Comparison of the ocular perfusion pressure fluctuation between medically controlled and operated eyes with glaucoma

Abstract

Purpose: To compare the fluctuation of the ocular perfusion pressure (OPP) between eyes treated with glaucoma medication and eyes with a functioning filtering bleb.

Study Design: cross-sectional controlled paired-eye design.

Methods: Fourteen patients with primary open angle glaucoma (POAG) with one eye operated on (trabeculectomy) and the fellow eye treated with medication enrolled the study. Blood pressure and intraocular pressure were measured at 7 a.m., 1 p.m., and 7 p.m. Systolic, diastolic and mean OPP were calculated for the three time points and the fluctuation (range between the highest and the lowest values) compared between the eyes.

Results: Mean values of the mean OPP fluctuation were 7.2 ± 3.9 mmHg and 8.5 ± 4.0 mmHg, for operated eyes and medically treated eyes, respectively (P = 0.149); mean systolic OPP fluctuation was 20.7 ± 11.2 mmHg for operated eyes and 21.2 ± 11.7 mmHg for medically treated eyes (P = 0.478); the mean diastolic OPP fluctuation was 8.4 ± 4.4 mmHg for operated eyes and 10.5 ± 5.4 mmHg for medically treated eyes (P = 0.085).

Conclusion: In this small cohort of patients with POAG, the mean, systolic and diastolic OPP fluctuation did not differ between the operated eyes and medically treated ones.

Key words: Glaucoma; primary open angle glaucoma; ocular perfusion pressure; treatment.

Introduction

Several population-based and clinical studies suggest a relationship between low ocular perfusion pressure (OPP) and the risk of primary open angle glaucoma (POAG) prevalence and progression of the disease. The pathogenic mechanism seems to be an impaired vascular autoregulation which, in turn, leads to reduced blood perfusion. Trabeculectomy is the procedure of choice for uncontrolled glaucoma patients. It has been reported that glaucoma surgery can increase OPP because of the decrease in IOP. Recently, an association between larger fluctuation in OPP and functional glaucoma severity has been reported. We hypothesize that eyes with trabeculectomy and steady circadian intraocular pressure have smaller OPP fluctuation as compared to medically treated eyes with glaucoma. Hence, the purpose of the study was to compare the fluctuation of the OPP between eyes treated with glaucoma medication and eyes with a functioning filtering bleb.

Methods

Study design and sample

This was a cross-sectional study and included consecutive patients with POAG with a functioning trabeculectomy in one eye and the fellow eye under medical therapy. In order to be included in the study, patients had to be older than 40 years of age, with 20/20 best corrected visual acuity, a trabeculectomy in one eye for at least six months, non-myopic, non-diabetic
Introduction

Ocular perfusion pressure (OPP) and the risk of glaucoma have been studied extensively. Studies suggest a relationship between low OPP and the incidence of primary open-angle glaucoma (POAG). Hence, the purpose of the study was to compare OPP between medically treated eyes with glaucoma and operated eyes with glaucoma surgery.

Methods

Fourteen patients with primary open angle glaucoma (POAG) were enrolled in the study. Eight patients had their right eye operated on (trabeculectomy) and the fellow eye treated with medication enrolled. The left eye operated on (trabeculectomy) and the fellow eye untreated were included in the study. Patients were taking topical ß-blockers, calcium channel blocker (one patient) either as monotherapy or in combination.

Table 1. Comparison of the mean, systolic and diastolic ocular perfusion pressure values between eyes.

<table>
<thead>
<tr>
<th></th>
<th>Medically treated eyes</th>
<th>Operated eyes</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean OPP fluctuation</td>
<td>8.5 ± 4.0 mmHg</td>
<td>7.2 ± 3.9 mmHg</td>
<td>0.149</td>
</tr>
<tr>
<td>Systolic OPP fluctuation</td>
<td>21.2 ± 11.7 mmHg</td>
<td>20.7 ± 11.2 mmHg</td>
<td>0.478</td>
</tr>
<tr>
<td>Diastolic OPP fluctuation</td>
<td>10.5 ± 5.4 mmHg</td>
<td>8.4 ± 4.4 mmHg</td>
<td>0.085</td>
</tr>
</tbody>
</table>

(mean ± standard deviation)

Results

The IOP fluctuation in the operated eyes was 3.4 ± 1.3 mmHg and for the medically treated eyes was 3.6 ± 1.7 mmHg (P = 0.639). The mean values of the mean OPP and systolic OPP were slightly lower than the normal limits; PSD with a P value < 5%, IOP higher than 21 mmHg (at the time of diagnosis on no medication) and open angles on gonioscopy.

