Research

Relationship of lowest oxygen saturation value with degree of obstructive sleep apnea on polysomnography

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is a part of sleep disorder breathing syndrome. Symptoms of OSA often occur, but it is difficult to detect. Upon diagnosis, patients generally have had symptoms of OSA for years. If it is not treated properly, OSA can lead into complications involving various other organ systems. The standard examination for diagnosing OSA is polysomnography. However, polysomnography examination during the era of Covid-19 pandemic could not be done. **Purpose:** To determine the relationship between the lowest oxygen saturation (SaO2) value and the degree of obstructive sleep apnea on polysomnography examination. **Method:** Observational analytic study with a cross sectional approach. The total sample was 59 subjects, consisted of 37 males and 22 females. The lowest SaO2 was assessed on polysomnography examination and compared with the degree of OSA. **Result:** The lowest SaO2 relationship with the degree of OSA showed a significant negative result with a strong relationship. In mild OSA, the Area Under Curve (AUC) value = 77.1%, and the cut off SaO2 value was obtained at 90.5%. In moderate OSA, the AUC = 85% and the cut off SaO2 value was at 87.5%. In severe OSA, the AUC value was 94% and the cut off SaO2 value was obtained at 84.5%. **Conclusion:** There was a significant relationship between the lowest oxygen saturation on polysomnography examination and the degree of OSA.

Keywords: obstructive sleep apnea, lowest oxygen saturation, polysomnography

ABSTRAK

Latar belakang: *Obstructive sleep apnea (OSA), atau apnea tidur obstruktif (ATO), merupakan salah satu bagian dari sindrom gangguan pernapasan saat tidur. Gejala ATO sering muncul, namun sulit dideteksi. Pada saat diagnosis, pasien umumnya sudah mengalami gejala ATO selama bertahun-tahun. Jika tidak ditangani dengan baik, ATO dapat menyebabkan komplikasi yang melibatkan berbagai sistem organ tubuh lainnya. Pemeriksaan standar untuk mendiagnosis ATO adalah polisomnografi. Namun pemeriksaan polisomnografi selama era pandemi Covid-19 tidak bisa dilakukan.* ***Tujuan:*** *Mengetahui hubungan nilai saturasi oksigen (SaO2) terendah dengan derajat ATO pada pemeriksaan polisomnografi.* ***Metode:*** *Penelitian observasional analitik dengan pendekatan potong lintang. Jumlah sampel sebanyak 59 orang, terdiri dari 37 laki-laki dan 22 perempuan. Saturasi terendah dinilai pada pemeriksaan polisomnografi, dan dibandingkan dengan derajat ATO.* ***Hasil:*** *Hubungan SaO2 terendah dengan derajat ATO menunjukkan hasil negatif signifikan dengan hubungan kuat. Pada ATO ringan* nilai Area Under Curve (AUC)*=77,1% dan nilai* cut off *diperoleh pada SaO2 90,5%. Pada OSA sedang, nilai AUC = 85% dan nilai* cut off *berada pada 87,5%. Pada OSA berat, nilai* AUC*=94% dan nilai* cut off *diperoleh pada 84,5%.* ***Kesimpulan:*** *Terdapat hubungan yang bermakna antara saturasi oksigen terendah pada pemeriksaan polisomnografi dengan derajat ATO.*

Kata kunci: *apnea tidur obstruktif, saturasi oksigen terendah, polisomnografi*

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INTRODUCTION

Obstructive sleep apnea (OSA) is part of the sleep disorder breathing syndrome. The incidence of OSA with complaints of snoring is common, but most ordinary people think that snoring is a natural thing and not a health problem.[1] OSA is a form of breathing disorder during sleep which is characterized by episodes of respiratory arrest (apnea) of at least 10 seconds/episode.[2] Apnea can be defined as loss of airflow for at least 10 seconds. A decrease in tidal volume greater than 50% but below 75% of baseline with cessation of airflow for at least 10 seconds is called hypopnea. Combined apnea/hypopnea is the pathophysiology of obstructive sleep apnea. In normal young adults, up to 5 apneas/hypopneas per hour of sleep are physiological, and this frequency is increasing by age.[3]

OSA is defined as a collection of recurrent apnea (loss of airflow >10 seconds) or hypopnea (decreased airflow >10 seconds, sufficient to cause a decrease in oxygen saturation) that occurs at least 5 times per hour, and is associated with snoring, and the onset of drowsiness and fatigue at noon. The severity of OSA was calculated by the apnea-hypopnea index (AHI). The AHI is the number of apnea and hypopnea per hour during sleep time with a minimum sleep time of 2 hours.[3] If not treated properly, OSA can lead to various kinds of complications involving various other organ systems. OSA is widely known to cause hypertension, which in turn gives cardiovascular complications. Endocrine complications and complications of the central nervous system are other complications that are often caused by OSA.[4] The occurrence of OSA in the United States: prevalence of OSA (AHI ≥5) in white adults aged 30–60 years was about 24% of men and 9% of women, while the AHI ≥15 was about 9% of men and 4% of women. In Europe, aged 30-70 years with AHI ≥5 was 26% of men and 28% of women, while AHI ≥ 15 was about 14% of men and 7% of women. In Hong Kong, the prevalence of age 30-60 years with AHI ≥5 was 9% for men and 4% for women, and AHI ≥15 was about 5% for men and 3% for women.[5]

