Rate of Screening for Obstructive Sleep Apnea Syndrome in Patients with Apparent Resistant Hypertension Attending Tertiary Care Hospital

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Abstract

Objectives: This study aimed to evaluate the rate of screening and the rate of obstructive sleep apnea syndrome (OSAS) in patients with apparent resistant hypertension attending Sultan Qaboos University Hospital (SQUH) and assess gender differences.

Methods: A cross-sectional retrospective study was conducted based on data collected from 500 patients with apparent resistant hypertension (ARH) between January 2018 and January 2023. The cohort included 270 women and 230 men. Data gathered from hospital medical records included demographic and clinical information, types of antihypertensive agents prescribed, details of OSA screening tests (such as the Epworth Sleepiness Scale (ESS) and STOP-BANG questionnaire), and polysomnography (PSG).

Results: Out of the 500 patients with apparent resistant hypertension (ARH), 54 patients (10.8%) were diagnosed with obstructive sleep apnea Syndrome (OSAS). Only 6.6% (n=33) of the patients were screened for OSA using the ESS or STOP-BANG questionnaire, while the majority (93.4%, n=467) were not screened. Women constituted 54% of the total patient group and had a higher body mass index (BMI) compared to men (32.7 kg/m^2 vs. 30.2 kg/m^2, p<0.0001). The prevalence of OSA was also higher in women than in men (14.1% vs. 7.0%, p=0.013).

Conclusions: There was a low rate of screening and investigation for OSAS in patients with apparent resistant hypertension (ARH) at SQUH, which may explain the lower prevalence observed. Contrary to published literature, OSAS was more prevalent in women, who were screened more frequently, suggesting that OSA in men might have been under diagnosed.

Keywords: Resistant hypertension, Apparent resistant hypertension Obstructive sleep apnea syndrome, STOP-BANG, Epworth Sleepiness Scale

Introduction

Hypertension or high blood pressure is defined as systolic blood pressure (SBP) reaching 140 mmHg or more and/or diastolic blood pressure (DBP) of 90 mmHg or more.[1] It is considered the world's leading risk factor for stroke, cardiovascular diseases, disability, and mortality.[2] One of the clinical phenotypes of hypertension in which blood pressure is difficult to control is resistant hypertension (RH). RH is the blood pressure (BP) of a hypertensive patient that stays elevated above goal despite using 3 antihypertensive medications of different classes administered at maximum doses or blood pressure that is controlled by 4 or more antihypertensive agents.[2] RH is estimated to be prevalent in around 10% to 30% of the hypertensive population,[3] and is associated with a higher risk of developing cardiovascular events compared to non-resistant hypertension.[4] It was also found to be associated with an increase in the prevalence and severity of target organ damage in the heart and kidney due to the persistent elevation of blood pressure.[5]

Several factors contribute to resistant hypertension including poor adherence to antihypertensive therapy, obesity, excess alcohol intake, and certain drugs, in addition to other secondary causes. Common secondary causes of RH include obstructive sleep apnea, renal parenchymal disease, primary aldosteronism and renal artery stenosis.[6]

Apparent resistant hypertension (ARH) is an office blood pressure reading of >140/90mmHg while taking ≥3 antihypertensive medications without excluding white coat effect and medication nonadherence. Once adherence to ≥3 antihypertensive medications and a mean 24-h ambulatory BP of >130/80mmHg has been confirmed along with the elevated office BP the patient is considered to have true resistant hypertension.[7]

Obstructive sleep apnea (OSA) is a sleep disorder characterized by episodes of complete or partial obstruction of the upper airway associated with a decrease in oxygen saturation or arousal from sleep leading to nonrestorative sleep. Symptoms accompanying obstructive sleep apnea include loud disruptive snoring, observed apneas during sleep, and excessive daytime sleepiness.[8] Depending on the apnea-hypopnea index (AHI) OSA is classified into Mild OSA with an AHI of 5–14.9, moderate with an AHI of 15–29.9 and severe with an AHI of ≥30.[9]