Discussion

The result of the study revealed that the OPP fluctuation in eyes that underwent trabeculectomy was not different from those under medical treatment. We originally considered that eyes that underwent trabeculectomy, which controls IOP through 24 h, would present shorter OPP fluctuations. Konstas et al showed 24-hour OPP control in patients with moderate to severe open-angle glaucoma treated with surgery versus non-medication and medical therapy. The OPP fluctuation did not differ between eyes so that the OPP fluctuation was essentially the same in both eyes. Different from Konstas, we have evaluated the IOP fluctuation for a 12-hour period and not 24-hour, and for that time period the IOP fluctuation did not differ between eyes. One might expect the IOP fluctuation to be larger in patients on medical therapy as a result of low
compliance due to the number of drops, the time interval between drops, and medication effect over 24 h period. However, in this study, both eyes that underwent trabeculectomy and those on medical therapy had the same IOP and OPP fluctuations.

The effect of IOP lowering with trabeculectomy on ocular blood flow and perfusion pressure is controversial. Trible et al performed color Doppler imaging of both eyes before surgery and then at two, five, and 14-week intervals after surgery in patients undergoing trabeculectomy. The authors report sustained increases in mean velocity and end-diastolic velocity and decreases in resistance index in the central retinal artery and the short posterior arteries with clinically attainable reductions in IOP after surgery.9 James observed a significant increase in pulsatile ocular blood flow of 29% in 17 patients who underwent trabeculectomy in the standing position following operation but, in some individuals, blood flow changed only slightly despite a large reduction in intraocular pressure.10 Poinosawmy et al reported that normal-tension glaucoma patients treated by trabeculectomy and those receiving topical latanoprost and brimonidine had lower IOP and higher pulsatile ocular blood flow following treatment.11 Berisha et al assessed the optic nerve head blood flow (ohnBF) with scanning laser Doppler flowmetry in 30 glaucoma patients scheduled for trabeculectomy, before and 10 weeks after surgery. The authors noticed a significant increase in onhBF after trabeculectomy in association with the increase in OPP.12 Tamaki et al, using the laser speckle method, observed little change in the ONH circulation induced by trabeculectomy.14 On the other hand, Cantor evaluated the effects of chronic reduction of IOP on ocular hemodynamics of patients requiring trabeculectomy and found that chronic reduction of IOP did not alter ocular blood flow and that IOP may be an independent risk factor for progression of glaucoma. The author proposes that eyes are able to autoregulate to chronically increased IOP over time.15 Differences in methods to measure and evaluate both ocular blood flow and perfusion pressure may explain these apparently contradictory results. In our study, OPP was estimated by the systemic pressure measured at the brachial artery and not by blood flow measurements in the eye and orbit.

In the study, we have used both eyes of the same patient. This approach has some advantages as well as shortcomings. Paired-eye designs reduce variability in response due to subject heterogeneity by using subjects as their own controls. For a given subject, each eye is treated differently. This design is ideal for the measurement of the efficacy of a single treatment: one eye is treated and the other eye serves as control.16 Paired designs generally offer a very powerful approach.17 Besides, by using both eyes of the same patient all systemic variables would affect equally both eyes, precluding additional bias. One shortcoming, however, is the small sample size. We had difficulty in selecting patients with a trabeculectomy in one eye only. That has made our sample size small and we are not sure if the results could have been different in a larger cohort of patients.

Some patients in the study were taking glaucoma medication in the operated eye as well, suggesting that the filtering surgery was not entirely functioning. Nevertheless, the addition of a hypertensive drug in an operated eye was done in order to reach the specific target pressure in some patients with advanced glaucoma. We believe this has not interfered with the results, since the same medications were used on both eyes.

In summary, in this small cohort of patients with POAG the mean, systolic, and diastolic OPP fluctuation did not differ between the operated eyes and medically treated ones.