Using Hand-Made SASD-14 to Evaluate the Relationship Between Hypertension and Obstructive Sleep Apnea Syndrome

Tien Hoang Anh and Minh Huynh Van

Abstract

Sleep apnea syndrome (SAS) is one of the causes of hypertension, relating to cardiovascular risk and cardiovascular disease, independently associated with other risks. *Method* Cross-sectional study with the short-term follow up and compare to the control group. Include 230 patients: 134 hypertension patients and 96 non-hypertension patients. We using hand-made SASD-14 (Sleep Apnea Syndrome Detective-2014), compare with portable polysomnography StarDust II combine with clinical symptoms to diagnose obstructive sleep apnea syndrome. *Result* (1) AHI in the OSAS patients with hypertension is 29.77 ± 13.03, higher than AHI in the OSAS patients without hypertension 25.21 ± 14.37 ($p < 0.05$). (2) There are strong positive correlation between AHI and systolic blood pressure with $r = 0.407$, $p < 0.001$. In multivariable analysis the affect of cardiovascular risk to AHI: two risks with statistic signification are degree of hypertension ($p < 0.01$) and obesity ($p < 0.05$). (3) The Kappa index for the SASD-14 compare with StarDust II is 0.775 ($p < 0.01$). *Conclusion* There is the signification relationship between hypertension and OSAS; SASD-14 can be use for diagnosing obstructive sleep apnea syndrome.

Keywords

Sleep apnea syndrome • Hypertension • SASD-14

1 Introduction

Sleep apnea syndrome is a condition of the repeat of apnea during sleep, which leads to reduced oxygen levels, increased carbon dioxide levels in the blood, increased sympathetic activity and cause adverse consequences such as poor sleep quality, excessive daytime sleepiness, reduce quality of life, reduced work capacity, increased risk of occupational accidents [3], … patients with sleep apnea, who traffic accident 2 to 4 times higher than the control group [9], cause of hypertension [1], increasing the risk of cardiovascular diseases such as stroke, coronary artery disease, ischemic cardiomyopathy, arrhythmia, heart failure, risk of death in cardiovascular disease patients [7, 17].

Estimated rates of obstructive sleep apnea is 3–7% in men and 2–5% in female [14]. In Asia, the rate in middle-aged men and women is 4.1–7.5% and 2.1–3.2% [16]. Obstructive sleep apnea syndrome not only contribute but also be an etiologic factors of cardiovascular disease, independent of other factors [8]. Until now, in Vietnam, there is very little research on obstructive sleep apnea syndrome (OSAS) and no studies on the association between obstructive sleep apnea syndrome in patients with primary hypertension. We conducted this study with the following three objectives:

1. Evaluate the AHI severity in patients with sleep apnea syndrome with hypertension and without hypertension

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2. Surveying the correlation between hypertension and obstructive sleep apnea syndrome
3. The Kappa index for the accordance between SASD-14 and StarDust II.

2 Subjects and Methods

2.1 Research Subjects

(a) *Sample*

230 continuous OSAS patients were hospitalized because of loud snoring and/or sleep apnea evidence in the Cardiology Department, Hospital of Hue university medicine and pharmacy, from March 01 2013 to March 07 2014.

(b) *Patient group's criteria*

Obstructive sleep apnea syndrome diagnosed by American Academy of Sleep Medicine 2009 (AASM) criteria [2] with hypertension (ESH/ESC 2013 criteria [6])

(c) *Control group's criteria*

Obstructive sleep apnea syndrome without hypertension

2.2 Method of Study

(a) *Study design*: Cross-sectional study with the short-term follow up and compare to the control group. The patients were measured in the same time by SASD-14 and StarDust II to calculate Kappa index.
(b) *The main study parameter*

Obesity

- BMI: WHO criteria for Asian countries [20]
- Scale assessment of daytime sleepiness (Epworth scale)
- Identifying characteristics respiratory in portable polysomnography
- Apnea—Hypopnea Index (AHI)
- Postural AHI index
- The oxygen saturation (SpO2) lowest index is the lowest SpO2 during sleep
- The longest duration of oxygen saturation (SpO2) <88%
- Snoring index: The number of snoring divided by the total hours of sleep.

