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Title-Kapalbhati Yoga and Inter-eye Intraocular Pressure and Perfusion Symmetry in eyes with Glaucoma

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Abstract

Aim: To study the inter-eye symmetry in change in intraocular pressure (IOP), mean ocular perfusion pressure (MOPP), and superficial retinal vascular perfusion on optical coherence tomography angiography (OCTA) following Kapalbhati yoga (KBY) in primary open angle glaucoma (POAG) eyes.

Methods: Prospective case control study (40 healthy and 40 POAG subjects). IOP, blood pressure was measured pre and post KBY (immediately and 10 minutes later, OCTA pre and at 10 minutes).

Results- IOP increased immediately after KBY in both healthy and POAG eyes (13.7±2.3mmHg to15.7±2.3mmHg, p<0.01;15.9±3.2 mmHg to 19.5±3.3 mmHg, p<0.01). It was1.9± 0.5mmHg (p<0.01) in healthy eyes versus 3.5±1.2mmHg (p<0.01) in POAG. A positive inter-eye correlation for IOP change immediately post KBY (r=0.8,p<0.01) in POAG eyes and MOPP change (-1.5±2.8mmHg OD, -1.3±2.9mmHg OS, r=.9, p<0.01) in healthy and POAG eyes was seen.

Conclusion-Significant IOP increase and a positive inter-eye correlation in IOP and MOPP change in POAG eyes was seen.

Introduction

Glaucoma is one of the leading causes of irreversible blindness worldwide. [1] Elevated intraocular pressure (IOP) is one of the main risk factors for both the development and progression of glaucoma. Apart from mean IOP, it has been postulated that IOP variations could also play a role in glaucomatous damage.[2,3]Many daily activities as well as lifestyle practices have been shown to have an effect on IOP.[4,5,6,7]

Yoga is practiced widely not only in India but worldwide. Kapalbhati is a yogic breathing technique which involves high frequency forceful exhalation through both nostrils using abdominal muscles and passive inhalation. [8] There is evidence in the current literature regarding increase in IOP during yoga postures with a head down position. [5,6]. In their meta-analysis, Chetry et al recommended that yogic breathing exercise involving breath holding may increase IOP.[9] Changes in retinal perfusion and average macular thickness have been reported following yogic exercise.[10,11,12]

However, there is scant literature regarding the IOP and ocular blood flow related changes associated with breathing techniques involving fast forceful exhalation like KBY in both healthy and primary open angle glaucoma patients. Moreover, there is very less literature regarding the inter-eye symmetry in these changes. Thus, we studied the short term effects of KBY on IOP and superficial retinal vascular perfusion in healthy individuals and patients with primary open angle glaucoma and the inter eye correlation among these parameters.

Methods

Ours is a prospective case control study conducted in a tertiary eye care hospital. POAG participants and normal participants visiting the out-patient and glaucoma department of Sankara Nethralaya Medical Research Foundation, and fulfilling the inclusion criteria were included. A total of 80 participants were included in the study. Of these 40 had primary open angle glaucoma and 40 were healthy participants. Primary open angle glaucoma was defined based on International Society of Geographical and Epidemiologic Ophthalmology (ISGEO) criteria.[13]

Participants with age >18 years were included. The criteria for inclusion of healthy controls was IOP between 10 and 21mmHg and an open angle of the anterior chamber. Patients with POAG and healthy participants with controlled diabetes and hypertension were included in the study. Participants with ocular pathology (significant cataract, dry eye, corneal abnormalities, retinal diseases, ocular surgery within 3 months), previous physical injury, cardiovascular diseases, pregnancy, menstruation, history of vertigo, gastric ulcer, epistaxis, hernia, abdominal surgery were excluded from the study. The study was approved by the Institutional Review Board and followed the tenets of Declaration of Helsinki. Informed consent was obtained from all the participants.

All participants underwent a detailed general and ocular history, a comprehensive ophthalmologic examination, which included measurement of the best-corrected visual acuity, refractive error, slit-lamp examination, gonioscopy, and fundus examination after dilation. Humphrey visual field, central corneal thickness, and digital biometry (IOL Master), was done. IOP was measured using Goldman applanation tonometry (GAT), in the undilated state just before KBY, immediately after and then 10 minutes after KBY in a masked fashion. The dial was set to a random value by one observer and applanation was done without looking at the dial. The dial was turned to obtain the end point without looking at the dial. The first observer read and recorded the pressure value from the dial. All patients underwent optical coherence tomography angiography ((OCTA);CIRRUS™ HD-OCT 5000 with AngioPlex® OCT Angiography; ZEISS, Dublin, CA)) prior to and 10 minutes after KBY (undilated). Perfusion density and flux index in the radial peripapillary capillary (RPC) slab were noted. The macular OCTA scan was performed using a volumetric scan covering a 6 × 6 mm area centred on the fovea. Perfusion density in the superficial slab and the area of the foveal avascular zone (FAZ) was noted. Only scans with adequate signal strength and without artifacts were included. Systolic and diastolic blood pressure was measured with a digital BP monitor (OMRON HBP – 1300 (HBP – 1300 – AP)) before and immediately after KBY using a standard blood pressure cuff on the left arm at heart level. Mean ocular perfusion pressure (MOPP) =2/3[diastolic BP+1/3 (systolic BP-diastolic BP)-IOP)] was calculated. A pulse oximetry sensor (AccuSure® Model (FS10C)) was used to measure the oxygen saturation prior, and during KBY.

