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Original Article

Opthalmology Section

The Assessment of Sleep Apnoea as a Risk Factor in Glaucoma

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ABSTRACT

Background: The risk of developing open angle glaucoma increases in the presence of associated disorders such as hypertension, Diabetes mellitus and migraine. In recent years, sleep apnoea is also being investigated as a risk factor in the development of open angle glaucoma.

Aim: To ascertain the significance of sleep apnoea as a risk factor in patients with glaucoma.

Study Setting and Design: A non – randomised, cross sectional study was undertaken at an urban teaching hospital.

Material and Methods: A sleep disturbance questionnaire and the Epworth sleepiness scale were used to screen the potential cases of sleep apnoea amongst 40 glaucomatous subjects, with both Primary Open Angle Glaucoma (POAG) and Normotensive Glaucoma (NTG), as well as 40 controls. Those which gave a positive response to the questionnaire were subjected to polysomnography for the diagnosis of sleep apnoea, with the calculation of the Apnoea Hypopnoea Index. The data was analysed by using the Chi–square test and the odds ratio calculations.

Results: Positive responses to the sleep apnoea questionnaire were obtained from a total of twenty participants, 16 (40%) from the glaucoma Group and four (10%) were obtained from the control Group. In the glaucoma Group, ten (37.03%) of the 27 POAG individuals, and six (46.15%) of the 13 NTG cases showed significant positive responses to the questionnaire. Four subjects (10%) (1POAG, 3 NTG) from the glaucoma Group and one (2.5%) from the control Group were diagnosed to have sleep apnoea by polysomnography. The percentage of the sleep apnoea positive cases was higher among the NTG subjects (23.07%) than among the POAG subjects (3.7 %). This study had an odds ratio of 4.333 (>1) and a p value of 0.382.

Conclusion: Although the odds ratio was significant, this study did not find the association between sleep apnoea and glaucoma to be statistically significant.

Key words: Primary open angle glaucoma, Normal tension glaucoma, Polysomnogrphy, Sleep apnoea, Apnoea hypopnoea index

INTRODUCTION

Glaucoma represents an optic neuropathy, wherein the tissue damage occurs at the level of the optic nerve head, resulting in a characteristic alteration of the optic nerve head appearance, as well as a distinct pattern of visual field disturbances. Whether these occur through a solely vascular or a mechanical mechanism, or a combination of both, has not yet been established [1].

A number of risk factors which are associated with the development of glaucomatous optic neuropathy have been identified, such as Diabetes mellitus, hypertension and migraine [2]. In the past decade, sleep apnoea has been added to this list of risk factors [3 – 6]. The individuals with sleep apnoea are reported to be at a greater risk of developing Primary Open Angle Glaucoma (POAG) and its normotensive variant (NTG) [3 – 6]. Sleep apnoea is a sleep disorder which is characterised by pauses in the breathing during sleep. An apnoeic event is defined as a minimum 10 seconds interval between the breaths, with either a neurological arousal or a blood oxygen desaturation of 3 – 4% or more, or both an arousal and a desaturation. The definitive diagnosis of sleep apnoea is made by polysomnography. It has been found that during sleep, the recurrent episodes of apnoea are associated with large swings in the blood pressure. It is thought that these repetitive hypoxic periods contribute to the optic nerve head damage [7]. This study was undertaken to ascertain the significance of sleep apnoea as a risk factor in the patients with glaucoma.

MATERIAL AND METHODS

Study Setting

This non – randomised, cross sectional, comparative study was conducted over one year at an urban tertiary health centre. The ethics committee's approval was obtained. Forty consenting individuals, with recently diagnosed POAG or NTG, were enrolled in the study (Group A), along with a control Group which comprised of an equal number of healthy age and gender matched individuals (Group B). The patients with secondary glaucoma and a past history of any ophthalmic surgery and the patients with media opacities which interfered with the retinal examination and the performance visual field analysis were excluded from the study. The ophthalmic evaluation in the glaucoma Group (Group A) included a visual acuity testing with the use of the Snellen's chart, a slit lamp examination, Gonioscopy with the use of Goldmann's three mirror lens, Applanation tonometry with the use of Goldmann's tonometer, and optic disc evaluation with the use of a Volk 90 D non – contact fundus lens.

The visual fields were examined by using the SITA standard 30-2 programme on the Humphrey automated perimeter.

A validated sleep disturbance questionnaire, which was based on the Proceedings of the American Thoracic Society [8], was administered to all the participants. The presence of snoring, morning headache, choking or suffocating episodes during sleep, a non – refreshing sleep, and a weight gain of 8 – 10 kgs or more

over the previous three years, were taken to be the positive responses to the sleep disturbance questionnaire. The excessive day time sleepiness was assessed by using the Epworth Sleepiness Scale [9] and a score which was greater than 10 was considered to be significant.