(c) *Procedure of portable polysomnography*

Prepare: the patient was explained the purpose of the procedure. Patients didn't drink alcohol, beer, and stimulant in the day before polysomnography measurement.

3 Results

Conducting a survey of 230 patients (134 patients with hypertension and 96 patients without hypertension), we have obtained the following results:

3.1 Characteristics of the Study Subjects

(a) *General characteristics of the study subjects* (Figs. 1 and 2; Table 1)
Proceed: Patients go to sleep in the period from 21–22 h in a quiet room, use the Portable Stardust II Sleep Recorder by Respironics (Germany).
(b) *Statistical: SPSS 18.0*

The average age of study objects: 61 ± 12. There are differences with statistical significance between men and women for age, height, weight, BMI and neck circumference.

3.2 Characteristic of Portable Polysomnography

There are differences with statistical significance in the group with hypertension (n = 134) and without hypertension (n = 96) for AHI ($p < 0.05$), AHI supine ($p < 0.05$), the min of sleep apnea duration ($p < 0.01$) (Table 2).

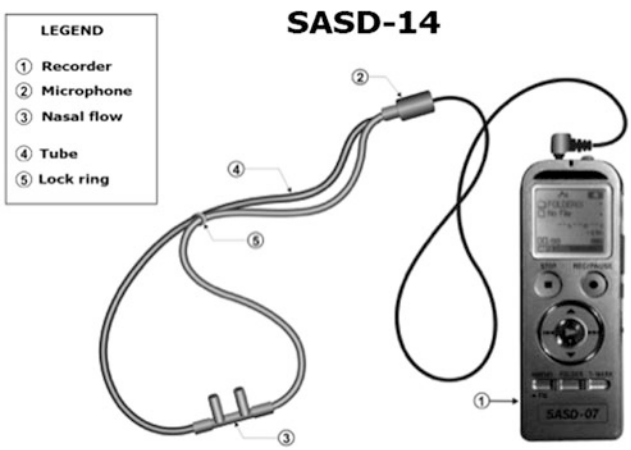

Fig. 1 Sleep Apnea Syndrome Detective 2014 (SASD-14)

