CASE REPORT

# Increase in the Field of Vision in a Patient with Primary Open-angle Glaucoma and Obstructive Sleep Apnea with Usage of Continuous Positive Airway Pressure

S Ramnathan Iyer[1], S Ramchandani[2]

## Abstract

Obstructive sleep apnea (OSA) has been reported to affect hypoxia-sensitive tissues (retina and optic tract) adversely. An 81-year-old gentleman, a known case of primary angle glaucoma, hypertension, and type 2 diabetes with visual field defects, was on established therapy, but there was no improvement in vision. He was evaluated for his sleep complaints viz. loud and habitual snoring. Polysomnography revealed obstructive sleep apnea predominantly in rapid eye movement (REM) sleep. Compared with non-rapid eye movement (NREM) sleep, REM sleep is associated with higher sympathetic activity and cardiovascular instability. Regular usage of continuous positive airway pressure during sleep was instituted. After 4 months of this mode of therapy, the perimetry showed improvement in the field of vision. The patient is being followed up regularly, and continuous positive airway pressure (CPAP) usage is being continued.

**Keywords:** Diabetes, Hypertension, Obstructive sleep apnea.

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## Introduction

Sleep is an active state and is a basic biologic function and is essential for life. Sleep is critical for our physical, mental, and emotional well-being.[1] Sleep-disordered breathing (SDB) is one of the most common disorders of sleep. It encompasses a spectrum of disorders viz. snoring, upper airway resistance syndrome, OSA. Obstructive sleep apnea which has a high prevalence is one of the most important disorders identified in the last 50 years. The disorder is characterized by a repeated pharyngeal collapse in sleep causing cyclical hypoxia and cyclical sympathetic stimulation. These episodes have deleterious systemic consequences viz. hypertension, diabetes, ischemic heart disease, stroke, dementia, and others.[2] Obesity and particularly central adiposity are potent risk factors for sleep apnea. Mild-to-moderate obesity has been associated with an increased prevalence of OSAHS. In a community-based cohort of middle-aged subjects, Young et al.[3] demonstrated that a 1-SD increase in BMI was associated with a fourfold increased risk for prevalent sleep apnea. Studies show that the prevalence of SDB increases with age ranging from 5 to 15% in middle-aged adults to approximately 24% in community-dwelling adults.[3,4]

Upper airway obstruction can occur in both non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. However, there is an increased tendency for upper airway collapse during REM sleep due to the decreased genioglossus muscle tone. REM OSA has been studied mostly on clinical grounds with small cohorts. The reported prevalence of REM OSA ranges between 10 and 36%.[5–7]

Management of OSA usually rests on the usage of CPAP therapy. CPAP helps by opening the pharynx. Usage of this device in sleep gives rewarding results viz. normalization of sleep architecture and favorable effects on body systems.

Retina has the highest oxygen consumption. The first author had proposed for the first time in 2003 that cyclical hypoxia of OSAHS can have deleterious effects on the retina.[8] Association of OSA with several eye disorders viz. floppy eyelid syndrome, anterior ischemic optic neuropathy, optic neuropathy, glaucoma, and papilledema secondary to raised intracranial pressure has been reported.[9]

Glaucoma is a wide-spectrum disease with progressive visual deterioration and is one of the leading causes of blindness in the world. Open-angle glaucoma is the most common type. There is an increase in the intraocular pressure (IOP) which damages the optic nerve. Most patients with open-angle glaucoma are initially asymptomatic. They do not notice a change in their vision because the initial loss of vision is of sides or peripheral vision, and the visual acuity or sharpness of vision is maintained until late in the disease. Patients with diabetes and hypertension are at higher risk for developing this glaucoma. Normal-tension glaucoma (NTG) is a type of open-angle glaucoma with normal IOPs. It must be appreciated that both hypertension and diabetes are strongly related to advancing age. The prevalence of SDB is also high in the elderly which is a risk factor for hypertension, diabetes, ischemic heart disease, and stroke.

