ORIGINAL ARTICLE

Role of Adjusted Neck Circumference Score for Screening of Obstructive Sleep Apnea

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Abstract

Background: Obstructive sleep apnoea (OSA) is a common medical condition diagnosed by polysomnography (PSG). The long waiting timefor PSG prompted researchers to make various pre-test probability scores for triaging the need for PSG. While most scores were formulated and evaluated in preoperative cases, modified sleep apnoea clinical score (SACS), the adjusted neck circumference score (ANCS), was also assessed for pre-test probability testing in OSA. This study was undertaken to explore the role of ANCS in our clinical setting.

Methods: Retrospective analysis of 113 patients with an apnoea hypopnoea index (AHI) of more than 5/hour on PSG was performed. The age and sex distribution was studied. ANCS, SACS and ESS were reviewed and correlated with AHI.Descriptive and analytical statistical analysis was applied.

Results: Hundred and thirteen cases of OSA consisted of 82 men and 31 women were taken. Average AHI of the study group was found to be 34.6 (22.7) per hour. Twenty-six, 34, 53 patients had mild, moderate, severe OSA, respectively.The mean AHI in the mild, moderate, and severe OSA groups were 10.87, 21.19, and 54.21 per hour, respectively. Mean ANCS and SACS were found to be 47.8 (4.7) and 17.8 (12.9), respectively. ANCS of 43 or more could identify 89.3% of cases while SACS was positive (>8) in only 76%. ANCS severity did not correlate with the severity of OSA. Screening patients with ANCS and ESS (>10) could identify all cases of moderate to severe OSA.

Conclusion: It is proposedthat ANCS in adjunct with ESS has the potential to be a simple screening tool for OSA.

Keywords: Polysomnography, Pre-test probability scores, Apnoea hypopnoea index (AHI), Adjusted neck circumference score

Introduction

Obstructive sleep apnoea(OSA) is the most common sleep disordered breathing disorder that involves multiple episodes of cessation or significant airflow limitation due to upper airway collapse during sleep andhas been recognised as an important chronic medical condition[1]. Prevalence ofobstructive sleep apnoea syndrome(OSAS) in population is thought to be between 2 and 5%[2]. It is characterised by symptoms of excessive daytime somnolence (EDS), loud snoring, and nocturnal choking episodes[3]. Epworth sleepiness scoring (ESS)is used to gauge the daytime sleepiness of a patient with value of more than 10 being considered significant[4].OSAS is diagnosed in presence of symptoms and detection of OSA on nocturnal polysomnography

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(PSG). As per American association of sleep medicine (AASM) guidelines, diagnosis of OSA is done by apnoea hypopnoea index (AHI) of more than or equal to 5 per hour on PSG. However, given the time, labour, and cost involved for a PSG study; simple to use screening tests/ scores are essential to streamline patients who genuinely need PSG. Various scores have been introduced to serve this purpose. While, most scores were formulated for the perioperative assessment, they were eventually used in clinical practice to assess the pre-test probability of OSA and the choice of laboratory attended versus portable home based PSG. In spite of the various scoring systems, 80% of OSA remained undiagnosed because the screening tests were either cumbersome or less efficient[5]. Hence, alternate screening scores were developed. One such score formulated was the adjusted neck circumference score (ANCS); a modified form of sleep apnoea clinical score (SACS)[6]. ANCS is calculated by adding to the exact value of neck circumference in centimetres (cm), three points each if the patient complaints of snoring and observed apnoeas and four points further if the patient is hypertensive [ANCS = neck circumference (in cms) + 4 (for hypertension) +3 (for snoring) +3 (for apneoas)][7,8]. ANCS is graded as:less than 43 - low probability of OSA, 43–47 - moderate probability of OSA, more than or equal to 48 - high probability of OSA. This study was undertaken to explore the role of ANCS in a clinical setting.

Aims and Objectives

This study was undertaken to study the role of ANCS over SACS as a screening test for OSA and the correlation between ANCS and severity of OSA.

