RISK FACTORS FOR ELEVATED INTRAOCULAR PRESSUE ON FIRST DAY POSTOPERATIVE REVIEW FOLLOWING PARS PLANA VITRECTOMY

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Abstract

Purpose: To assess the relationship between day one post-operative intra-ocular pressure and patient demographic information, lens status, tamponade medium (air, perfluoroethane, sulfur hexafluoride) and laser treatment.

Methods: A prospective observational study of all patients undergoing pars plana vitrectomy by a single surgeon within one case study. All patients had intraocular pressure recorded one-day after surgery. None of the patients had postoperative anti-glaucoma medications. All patients undergoing pars plana vitrectomy were previously pseudophakic or underwent combined surgery.

Results: Out of a final cohort of 161 patients, 6% had raised IOP (defined as >30mmHg). A parsimonious regression model showed no strong correlation between raised IOP and type of gas tamponade ($p=0.028$ for C_2F_6, $p=0.067$ for SF_6, air was the reference category), and a moderate association with number of laser burns ($p=0.067$).

Conclusion: The use of gas tamponade, in particular C_2F_6, does not constitute justification for pre/post-operative anti –glaucoma prophylactic treatment. In addition we postulate that careful consideration should be given to the frequency of laser burns during PPV.

Introduction

The issue of intraocular pressure (IOP) on day 1 post pars plana virtrectomy (PPV) is up for considerable debate[1,2]. Over 25 years ago, Han et al[3] reported a significant rise in IOP immediately following the procedure. It has been common practice to assess the majority of such patients on day one postoperatively. This brings with it a considerable economic and personal burden to both patients and clinicians.

Since then, there has been much advancement in vitrectomy techniques, in particular the usage of transconjunctival (TSV) sutureless, small gauge ports, which have had a greatly positive impact on postoperative IOP. Ahn et al[4] have provided compelling evidence for this, with a 0.5% incidence of elevated IOP post 23g compared to 22.9% reported by other authors[5] in patients undergoing 20g vitrectomy. A recent study by Alexander et al reported that the incidence of Day 1 post vitrectomy raised IOP is low with the use of postoperative prophylactic anti-glaucoma treatment [6].

A current trend therefore is to use immediate prophylactic oral or topical anti-glaucoma medication to justify avoidance of day one postoperative review. However the evidence to support this approach is currently deficient and it remains questionable whether prophylactic treatment is essential in all vitreo-retinal cases. In addition, it has been suggested that gas tamponade as opposed to air, has more of an IOP elevation effect, however there is limited evidence to support this[6].

With the growing evidence that raised IOP is unlikely to be a significant problem following PPV, in this study we aim to identify risk factors such as type of tamponade used, lens status and the number of laser burns applied, to inform clinicians as to which patients may not require day one follow up.

Methods

A prospective consecutive case series was conducted. Patient information was collected prospectively and reviewed retrospectively. All patients underwent surgery by a single surgeon in a District General Hospital in the UK.

Inclusion criteria were patients undergoing PPV for Macular hole (MH), Epiretinal membrane (ERM) or Rhegmatogenous retinal detachment (RRD). These patients were stratified according to demographic information, vitrectomy gauge, lens status, tamponade medium (air, C2F6 or SF6), laser treatment and number of burns.

We excluded patients with coexisting conditions such as ocular hypertension, glaucoma and diabetic or non-diabetic vitreous haemorrhage. The silicone oil group was excluded due to fewer numbers compared to other tamponade groups to balance all groups for statistical purposes. None of the patients had scleral buckling combined with vitrectomy.

All patients were seen on their first postoperative day. Slit-lamp biomicroscopy was performed and IOP measurements were taken by Goldmann applanation. None of the patients in the study received any immediate postoperative prophylactic anti-glaucoma medications.

Primary endpoints were raised IOP of over 30mmHg or hypotony (IOP of less than 8mmHg). There were no secondary outcome measures.