KBY was performed stepwise under the supervision of a certified instructor (D.M.T). No food, water, or beverage was allowed 30 minutes prior to the exercise. Participants were asked to breathe in normally through both the nostrils and then exhale quickly and forcefully for 1 minute. While doing so the abdomen was pushed upwards and back to normal. The procedure was repeated 5 times with a rest period of one minute between each round.

Statistical Analysis

All statistical analyses were performed using a standard statistical software package (Stata, version 15.0; StataCorp). Normality of data was determined using Shapiro Wilk test and histograms. The data are presented as the mean values ± standard deviations, where applicable. Appropriate paired and unpaired parametric and non parametric tests were used to compare the data. Pearson and Spearman's correlation coefficient was used to assess the correlation between eyes. Bonferroni correction was used to adjust for multiple comparisons. All tests were two tailed and a P value <0.05 was taken as significant.

Results

A total of 80 participants (40 healthy volunteers; 40 POAG patients) were enrolled in this study. Mean age of POAG participants was 50.6 ±13.04 years and controls was 46.1±12.7 years (p>0.05). In the controls, there were 25 (62.5%) males and in the POAG group, 29 (72.5%) were males.

IOP increased significantly immediately after KBY in both healthy (right eyes 13.7±2.3mmHg to15.7±2.3mmHg, p<0.01; left eyes 13.43±2.1mmHg to 15.33±2.07mmHg, p<0.01) and POAG eyes (right eyes 15.9±3.2 mmHg to 19.5±3.3mmHg, p<0.01; left eyes 15.78±4.5 mmHg to 18.93±3.04mmHg, p<0.01). The increase in IOP immediately post KBY was significantly more in POAG eyes as compared to healthy eyes (right eyes 1.9± 0.5mmHg versus 3.5±1.2mmHg, p<0.01; left eyes 1.9± 0.3mmHg versus 3.48±0.91mmHg, p<0.01) A positive inter-eye correlation for IOP change immediately post KBY (r=0.8, p<0.01) in POAG eyes was present. There was no significant difference in the IOP at baseline and at 10 minutes in both groups.

A significant correlation for MOPP change (-1.5±2.8mmHg right eyes, -1.3±2.9mmHg left eyes, r=.9, p<0.01) in healthy and POAG eyes was seen. No significant change in RPC flux, RPC perfusion, macular perfusion density and FAZ area was seen in healthy eyes. A significant decrease in the mean macular perfusion density was seen in the right eyes of POAG participants (p=0.019) 10 minutes following KBY.

Discussion

We observed a significant increase in IOP immediately after KBY (performed for 5 minutes with 1 minute interval after each round) in comparison with the baseline value in both normal and POAG eyes. The increase was significantly more in eyes of POAG participants. In both groups, IOP returned to pre exercise levels 10 minutes post KBY. The IOP changes could be related to the changes in the autonomic function (sympathetic and parasympathetic) and blood flow due to high-frequency breathing. Nivethitha et al found a significant increase in systolic pressure and diastolic blood pressure after KBY (performed for 3 minutes with one minute of normal breathing after every round) in healthy individuals.[14] A decrease in cardiac vagal tone, increased blood pressure and spontaneous pneumothorax have been reported to be associated with KBY. [14, 15, 16] IOP has been found to increase during Valsalva manoeuvre and partial Valsalva manouver (23-115%; depending upon the degree) and activities associated with increased intra abdominal pressure like weight lifting. [16,17, 18, 19] All these factors could produce a complex interaction leading to increase in IOP during KBY. We assessed the inter eye symmetry to know the response to KBY between eyes. We found a strong correlation in IOP change immediately post KBY among the right and left eyes in the POAG group. A strong correlation was seen in change in MOPP in both POAG patients and controls. However, no significant correlation among the superficial retinal vascular parameters was seen. This could be because we performed the measurement after 10 minutes when parameters may have normalised. Additionally, right eyes were measured first.

The limitation of our study was that it assessed the short term effects of KBY. Additionally, KBY was performed for only 5 minutes with one minute rest in between each cycle. Moreover, it was not possible to measure IOP while the participants were performing KBY. However, we measured the IOP immediately post cessation of KBY.

Conclusion

KBY was associated with a significant increase in IOP immediately post exercise in POAG and healthy eyes with a significantly greater increase in POAG. There was a significant positive correlation between right and left eye in IOP change in POAG eyes. Patients with glaucoma should be made aware of the bilateral short term IOP fluctuations associated with KBY.

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