Several predisposing factors for OSA include obesity, neck circumference size, age, gender, craniofacial structural abnormalities, and airway anatomic abnormalities. Obesity is reported as a major factor that can increase the risk of OSA. From the literature, it is stated that OSA patients have at least a body mass index (BMI) one level above normal. Obesity can change the volume and shape of the anatomy, the tongue can be raised, and thereby reducing the volume of the upper airway. Likewise, anatomical abnormalities such as tonsil hypertrophy, septal deviation, turbinate hypertrophy and maxillofacial anomalies such as micrognathia, retrognathia, adenoid-tonsil hypertrophy, macroglossia and acromegaly.[6]

The diagnosis of OSA is established through history taking, physical examination, and supporting examinations. In general, the management of sleep disorders in OSA can be divided into 3 categories. The first is lifestyle changes by losing weight, avoiding alcohol and sedative and hypnotic drugs, sleeping position by side, and avoiding sleeping in the supine position. The second is artificial devices/intraoral devices, which are tools that can be used to reposition the jaw using a mandible advancement device (MAD), or a tool to prevent the tongue from falling backwards (maintaining the tongue in an anterior position) by using a tongue retaining device (TRD), or it can also be done with continuous positive airway pressure

(CPAP). The third is surgical intervention, surgery to remove obstruction of the nose, nasopharynx, oral cavity, hypopharynx and larynx, uvulopalatoplasty, and tracheostomy surgery.[7]

The standard examination for diagnosing and determining the degree of OSA is polysomnography.[8] The determination of the degree of OSA is based on the AHI value on polysomnography examination. Where the AHI value is calculated based on the number of apnea and/or hypopnea experienced by the patient per hour during the polysomnography examination. So the higher the AHI value, the more severe a person's OSA degree is. Continuous apnea or hypopnea events can cause hypoxia and a decrease in oxygen saturation in the blood.[9] However, polysomnography examination during the Covid-19 pandemic era could not be carried out. Thus, the purpose of this study was to determine the relationship between the lowest oxygen saturation value and the severity of OSA on polysomnography examination, and it could be used as basic data for further research.

METHOD

This study was an observational analytic study with a cross-sectional approach in patients with suspected OSA. The method of collecting research data was executed by taking polysomnography medical record status data from the neurology polysomnography of suspected OSA patients who underwent polysomnography examination at Dr. Saiful Anwar Hospital Malang from January 1st, 2016 to December 31st, 2019 based on the research variables. The study population was patients with suspected OSA who underwent polysomnography examination during the admission at Dr. Saiful Anwar Hospital Malang, from January 2016 to December 2019, and the sampling method was based on total sampling.

The inclusion criteria for this study were all suspected OSA patients who underwent polysomnography examination. The exclusion criteria were incomplete medical records, and age <12 years. All data that had been collected was tested statistically using the IBM SPSS version 26 computer program. Spearman analysis was used to test the relationship between the lowest SaO_2 and the degree of OSA based on the AHI, and it was presented in the form of a table.

RESULT

The characteristics of the study sample were based on gender and the incidence of OSA, the sample with male sex was 37 subjects (62.7%), normal results were obtained in 5 subjects (8.5%), the incidence of mild OSA was 7 subjects (11.9%), moderate OSA was 10 subjects (16.9%), severe OSA was 15 subjects (25.4%); with a total of 32 male patients experiencing OSA (72.7%). Whereas in female from a sample of 22 subjects (37.3%) of the total sample; normal results were obtained in 10 subjects (16.9%), the incidence of mild OSA was 8 subjects (13.6%), moderate OSA was 2 subjects (3.4%), severe OSA was 2 subjects (3.4%); with a total of 12 female patients experiencing OSA (27.3%).

Table 1. Clinical characteristics of subjects based on gender and degree of OSA

	Normal		Mild		Moderate		Severe	
	n	%	n	%	n	%	n	%
M	5	8.5	7	11.9	10	16.9	15	25.4
F	10	16.9	8	13.6	2	3.4	2	3.4

Characteristics of the study sample, which were based on age and incidence of OSA showed there were 10 cases of OSA in adolescence (22.7%), 10 cases of OSA in adults (22.7%), and 24 cases of OSA in the elderly (54.6%).

Table 2. Clinical characteristics of subjects based on age and degree of OSA

Age	Normal		Mild		Moderate		Severe	
	n	%	n	%	n	%	n	%
Adolescence	8	13.6	5	8.5	3	5.1	2	3.4
Adult	2	3.4	1	1.7	3	5.1	6	10.2
Elderly	5	8.5	9	15.3	6	10.2	9	15.3

Based on research conducted on 59 patients with suspected OSA, the lowest SaO_2 relationship value on polysomnography examination with OSA degrees was with a correlation coefficient of -0.681, and with a significance value of 0.00.

