Acute Aortic Dissection Associated with Sleep Apnea Syndrome

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Background: Sleep apnea syndrome (SAS) is an independent risk factor for hypertension which is a major risk factor for acute aortic dissection. The purposes of this study were to assess the prevalence of SAS in patients with acute aortic dissection, delineate the characteristics of patients who have acute aortic dissection with SAS.

Methods: Of 95 consecutive patients with acute aortic dissection, 13 had episodes of sleep apnea and nocturnal hypoxemia. A portable sleep monitoring system was used to assess sleep status in the 13 patients.

Results: The SAS-positive group consisted of 12 patients (12.6%), 8 with type A dissection and 4 with type B dissection. Age was significantly lower in the SAS-positive group (47.2 ± 8.5 years) than in the SAS-negative group (64.9 ± 10.3 years) \( p < 0.001 \). The male:female ratio was significantly higher in the SAS-positive group than in the SAS-negative group \( p < 0.001 \). The body mass index was significantly greater in the SAS-positive group than in the SAS-negative group \( p < 0.001 \). All 12 patients in the SAS-positive group had hypertension.

Conclusions: Patients who have acute aortic dissection with SAS are characterized by being tall, fat, and relatively young men with hypertension. Sleep apnea syndrome may be a risk factor for acute aortic dissection in middle-aged men.

Keywords: aortic dissection, sleep apnea syndrome, hypertension, obesity, middle-aged men

Introduction

Sleep apnea syndrome (SAS) was first described by investigators at Stanford University in 1976. Sleep apnea syndrome is defined as 30 or more episodes of apnea (cessation of airflow for at least 10 seconds) during 7 hours of sleep in a single night or 5 or more episodes of apnea per hour of sleep (apnea index \( \geq 5 \)).1,2 Sleep apnea syndrome is classified into obstructive SAS caused by upper-airway obstruction, central SAS caused by abnormal respiratory control by the central nervous system, and mixed SAS. Obstructive SAS accounts for most cases.1

Two large multicenter, observational studies performed in the United States, the Sleep Heart Health Study2 and Wisconsin Sleep Cohort Study,3 found that respiratory disturbances during sleep are an independent risk factor for hypertension. Other studies have shown that the severity of SAS is related to the incidence of cardiovascular disease, including angina pectoris, myocardial infarction, arrhythmias, and cerebrovascular disease.4

Acute aortic dissection is a serious, life-threatening condition requiring emergent treatment.5,6 Hypertension is also a major risk factor for aortic dissection.7
However, the relation between SAS and acute aortic dissection remains largely unexplored.\textsuperscript{8,9} To gain insight into this relation, we retrospectively studied the incidence, characteristics, and pathologic features of acute aortic dissection in patients with SAS.

**Patients and Methods**

We studied 95 consecutive patients with acute aortic dissection (51 men and 44 women, mean age, 62.7 years; range, 33 to 83 years) who were treated at Yokohama City University Medical Center from January 1, 2002 through April 30, 2003. All patients who underwent computed tomography and acute aortic dissection were classified according to the Stanford classification. Sixty-three patients had the Stanford type A acute aortic dissection (type A dissection), and 32 had the Stanford type B acute aortic dissection (type B dissection). Most patients with type A dissection underwent surgery. Patients with type B dissection who had organ ischemia or aortic rupture, also underwent surgery; those without these complications received lowering pressure therapy. No patient had Marfan’s syndrome or traumatic aortic dissection.

SAS was suspected if snoring, sleep apnea, or nocturnal hypoxemia (determined by percutaneously measuring the arterial oxygen saturation with the use of a pulse oximeter) occurred after the withdrawal of mechanical ventilation in patients with type A dissection and those with type B dissection accompanied by organ ischemia or aortic rupture, or occurred during lowering pressure therapy in patients who had type B dissection without complications. SAS was diagnosed by interviewing suspected patients with the use of the Epworth Sleepiness Scale (ESS),\textsuperscript{10} and daytime drowsiness was quantified as the ESS score. In addition, a portable sleep monitoring system\textsuperscript{11} was used to assess sleep status on 2 consecutive nights. Apnea was defined as a cessation of airflow at the nose and mouth for 10 seconds or more. The average number of episodes of apnea per hour of sleep as determined by the portable sleep monitoring system was defined as the apnea index. SAS was diagnosed if the apnea index was 5 or higher. The severity of sleep apnea was classified according to the report of the American Academy of Sleep Medicine Task as follows: mild, apnea index $\geq$ 5 to $<$ 15; moderate, $\geq$ 15 to $<$ 30; and severe, $\geq$ 30.\textsuperscript{12}

Patients who had an acute aortic dissection with SAS (SAS-positive group) were compared with those who had acute aortic dissection without SAS (SAS-negative group), with regard to the following variables: age, sex, height, body weight, body-mass index (the weight in kilograms divided by the square of the height in meters), history of hypertension, previous treatment for SAS, whether asleep or awake at the onset of dissection and surgery-related mortality. This study was approved by the ethics review board of our institution, and written informed consent was obtained from all patients.

