Prevalence of Obstructive Sleep Apnea Among Patients with Secondary Polycythemia

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Abstract

Objectives: Obstructive sleep apnea (OSA) may cause several humeral changes. The relationship between secondary OSA and secondary polycythemia is controversial. The aim of this study is to explore the prevalence of OSA among patients with secondary polycythemia in our local population.

Methods: This is a retrospective cross-sectional study. We have included all adult patients with polycythemia who are attending hematology clinic in Sultan Qaboos University Hospital.

Results: We have reviewed 524 patients with polycythemia. Only 44 patients have secondary polycythemia and sleep study was done for them. Majority of patients (n=44) were male (95.45%) with mean age of 40.66 years and mean BMI of 31.72 Kg/m2. The mean hemoglobin was 16.5 g/dl and mean hematocrit was 0.49 L/L. The mean apnea/hypopnea index (AHI) was 33 and desaturation index of 24.45 and 52.27% of patients have severe OSA (AHI>30).

Conclusions: Severe OSA is highly prevalent in patients with secondary polycythemia and it should be considered as a cause of polycythemia.

Keywords: Polycythemia; Obstructive Sleep Apnea; Hematocrit; Desaturation.

Introduction

Obstructive Sleep Apnea (OSA), is a prevalent sleep disorder characterized by repetitive interruptions of breathing during sleep, poses significant health challenges globally.[1,2] OSA results from upper airway collapse and is often associated with hypoxia, fragmented sleep, and daytime somnolence.[3] OSA can lead to substantial systemic complications, ranging from cardiovascular and metabolic diseases to neurocognitive impairments.[4,5]

One of the less commonly highlighted but equally critical sequelae of OSA is secondary polycythemia.[(6)] This condition, characterized by an abnormal increase in red blood cell mass, often results from chronic hypoxemia—one of the hallmark features of OSA. In response to recurrent oxygen desaturation during apneic episodes, the body undergoes a compensatory mechanism involving erythropoietin stimulation, driving erythrocyte production.[7] While this adaptation aims to improve

oxygen delivery, the resultant polycythemia can increase blood viscosity, predisposing patients to thrombotic complications.[8]Furthermore, Red cell distribution width (RDW) is a measure of the variability in the size of red blood cells. In OSA, RDW has been found to be elevated, potentially reflecting the body's response to chronic intermittent hypoxia.[9] RDW is a helpful parameter in differentiating between secondary and primary erythrocytosis.[10]

Despite the clear physiological link, the intersection of OSA and secondary polycythemia remains underexplored. Understanding the prevalence, pathophysiology, and clinical implications of this association is critical for early diagnosis and tailored management. Moreover, effective treatment of OSA, particularly with continuous positive airway pressure (CPAP), may have the potential to mitigate polycythemia, underscoring the importance of timely intervention.

This study aims to delve into the interplay between OSA and secondary polycythemia, and to assess the prevalence and severity of OSA in patients with secondary polycythemia. We hope to emphasize the need for comprehensive management strategies in patients with polycythemia to prevent downstream complications such as thrombosis.

Methods

A hospital-based retrospective cross-sectional study was conducted among patients attending a hematology clinic in Sultan Qaboos University Hospital (SQUH), a tertiary healthcare hospital in Muscat government, Sultanate of Oman. The study included all patients admitted to the hematology clinic in SQUH with polycythemia and a sleep study was done for them between 2013-2023. The inclusion criteria included in this study were the following; Adult patients (age ≥18) and diagnosed with secondary polycythemia. The secondary polycythemia, also known as erythrocytosis, is diagnosed by identifying an elevated red blood cell count (RBC) and hemoglobin/hematocrit levels due to an underlying condition, rather than a bone marrow abnormality.[11]

The exclusion criteria include the following conditions; primary polycythemia,[12] smoking, chronic obstructive pulmonary diseases (COPD), such as chronic bronchitis, emphysema, and asthma, patients living at high altitudes., renal failure and blood cancer patients, such as leukemia, lymphoma, and myeloma.

Data collection was done using the trackcare system of Sultan Qaboos University Hospital (SQUH). The following demographic information was determined: sex, age, body mass index (BMI), systolic blood pressure (SBP), and diastolic blood pressure (DBP). The following hematological parameters were also determined from complete blood count: red blood cell count (RBCs), hemoglobin (Hb), hematocrit (Hct), main cell volume (MCV), main cell hemoglobin (MCH), white blood cells (WBC), and platelets (Plt). Sleep study reports were used to determine the following parameters: Epworth Sleepiness Scale (ESS), apnea-hypopnea index (AHI), Baseline saturation desaturations below 90%, and desaturation index (DI).