Those individuals who gave positive responses to the questionnaires were then evaluated by polysomnography. The polysomnographic assessment included Electro Encephalography (EEG), Electrocardiography (ECG), Electromyography (EMG), oxygen saturation, the snoring microphone recording, the oronasal airflow detection, chest wall and thoracic effort monitoring, and body position recording.

The severity of the sleep apnoea was graded according to the Apnea Hypopnea Index (AHI) scale [8], as was determined by the total number of apnoea and hypopnoea episodes which occurred during one hour of the recording. A score of <5 was considered as normal, that of 6-15 was graded as mild, that of 16-30 was graded as moderate and that of > 30 was considered as severe.

RESULTS

A total of 80 subjects (22 males and 58 females) were enrolled in the study. Their ages ranged from 40 – 60 years. The mean age was 50.8 years. The participants were assigned to either the glaucoma Group (A) or to the control Group (B).

Group A comprised of 40 individuals, of whom 27 (67.5%) had POAG and 13 (32.5%) individuals had NTG.

Positive responses to the sleep apnoea questionnaire were obtained from among a total of twenty (25%) participants, of whom 16 (40%) were from Group A and four (10%) were from Group B. In Group A, ten (37.03%) of the 27 POAG individuals, and six (46.15%) of the 13 NTG cases showed significant positive responses to the questionnaire. Polysomnography was performed on all the 20 'questionnaire positive' participants of both the Groups A and B. Four subjects (10%) from the glaucoma Group and one (2.5%) from the control Group were diagnosed to have sleep apnoea by polysomnography. The distribution of sleep apnoea amongst the glaucoma Group was as follows- one (3.7%) POAG case and three (23.07%) NTG cases.

The AHI values which indicated the severity of the sleep apnoea revealed that three were mild cases, and that two were moderate cases [Table/Fig-1]. The distribution of Diabetes mellitus and hypertension amongst the cases and the controls was as shown in [Table/Fig-2 and 3]. The study had an odds ratio of 4.333 (>1) and a p value of 0.382 (by the Chi – square test).

DISCUSSION

Various studies [3 – 6] in the literature have reported an association between glaucoma and sleep apnoea. The comparison of our results with these studies is difficult for various reasons. Some studies were conducted only on the POAG patients, while others assessed only the NTG patients. Further, the diagnostic tests for sleep apnoea were not uniform [Table/Fig-4].

In our study, both the POAG and the NTG cases were included. The diagnosis of sleep apnoea was based both on the positive responses to the sleep disturbance questionnaire as well as to the polysomnography.

The Association of Sleep Apnoea in the NTG Cases

In our study, positive responses to the questionnaire were obtained from 6 out of 13 (46.15%) NTG cases. Sleep apnoea was diagnosed by Polysomnography in 3 out of 13 (23.07%) NTG cases. Our results and methodology were in agreement with those of Marcus DM, Gokhale P and Costaride AP et al., [3]. They reported figures of 57% NTG patients with questionnaire positive responses and 30.43% NTG patients with sleep apnoea.

	No. of POAG cases	No. of NTG cases	No. of Controls
Mild sleep apnoea	1 AHI-6	1 AHI-7	1 AHI-6
Moderate sleep apnoea		2 (AHI-16 and 18)	
Severe sleep apnoea			

[Table/Fig-1]: Severity of sleep apnoea among cases and controls

	No sleep apnoea	sleep apnoea
DM	15	0
HTN	9	1
DM + HTN	4	1
Normal	8	2

[Table/Fig-2]: Distribution of diabetes mellitus and hypertension among glaucoma Group

	No sleep apnoea	sleep apnoea
DM	10	0
HTN	10	0
DM + HTN	0	0
Normal	19	1

[Table/Fig-3]: Distribution of diabetes mellitus and hypertension among control Group

Study	Type of glaucoma included in study	Tests used to assess sleep apnea
Marcus DM et al., [3]	NTG	Polysomnography
Onen SH et al., [4]	POAG	Sleep questionnaire
Majon DS et al., [5]	Snoring POAG patients	Transcutaneous oxymetry
Blumen Ohana et al. [6]	POAG	Polysomnography

[Table/Fig-4]: Various studies with different tests to diagnose sleep apnoea in different types of glaucoma cases

The Association of Sleep Apnoea in the POAG Cases

In our study, positive responses to the sleep disturbance questionnaire were obtained from 10 of the 27 (37.03%) POAG cases. This result was similar to that which was obtained in a questionnaire based study which was done by Onen SH et al., [4] wherein they reported positive responses in 27.3% POAG patients.

Majon DS et al., [5] diagnosed sleep apnoea in 20% POAG patients by using transcutaneous finger oxymetry by calculating the oxygen disturbance index. In our study, the diagnosis of sleep apnoea was based on a combination of the positive questionnaire responses and the positive polysomnography results. With this method, we detected sleep apnoea in only one of the 27(3.7%) POAG patients.

Regarding snoring, we found that 1 out of 10 questionnaire positive (10%) snorers in the POAG Group suffered from sleep apnoea. Blumen Ohana E et al., [6] performed polysomnograhy on a cohort of 31 snorers with POAG. They reported a much higher incidence

(49%) of the obstructive sleep apnoea syndrome.