**Statistical Analysis**

Numerical data are expressed as means $\pm$ standard deviations. Continuous variables were compared between the groups with the use of unpaired Student’s $t$-tests. Categorical variables were compared with the use of chi-square tests. Statistical analysis was done with Dr. SPSS II for Windows (SPSS Inc.). Probability values of less than 0.05 were considered to indicate statistical significance.

**Results**

Of 63 patients with type A dissection, 58 (92.1%) underwent surgery and 5 (7.9%) were treated conservatively. Of 32 patients with type B dissection, 6 (18.8%) underwent surgery and 26 (81.2%) were treated conservatively.

Eight patients with type A dissection had episodes of sleep apnea and nocturnal hypoxemia after emergency surgery and were thus suspected to have SAS. Sleep status was examined an average of 30.43 $\pm$ 18.89 days after surgery. Among the 26 patients with type B dissection who were treated conservatively, five had episodes of sleep apnea and nocturnal hypoxemia and were suspected to have SAS. In these patients, sleep status was monitored an average of 7.75 $\pm$ 1.38 days after admission. The apnea index was less than 5 in 1 of the 5 patients with type B dissection. SAS was thus diagnosed in a total of 12 patients (12.6%; SAS-positive group), 8 with type A dissection and 4 with type B dissection. The other 83 patients, 55 with type A dissection and 28 with type B dissection, comprised the SAS-negative group. The prevalence of SAS did not differ significantly between patients with type A dissection and those with type B dissection ($p = 0.978$).

Table 1 shows the ESS scores and the results of sleep examinations in the SAS-positive group. SAS

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was suspected when the ESS score was 10 or higher, suggesting the presence of daytime drowsiness. The mean ESS score was not high in this group (8.9 ± 4.9), and only 4 patients had an ESS score of 10 or higher. However, the mean apnea index was high (28.9 ± 15.6), and many patients had moderate to severe SAS. Many patients with type A dissection had severe SAS, although all patients with type B dissection had moderate SAS (Table 1).

Table 2 shows the demographic characteristics of the patients. The patients in SAS positive group were significantly younger than the patients in SAS-negative group. All patients were men in the SAS-positive group, and the proportion of men was significantly higher in this group than it in the SAS-negative group. The patients in SAS-positive group were significantly taller than in the SAS-negative group. Body weight was significantly greater in the SAS-positive group than in the SAS-negative group. Body-mass index in the SAS-negative group was within the normal range (18.5 to 25.0).13) Body-mass index in the SAS-positive group was higher than 25, the cutoff point for obesity and was significantly greater than that in the SAS-negative group. All 12 patients (100%) in the SAS-positive group had a history of hypertension, as compared with 57 (68.7%) in the SAS-negative group. Six (50%) of the 12 patients in the SAS-positive group had received oral antihypertensive therapy at other hospitals before admission to our hospital.

As for previous treatment of SAS, 8 of the 12 patients in the SAS-positive group had had episodes of apnea before the onset of aortic dissection, but SAS had not been definitively diagnosed in any of these patients. In the other 4 patients, the presence or absence of episodes of apnea was unknown, and SAS had not been diagnosed. Therefore, no patient in the SAS-positive group had previously received treatment for SAS before emergency admission.

Dissection occurred during sleep in only 1 patient (8.3%) and while awake in 11 patients in the SAS-positive group. In the SAS-negative group, dissection occurred during sleep in 5 patients (6.0%).

In the SAS-positive group, all 8 patients with type A dissection underwent aortic graft replacement. 4 patients with type B dissection had no organ ischemia or aortic rupture and were treated conservatively with antihypertensive drugs. In the SAS-negative group, 5 patients with type A dissection conservatively received lowering pressure therapy because of advanced age, poor general condition, or refusal of surgery; the other 50 patients with type A dissection underwent surgery. Among 6 patients with type B dissection in the SAS-negative group, revascularization was done in 2 patients, due to lower-extremity ischemia; small-bowel resection in 1, due to intestinal ischemia; and aortic-arch replacement and descending aorta replacement in 2, due to aortic rupture; and descending aorta replacement in 1, due to aortic rupture.

