Association Between Sleep Apnea Syndrome and Nonarteritic Anterior Ischemic Optic Neuropathy

Daniel S. Mojon, MD; Thomas R. Hedges III, MD; Bruce Ehrenberg, MD; Emely Z. Karam, MD; David Goldblum, MD; Alex Abou-Chebl, MD; Matthias Gugger, MD; Johannes Mathis, MD

Objective: To determine if patients with nonarteritic ischemic optic neuropathy (NAION) have sleep apnea syndrome (SAS), an entity characterized by repetitive upper airway obstructions during sleep, inducing hypoxia and sleep disruption.

Methods: We recruited 17 patients with NAION and 17 age- and sex-matched controls from patients referred for treatment because of suspected restless legs syndrome. We performed overnight polysomnography and determined the respiratory disturbance index during night sleep, a value used to diagnose and grade SAS. We compared the proportions of patients with SAS among patients with NAION and matched controls using the χ² test. Additionally, we compared the proportions of patients with SAS among patients with NAION and a large SAS prevalence study using the binomial test.

Results: Twelve (71%) of 17 patients with NAION had SAS. According to the respiratory disturbance index, 4 patients (24%) had mild, 4 patients (24%) had moderate, and 4 patients (24%) had severe SAS. Only 3 (18%) of 17 controls had SAS (P=.005). In the 45- to 64-year age group, 4 (50%) of 8 patients with NAION had SAS; 18 (24%) of 75 of the random sample in the prevalence study had SAS (P<.001).

Conclusions: We found a high prevalence of SAS in patients with NAION, which supports previous case reports suggesting that such an association exists. This association may explain why approximately 75% of all patients with NAION discover visual loss on first awakening or when they first use vision critically after sleeping. Our findings indicate that SAS may play an important role in the pathogenesis of NAION.

Arch Ophthalmol. 2002;120:601-605

ONARTERITIC anterior ischemic optic neuropathy (NAION) is a disease characterized by sudden, painless, mostly irreversible, and generally nonprogressive visual loss accompanied by nerve fiber bundle field defects, a relative afferent pupillary defect, and optic disc edema. The pathophysiologic characteristics of NAION remains unclear. Although several risk factors have been associated with this relatively common condition, the exact mechanism(s) that lead to optic nerve infarction remain unknown. Risk factors include aging, a small optic nerve head, and microvascular changes associated with diabetes and systemic hypertension. No treatment is available since neither steroids nor surgical optic nerve sheath fenestration has proved to be effective. Prevention with aspirin has not been demonstrated to be effective, although it is recommended. Many patients with NAION notice their symptoms in the morning. This has prompted investigations into changes in the systemic blood pressure at night in patients with NAION and raises the question of whether other nocturnal events may predispose patients to NAION. In a 1986 case report, optic disc edema was associated with sleep apnea syndrome (SAS). Recently, reports by Hayreh and Mojon et al suggest an association between NAION and SAS. Other ophthalmologic findings in patients with SAS include floppy eyelid syndrome, keratoconus, reduced tear film break-up time, endothelial dystrophy, and glaucoma. Sleep apnea syndrome is a disease characterized by recurrent complete or partial upper airway obstructions during sleep. These obstructive respiratory dis-
Sleep apnea syndrome is usually diagnosed by overnight polysomnography, including simultaneous electroencephalography, electromyography, electro-oculography, electrocardiography, oxymetry, plethysmography, and air flowmetry through the mouth and nose. From the polysomnographic data, the respiratory disturbance index (RDI), a value used to diagnose and grade SAS, is calculated. The treatment of first choice to prevent upper airway obstructions is the application of nasal continuous positive airway pressure with a mask during sleep. In this study, we prospectively determined the prevalence of SAS in patients with NAION.

The clinical and polysomnographic data of all patients with NAION are summarized in Table 1. The age of the 17 patients (15 men and 2 women) ranged from 48 to 83 years.

Table 2 gives the summarized clinical and polysomnographic findings of the patients with NAION and matched controls. Except for the RDI, no statistically significant difference was found between the 2 groups. Six (75%) of 8 patients with NAION seen at the University Eye Institute of Bern had SAS (RDI ≥10). Six (67%) of 9 patients with NAION seen at the New England Eye Center had SAS. Twelve (71%) of all 17 patients with NAION seen at either center had SAS. All patients with SAS were men. According to the RDI, 4 patients (24%) had mild, 4 patients (24%) had moderate, and 4 patients (24%) had severe SAS. Table 2 gives the prevalences of SAS in patients with NAION (71%) and the matched controls (18%). The difference is statistically significant (P = .005).
The prevalences of SAS were also compared with data from a large prevalence study.\(^1\) In the 45- to 64-year age group, 4 (50\%) of 8 patients with NAION had SAS, whereas only 41 (10\%) of 430 in the prevalence study had SAS. The SAS prevalence in patients with NAION was significantly higher than in the controls (\(P=0.005\)).

In the group of patients older than 64 years, 8 (89\%) of 9 patients with NAION had SAS, whereas only 18 (24\%) of 75 in the prevalence study had SAS. In this age group, the difference in prevalence was also significantly higher (\(P<0.001\)).

**COMMENT**

We found an increased prevalence of SAS in patients with NAION. Sleep apnea syndrome is a frequent breathing disorder caused by intermittent upper airway obstruction during sleep with concurrent hypoxia, negative intrathoracic pressure, and sympathetic activation. Since airway obstructions are terminated by repetitive arousal...
reactions, normal sleep is disrupted. Long-term cardiovascular sequelae and complications include pulmonary and systemic arterial hypertension, cardiac arrhythmias, myocardial infarction, and stroke.6,14,15 Sometimes only episodic nocturnal systemic arterial hypertension or hypotension occurs.16

Recently, Hayreh1 mentioned that he had anecdotal evidence of SAS in several patients with NAION. Also, Mojon and colleagues6 found that visual fields of patients with SAS revealed defects consistent with an optic neuropathy. More recently, SAS was found to be associated with optic disc swelling and visual field loss similar to those of the study by Bixler and coauthors.5 Because the prevalence of SAS for all ages is lower than that in the study by Bixler et al12 consisted of only men, no bias has been introduced by our high percentage of men. Since we performed a double comparison of our SAS prevalences among patients with NAION with our own and a historic control group, and since we found similar prevalences in 2 independent centers, we believe that our high SAS prevalence is real and clinically significant.

Although approximately 70% of patients with NAION recover from NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative nocturnal upper airway obstructions might diminish or prevent the occurrence of NAION. Since there is no proven treatment of NAION, further studies are needed to clarify whether restorative noc...