CHEST

Original Research

SLEEP DISORDERS

The Utility of the Elbow Sign in the Diagnosis of OSA

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Background: **Multiple questionnaires have been used to predict the diagnosis of OSA. Such models typically have multiple questions requiring cumulative scoring for interpretation. We wanted to determine whether a simple two-part questionnaire has predictive value in the pretest clinical evaluation for OSA.**

Methods: **A questionnaire consisting of two questions—(1) Does your bed partner ever poke or elbow you because you are snoring? and (2) Does your bed partner ever poke or elbow you because you have stopped breathing?—was prospectively administered to patients evaluated in a sleep disorders clinic prior to undergoing polysomnography. Age, sex, BMI, and Epworth Sleepiness Scale data were collected.**

Results: **Among the 128 patients who had a polysomnogram, answering "yes" to being awakened for snoring increased the OR of an apnea-hypopnea index ≥ 5/h 3.9 times compared with "no." Answering "yes" to being awakened for apneic spells was associated with an OR of 5.8 for an apnea-hypopnea index ≥ 5/h compared with "no." These associations did not differ by sex, BMI, Epworth Sleepiness Scale or answering "yes" to the other question. Subjects > 50 years old with OSA were less likely to report a positive elbow sign and had a significantly lower OR for being awakened for apneic spells than those < 50 years old. The sensitivity and specificity of being awakened for apneic spells was 65% and 76%, respectively, with a positive predictive value of 90%. Subgroup analysis revealed that in men with a BMI > 31 a positive elbow sign had a specificity of 96.6% for a diagnosis of OSA.**

Conclusions: **Among patients referred to a sleep disorders clinic, a positive response to being elbowed/poked for apneic spells significantly improves the pretest prediction of OSA.**

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Abbreviations: AHI = apnea-hypopnea index; ESS = Epworth Sleepiness Scale; PPV = positive predictive value; PSG = polysomnography; SDC = sleep disorders clinic

OSA is a common disorder[1] that is associated with hypertension and cardiovascular disease,[2] increased risk of motor vehicle accidents,[3] and increased healthcare costs along with increased absenteeism and decreased productivity in the workplace,[4] all of which have significant individual and societal consequences. OSA remains undiagnosed in a significant proportion of the population,[5] in part related to underrecognition; however access to testing facilities is a major barrier to diagnosis in many jurisdictions. In 2004, Flemons et al[6] reported the wait time for polysomnography (PSG) in Canada was 4 to 35 months, 7 to 60 months in the United Kingdom, and 2 to 10 months in the United States. Other reviews suggest that poor access remains a significant issue.[7] As a result,

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adaptations including increased use of level 3 testing[8] and even empirical use of CPAP[9] have been implemented. It has also meant that waiting lists for PSG are carefully monitored and triaged, often according to health risk (cardiovascular comorbidities) and societal risk (eg, truck drivers).

Multiple clinical prediction models and questionnaires have been published to aid in the diagnosis of OSA.[10] However, such models are cumbersome to use in the clinical setting and have not been widely accepted. Several questionnaires,[11-16] including the Berlin questionnaire and the STOP-Bang questionnaire, have been developed to improve pretest prediction of OSA. The Berlin questionnaire has been validated in the general population but has limited diagnostic specificity. The STOP-Bang questionnaire was developed as a preoperative screening tool to identify high-risk surgical patients who require diagnostic testing for OSA. As such, it achieves a high sensitivity but low specificity with a score under 4 with improved specificity at higher scores in patients awaiting surgery.[17] In a review, Abrishami et al[18] reported that many questionnaires are specific to certain populations, but overall have limited sensitivity and specificity in the diagnosis of OSA. All of the models and questionnaires developed to date have multiple questions and domains to remember along with scoring systems that make them cumbersome and of limited usefulness in the clinical setting.

We recognized that many patients presenting to our sleep disorders clinic (SDC) often reported being elbowed or poked by their bed partner because of snoring or witnessed apneic spells. We hypothesized that simply asking about this phenomenon, particularly related to apneic spells, has diagnostic value in identifying patients with OSA.