Materials and Methods

A retrospective study of consecutive adult patients (>18 years), diagnosed with OSA, by PSG in a two-year period from 2012 to 2014 in a tertiary care hospital was proposed. Institution ethics committee approval was obtained. Records of adult patients who were diagnosed as cases of OSAS were reviewed for demographic data, detailed history, and clinical examination. ESS and the pre-test probability scores like SACS, ANCS were noted. The sleep study reports were studied for AHI values and severity classification of OSA as per AASM criteria. Statistical analysis was done as follows. A descriptive analysis of demographic data, distribution for SACS, ANCS, and ESS was done using mean and percentages. True positive identified by SACS and ANCS were compared in percentages. Student T test was used to analyse the significance in differences of percentages and means wherever required. Pearson correlation coefficient was calculated for ANCS and severity of OSA.

Results

Of the 116 patients, 3 were excluded as they were children. Rest 113 patient records were selected for the study. Mean age of the patients was 50.45(10.98) years. Men and women consisted of 82 and 31 of the patients, respectively. The male to female ratio was 2.65:1. Eighteen (15%) of the study population were under 40 years of age with male to female ratio of 5:1. Ninety-five (85%) of the study candidates were over 40 years of age with a male to female distribution of 2.35:1. The age-sex distribution is given in Table 1. Average AHI of the study group was found to be 34.6 (22.7) per hour. Twenty-six (23%) patients had mild OSA, 34(30%) had moderate OSA and 53(47%) had severe OSA. The mean AHI in the mild OSA, moderate OSA, and severe OSA groups were 10.87, 21.19, and 54.21 per hour, respectively. Mean ANCS and SACS were found to be 47.8(4.7) and 17.8(12.9), respectively. The characteristics in each group of mild, moderate, and severe OSA are depicted in Table 2. Distribution of AHI with ANCS and SACS is summarised in Table 3 and Fig. 1. Keeping a cut off of more than 42 for ANCS and more than 7 for SACS; 89.3% of study population had significant ANCS as compared to 76% having significant SACS. These difference in percentage was found to be statistically significant (p=0.006) (Fig. 2). In patients who had low probability as per ANCS (<43), 53.8% had severe OSA. Hence, a combination of ESS and ANCS was considered. Average ESS of the present study group was 13.9 (3.6) with 87.6% having a significant ESS (>9); of these 81.8% had severe OSA.When ANCS>42 and ESS >9 was considered, the combination could identify all patients with moderate to severe OSA. Correlation between ANCS and OSA severity was poor (r=0.23),which was statistically significant (p<0.05) (Fig. 3).

Table 1: Age-sex distribution

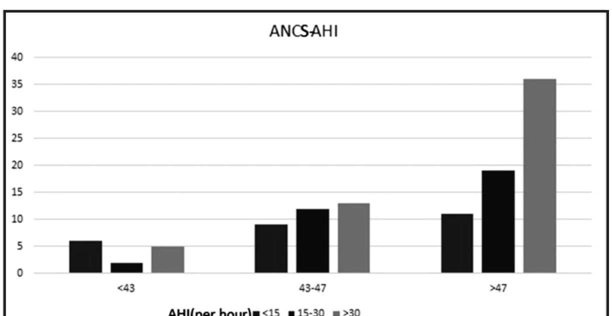
Gender	Total	Age<40
Males	82	15
Females	31	3
Total	113	18

Table2: Distribution of various characteristics in OSA

Characteristics	All	Mild OSA	Moderate OSA	Severe OSA
Age (mean)	50.45	51.76	51.78	49
Gender (M/F)	82/31	17/9	21/12	44/10
ESS (mean)	13.92	11.84	13.27	15.33
SACS (mean)	17.80	12.84	17.51	20.37
ANCS (mean)	47.83	45.84	47.81	48.79
AHI (mean)	34.60	10.87	21.19	54.21
Total	113	26	33	54

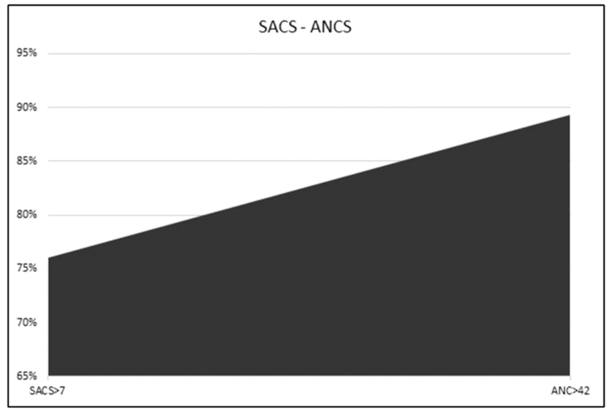
Table 3: Distribution of ANCS over mild, moderate, and severe OSA

