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Observation of intraocular pressure after vitrectomy with various materials for internal tamponade

Pars plana vitrectomy (PPV) was performed for the first time by Robert Machemer in 1970 (15). Rapid development of vitreoretinal surgery followed popularization of silicone oil (SO) and expandable gases for internal tamponade in the early eighties (16, 7). Since then intraocular pressure (IOP) changes are common, well-recognized postoperative complications for both materials (8). Recent experimental studies however show that even short but high enough IOP rise may cause changes in optic nerve disc topography and lamina cribrosa even in non-glaucomatous eyes (3). On the other hand, decreased IOP is a well-recognized risk factor for postoperative intraocular hemorrhage (12). In the current study we want to address the question whether IOP changes after PPV with various tamponade materials used may reach relevant levels to be considered as risk factors for the complications listed above.

METHODS

Sixty-seven patients (68 eyes) from the population of patients who underwent PPV in the 1st Department of Ophthalmology, Medical University of Lublin were randomized for the study. This population included 42 women (62.7%) and 25 (37.3%) men aged 20 to 87 (mean age 53.8±15.6).

Indications for surgery included: retinal detachment (40 eyes – 58.82%), proliferative diabetic retinopathy (PDR) (13 eyes – 19.12%), intravitreal hemorrhage not PDR-related (6 eyes – 8.82%), macular hole (4 eyes – 5.88%), lens luxation into vitreous (2 eyes – 2.94%), intraocular inflammation (2 eyes –2.94%) and intraocular alien body (1 eye – 1.47%).

Population examined was subsequently divided into three cohorts according to internal tamponade material used: Group I – patients after PPV with expandable gas (17% perfluoropropane <17% C_3F_8) in the air) – 30 eyes, Group II – patients after PPV with silicon oil – 21 eyes, Group III – patients after PPV without internal tamponade – 17 eyes. All surgical procedures were performed by one surgeon (J.M.) IOP was measured one day before surgery, immediately after surgery, 6 and 24 h after surgery, 3, 5, 14 and 30 days after surgery and was expressed in mmHg. IOP was considered as increased when it was equal or higher than 25 mmHg and as decreased when in was equal or lower than 5 mmHg. The data are expressed as mean ± SD. Differences among means were evaluated by ANOVA, followed by Duncan D *posthoc* tests if indicated. For all analyses, the null hypothesis was rejected at the 0.05 levels.

RESULTS

Increased IOP was observed in 35 (51.47%) eyes while decreased IOP was observed in 24 (35.29%) eyes. Increased IOP was noticed in 17 (56.67%), 10 (47.62%) and 8 (47.06%) eyes while decreased IOP was detected in 11 (36.67%), 9 (42.85%) and 4 (23.53%) eyes in groups I, II and III

respectively. Numbers of eyes with increased (Table 1) and decreased (Table 2) IOP in following time-points for respective groups are also presented.

Table 1. Number of eyes with increased IOP in time-points examined for respective groups

Group	Time after surgery						
	Instantly after	6 h	24 h	3 days	5 days	14 days	30 days
Group I	6 (20.0%)	4 (13.3%)	8 (26.7%)	11 (36.7%)	6 (20.0%)	2 (6.7%)	1 (3.3%)
Group II	2 (9.5%)	2 (9.5%)	8 (38.1%)	3 (14.3%)	5 (23.8%)	3 (14.3%)	3 (14.3%)
Group III	5 (29.4%)	3 (17.7%)	1 (5.9%)	3 (17.7%)	3 (17.7%)	3 (17.7%)	2 (11.7%)

Table 2. Number of eyes with decreased IOP in following time-points for respective groups

Group	Time after surgery						
	Instantly after	6 h	24 h	3 days	5 days	14 days	30 days
Group I	1 (3.3%)	5 (16.7%)	0 (0.0%)	1 (3.3%)	2 (6.7%)	3 (10.0%)	3 (10.0%)
Group II	6(28.6%)	6 (28.6%)	1 (4.8%)	1 (4.8%)	0 (0.0%)	0 (0.0%)	1 (4.8%)
Group III	0 (0.0%)	3 (17.7%)	2 (11.8%)	2 (11.8%)	1 (5.9%)	1 (5.9%)	0 (0.0%)

We have found no statistically significant differences between average IOPs for respective groups in distinct time-points except for 24 h and 14 days after surgery when statistically significant differences between groups II and III were seen i.e. 19.45±8.65 mmHg vs. 14.67±5.00 mmHg ($p=0.04$) and 13.05±5.92 vs. 18.19±6.63 mmHg ($p=0.01$), respectively (Fig. 1).