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## Case Report

We present the case report of an 81-year-old male, resident of Dombivli, District Thane, Maharashtra, who was being treated by the second author for primary open-angle glaucoma in both eyes since 2011. The patient gave a history of hypertension for 21 years and type 2 diabetes for 13 years for which he was advised diet restrictions, beta-blockers, sulfonylurea and statin. He was maintaining 6/6 vision with regular checkups. Disc evaluation in 2011 showed 0.9 cup–disc ratio (CDR) in the right eye and 0.6 CDR in the left eye (normal CDR is up to 0.3). The IOP was 20 mm Hg in both eyes (normal IOP is up to 20–21 mm Hg). In 2014, the acuity of vision dropped due to a cataract which was successfully treated by surgery. Later, during follow-up, perimetry showed a biarcuate scotoma in the right eye and superior arcuate scotoma in the left eye. He was started on timolol 0.5% eye drops (one drop twice a day) and was regularly followed up with a recording of IOP and perimetry. It was observed that the IOP was always in the range of 15–16 mm Hg in both eyes. Serial perimetry demonstrated

**Table 1:** Showing polysomnography findings

| *Sleep indices* | *Diagnostic polysomnography* | *CPAP titration* |
|---|---|---|
| Sleep efficiency | 77.1% | 85.1% |
| REM sleep percentage | 16.1% | 25.6% |
| Respiratory disturbance index | 6.3 | 0.6 |
| Non-REM sleep | 0.6 | 0.2 |
| REM sleep | 35.6 | 1.8 |
| Lowest oxygen saturation | 86% | 93% |
| Periodic limb movement (PLM) | 5.9 | 0.0 |
| PLM with arousal | 0.7 | 0.0 |
| Total arousal index | 10.4 | 1.9 |
| Respiratory arousal index | 2.7 | 0.5 |
| Limb movement arousal index | 3.9 | 1.1 |
| Snoring-related arousal index | 0.0 | 0.0 |
| Spontaneous arousal index | 3.8 | 0.3 |

