Current Medical Treatment of Obstructive Sleep Apnea (OSA) in Sleep Center

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Introduction

Obstructive Sleep Apnea (OSA) refers to the occurrences of complete or partial obstruction of the upper airway during sleep. OSA is often associated with intermittent hypoxemia and hypercapnia. Intermittent hypoxemia causes endothelial dysfunction and long-term hypoxic stresses in various organs^{1) 2)}. For adults, OSA causes sleep deprivation induced symptoms and indirectly induces systemic symptoms, such as impaired glucose tolerance, hypertension, and potentially cause serious traffic accidents³⁾⁻⁹⁾. The most important consequence of OSA may be the increased risk for cardiovascular morbidity and mortality.

Functions of sleep and types of sleep disorders

Generally, older populations tend to require shorter sleep duration. For example, young adults need about 8 hours of sleep, but elderly adults only need about 6 hours of sleep. The percentage of REM sleep changes by age. The percentage of REM sleep of an infant is about 50%, but after childhood it changes to about 20%. Some of the functions of REM

sleep is to relieve stress and fix memory; the functions of non-REM sleep include the secretion of growth hormone, decrease core body temperature, and improve immunologic functions.

There are many types of sleep disorders as classified in the most recent edition of the International Classification of Sleep Disorders (ICSD), ICSD-III, such as insomnia disorder, sleep-disordered breathing (SDB), central disorders of hyper somnolence, parasomnias, sleep related movement disorders, and circadian rhythm sleep-wake disorders. And OSA is one of the main diseases of SDB.

Characteristics of OSA

1. Risk factors for OSA

Intermittent upper airway obstruction causes OSA. Specifically, common factors of OSA include obesity, specific craniofacial disorders (e.g., Treacher-Collins, Pierre-Robin syndromes), retroposed mandible/maxillae, adenotonsillar hypertrophy, nasal problems (e.g. septal deviation), allergic rhinitis, endocrine abnormalities (e.g. hypothyroidism/acromegaly), polycystic ovarian syndrome, post menopause, down syndrome, family aggregation,

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and the APOε4 allele (in subjects <65 yr.)¹⁰⁾.

2. Consequences of OSA

Nocturnal symptoms of obstructive sleep apnea syndrome (OSAS) are disrupted sleep due to snoring and pauses in breathing caused by OSA. Hypoxemia, hypercapnia, pleural pressure variation, and occurrence of arousal response are caused by the OSA. Diurnal symptoms of OSAS are excessive daytime sleepiness, sleep attack, impaired vigilance, and psychomotor deficiency. OSA adversely affects metabolic issues, cardiovascular

disease (CVD), diabetes, stroke, cognitive issues, and decreases life expectancy.

The risk of cardiovascular disease increased in patients with Respiratory disorder index (RDI) ≥ 11 , and it was indicated that the odds ratio was (1.27–2.38) for coronary artery disease¹¹⁾. Many mechanisms are related to cardiovascular diseases and OSA (Figure-1).

In recent years, the focus seems to be on the influence of sleep disorders and psychotic disorders. We investigated the relationship between OSA and psychotic disorders in our sleep center. Of the 970

Figure-1 Intermediary mechanisms associated with OSA

Figure-2 Mental disorder and OSA in sleep center (24 people)

Figure-3 Staging of changing the motivation of management for OSA
Alteration from the ministry of health, labour and welfare workers' accident disease clinical study (2016).

people who were diagnosed as OSA with polysomnography in our center, 24 people were diagnosed as psychotic disorder, 83% with depression, 5% with borderline disorder, 4% with adjustment disorder, 4% with schizophrenia, and 4% with anxiety neurosis (Figure-2).

3. OSA and traffic accidents

OSA prevalence is about 13% of men in the general population of USA and at least 20–25% in the commercial driving population. Commercial truck accidents cause about 4,000 deaths and 80,000 serious injuries yearly in the US. In Japan, a highway bus crash in April 2012, who died or were injured of the 46 people. A medical investigation from the crash revealed that the driver had moderate SDB. Another bus crash in May 2015, resulted in 17 people suffering injuries. Similar to the accident in April 2012, the medical investigation report found that the main reason of the accident was driver falling asleep due to OSA.

OSA is primary medical cause of excessive daytime sleepiness (EDS) and increases the risk of accidents 2.5 times⁷⁾.

Early discovery and early treatment of OSA are needed to reduce traffic accidents and save lives as crash risk is reduced by 72% following treatment

with Continuous Positive Airway Pressure (CPAP). So, collaboration of commercial truck companies, industrial doctors, and sleep specialists is very important.

We are now going to establish guidelines for this collaboration. Stages of the changing the approach of management for OSA are shown (Figure-3).

4. Treatment with OSA

Treatment of OSA ranges from general life style improvements, CPAP, Oral appliances (OA), and surgical treatment.

Some general life style improvements include losing weight, restriction of drinking before going to bed, restriction of drinking alcohol, cessation of smoking, and lateral recumbent position sleep.

CPAP treatment increases deep sleep and improved the blood levels of oxygen to normal (Figure-4). Treatment with CPAP leads to lowering high blood pressure¹²⁾, lowering the risk of coronary artery disease¹³⁾, and heart failure¹⁴⁾.