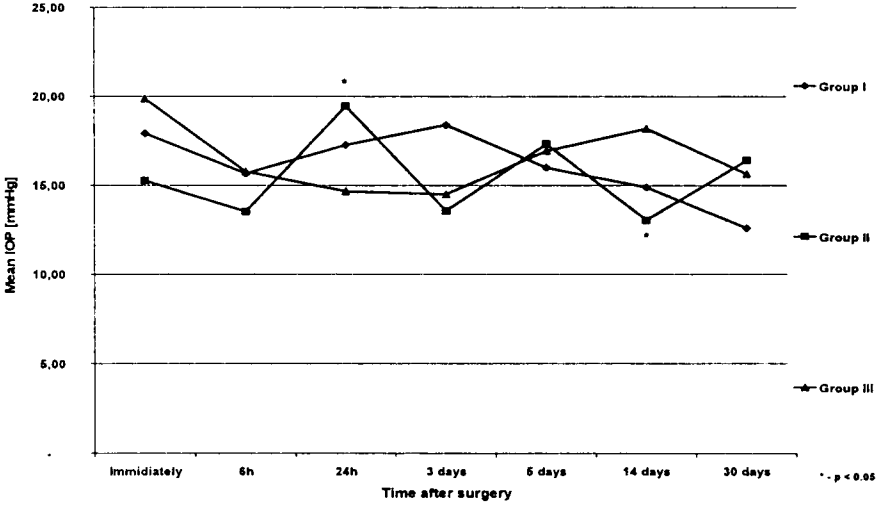

Fig. 1. Mean values of IOP [mmHg] in respective groups in following time-points

DISCUSSION

Both increase (6, 10) and decrease (2, 5, 4) of IOP are among the most common complications of PPV. Despite the fact that the increase of IOP is usually transient and responds well to therapeutic modalities it may cause permanent injury to the eye. Typically, two mechanisms are involved – optic nerve ischemia (1, 17) or central retinal artery occlusion (1).

Our studies showed that overall at least single IOP increase was seen in 51.47% of cases. Moreover, we have established arbitral threshold for increased IOP at ≥ 25 mmHg while usually IOP ≤ 21 mmHg is considered as normal (11). Others noticed IOP increases (with thresholds that varied from ≥ 22 mmHg to > 30 mmHg or defined as an increase ≥ 10 mmHg in comparison to preoperative IOP) in 20 to 60% of patients after PPV without internal tamponade specification (6, 10, 2).

We found that IOP increase was present in 56.7% of eyes after PPV with 17% C_3F_8 used for internal tamponade. Other authors reported IOP increase in 11 to 60% of patients, which depended on C_3F_8 concentration. We observed the highest percentage (36.7%) of IOP increases in early postoperative period i.e. 3 days after surgery. Others conversely noticed analogous increases 24 to 48 hours after surgery (6, 17).

Here, we report IOP increase in 47.6% of patients after PPV with SO for internal tamponade. Other investigators stated analogous findings and correspondingly to previous reports with C_3F_8 use the spectrum of results was wide ranging from 0 to 56% (10). The highest percentage of IOP elevations was observed 24 h after surgery (38.1%). Subsequently the number of eyes with increased IOP diminished, however, 23.8% still showed elevated IOP 5 days after PPV. These data are in accordance with previous reports that discovered IOP increases in 7 to 48% of patients (10) during early postoperative period. On the other hand, A z e n et al. (2) reported maximal IOP increase as late as 7 days after surgery. In our cohort we have found 14.3% of patients with increased IOP 30 days after surgery. Several other authors reported persistent IOP elevations in 8 to 15% of patients after PPV with SO (5, 4).

Risk factors as well as mechanisms responsible for IOP rise after PPV are not completely understood (10). Among others, various preoperative factors like diabetes, previous trauma, previously diagnosed glaucoma or pathological changes in the anterior chamber angle may predispose to IOP rise after PPV (10). Perioperative and postoperative features that may also be responsible for this complication include: scleral buckle, endophotocoagualtion, lensectomy, aphakia, the presence of SO (especially when emulsified) within anterior chamber, neovascularisation of the iris and fibrinous membrane formation in the pupil (10, 8).

Hypotony is another important complication of PPV (4, 9). Too low IOP values may cause visual acuity impairment resulting from hypotony-related maculopathy consisting of cystoid macular edema and macular serous detachment along with choroidal folds (14), suprachoroidal hemorrhage, choroidal detachment (12) and ultimately, ocular bulb atrophy (18).