The study was approved by the ethical committee at college of medicine and health science, Sultan Qaboos University (MREC#3075)

The data was analyzed using the IBM-SPSS software version 27 (IBM-USA). The continuous variables were presented as means, while the categorized variable was displayed as percentages and frequencies using frequency tables. Chi-square was also used to explore any significant association.

Results

We have screened 524 patients who were diagnosed with polycythemia. We excluded those who did not meet the inclusion and exclusion criteria, which resulted in 44 patients who were diagnosed with secondary polycythemia and had undergone a sleep study as shown in Figure 1.

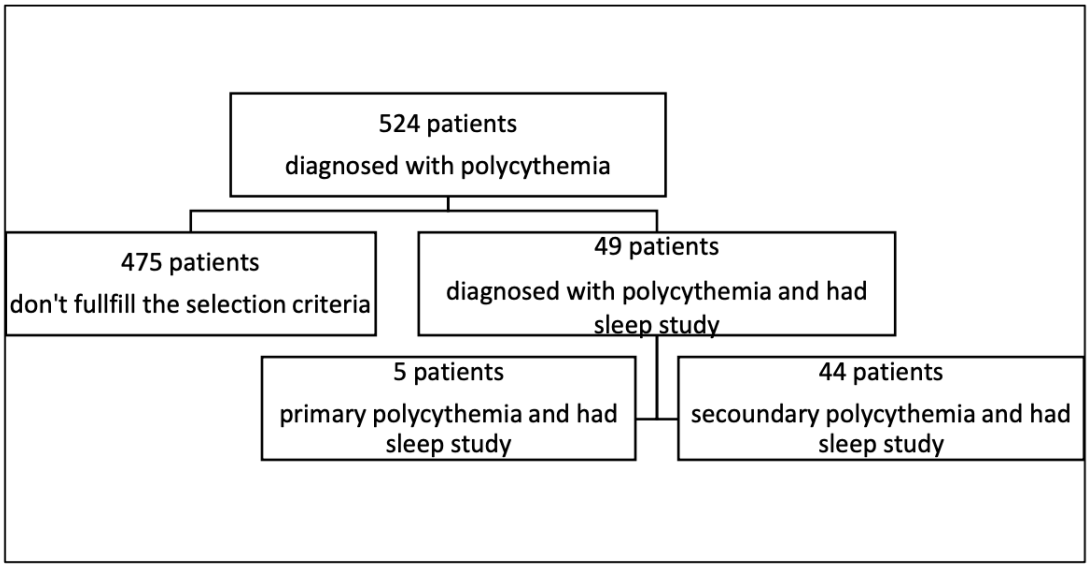

Figure 1: Flow chart of study patients and selection criteria.

There were 42 males (95.45%) and two female patients in the study. The mean BMI was 31.72± SD 6.26 Kg/m^2 and the mean age was 40.66 ± SD10.55 (years) [Table 1].

Table 1. Patients' characteristics.

N = 44	**Mean**	**SD**
Age (years)	40.66	10.55
BMI (kg/m^2)	31.72	6.26
SBP (mmHg)	137	16
DBP(mmHg)	84	11

BMI: Body mass index; SB: systolic blood pressure; DBP: diastolic blood pressure.

All included patients met the diagnostic criteria for secondary polycythemia with mean Hb of 16.5± SD 1.38 and mean Hct of 0.49± SD0.04. The rest of hematological features are listed in Table 2.

Table 2. The descriptive statistics of blood parameters.

	Mean	**Std. Deviation**
Red blood cells (×10^6 /µL)	6.27	0.91
Hemoglobin (g/dl)	16.5	1.38
Hematocrit (%)	0.49	0.04
Main cell volume (fL)	79.98	7.83
Main cell hemoglobin (pg)	27.67	9.38
White blood cell (×10^3 /µL)	6.72	1.99
Platelet (×10^3 /µL)	263.66	109.13

The results indicates that the majority (52%) of the sample falls in the category of severe OSA with mean AHI of 33.27±SD23. 22. Severe OSA constitutes 52.27%, whereas moderate and mild OSA

constitutes 18.8% and 29.55% respectively. Figure 2 Furthermore, it indicates that the patients have severe desaturation index below 90% with mean of 47.67±SD 24.45. Table 3Kurskal Wallis test indicates that that higher Hct is associated with severe OSA (P=0.036) as shown in Figure 3. Nevertheless, there is no significant association between severity of OSA and other hematological parameters (P>0.05).