Adjusted neck circumference score			
AHI	<43	43-47	>47
5–14.9	6	9	11
15–29.9	2	12	19
>=30	5	13	36



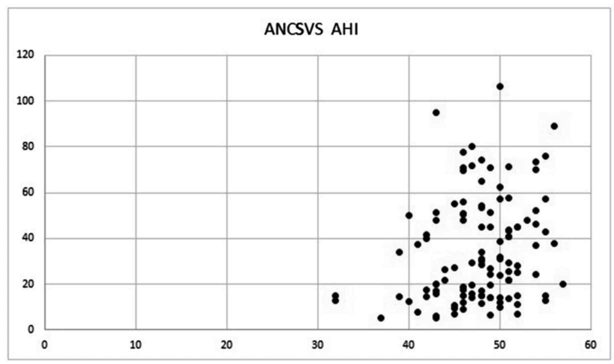
ANCS-Adjusted neck circumference score; AHI-Apnea-hypopnea index; OSA-obstructive sleep apnea

Figure 1: Distribution of OSA severity over ANCS severity



SACS-sleep apnea clinical score; ANCS-Adjusted neck circumference score

Figure 2: Comparison of positive proportions of SACS and ANCS in study group.



ANCS-Adjusted neck circumference score; AHI-Apnea-Hyponea index

Figure 3: Scatter diagram showing the ANCS and AHI correlation.

Discussion

OSA and OSAS are subsets of sleep-disordered breathing. OSA is the occurrence of an average 5 or more episodes of obstructive respiratory events (apneoas, hypopnoeas, or RERAs) per hour of sleep with either sleep related symptoms or comorbidities or =15 such episodes without any sleep related symptoms or comorbidities. OSAS is defined as OSA associated with daytime symptoms; most often excessive sleepiness[9]. Community based epidemiological studies from India have shown that the prevalence of OSAS is 1-5%. There is no considerable variation in the prevalence of OSAS compared to rest of the world[9]. Certain risk factors associated are older age, male gender, pregnancy, post-menopausal state, obesity, central body fat distribution, increased neck circumference, and upper airway abnormalities[9]. OSA has multisystem effects. It is a very important risk factor for systemic hypertension and resistant hypertension. It is associated with an increased prevalence of coronary artery disease, congestive cardiac failure, and arrhythmias[10]. There is an increased risk of cerebrovascular diseases, diabetes mellitus, dyslipidemias, and metabolic syndrome. Neurocognitive effects of OSA include slow thought process, early forgetfulness, impaired concentration, decreased workrelated performance, impairment in verbal episodic memory, visuospatial episodic memory, attention span, driving ability, vigilance, and executive function. Excessive daytime sleepiness in OSA has been associated with increased risk of motor vehicle accidents. More so, the chronic nature of the disease is associated with a profound impact on mental health and quality of life. As per AASM guidelines, diagnosis of OSA is done by AHI of more than or equal to 5 per hour on PSG. OSA severity is classified as mild- AHI 5-15/hour, moderate- AHI 15-30/hour, severe- AHI 30/hour or more[9]. Conventional PSG (type 1) study or in-hospital, in-laboratory, technician-attended, overnight PSG is the gold standard for evaluation of sleep-disordered breathing. Due to the time consuming, long waiting periods for the type 1 PSG alternatives were developed. Portable monitoring (PM) is used as an alternative to PSG for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA. Portable monitoring uses simpler devices (which should at least include airflow, oxygen saturation and respiratory effort).