In the SAS-positive group, episodes of sleep apnea occurred in 8 patients with type A dissection after surgery and the withdrawal of mechanical ventilation and in 4 with type B dissection during antihypertensive treatment. Two patients were placed in a lateral position, 7 received nasal continuous positive airway pressure (nasal CPAP), and 2 received dietary therapy. Thus, episodes of sleep apnea disappeared or improved.
The rate of surgery-related mortality did not significantly differ between the SAS-positive group (0%) and SAS-negative group (7.1%, $p = 0.435$). Causes of death in the latter group were cerebral hernia, respiratory failure, and pneumonia caused by methicillin-resistant Staphylococcus aureus in 1 patient each with type A dissection and intestinal ischemia in 1 patient with type B dissection.

Of 55 patients with type A dissection in the SAS-negative group, 5 were treated conservatively. Two of these patients died; 1 from cardiac tamponade and the other, from left-coronary-artery occlusion.

**Discussion**

The prevalence of SAS is 4% for middle-aged men and 2% for women in the United States. In our study, the prevalence of SAS in patients with acute aortic dissection was 12.6%, clearly higher than that in the general population. All patients with acute aortic dissection and SAS in our series had a history of hypertension. This finding suggests that SAS plays an important role in the development of acute aortic dissection, most likely via hypertension.

Sampol et al. compared 19 patients who had thoracic aortic dissection with 19 patients who had hypertension. The groups were matched for age, sex, and body-mass index. They found that the apnea index was higher in patients with thoracic aortic dissection (28.0 ± 30.3) than in those with hypertension (11.1 ± 10.4). Hata et al. reported that sleep disorders were considered one of the risk factors for the occurrence of acute aortic dissection at younger active ages.

The negative intrathoracic pressure generated during sleep apnea may alter the structure of the aorta, increasing the risk of acute aortic dissection. In our series, however, few patients in the SAS-positive group had acute aortic dissection during sleep.

Previous studies have reported that SAS may activate the sympathetic nervous system, resulting in worsening and persistence of hypertension, chronically increased mechanical stress against the aortic wall, and progression of atherosclerosis. SAS may participate in the development of aortic dissection through a combination of these factors.

Although all of seven operated patients with acute type A dissection associated with SAS have mild atherosclerosis in pathological findings of resected aortic specimen, three (42.9%) of them have moderate to severe myxomatous degeneration (data not shown). These findings suggest that patients with acute type A dissection associated with SAS have connective tissue disorder.

Ordinarily polysomnography is required for the definitive diagnosis of SAS, but it is not feasible to perform this examination postoperatively in all patients suspected to have SAS. The portable sleep monitoring system is now considered an useful SAS screening system because of good correlation between the results obtained with the portable sleep monitoring system and those with polysomnography.

In the SAS-positive group, the ESS score was lower than 10, the cutoff value suggesting daytime drowsiness; however, the apnea index was high. The reason for this inconsistency is unclear, but might be related to the mild symptoms associated with sleep disturbances in the SAS-positive group or to an increase in the apnea index due to factors such as surgery or anesthesia after the onset of aortic dissection.

All patients with type B dissection in the SAS-positive group were treated conservatively, eliminating potential effects of surgery on sleep apnea. In contrast, all patients with type A dissection in the SAS-positive group underwent graft replacement. Whether surgery, anesthetics, sedatives, or analgesics could have triggered postoperative sleep apnea should be examined in such patients. In our study, however, sleep status was monitored an average of 30.43 ± 18.89 days after surgery, when the effects of the thoracotomy and anesthesia were probably minimal. The relation of SAS to surgery and anesthesia thus remains unclear.

The use of sedatives and anesthetics for surgery in patients with SAS may affect upper-airway obstruction, contributing to increased perioperative morbidity and mortality. Special precautions are, therefore, required in the anesthetization and perioperative care of patients with SAS.

Nasal CPAP helps to prevent upper-airway obstruction, thereby avoiding elevations of blood pressure due to negative intrathoracic pressure and sympathetic activation and improving hypertension. Yamashita et al. reported that in a case of obstructive sleep apnea with acute aortic dissection DeBakey type IIIb, application of CPAP treatment should be considered promptly along with resting and antihypertensive therapy. Nasal CPAP is thus a useful treatment for patients with acute aortic dissection who have SAS. In the
chronic phase of aortic dissection, SAS should be continuously treated to ensure adequate control of blood pressure.

**Conclusion**

Our results suggest that tall, heavy and middle-aged men, who are suffered from acute aortic dissection, are at increased risk for latent SAS. The risk of SAS should be taken into account when examining and treating such patients. Adequate precautions against SAS would be contributed to improved outcomes during both the acute and chronic phases of aortic dissection.

**Disclosure Statement**

The authors declare no conflicts of interest.

**References**