Sleep Apnoea in the Non – glaucomatous Group (Group B)

In our study, only one out of the 40 controls had sleep apnoea. Such patients need a long term follow up, in order to detect any development of glaucoma. The advanced glaucoma diagnostic tests such as Short Wavelength Automated Perimetry (SWAP), retinal nerve fibre layer analysis and optic nerve head analysis with Heidelberg Retinal Tomography (HRT), may also help in detecting the early glaucomatous changes in such individuals.

Analysis of the Other Risk Factors

Girkin CA et al., [10] have reported that Diabetes mellitus and systemic hypertension are the risk factors of greater significance than sleep apnoea for the eventual development of glaucoma. The present study found that 75% (30 out of 40) patients of the glaucoma Group, who presented at this centre during the period of the study, had either Diabetes mellitus (15out of 40, 37.5%) or systemic hypertension (10 out of 40, 25%) or both (5 out of 40, 12.5%).

Of the four subjects in Group A who had a definitve diagnosis of sleep apnoea, one had hypertension, while another had both diabetes as well as hypertension. These two conditions are associated with sleep apnoea as well as glaucoma. It has been reported that 40% of the patients with sleep apnoea are diabetics [11], while 40-60% patients with sleep apnoea have arterial hypertension [12].

However, our study did not support a statistical significance in the association between glaucoma and sleep apnoea (p= 0.382). This may be attributed to the following limitations of the study:

- Its small sample size
- The short duration of the study
- The presence of confounding factors like Diabetes mellitus and systemic hypertension.

CONCLUSION

Although the present study did not show a statistically significant association between glaucoma and sleep apnoea, it has been suggested that the further prospective studies which are performed over a longer duration, may show a statistically significant association between sleep apnoea and the development of glaucoma.

A study on the additional factors such as the ocular blood flow with respect to the nocturnal intra-ocular tension, amongst the individuals with sleep apnoea would also be helpful. Such studies are also likely to help elucidate the possible mechanism for the development of glaucoma in them.

To conclude, the sleep disturbance questionnaire should be a part of all the glaucoma work ups. Those patients who report positive for the sleep questionnaire should be referred for a sleep study. The sleep apnoea patients should be placed on a regular watch for the development of glaucoma. This will aid in an early diagnosis, treatment and prevention of the complications of both these conditions.

REFERENCES

[1] Plmberg P. Mechanisms of glaucoma. In: Yanoff M, Duker TS, eds. *Ophthalmology*. Volume 2. 2nd edition. New Delhi: Elsevier, 2006; 1425.
[2] Zimmerman R. Primary Open Angle Glaucoma. In: Yanoff M, Duker T S, eds. *Ophthalmology*. Volume 2. 2nd edition. New Delhi: Elsevier, 2006; 1484.
[3] Marcus DM, Gokhale P, Costaride AP, et al. Sleep disorders: a risk factor for normal tension glaucoma. *J glaucoma* 2001 June; 10(3): 177-83.
[4] Onen SH, Mouriaux F, Berramdane L. High prevalence of sleep disordered breathing in patients with primary open angle glaucoma. *Acta Ophthalmol Scand.* 2000 Dec;78(6): 638-41.
[5] Majon DS, Hess CW, Goldblum D et al. Primary open angle glaucoma is associated with sleep apnoea syndrome. *Ophthalmologica.* 2000; 214(2):115-18.
[6] Blumen Ohana E, Blumen MB, Bluwol E, et al. Primary open angle glaucoma and snoring , prevalence of Obstructive sleep apnoea syndrome. *Eur Ann Otorhinolaryngol Head neck Dis.* 2010 Nov; 127(5): 159-64.
[7] Sergi M, Salerno DE, et al. Prevalence of normal tension glaucoma in obstructive sleep apnoea syndrome. *J Glaucoma.* 2007; 16: 42-6.
[8] Mc Nicholas , Walter T et al .Diagnosis of obstructive sleep apnoea in adults. *Procedings of American Thoracic Society.* Feb 15, 2008 Volume 5; 2 : 154-60
[9] Patel NP, Shwab RJ. Sleep apnoea Syndrome. In: Fishman AP, Elias JA, Fishman JA, eds. Fishman' pulmonary diseases and disorders. Volume 2. 4th edition. China: McGraw – Hill Companies, 2008; 1697-727.
[10] Gerkin CA, Mc Neal SF, et al. Is there association between pre existing sleep apnoea and development of glaucoma. *Br J Ophthalmolgy.* 2006 Jun; 90(6):679-81.
[11] Meslier N, Gagnadoux F, Giraud P et al. Impaired glucose insulin metabolism in males with OSA Syndrome. *Eur Respir J.* 2003; 22(1):156-60.
[12] Partinen M, Telakivi T. Epidemiology of obstructive sleep apnoea syndrome. *Sleep.* 1992; 15:81-84.

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