The most common screening tests used to identify patients with daytime sleepiness and obstructive sleep apnea include the Epworth Sleepiness Scale (ESS) and the STOP-BANG questionnaire. Epworth Sleepiness Scale (ESS) evaluates the severity of sleepiness using a questionnaire. The ESS score ranges from 0 to 24 and any score > 10 indicates the presence of excessive daytime sleepiness with any cause of sleep disorders and not specific for OSA and it requires further assessment to confirm the presence of the disease.[10] The STOP-BANG questionnaire is the most widely accepted screening tool used to assess obstructive sleep apnea. It evaluates the presence of snoring, fatigue or daytime sleepiness, observed apnea during sleep, presence of hypertension, body mass index (BMI) of ≥ 35 kg/m^2, age > 50 years, neck circumference >40 cm and male gender. The STOP-BANG questionnaire assesses the probability of having moderate to severe OSA with the risk being high if 'YES' to ≥ 3 items and low risk if 'YES' to < 3 items.[8] To confirm the diagnosis of obstructive sleep apnea an in-laboratory polysomnography (PSG) (also known as sleep study) is used.[11]

Sleep apnea and sleep-disordered breathing are associated with systemic hypertension in different age groups.[12] Obstructive sleep apnea was specifically found to be the most common secondary condition related to resistant hypertension.[13] Furthermore, it was reported that treating OSA with continuous positive airway pressure (CPAP) reduced the 24-hour BP of patients with resistant hypertension.[14]

Gender is an important factor that impacts the relationship between OSA and RH; where it was found that a significantly higher number of men with RH had OSA than women.[15] However, this might not be the case as research indicates that, despite having a similar probability of developing OSA side effects, women with OSA symptoms may have been under-diagnosed and under-treated compared to men.[16]

The link between obstructive sleep apnea syndrome (OSAS) and resistant hypertension is mediated by several interrelated pathophysiological mechanisms which involve complex neurohumoral, vascular, and metabolic interactions. The most significant mechanism involves the activation of sympathetic activity triggered by OSA, which extends beyond the apnoea/hypopnoea episodes and results in a persistent increase in sympathetic activation even

during the daytime when patients are awake. This elevated sympathetic activity leads to increased vascular resistance and cardiac output while also stimulating the renin-angiotensin-aldosterone system, all of which contribute to elevated blood pressure. Additionally, other pathophysiological impacts of OSA, such as increased oxidative stress, greater vascular stiffness, and proinflammatory responses, further exacerbate the rise in blood pressure.[17]

Studies that evaluate the screening of OSA among resistant hypertension patients are scanty. It indicates that the awareness among physicians regarding the link between the two disorders is sub-optimal. A study done on a primary care hospital revealed that over 60% of the patients treated for hypertension (HTN) did not achieve the desired result and had not properly controlled HTN,[18] which may suggest that further screening for other factors including obstructive sleep apnea should have been done. Furthermore, it has been showed that the major reason patients were referred to a sleep study was because of suspicion of OSA and not for screening of resistant hypertension.[19]

This study aimed to evaluate the rate of screening and the rate of obstructive sleep apnea in patients with apparent resistant hypertension in the local population and to elicit any differences between men and women.

Methods

This was a retrospective study conducted at a tertiary university hospital in Oman. Data was collected from patients with apparent resistant hypertension (ARH) at Sultan Qaboos University Hospital in Muscat, Oman, who attended the outpatient clinics between January 2018 and January 2023. Patients aged 18 years and older who met the RH criteria, as defined by the American Heart Association—having elevated blood pressure despite the use of 3 antihypertensive medications of different classes administered at maximum tolerated doses, or blood pressure controlled by ≥4 antihypertensive agents—were included.