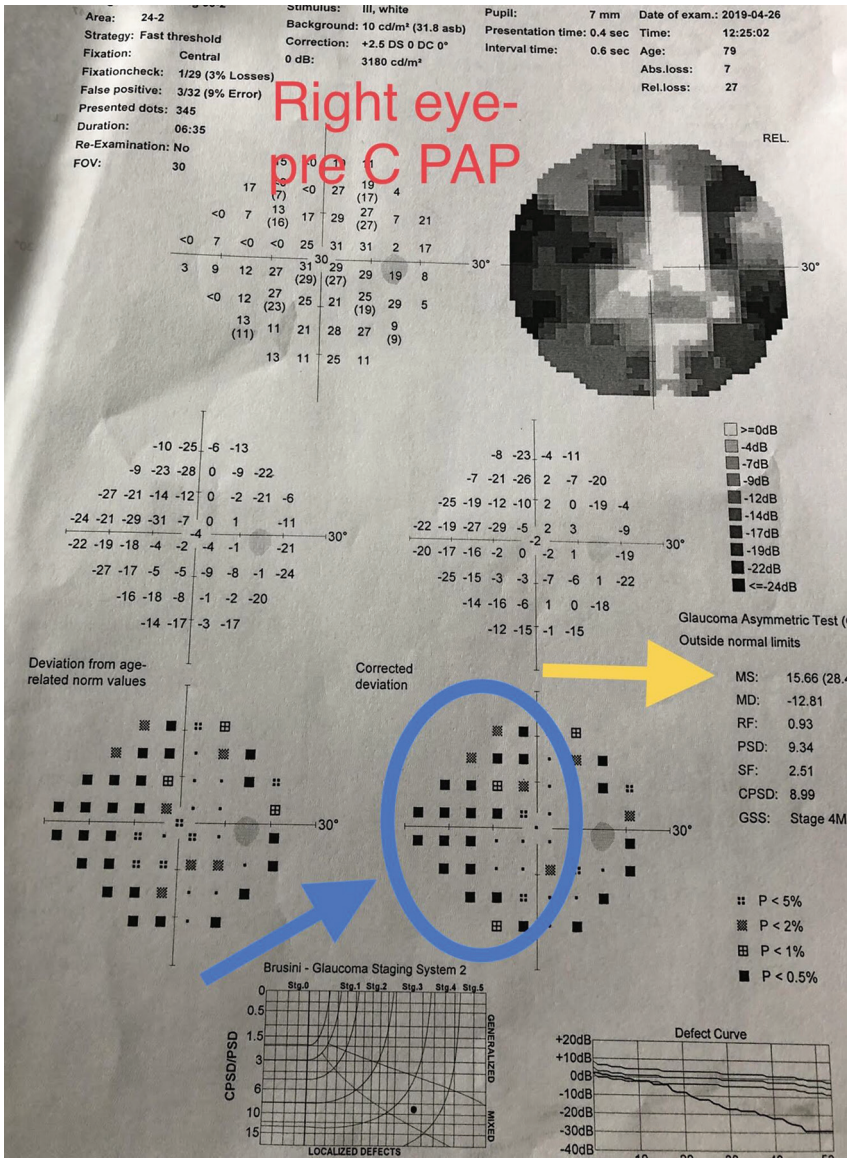


**Fig. 1:** Blue circle and arrow—prominent superior and inferior nasal step. Yellow arrow—MS 15.66

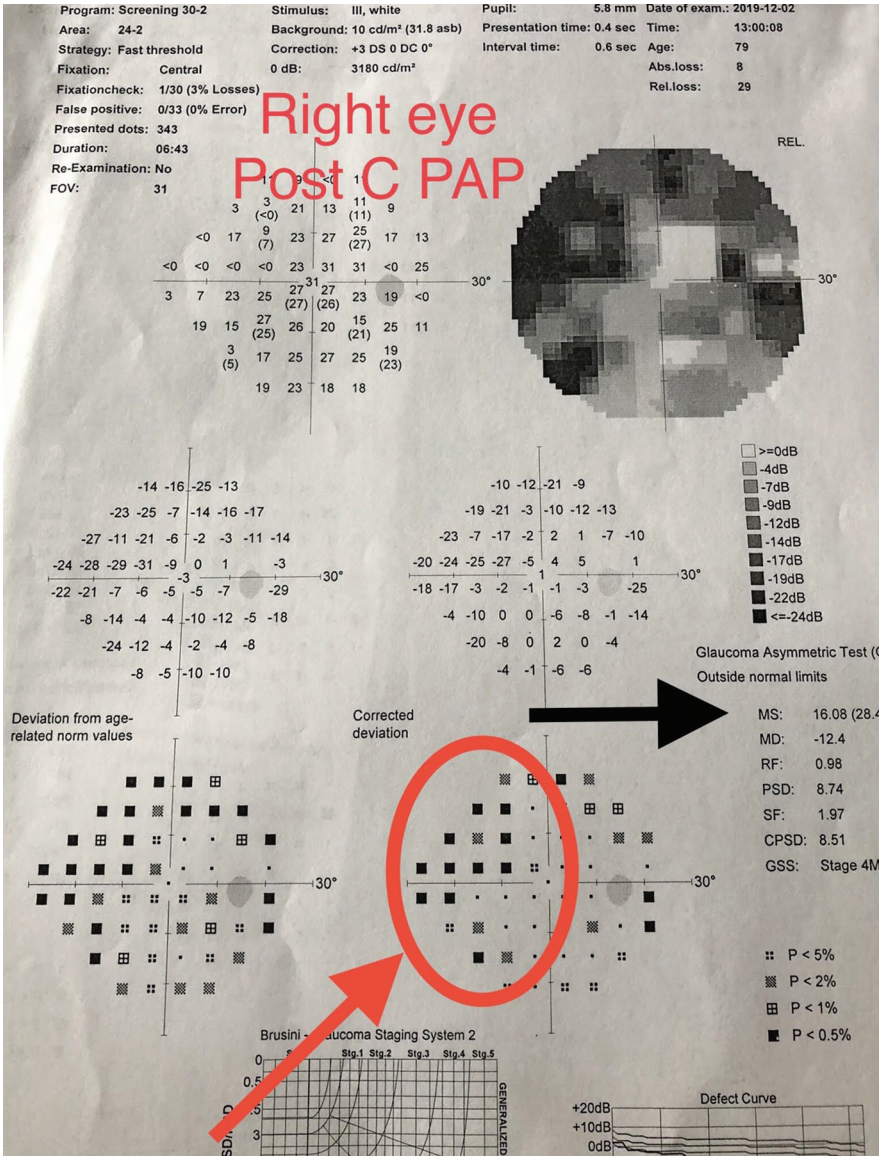


**Fig. 2:** Red circle and arrow—note a marked reduction in the inferior nasal step and decrease in the superior nasal step. Black arrow—improvement in MS to 16.08

no change till 2016. Subsequent perimetry showed worsening in spite of normal IOPs. Latanoprost eye drops were added and repeat perimetry was done after 4 months which showed similar results as the previous one. On further questioning, he disclosed that he did snore significantly. The wife of the patient, being a doctor, a retired professor of Physiology, could appreciate the significance of nocturnal hypoxia and nocturnal hypertension of OSA. The patient was advised to consult a physician practicing sleep medicine.

Sleep history recorded by the first author revealed snoring which was loud and habitual for many years coupled with nocturia and nocturnal awakenings. He gave a history of fear of falling from bed due to jerking in sleep. On clinical examination, his height was 163 cm and weight was 66.5 kg; BMI 25. His neck circumference was 39 cm. Pulse rate was 80/minute, regular and equal on both sides, with a blood pressure of 140/80 mm Hg. Systemic examination was essentially normal.

The first author conducted level 1 polysomnography (Alice PDx unit) at Indira Surgical and Maternity Nursing Home, Dombivli West, District Thane. A diagnostic study was performed on May 24, 2019. Based on this report, he was advised on CPAP titration, which was conducted on May 31, 2019. Polysomnography findings of both studies are shown in Table 1.

Perimetry done after 4 months demonstrated a remarkable improvement in both eyes (see perimetry images of both eyes pre-CPAP and post-CPAP). All images were recorded and reported by Dr Suresh Ramchandani.

## Notes of Perimetry Observations

### Right Eye—Pre-CPAP

Shows a biarcuate scotoma with superior and inferior nasal steps.

Mean sensitivity—MS (which is the average of the sensitivity of all points) is 15.66 dB (yellow arrow). Normal for this age is 28.53 (Fig. 1).

