaged optic nerve,5 and in an animal, eyes with intact optic nerve and damaged supraoptic nucleus.9 This confirms the central nervous system control of IOP via osmoreceptors in the hypothalamus which decreases aqueous production.

Our study showed a significant reduction in IOP with mannitol in both vitrectomized and nonvitrectomized eyes, which suggests that osmotic removal of water from the vitreous cavity may not be the predominant mechanism of IOP reduction. Hence the IOP lowering effect of mannitol could be due to both direct osmotic mechanism (removal of water from the aqueous humour in the anterior chamber) and the floor of the vitreous cavity, vitreous, and uvea) as well as central mechanism via osmoreceptors.

Mean IOP reduction in vitrectomized eyes was 36% (range, 0% to 72%) in our study. The response was quite variable with 5 eyes having an IOP reduction of <20%. Univariate regression analysis did not reveal any association between the eyes with <20% IOP reduction and age, sex, baseline IOP, visual acuity, and corneal edema. Takkar et al10 reported a maximum IOP drop of 4.8 mm Hg in vitrectomized eyes which is <15.5 mm Hg in our study. The reason for better IOP reduction in our study could be higher baseline IOP compared with Takkar and colleagues. Mean IOP reduction in nonvitrectomized eyes was 37% (20% to 68%) in our study which is less compared with 53% (range, 40% to 75%) reported by Smith and Drance.4

The average time of maximum reduction in IOP in our study was 3 hours (range, 60 min to 4 h) in group 1 and 2.5 hours (range, 30 min to 4 h) in group 2. Vitrectomized eyes took little longer to achieve the peak IOP reduction compared with non-vitrectomized eyes. Smith and Drance reported an average time of maximum reduction in IOP to be 1.5 hours in glaucomatous eyes, which is faster than 2.5 hours in our study. The reason for achieving maximum IOP reduction earlier could be the usage of 500 mL of mannitol for all patients in their series.

Corneal edema was assessed taken into consideration that epithelial edema due to increased pressure causes underestimation of IOP which can blunt the IOP response to mannitol. Even though mean corneal edema decreased significantly in both the groups, there was no correlation.
between the decrease in corneal edema and decreased IOP response to mannitol.

Limitations of our study include IOP was recorded only till 4 hours. In both the groups some eyes had a maximum reduction in IOP at 4 hours, so we cannot comment on the exact duration at which peak IOP reduction occurred in those eyes.

In conclusion, our study showed a significant reduction in IOP with mannitol in both vitrectomized and non-vitrectomized eyes and substantiates the usage of mannitol for reducing IOP in vitrectomized eyes.

REFERENCES