Data was collected from hospital medical records and included demographic information such as age, gender, weight, and height, along with details of co-morbidities and the types of antihypertensive agents used. Additionally, information related to OSA screening tests (ESS, STOP-BANG questionnaire, home sleep studies, and full polysomnography), as well as the results of these tests, was obtained. For patients who underwent polysomnography (PSG) to diagnose OSA, variables such as the apnea-hypopnea index (AHI), oxygen desaturation index (ODI), and whether the patient was receiving CPAP therapy were also collected.

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were presented as mean ± standard deviation (SD). Mann-Whitney U test was used for continuous variables that did not follow normal distribution while the Chi square test and Fisher's Exact test were used to test the association between categorized variables. P-value of ≤ 0.05 was considered for statistical significance.

The ethical approval was granted from the medical ethics committee in the college of medicine and health sciences in Sultan Qaboos University (MREC # 3050).

Results

Data was collected from the medical records of 500 patients who were eligible for the study according to the inclusion criteria.

The main characteristics of these patients are presented in Table 1. Two hundred and seventy (54%) of the patients were women. The age of patients ranged from 22-103 years with a mean age of 67.4 ± 12.4 years. The mean body mass index (BMI) was 31.6 ± 10.6 kg/m^2, Mean systolic blood pressure (BP) of 140.6 ± 25.5 mmHg and diastolic BP of 69.6 ± 13.9 mmHg.

Table 1: General characteristics, Co-morbidities and the main antihypertensive classes prescribed in the study population.

Variable	Mean ± SD
Age (Year)	67.38 ± 12.38

Body Mass Index(kg/m^2)	31.59 ± 10.55
SBP (mmHg)	140.60 ± 25.46
DBP (mmHg)	69.59 ± 13.91
Comorbidities	
Heart Failure (HF)	17.4%
Ischemic Heart Disease (IHD)	39.8%
Chronic Kidney Disease (CKD)	26.2%
Diabetes Mellitus (DM)	64%
Dyslipidemia (DLP)	40.4%
Hyperthyroidism	1%
Hypothyroidism	6.8%
Main Antihypertensive agent	
Diuretic	97.8%
ACEI/ARB	85%
Beta-Blocker	80%
Calcium Channel Blockers	80%
Vasodilator	29.2%

SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, ACEI: Angiotensin converting enzyme inhibitor; ARB: Angiotensin receptor blocker.

The most common co-morbidities in addition to hypertension in these patients were diabetes mellitus (64%) followed by dyslipidemia and ischemic heart disease 40.4% and 39.8% respectively. The most common class of antihypertensives prescribed was diuretics (97.8%) and the least common was vasodilators (29.2%). (Table 1)

Only 6.6% (n=33) of patients with ARH were screened for OSA by ESS or STOP-BANG questionnaire. All of them had sleep study and was positive for obstructive sleep apnea syndrome. Sleep study was directly done for 21 patients without the initial screening by questionnaire. Therefore, 54 patients out of the 500 patients (10.8%) were found to have obstructive sleep apnea syndrome.

Women represented 54% (n=270) of the study population with tendency to be older than men (mean age was 68.46 ± 11.693 vs 66.11 ± 13.04 years, P 0.08). In contrast to men, women had a significantly higher BMI (32.7 ± 10.3 vs 30.2 ± 10.7, p=0.0001) while men had a significantly higher DBP (mean DBP=70.68 ±13.05 vs 68.65 ±14.57, p=0.029). (Table 2)

Table 2: Comparison of the general characteristics, co-morbidities and prevalence of OSA between men and women in patients with resistant hypertension.

Variable	Men (n = 230)	Women (n = 270)	P value
Age (Year)	66.11 ± 13.04	68.46 ±11.69	0.080
Body Mass Index (kg/m^2)	30.17 ± 10.65	32.74 ± 10.34	**0.000**
SBP (mmHg)	139.40 ± 25.13	141.63 ± 25.73	0.301
DBP (mmHg)	70.68 ±13.05	68.65 ±14.57	**0.029**
Comorbidities			
Obstructive sleep apnea	7.0%	14.1%	**0.013**
Heart Failure (HF)	15.2%	19.3%	0.24
Ischemic Heart Disease (IHD)	47.4%	33.3%	**0.002**
Chronic Kidney Disease (CKD)	25.2%	27%	0.684
Diabetes Mellitus (DM)	65.7%	62.6%	0.513
Dyslipidemia (DLP)	37.0%	43.3%	0.170
Hyperthyroidism	0.9%	1.1%	1.00
Hypothyroidism	4.3%	8.9%	**0.05**

SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure.