We have found that overall, at least single IOP decrease to values ≤ 5 mmHg was present in 35.3% of cases. B a t m a n (5) and K e r t e s (13) report hypotony in 5 to 10% of patients after PPV without internal tamponade specification while B a r r found up to 24% hypotony cases after PPV (4) and H e n d e r e r nearly 30% of patients 2 years after surgery (9). Within patients after PPV with 17% C_3F_8 used for internal tamponade low IOP values were seen in late (14–30 days) while in group with SO used for internal tamponade in early (day of surgery) postoperative period.

Mechanisms underlying postoperative hypotony remain elusive. One hypothesis proposes that ciliary body traction by vitreous base and/or retracting membranes (PVR) leads to hyposecretion with subsequent hypotony possibly in small cyclodialysis mechanism (4, 5). The other suggests that IOP decrease rises from deleterious influence of tamponade material on ciliary body processes (4). Possible risk factors for postoperative hypotony include preoperative hypotony, aphakia, neovascularisation of the iris and big macular holes (4, 9).

We can conclude that IOP measurements after PPV independent of material for an internal tamponade used should be a routine postoperative regimen during first few days and even hours after surgery due to higher risk of IOP increase particularly in patients after PPV with 17% C_3F_8.

Patients after PPV with SO on the other hand show the tendency to IOP decrease on surgery day. IOP measurements is also strongly advised during late postoperative period, even several months after surgery since patients after PPV with SO are prone to late IOP increase and patients after PPV with 17% C_3F_8 show tendency to prolonged hypotony. Moreover, patients after PPV without internal tamponade are also in a relatively high risk of IOP changes especially in early postoperative period. Our results do not support the thesis that any kind of internal tamponade material use is connected with significantly higher risk of IOP variations.

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SUMMARY

The objective of the study was to analyze intraocular pressures (IOP) after pars plana vitrectomy (PPV) with various internal tamponade (IT) materials used. Design materials and methods:

The study material comprised 68 eyes after PPV with 17% perfluoropropane (group I), silicon oil (II), without IT (III). IOP was measured before, after and 6, 24 h, 3, 5, 14 and 30 days after surgery. Increased IOP was observed in 35 eyes, decreased in 24 eyes. In groups I, II and III increased IOP was noticed in 17, 10, 8, decreased in 11, 9, 4 eyes, respectively. There were no statistically significant differences of mean IOP except for groups II and III 24 hours and 14 days after PPV: 19.45±8.65 vs. 14.67±5.00 (p=0.04) and 13.05±5.92 vs. 18.19±6.63 mmHg (p=0.01), respectively. Conclusions: IOP measurements are essential in postoperative treatment after PPV due to high risk of IOP changes. There are no significant differences between mean IOP depending on materials for IT used.

Obserwacja ciśnienia śródgałkowego po witrektomii z zastosowaniem różnych materiałów do tamponady wewnętrznej

Celem pracy była obserwacja ciśnienia śródgałkowego (CŚ) u chorych po witrektomii tylnej (WT) z zastosowaniem różnych rodzajów tamponady wewnetrznej (TW). Badaniami objęto 68 oczu po WT z zastosowaniem jako TW: 17% perfluoropropanu (grupa I), oleju silikonowego (grupa II) lub bez stosowania TW (grupa III). CŚ mierzono bezpośrednio przed, bezpośrednio po zabiegu oraz po 6 i 24 godzinach, 3, 5, 14 i 30 dniach po zabiegu. Podwyższone CŚ zaobserwowano w 35, a obniżone w 24 oczach. W grupie I, II i III zaobserwowano odpowiednio podwyższone CŚ w 17, 10 i 8 oczach, a obniżone w 11, 9 i 4 oczach. Nie wykazano statystycznie znamiennych różnic pomiędzy średnimi CŚ w poszczególnych grupach, z wyjątkiem grup II i III w 24 godziny i 14 dni po WT: 19.45±8.65 i 14.67±5.00 (p=0.04) oraz 13.05±5.92 i 18.19±6.63 mmHg (p=0.01) odpowiednio. Należy wnioskować, że pomiar CŚ jest istotnym elementem opieki nad pacjentem po WT ze względu na wysokie ryzyko wystąpienia zaburzeń CŚ. Rodzaj materiału zastosowanego do TW nie powoduje statystycznie znamiennych różnic średnich CŚ u chorych po WT.