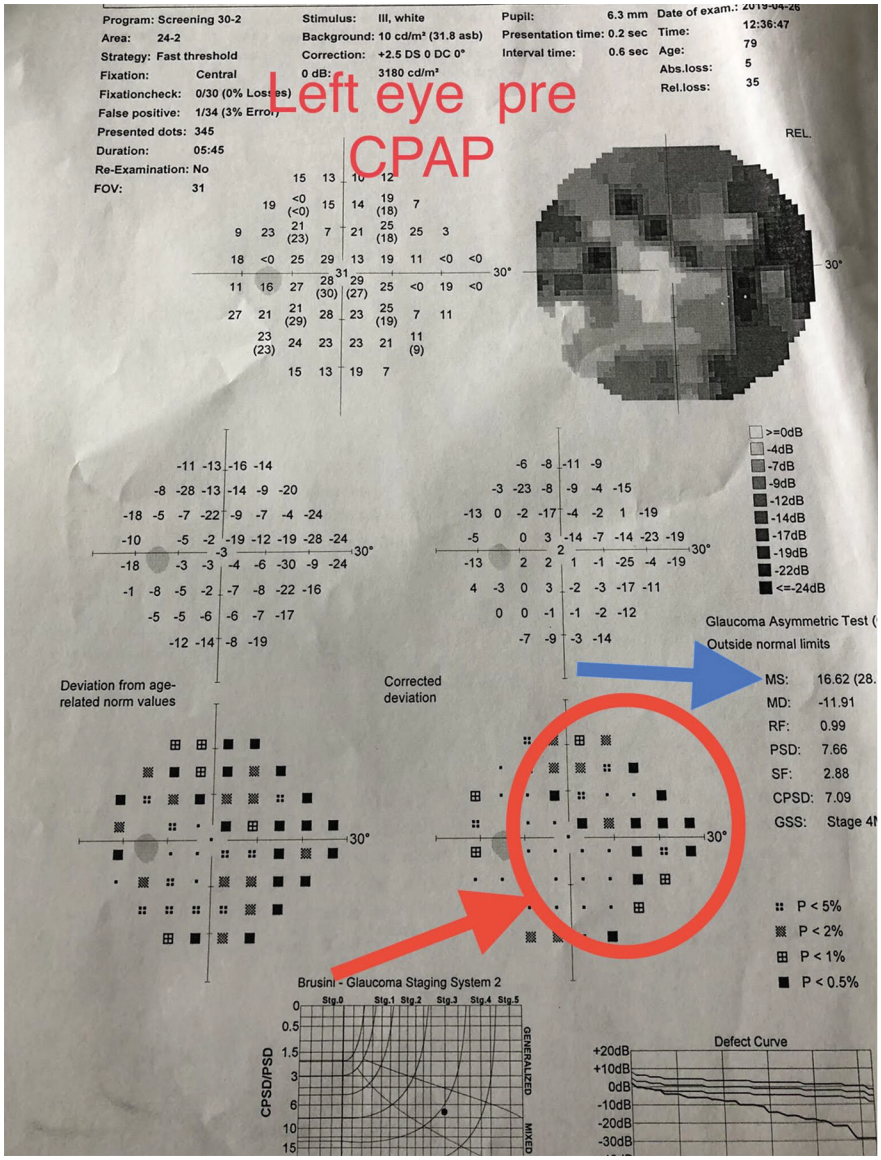


**Fig. 3:** Red circle and arrow—superior and inferior nasal step. Blue arrow—MS of 16.62

### Right Eye—Post-CPAP

Shows improvement in the arcuate scotoma with a marked reduction in the inferior nasal step. Other scotomas also show improvement (Fig. 2).

MS has also improved to 16.08—black arrow.

### Left Eye—Pre-CPAP

Shows a biarcuate scotoma with a prominent superior nasal scotoma (red circle).

MS is 16.62 blue arrow (Fig. 3).

### Left Eye—Post-CPAP

There is improvement in the nasal biarcuate scotoma and superior nasal step (blue arrow and circle).

MS has improved to 21.68 dB (yellow line) (Fig. 4).

## Discussion

The present case illustrates dominant REM sleep OSA with primary open-angle glaucoma. Studies have shown that REM OSA is independently associated with non-dipping nocturnal blood pressure, incident hypertension, and increased insulin resistance.[10] These effects are also expected to affect hypoxia-sensitive tissues like the retina and optic tract. Sleep history was suggestive of SDB-OSA. Past history of hypertension and diabetes mellitus was also documented and was being treated for the ailments including glaucoma with no benefit in vision. The etiology of primary open-angle glaucoma remains unclear. Various risk factors, including vascular abnormalities, have been associated with this disease. Sleep-associated diseases, like sleep apnea syndrome, might also represent a risk factor. Primary open-angle glaucoma is associated with sleep apnea syndrome.[11]