When comparing the co-morbidities ischemic heart disease was found to be higher in men (47.4% vs 33.3%, p=0.002) while hypothyroidism was more prevalent in women (8.9% vs 4.3%, p = 0.05).

Obstructive sleep apnea was significantly higher in women compared to men (14.1% vs 7.0% p=0.013). (Table 2)

Discussion

To the best of our knowledge, this is the first study to evaluate the screening rates and rate of obstructive sleep apnea syndrome (OSAS) in patients with apparent resistant hypertension (ARH) in Oman, and to examine gender differences. Data was gathered from 500 patients treated at a tertiary care hospital.

OSAS was diagnosed in 10.8% of the patients with apparent resistant hypertension (ARH) in this study. This is significantly lower compared to other studies, which report a prevalence of OSAS in 71% to 83% of RH patients.[20-22] In those prospective studies, all patients with resistant hypertension underwent full-night polysomnography to assess for OSAS and its severity. Therefore, our study likely underestimates the true prevalence of OSAS in these patients due to the absence of sleep studies.

In our sample, the screening rate for OSAS was very low, only 6.6% were screened using the ESS or STOP-BANG questionnaire. This suggests that physicians were selective in administering the questionnaire or referring patients to a sleep specialist, likely focusing on patients who exhibited clear symptoms or signs of OSAS. This assumption is supported by the fact that all patients who were screened had positive sleep study.

When analysing gender differences, we found that more women had ARH, and they tended to be older and more obese than the men, consistent with previous studies.[23,24]

Interestingly, OSAS was significantly more prevalent in women (14.1%) compared to men (7.0%). This contradicts existing literature, which generally shows that while OSAS is common in women,[25] it is more prevalent in men, with a male-to-female ratio estimated at about 2:1.[15,26,27] This discrepancy in our results may be attributed to the higher BMI in women, which could have led to more frequent screening and sleep studies, thereby increasing the detection of OSAS among women with RH at SQUH.

As the findings of this study indicate a low screening rate of OSAS among patients with ARH, it is strongly recommended that OSAS screening be integrated into the management plans for all patients with true resistant hypertension. Early identification and diagnosis of OSAS in these patients will allow timely initiation of CPAP treatment, leading to improved blood pressure control and better cardiovascular outcomes.

This study had some limitations that should be considered when interpreting its findings. First, the sample does not represent the true resistant hypertension as white coat hypertension and non-adherence to medications were not excluded from some of these patients. This was a single-center study, conducted exclusively at Sultan Qaboos University Hospital (SQUH) and some patients with resistant hypertension (RH) may have been treated or screened for OSA at sleep clinics in other hospitals, without their records being reflected at SQUH. As a result, some patients with OSA may have been missed. Additionally, the retrospective nature of the study which based on the data gathered from medical records, there is a possibility that the results of OSA screenings or polysomnography (PSG) may have been incomplete or missing from the records.

Conclusion

In conclusion, there is a low rate of screening and investigation for OSAS among patients with apparent resistant hypertension (ARH) at Sultan Qaboos University Hospital (SQUH), resulting in a lower observed prevalence of OSAS. Contrary to published literature, OSA was more prevalent in women, who were screened more frequently, suggesting that OSA in men may have been underdiagnosed. Although this rate may not reflect the true prevalence of OSAS in RH patients, it highlights the need for increased screening efforts to identify OSAS in this population, which could improve blood pressure control and other cardiovascular outcomes. To evaluate the true prevalence of OSAS in resistant hypertension in omani population, a multicenter, prospective study should be conducted.

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