The sample was summarized descriptively. Multiple linear regression analysis was conducted to assess the relationship between post-operative intra-ocular pressure (IOP) and the predictors outlined above; patient demographic information (age and gender), lens status, vitrectomy gauge, tamponade medium (air, C2F6 or SF6), laser treatment, type of procedure (ERM, macular hole or vitrectomy for RRD) and the number of burns. The extent of missing data was assessed, but no loss to follow up analysis was performed. A sequential modeling strategy (with backward elimination applied within blocks) was utilized to derive a parsimonious regression model, with higher priority variables entered in later blocks. Liberal criteria (p<0.1) were used to remove variables from the model. Demographic parameters were entered as an initial block, treatment parameters in a second block, and type of surgery (dichotomized into macular surgery [ERM and MH] and vitrectomy for RRD) alone in the final block. Parameter estimates were derived to assess the effect of significant predictors on the outcome, controlling for other variables. P-values and confidence intervals were also reported. The goodness-of-fit of the final model was assessed using the adjusted R^2 statistic, and regression assumptions were checked using residual analysis.

Results

Out of an initial cohort of 183 patients, 22 were excluded as they had a history of ocular hypertension/glaucoma and/or were treated with silicone oil, leaving 161 eligible patients. Patient demographics, lens status, tamponade medium, laser treatment, type of surgery and number of burns for these patients are summarized in table 1. The vitrectomy gauge used for ERM, RRD or MH was recorded. All patients underwent TSV, 35% 27g, 18% 25g, 47% had 23g. None of the patients had 20g surgery.

The most used gauge was 23g across all diagnoses (n=75), and the majority of cases were phakic (n= 142).

Incidence of IOP (defined as ≥ 30mmHg) was noted in 10 patients (6 %). Hypotony (IOP less than 8 mmHg) was noted in 5 patients (3 %) all of which resolved spontaneously. All patients received air or gas tamponade; none of the eyes were fluid filled at the end of the surgery. Thirty-seven patients had air

tamponade, while 124 had gas tamponade (SF_6 in 53 eyes and C_2F_6 in 71 eyes). The sample is summarized in Table 1.

Table 1: descriptive summary of sample

Categorical variable	**Frequency (Valid %)**
Gender	
Male	76 (47.2%)
Female	85 (52.8%)
Lens status	
Phakic	139 (86.3%)
Pseudophakic	22 (13.7%)
Tamponade medium	
Air	37 (23.0%)
SF_6	53 (32.9%)
C_2F_6	71 (44.1%)
Laser treatment	
No treatment	113 (70.2%)
Treatment	48 (29.8%)
Procedure	
ERM	61 (37.9%)
Macular hole	47 (29.2%)
Retinal detachment	53 (32.9%)
Numerical variable	**Mean (SD; range)**
Age (years)	68.9 (11.7; 29.2-93.6)
Number of burns	209.6 (392.4; 0-1477)
Post-operative IOP	17.1 (6.49; 0-39)

Regression model

Neither of the demographic parameters (gender, age) were carried forward from the first block to a block including procedural variables. Number of burns and tamponade agent were carried from the second block to a block including the forced entry variable type of surgery. This variable was not carried forward into a final parsimonious model which thus comprised number of burns and tamponade agent.

Gas tamponade

Controlling for other variables, patients treated with C_2F_6 had IOP values 3.03 units higher respectively than those treated with air (95% CI: 0.325 to 5.73, p=0.028).

Patients treated with SF_6 had IOP values 2.50 units higher respectively than those treated with air (95% CI: -0.180 to 5.187, p=0.067).

Number of burns

Controlling for other variables, each additional burn was associated with a raised IOP of 0.003 units (95% CI 0.000 to 0.006, p=0.028).

No other substantive associations were found. The adjusted-R^2 statistic for the final model was 0.071, indicating a moderately well-fitting model. Examination of residuals revealed no evidence for violation of regression assumptions; residuals were normally distributed and no discernible patterns were apparent in a plot of standardized residuals against standardized predicted values.

Discussion

Examples of elevated IOP post 20G vitrectomy is well documented in the literature.[3,4,5] However recent advancements in the usage of TSV PPV has significantly reduced the risk of elevated IOP postoperatively. A recent paper published by Ahn et al[4] presented compelling evidence that 20G vitrectomy had considerably worse IOP readings as compared to 23G.