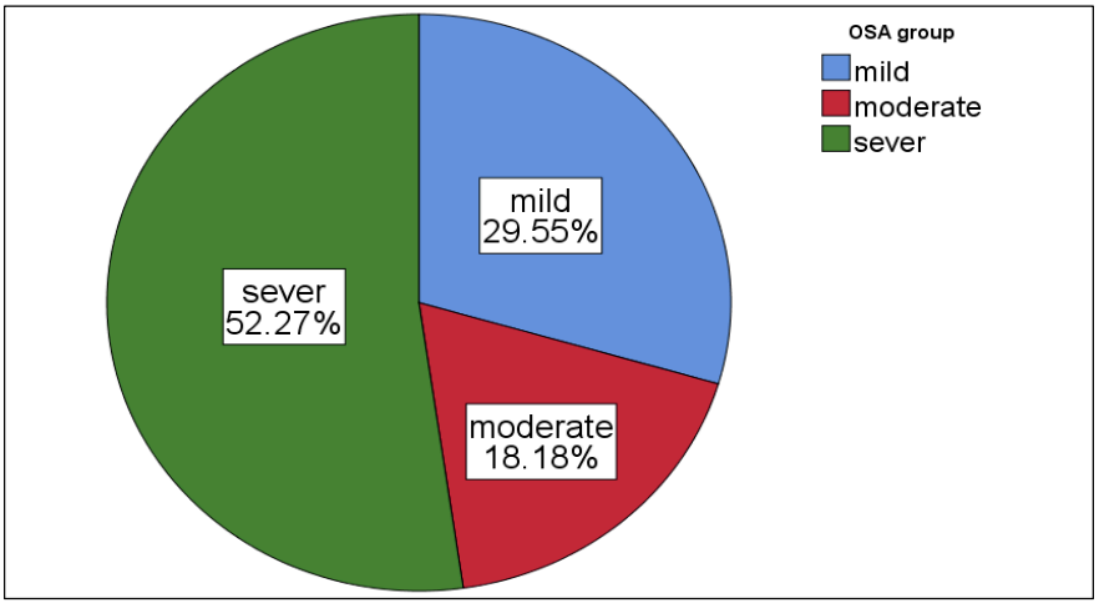

Figure 2: Distribution of OSA severity among the patients with secondary polycythemia.