Table 3. The relationship of the lowest SaO2 with the degree of OSA

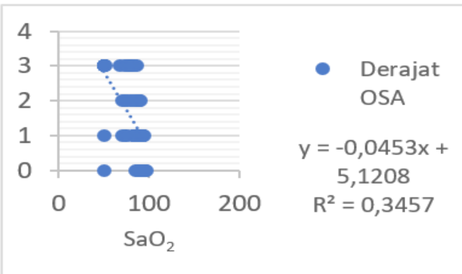
Nonparametric Correlations

Correlations

			DERAJAT_OSA	SaO2Terendah
Spearman's rho	DERAJAT_OSA	Correlation Coefficient	1.000	-.681**
		Sig. (2-tailed)	.	.000
		N	59	59
	SaO2Terendah	Correlation Coefficient	-.681**	1.000
		Sig. (2-tailed)	.000	.
		N	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4. The relationship of the lowest SaO2 value with the degree of OSA based on the PSG examination



From the linearity graph, R2 = 0.3457, it meant that the relationship between the lowest SaO_2 and the degree of OSA could be explained by 35%, and the rest might be be due to other relationships.

The cut off point of sensitivity and specificity Normal - Mild OSA was 90.5% SaO_2 with AUC=77.1% (including statistically moderate). The cut off point of sensitivity and specificity Normal - Moderate OSA was 87.5% SaO_2 with AUC=85% (including statistically good). The cut off point of sensitivity and specificity Normal - Severe OSA was 84.5% SaO_2 with AUC=94% (including statistically very good).

DISCUSSION

The characteristics of the sample were based on gender: 37 male (62.7%) and 22 female (37.3%). The total number of male patients with OSA was 32 people (72.7%) and 12 female patients (27.3%). Based on these data, the incidence of OSA was more common in males than females. This is in accordance with the literature, where it is said that 24% of men and 9% of adult women have an OSA/AHI incidence of more than 5x/hour.[9] Gender could have an important effect on the size of upper respiratory soft tissue structures. Men have more fat and soft tissue deposition in the neck than women, which can trigger an increase in upper airway resistance that increases the risk of OSA.[10]

Based on the characteristics of the sample, the highest incidence of OSA occurred in the elderly, which was obtained as many as 24 sample (54.6%). This was in match with the literature where it was said that the incidence of OSA would increase with increasing age, in elderly men it occured around 28-67% and in elderly women it occured on 20-54%. The mechanism of sleep apnea in the elderly is related to fat deposition in the parapharyngeal area, flattening of the soft palate and changes in the structure around the parapharynx.[11]

Based on the results of statistical analysis using Spearman test where this study involved 59 suspected OSA patients, a significant relationship was found between the lowest SaO_2 value on polysomnography examination and the degree of OSA, with a relationship value of -0.681 with a significance value of 0.00. This showed the suitability between the initial hypothesis and the results of the study, namely that there was a significant relationship between the lowest SaO_2 on polysomnography examination and the degree of OSA. This was in contrast with the research conducted by Mirwan et al.[12] which said that there was no significant relationship between oxygen saturation and the risk of OSA; this could be due to the study conducted by Mirwan et al.[12] was using pulse oximetry shortly after the subject fell asleep. This could lead into inaccurate results, compared to polysomnographic examinations where oxygen saturation was evaluated throughout the examination. Besides, there were other limitations such as measurement of oxygen saturation that was not carried out directly by researchers, which allowed information bias to occur in the delivery of the use of pulse oximetry devices; and there were several variables that were not examined, such as body movement during sleep, frequency of awakening, and the number of apneas that occured which might cause the research unrelated.

Several other variables were not examined and it could also affect a person's oxygen saturation value, for example the presence of systemic diseases, diseases of the lungs where lung function decreased, disruption of the body's oxygen fulfillment resulting in hypoxia. In patients with anemia, Hb levels are low, so the ability to bind O2 is also low.[13] In a study conducted by Sudaryanto et al.[14], it was said that there was a relationship between exposure to cigarette smoke and the value of oxygen saturation in the blood. This could happen because in chronic carbon monoxide exposure, carbon monoxide will be bounded by hemoglobin and circulated throughout the body, where this would reduce hemoglobin's affinity for oxygen.

Based on statistical data processing using the ROC Curve in finding the intersection point between the lowest SaO_2 value and the degree of OSA, the cut off point for mild OSA was at 90.5% saturation, for moderate OSA was at 87.5% saturation, and the cut off point for severe OSA was at 84.5% saturation.

The limitations of the secondary data, the large number of confounding variables and the minimal sample size allowed bias to occur in statistical calculations.

The results of this study found a significant relationship between the lowest oxygen saturation on polysomnography examination and the degree of obstructive sleep apnea. The cut off point SaO_2 for mild OSA was 90.5%, the cut off point SaO_2 for moderate OSA was 87.5%, and the cut off point SaO_2 for severe OSA was 84.5%. The author suggested to continue this research by involving a larger number of samples and other variables. It is hoped that further research can be carried out to find the lowest SaO_2 relationship in the polysomnographic examination method compared to the Drug Induced Sleep Endoscopy (DISE) examination method.

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