In spite of these newer technologies, the prioritisation and use of PSG/PM was a challenge. Hence, came the era of evolution of the various pre-test probability scores. The various scores developed included Flemon's SACS in 1994[6], Berlin score in1996[11], ASA scoring in 2006[12], STOPBANG in 2008[13], and PSAP score in 2010[14]. In 1994, Flemon et al[6]. proposed a clinical prediction model for sleep apnoea which included 4 parameters, neck circumference, hypertension, history of snoring, and observed apnoeas. The Berlin questionnaire (1996) consisted of 10 questions in 3 categories with no measurements involved. The ASA checklist (2006) had 14 questions in 3 categories including calculated and measured values. The STOPBANG (2008) had 8 points including historical facts, calculated, and measured values. PSAP (2010) had 9 items including calculated and measured values and a special airway examination. Researchers from Mayo clinic reformulated SACS in 2009, with same parameters arranged in a tabular form with predetermined points. Still 80% of OSA remains undiagnosed, points to the fact that the screening tests were either cumbersome or less efficient. The main reason was that most of these tests were primarily designed to screen only preoperative patients and had the limitation of patient selection bias. Hence, alternate screening scores were developed. One such score was ANCS, a modified and simplified form of SACS[6]. SACS is cumbersome as it requires reference to the tabular values, whereas ANCS is calculated by adding to the exact value of neck circumference in centimetres, three points each if patient complaints of snoring and observed apnoeas and four points further if he is hypertensive[7]. Compared to other sleep scores described, ANCS had the advantage of being simple enough for use in an out-patient department screening.

The traditional OSA prevalence rate of 2-5% is currently being reconsidered[15]. Few studies are available on Indian population and have estimated prevalence of OSA in Indians to be around 13%[16]. The age and sex distribution is depicted in Tables 2 and 3.It corresponds with earlier studies[5,17]. Of our OSA patients,10.6% were older than 65 years of age.The male to female ratio in earlier community studies were reported around 2-3:1[18,19]. Two to five-fold increase in OSA is seen in men with the gap narrowing as age advances[15]. This difference is mainly attributed to the effect of sex hormones in women playing a protective role and anatomical differences in upper airways[15].Also male pattern of fat distribution concentrates around upper airways and hence is regarded as the cause for having higher prevalence of OSA. Many large epidemiologic studies have showed that post-menopausal women have increased prevalence of OSA[20-22]. This reflects in the observation of the male to female ratio of 5:1 in under 40 years decreasing to 2.35:1 in over 40 years age group. Women tend to under report their symptoms and higher prevalence of diseases such as hypothyroidism and depression may cause underdiagnosis of OSA in them. Also, it was observed that women have a lower AHI than men[23]. In the present study, the average AHI was 31.7/hr and 35.6/hr in women and men, respectively, the differencehoweverwas not statistically significant.

ESS described in 1991, is a self administered questionnaire for subjective assessment of sleepiness[24]. Patient is asked to rate their chance of dozing off in a score of 0-3 in 8 different daily life situations. It was shown to be high (>10) in patients with sleep disordered breathing and have been used extensively in OSA evaluation[25]. However, hypersomnolence may not be a significant complaint in 40% of patients and ESS should not be confused for a pre-test probability score[26]. In the present study 12.3% patients had ESS <10 and 42.8% among them had moderate to severe OSA. The present study was able to show a significantly higher proportion of true positives detected by ANCS compared to SACS. As BMI is a poor predictor in Asian population for obesity related complications we suppose, ANCS will be more ideal screening tool for our population[27]. A cut off of more than 42 for ANCS could screen 89.3% of the present study population. However, neither difference in ANCS in the mild, moderate, and severe OSA group was statistically significant nor the ANCS and OSA severity correlate in the present study. In contrast, a 2007 study showed a significantly higher ANCS in patients with moderate-severe OSA[8]. They further found that 37.8% of patients with mild OSA had a score >48, 56.6% with moderate–severe OSA had a score >48, 70.9% with severe OSA had score >48. 86.5% of males with severe OSA had a score >48.A 2011 study concluded that the ANCS could be used to distinguish mild from moderate to severe OSA[28]. However, the score did not show a significant correlation with AHI as seen in the present study.

Limitations of the present study were that it was not a population based study. Further, sensitivity and positive predictive value of ANCS could not be calculated as this was a retrospective study and patients were selected based on in-hospital screening method.

Conclusion

ANCS could identify significantly more true positives when compared to conventional SACS. The present study demonstrated no significant correlation between ANCS values and severity of OSA. ANCS $\geq$43 and ESS$\geq$8 could effectively screen in all patients with moderate to severe OSA in this study. It is proposed that ANCS in adjunct with ESS has the potential to be a simple screening tool for high risk patients visiting an OPD. However, further validation of this observation need to be done by a community based study.

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