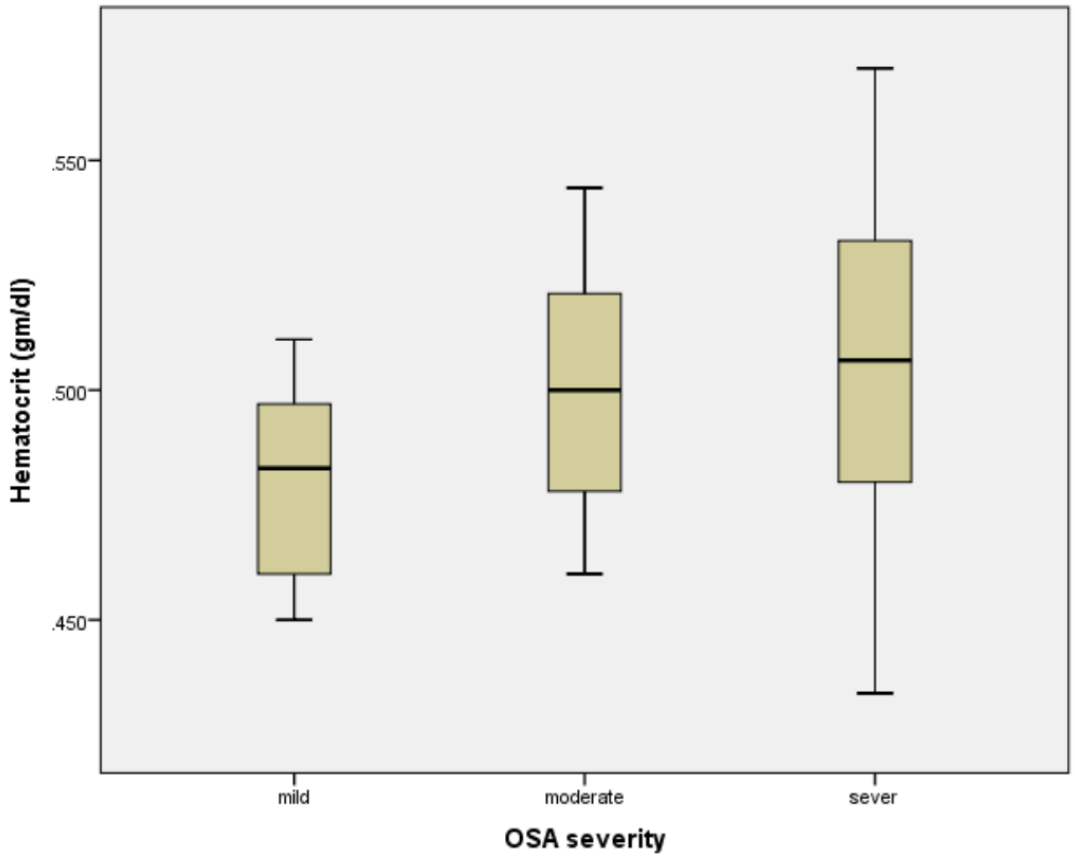

Figure 3: ANOVA comparison of Hematocrit and severity of OSA. Hematocrit level is correlated with severe OSA (P=0.036). mild OSA (AHI=5-15), modeate OSA (AHI=15-30), severe OSA (AHI> 30).

Table 3: OSA characteristics of the patients with secondary polycythemia.

N = 44	**Mean**	**Std. Deviation**
ESS	11	5
Apnea-hypopnea index (events/h)	33.27	23.22
Baseline saturation (%)	94.32	3.41
Minimum O_2 saturation (%)	81.11	10.11
Desaturations index below 90%	47.67	24.45
Overall desaturation index (DI)	20.28	85.16

ESS: Epworth sleepiness scale

Table 4: ANOVA comparison of Hematocrit and severity of OSA.

					95% Confidence Interval for Mean				***p*-value**
	N	**Mean (gm/dl)**	**SD**	**Std. Error**	**Lower Bound**	**Upper Bound**	**Minimum**	**Maximum**	
Mild OSA	12	0.48	0.02	0.006	0.47	0.49	0.45	0.51	0.036
Moderate OSA	7	0.50	0.03	0.01	0.47	0.53	0.46	0.54	
Sever OSA	20	0.51	0.04	0.008	0.49	0.53	0.43	0.57	
Total	39	0.50	0.03	0.005	0.49	0.51	0.43	0.57	

Discussion

This study aimed primarily to assess the prevalence of obstructive sleep apnea (OSA) among patients with secondary polycythemia. It indicates that the majority of patients with polycythemia have sever OSA. Severe OSA is associated with severe desaturations as indicated by the results and that might have contributed to increased hematocrit.

The prevalence of OSA among our study population was notably high, aligning with previous research that has identified OSA as a cause of secondary erythrocytosis.[13] The intermittent hypoxia characteristic of OSA triggers erythropoiesis through increased erythropoietin production, leading to an elevated red blood cell mass. [7,8]This chronic hypoxic state may explain the elevated hematocrit levels observed in patients with untreated or undiagnosed OSA. Our results further support the recommendation that patients presenting with unexplained secondary polycythemia should be screened for OSA.

A significant proportion of our study participants exhibited moderate to severe OSA, which suggests that the severity of sleep-disordered breathing correlates with the degree of erythrocytosis. This finding is in agreement with previous studies indicating a relationship between OSA severity and hematocrit levels.[13,14] Additionally, our results highlight the importance of sleep study as a diagnostic

tool in patients with secondary polycythemia, particularly those with risk factors such as obesity, male sex,[15] and a history of excessive daytime sleepiness.

Interestingly, we observed that patients with OSA-related secondary polycythemia often presented with higher body mass index (BMI) and greater neck circumference, both of which are known risk factors for OSA.[16] This underscores the multifactorial nature of polycythemia in these patients, where obesity-related hypoventilation may further exacerbate erythrocytosis.[17] Moreover, the role of continuous positive airway pressure (CPAP) therapy in reversing polycythemia has been well-documented, and our findings further emphasize the need for early diagnosis and treatment of OSA in these patients.

Despite the strengths of our study, including a well-characterized patients' cohort and objective sleep study assessments, several limitations should be acknowledged. First, our study was conducted in a single-center setting, which may limit the generalizability of our findings, in addition to relatively small sample size. Second, the study was a cross-sectional and association can only be obtained by long term follow-up. Future research should aim to explore the long-term impact of CPAP therapy on hematocrit levels in secondary polycythemia with moderate and severe OSA, as well as the potential genetic predisposition to OSA-related erythrocytosis.

Conclusion

Our study highlights the prevalence of OSA among secondary polycythemia patients, emphasizing the importance of routine OSA screening in patients with unexplained erythrocytosis. Early identification and treatment of OSA in this population could not only improve sleep-related outcomes but also mitigate the hematologic consequences of chronic hypoxia, thereby reducing the risk of thromboembolic complications.

Disclosure

All authors declare no conflict of interest to any third party. The study was approval by the local ethics committee, college of medicine and health sciences at Sultan Qaboos University. There was no fund for this study

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