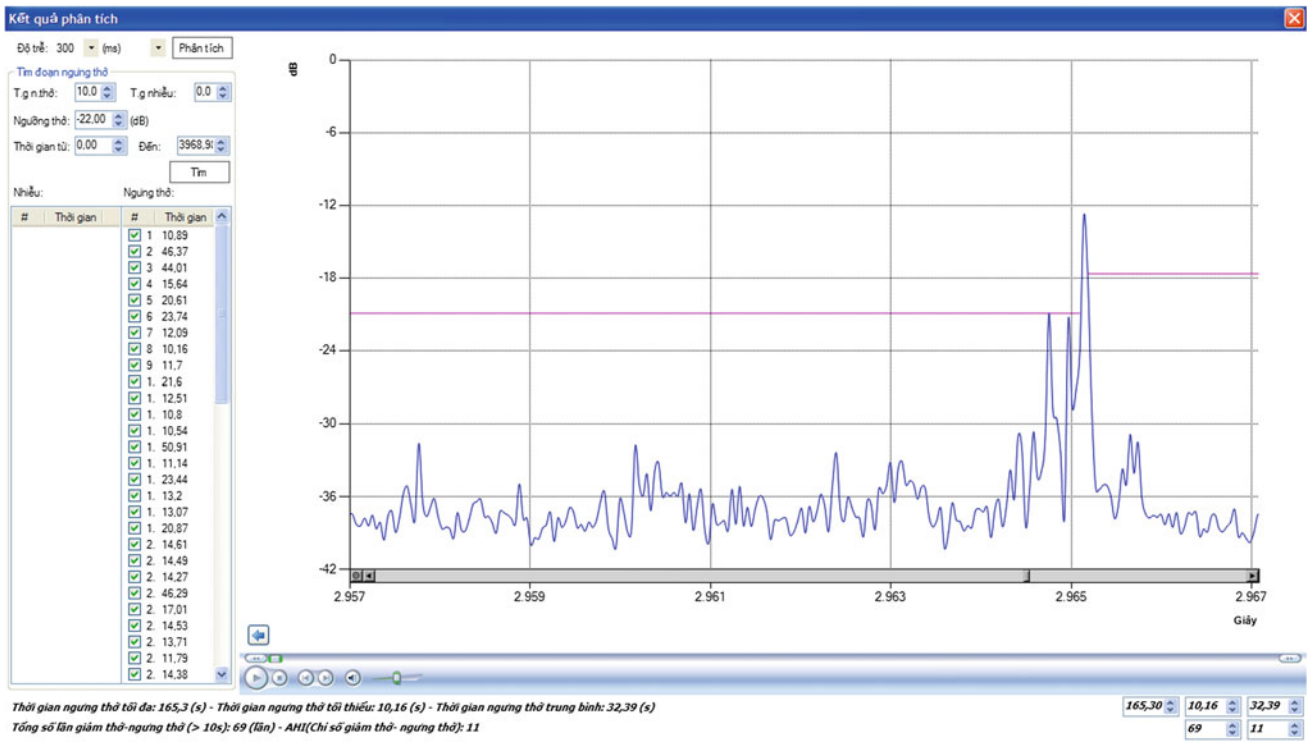

Fig. 2 Software for SASD-14 to diagnose OSAS

Table 1 General characteristics of the study subjects

	Male (n = 119)	Female (n = 111)	Total (n = 230)	*p*
Age	58 ± 13	63 ± 12	61 ± 12	<0.01
Height	1.62 ± 0.07	1.54 ± 0.07	1.58 ± 0.08	<0.01
Weight	58 ± 8	55 ± 8	56 ± 8	<0.01
BMI	22.16 ± 2.67	22.97 ± 3.11	22.55 ± 2.91	<0.05
Neck circumference	35 ± 3	34 ± 3	35 ± 3	<0.05
Systolic blood pressure	137 ± 20	140 ± 21	138 ± 21	>0.05
Diastolic blood pressure	85 ± 10	85 ± 12	85 ± 11	>0.05
Pulse	80 ± 16	77 ± 13	79 ± 15	>0.05
Epworth	10 ± 4	9 ± 3	10 ± 3	>0.05

Table 2 Portable polysomnography characteristics of hypertension and non-hypertension group

	Non-hypertension	Hypertension	Total	*p*
AHI	25.21 ± 14.37	29.77 ± 13.03	27.87 ± 13.76	<0.05
AHI supine	28.19 ± 17.07	33.83 ± 16.55	31.47 ± 16.96	<0.05
AHI non-supine	24.11 ± 17.8	27.75 ± 15.77	26.23 ± 16.71	>0.05
SpO2 index	17.44 ± 26.73	19.26 ± 28.29	18.5 ± 27.6	>0.05
Total time of sleep apnea	277.88 ± 129.68	302.79 ± 125.07	292.39 ± 127.33	>0.05
Max of Sleep apnea duration	257.84 ± 213.13	278.4 ± 184.3	269.82 ± 196.66	>0.05
Min of Sleep apnea duration	23.33 ± 15.82	29.25 ± 14.48	26.78 ± 15.3	<0.01

Table 3 The cardiovascular risk factors of sleep apnea syndrome

		Non-sleep apnea syndrome		Sleep apnea syndrome		Total		*p*
		n	%	n	%	n	%	
Dyslipidemia	No	35	15.22	115	50	150	65.22	>0.05
	Yes	16	6.96	64	27.83	80	34.78	
Diabetes	No	48	20.87	161	70	209	90.87	>0.05
	Yes	3	1.3	18	7.83	21	9.13	
Hypertension	No	32	13.91	64	27.83	96	41.74	<0.01
	Yes	19	8.26	115	50	134	58.26	
Obesity	No	47	20.43	137	59.57	184	80	<0.05
	Yes	4	1.74	42	18.26	46	20	
Heart failure	No	47	20.43	160	69.57	207	90	>0.05
	Yes	4	1.74	19	8.26	23	10	
Arrhythmia	No	46	20	159	69.13	205	89.13	>0.05
	Yes	5	2.17	20	8.7	25	10.87	

3.3 Sleep Apnea and Cardiovascular Risk Factors

(a) *The cardiovascular risk factors of SAS* (Table 3)

There is an association between hypertension and obstructive sleep apnea syndrome ($p < 0.01$); obesity and obstructive sleep apnea syndrome ($p < 0.05$).