Case reports

1. OSA and depression case (patient A)

This is a 47-year old man whose chief complaints were daytime sleepiness, snoring, awaking during

nocturnal sleep, frequent urination at night, and lack of deep sleep. He had a history of lipid disorders, obesity, and depression. Full polysomnography findings are shown in Table-1, Figure-5 and Figure-6 (Apnea Hypopnea Index (AHI) was 51.7 per hour).

He was diagnosed with severe OSAS and was put on CPAP (Sleepmate S9 Auto, Resmed, Australia). After CPAP treatment, his AHI dropped to 2.0 times per hour and the previous complaints of daily sleepiness, snoring, wake time after sleep onset (WASO), frequent urination at night and lack of

Figure-4 Changes of Sleep stages and oxygen levels

Table-1 Polysomnography analysis data of patient A

Time in bed TIB : Light off→Light on	485.0	min
Sleep period time SPT : Sleep onset → Last sleep page	478.7	min
Total sleep time TST : SPT-WASO	388.7	min
Wake time after sleep onset WASO : SPT-TST	90.0	min
Sleep efficiency : TST/TIB × 100%	80.1	%
Sleep latency	6.3	min
REM latency	85.5	min
Sleep stage REM (%TST)	13.6	%
Sleep stage N1 (%TST)	19.2	%
Sleep stage N2 (%TST)	67.2	%
Sleep stage N3 (%TST)	0.0	%
Arousal index	39.7	#/h of TST
Apnea Hypopnea index : AHI	51.7	#/h of TST
Apnea index AI	1.4	#/h of TST
Hypopnea index HI	50.3	#/h of TST
3%Oxygen desaturntion index	48.9	#/h of TST
SpO2 90%>	19.7	min
Minimum of the resp. events SpO2 min levels	81	%
Total duration with snoring (%TST)	11.3	%
Periodic limb movement of sleep PLMS index		#/h of TST
Arousal meeting PLMS criteria		#/h of TST

Figure-5 Polysomnography data of patient A (five minutes)

Figure-6 Polysomnography data of patient A (overnight)

deep sleep disappeared; the CES-D scale also improved.

2. OSA and diabetes case (patient B)

This is a 56-year old man whose chief complaints were daytime sleepiness, snoring, awakening during nocturnal sleep, frequent urination at night, and

lack of deep sleep. He also had a history of diabetes. His HbA1c blood test result was 9.2% (normal range of HbA1C in Japan ranges from 4.3% to 5.8%). Full polysomnography findings are shown in Table-2, Figure-7, and Figure-8.

The Apnea Hypopnea Index (AHI) was 36.3 times per hour. He was diagnosed with severe

Table-2 Polysomnography analysis data of the patient B

Time in bed TIB : Light off→Light on	479.8	min
Sleep period time SPT : Sleep onset → Last sleep page	476.4	min
Total sleep time TST : SPT-WASO	411.4	min
Wake time after sleep onset WASO : SPT-TST	65.0	min
Sleep efridency : TST/TIB × 100%	85.7	%
Sleep latency	3.4	min
REM latency	124.5	min
Sleep stage REM (%TST)	20.2	%
Sleep stage N1 (%TST)	23.6	%
Sleep stage N2 (%TST)	56.3	%
Sleep stage N3 (%TST)	0.0	%
Arousal index	41.6	#/h of TST
Apnea Hypopnea index : AHI	36.3	#/h of TST
Apnea index AI	31.9	#/h of TST
Hypopnea index HI	4.4	#/h of TST
3%Oxygen desatunmion index	31.5	#/h of TST
SpO2 90%>	54.6	min
Minimum of the resp. events SpO2 min levels	77	%
Total duration with snoring (%TST)	17.2	%
Periodic limb movement of sleep PLMS index	12.4	#/h of TST
Arousal meeting PLMS criteria	1.0	#/h of TST

Figure-7 Polysomnography data of patient B (five minutes)

Figure-8 Polysomnography data of patient B (overnight)

OSAS and was put on CPAP (REMstar Auto System One 60, Philips, Netherlands).

After CPAP treatment, his AHI dropped to 1.0 times per hour and the previous complaints of daily sleepiness, snoring, awaking nocturnal sleep, frequent urination at night, and lack of deep sleep disappeared; BMI also improved from 25.7 to 24.7 and HbA1c levels dropped to 6.4%.

3. OSA and changes of disease severity from weight loss case

This is a 41-year old man whose chief complaints were daytime sleepiness, snoring, and lack of deep sleep. Utilizing full polysomnography, his AHI was reported as 36.1 times per hour. He was diagnosed with severe OSAS and was put on CPAP (Sleepmate S9 Auto, Resmed, Australia). He managed to lose 10 kilograms and also received nose mucous membrane cauterization, fexofenadine, and mometasone furoate hydrate. After weight loss and EMT treatment, his AHI dropped to 8.8 times per hour via the home sleep test; However, his AHI dropped to 4.4 times per hour after being treated with OA.

Conclusion

OSA is associated with intermittent hypoxemia

and hypercapnia. Intermittent hypoxemia causes endothelial dysfunction and long-term hypoxic stresses in various organs. OSA may increase the risk for the development of various diseases such as hypertension, diabetes, depression, cardiovascular disease and cause serious traffic accidents.

Therefore, the need to be tested promptly and undergo specialized medical consultation if snoring, daytime sleepiness, concentration and frequent urination continue to interrupt one's daily life is paramount.

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