Previous studies have argued for the use of prophylactic anti-glaucoma treatment prior to surgery, on the basis of observed elevated post-operative IOP[6]. A study by Muether et al[5] observed a 29.5% IOP elevation in the first 24 hours after vitreoretinal surgery. However the majority of these cases used a 20G vitrectomy. In our study the use of 23 or smaller gauge vitrectomy, may have lowered the incidence of elevated IOP observed on the first day post-surgery. In addition, transient isolated spikes of IOP are likely to occur postoperatively, so a raised IOP on day one may not be indicative of sustained problematic IOP as a result of PPV.

Of course raised IOP is not the only complication of PPV, with endophthalmitis and wound leaks perhaps being the most dangerous. Endophthalmitis is highly unlikely to occur on the first day after surgery, rather having a clinical course starting a few days after surgery. It is unlikely that a routine check day one postoperatively will spot this. None of the patients in our cohort had endophthalmitis or wound leak. Wound leak is becoming less and less of an issue with the advent of sutureless ports and regular use of air tamponade in all cases. It often tends to be transient and resolve spontaneously – day one review is highly unlikely to spot this.

This study shows that the incidence of elevated IOP on day one post PPV without prophylactic IOP lowering medication is low. With much documented elsewhere about the low risk of elevated IOP post PPV, and therefore the lack of need for day 1 reviews, little however has been shown to identify *which* surgical retina patients *do* require such a review. Comparisons we performed have not received research attention until now, particularly assessing gas versus air tamponade and number of laser burns. Prior studies[5] have tended to combine factors which predispose to elevated IOP such as scleral buckling, silicone oil and pre-operative vitreous hemorrhage. We have

performed a more focused analysis of risk factors in specific group of patients to provide a clearer assessment of true IOP measurement post-surgery.

A study by Muether et[5] al observed a 29.5% IOP elevation in the first 24 hours after vitreoretinal surgery. However, this study included patients undergoing 20g vitrectomy combined with scleral buckling, silicone oil in complex diabetic/RRD and trauma cases. Our study focused on a selected group of patients and reported an incidence of 6% day 1 postoperative IOP, without prophylactic treatment. Brennan et al[1] recently reported a 0.5% incidence of raised IOP on day one post vitrectomy and have justified omitting first day review of low risk TSV procedures.

One study performed by Framme et al[7] in eight hundred and fifty one patients comparing air versus SF_6 versus silicone oil, showed that gas tamponade was associated with a prolonged elevated IOP, however the most significant risk factor for elevated IOP was the use of silicone oil.

Our results show that transient minimal elevations in IOP are associated with the number of laser burns and gas. However this does not warrant prophylactic anti-glaucoma medication in all cases, and is only justified in high risk patients. We did not establish a relationship between the variables of vitrectomy gauge, lens status or indications for surgery (ERM, MH or RRD). However previously Yang et al[8] have shown in a comparative study that phakovitrectomy was associated with a higher risk of IOP elevation during the early postoperative period than PPV alone.

We argue that there is no *added* reason for anti-glaucoma treatment in gas use over air, in terms of reduced risk for IOP elevation.

Conclusion

The use of gas tamponade, in particular C_2F_6, does not constitute justification for pre-operative anti glaucoma, prophylactic treatment. In addition, careful consideration should be given to the frequency of laser burns during PPV. We argue that assessing singular, rather than combined factors in a robust model will enable surgeons to effectively differentiate those cases which may or may not require prophylactic anti-glaucoma treatment, however in the majority of cases, such prophylaxis is not required. Further studies will hopefully establish a revised evidence-based argument and guidelines for the routine use of anti-glaucoma treatment prior or post-vitrectomy to be reduced or removed.

What we know already:

- There is still a common trend to have day one postoperative review.
- There is growing evidence that elevated IOP is rare in patients who have had PPV.

- Smaller gauges and sutureless ports are associated with lower and more stable postoperative IOP compared to 20g vitrectomy.

What this study adds:

- There is little to support a conclusion that the use of gas tamponade leads to raised IOP post-PPV.
- There is a moderate association between the number of laser burns and raised IOP.

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