(b) *The correlation between AHI and Epworth scale*
There is a correlation between AHI and Epworth scale (r = 0.345, $p < 0.01$).

3.4 Hypertension and Obstructive Sleep Apnea Syndrome

(a) The relationship between hypertension and sleep apnea syndrome (Table 4)

There is an association between hypertension with the sleep apnea syndrome with $p < 0.05$.

(b) The relationship between the grade of hypertension and the severity of sleep apnea syndrome (Table 5)

There is a relationship between the grade of hypertension and the severity of sleep apnea syndrome with $p < 0.01$.

(c) *Correlation between systolic blood pressure and AHI* (Chart 3)

There is a positive correlation between the SBP with the severity of OSAS according to AHI, r = 0.407, $p < 0.001$.

(d) *Multivariate regression factors affecting sleep apnea syndrome* (Table 6)

The factors affecting sleep apnea syndrome in multivariate regression analysis is hypertension ($p < 0.01$) and obesity ($p < 0.05$).

3.5. Kappa index of the correspondence between SASD-14 and StarDust II (Table 7).

The Kappa index improve the good correspondence between SASD-14 and StarDust II with $p < 0.01$.

Table 4 The relationship between hypertension and sleep apnea syndrome

	Non-hypertension		Hypertension		Total	
	n	%	n	%	n	%
Non-sleep apnea syndrome	29	12.61	22	9.57	51	22.17
Sleep apnea syndrome	67	29.13	112	48.7	179	77.83
Total	96	41.74	134	58.26	230	100
	$\chi^2 = 6.16$				$p < 0.05$	

Table 5 The relationship between the grade of hypertension and the severity of sleep apnea syndrome

									Non-hypertension	
	Grade 1		Grade 2		Grade 3		Total			
n	%	n	%	n	%	n	%	n	%	
Mild	17	7.39	9	3.91	4	1.74	0	0.00	30	13.04
Medium	59	25.65	42	18.26	18	7.83	2	0.87	121	52.61
Severe	20	8.70	11	4.78	23	10.00	25	10.87	79	34.35
Total	96	41.74	62	26.96	45	19.57	27	11.74	230	100.00
	$\chi 2 = 62.27$								$p < 0.01$	

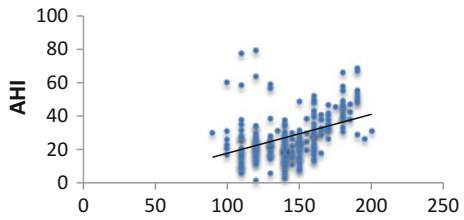

Chart 3 The correlation between systolic blood pressure and AHI

4 Discussion

4.1 The Risk Factors of Obstructive Sleep Apnea Syndrome

The main risk factors of OSAS are older, male and obesity. 60% of the population of industrialized countries is overweight, body mass index (BMI) > 25 kg/m^2 and at least 30% of obesity, BMI > 30 kg/m^2 resulting to rise the rate of SAS [13]. OSAS ratio increases with the level of body fat, 60–70% of patients are overweight and obese may suffer OSAS. Obesity and OSAS has close relationships with each other. The patients reduce from 5 to 10% weight will reduce 10–35% of AHI [10]. Similarly, increased BMI by one standard deviation will increase 4 times the OSAS [21].

In our study, the factors affecting sleep apnea syndrome in multivariate regression analysis is hypertension ($p < 0.01$) and obesity ($p < 0.05$). The rate of OSAS is 65% of obese patients in the research of Le Thuong Vu et al. [11]; 66.8% in Korea, India, China, Singapore [15, 19].