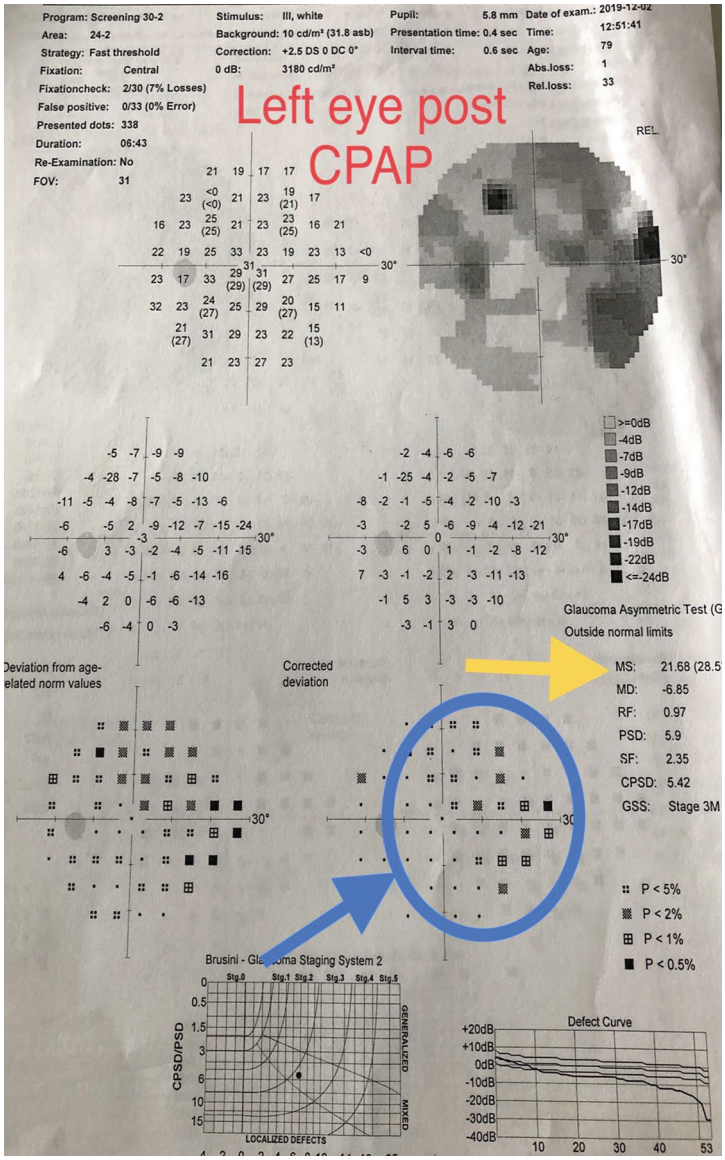


**Fig. 4:** Blue arrow and circle—marked improvement in superior and inferior nasal steps. Yellow arrow—marked improvement in MS from 16.62 to 21.68

In a study of 110 patients, Bahr et al.[12] concluded that OSA leads to an increase in IOP and high IOP phenotypes namely primary open-angle glaucoma and ocular hypertension. However, there was no correlation between OSA and low-tension glaucoma. Although the mainstay of NTG treatment is lowering of IOP, half of the cases still experience disease progression in spite of IOP control.[13] Therefore, there are other disease mechanisms that are responsible for this outcome. In a retrospective study, Lan-Hsin[14] evaluated NTG in patients with obstructive sleep apnea syndrome (OSAS) and they concluded that OSAS was a risk factor for NTG. Also, with the aid of optical coherence tomography, angiography supported the view that vascular dysregulation of OSAS leads to NTG. A high prevalence of OSAS in patients with primary open-angle glaucoma has been reported.[15] It has been reported that CPAP usage can lead to an increase in IOP. It is interesting to note that patients with OSA demonstrated significant 24-hour IOP fluctuations with the highest values at night.[16] CPAP therapy is the widely accepted mode of therapy for treating patients with OSA since it gives rewarding results. It is also reported that CPAP therapy causes an additional IOP increase, especially at night. However, this study had several limitations viz. there was no matched control group and the number of studied patients was limited. However, regular screening of visual fields and the optic disc is warranted.

## Conclusion

This case has been presented for the following reasons:

- The presence of SDB-OSA in patients with glaucoma is usually not suspected.
- Treatment of OSA by CPAP led to an improvement in the field of vision as demonstrated and confirmed by perimetry.

- Response to CPAP therapy needs to be appreciated and the application of these scientific observations must find a place in the management of glaucoma patients.
- To the best of our knowledge, this is the first case report in the literature.

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