According to Young et al. [22] these elements reflect the distribution of body fat in the central (waist circumference) or peripheral (neck circumference) can be combined with a high risk of OSAS. Large neck circumference is an important factor to predict OSAS, particularly in men over 48 cm (higher risk) and less than 37 cm (lower risk) [18].

4.2 Hypertension

OSAS is often accompanied by hypertension, atherosclerosis, coronary artery disease and hypertension [17]. In our study, 58.26% of patients with hypertension, 10.87% of patients with arrhythmias. Research by Le Thuong Vu et al. OSAS has 35.95% of patients with hypertension.

Table 6 Multivariate regression factors affecting obstructive sleep apnea syndrome

	Unstandardized coefficients		Standardized coefficients	t	*p*
	B	Std. error	Beta		
Constant	0.653	0.044		14.912	<0.01
Grade of hypertension	0.082	0.026	0.205	3.155	<0.01
Obesity	0.161	0.067	0.155	2.387	<0.05
Diabetes	0.052	0.093	0.036	0.554	0.58
Dyslipidemia	−0.001	0.057	−0.001	−0.019	0.985
Heart failure	0.056	0.089	0.04	0.622	0.535

Table 7 Kappa index of the correspondence between SASD-14 and StarDust II

	Value standard	Error	T value	*p*
Kappa	0.775	0.052	11.801	<0.01

In the report of the US Seventh Joint National Committee on prevention, evaluation and treatment of hypertension, OSAS was ranked the causes of secondary hypertension [1], the same in 2013 ESH/ESC guideline for the management of arterial hypertension.

In US, 30–80% of patients with hypertension have attached with OSAS. In India, 59% of patients with hypertension have OSAS. Young et al. study the relationship between OSAS and hypertension concluded an every extra hypopnea or apnea during the night, 0.24 mmHg increased in systolic blood pressure and 0.12 mmHg increased in diastolic blood pressure. When age, sex and body mass index well controlled, the risk of OSAS patients with hypertension increased by about 4%. Patients with OSAS with good treatment also contributes significantly reduced blood pressure [4, 12].

Recent studies demonstrate that a repeated condition of oxygen lacking leads to increase sympathetic nervous system, and then leads to hypertension. This condition is maintained even when the patients awake. According Dreher [5] OSAS can affect the cardiovascular system. In a bout of apnea, blood pressure tends to decrease and increase at the end of apnea. In some cases, systolic blood pressure can be up to 300 mmHg and affect the organs and lead to stroke. Oxygen demand on the heart to work during the period of apnea increased, but this time blood oxygen levels decreased rapidly and hypoxemia leads to reduced oxygen to the myocardium.

In our study there was positive correlation between systolic blood pressure with AHI index ($r = 0.41$, $p < 0.001$), as well as an relationship between hypertension with sleep apnea syndrome with $\chi^2 = 6.16$, $p < 0.05$. The average AHI group was 25.21 ± 14.37 in non-hypertension groups different from AHI in hypertension group 29.77 ± 13.13 ($p < 0.05$). Multivariate regression analysis showed that hypertension ($p < 0.01$) and BMI ($p < 0.05$) are correlation with sleep apnea syndrome. This proved significant influence of hypertension to obstructive sleep apnea syndrome.

4.3 Value of SASD-14

The Kappa index for the accordance between SASD-14 and StarDust II is 0.775 ($p < 0.01$). It demonstrates that, in clinical we can use SASD-14 for diagnosing obstructive sleep apnea syndrome, especially in the place can't be equipped with polysomnography.

5 Conclusion

1. AHI in the obstructive sleep apnea syndrome patients with hypertension is 29.77 ± 13.03, higher statistically significant than AHI in the obstructive sleep apnea syndrome patients without hypertension 14.37 ± 25.21 ($p < 0.05$).
2. There is a positive correlation between AHI and the systolic blood pressure ($r = 0.41$, $p < 0.001$). In multivariate regression analysis, AHI ($p < 0.01$) and obesity ($p < 0.05$) correlated with the severe of hypertension.
3. The Kappa index for the SASD-14 compare with StarDust II is 0.775 ($p < 0.01$).

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