Materials and Methods

Ethics approval was obtained from the University of Saskatchewan Biomedical Research Ethics Board (Bio No. 09-173). A simple self-administered questionnaire consisting of the following two questions was developed: (1) Does your bed partner ever poke or elbow you because you are snoring? and (2) Does your bed partner ever poke or elbow you because you have stopped breathing? It was administered prospectively to patients referred with a suspected sleep disorder to the SDC at the University of Saskatchewan. No exclusion criteria were applied, and no specific inquiry as to the existence of a current bed partner was made. Participants' age, sex, BMI, and Epworth Sleepiness Scale (ESS) score were also collected. At the discretion of the responsible sleep physician, who was blinded to the results of the questionnaire, patients were referred on for further diagnostic testing with either PSG or level 3 testing. Typically, level 3 testing is used for patients without serious comorbidities deemed to have a high pretest probability of OSA. However, such patients may also be referred for PSG depending on other considerations including, but not limited to, occupation and distance to care. The majority of testing within our region is coordinated through our SDC, which offers both attended in-laboratory level 1 PSG and home-based level 3 testing. Our SDC is the only source of level 1 testing locally. However, there are both private (direct cost to patient) and public (indirect cost to patient) avenues for level 3 testing. Patients sent for PSG were placed on a common waiting list. PSG was done according to the usual clinical practice in our SDC independent of individual questionnaire results.

PSG (Sandman software, version 9.1; Mallinckrodt) was done using standard American Academy of Sleep Medicine protocols[19] and supervised by registered sleep technicians who were blinded to the questionnaire results. The studies were scored in accordance with the American Academy of Sleep Medicine scoring manual[20] by registered sleep technicians and interpreted by sleep physicians, all of whom were blinded to questionnaire results. For the purposes of this study, a PSG result was considered positive for OSA if the apnea-hypopnea index (AHI) was $\geq$5/h in accordance with standard definitions of OSA. Values $<$5/h were considered negative. If a split-night protocol was used, only the diagnostic portion of the night was used to determine AHI. Individual management of each patient was left to the discretion of the most responsible physician independent of this study.

Average wait time for PSG in our SDC was approximately 270 days, despite careful triage and implementation of a level 3 care pathway. Because of the unpredictability of the date when all patients would have completed testing, we elected to sample our database 1 year after closing enrollment.

Basic descriptive statistics (mean, median, SD, range, and proportion) were calculated as appropriate to describe the study subjects regarding age, BMI, sex, ESS result, and awakening by sleeping partner for snoring or apnea. χ^2 and t test analyses were used to compare categorical and continuous characteristics, respectively, between those with and without a positive PSG result, defining a positive result as an AHI $\geq$ 5. Positive PSG results were also subdivided by severity into mild, moderate, and severe categories, respectively, defined by AHI values of 5 to 14.9, 15 to 29.9, and $\geq$30. Results were deemed statistically significant at P values $<$.05, and all analyses were undertaken using SPSS Statistics for Windows, version 20.0 (IBM).

Awakening by partner for snoring and awakening by partner for apnea in relation to PSG outcome were initially examined individually using two separate univariate logistic regression models. To assess the consistency of these associations in different population subgroups, the models were repeatedly evaluated, each time with the inclusion of a different covariate and its interaction with the key snoring or apnea variable. Overall sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios were also calculated. The Mantel-Haenszel χ^2 (linear-by-linear association) test was used to assess whether a statistically significant trend toward higher probabilities of partner-initiated awakening could be seen with increasing OSA severity.

Additional consideration was given to the utility of evaluating partner-initiated awakening for snoring or apnea in conjunction with other well-established OSA risk factors, specifically for the purpose of developing an easily recognizable pretest profile of high probability subjects in the context of this referred population. Only the variables of BMI, age, sex, and partner-initiated awakening for snoring or apnea were considered as potential characteristics due to their relatively simple clinical assessment. Again, for ease in real-world application, continuous variables were categorized only utilizing two categories; for effective grouping, various cutpoints were evaluated for each variable, determining divisions with strong positive predictive values (PPVs) and at least a moderate degree of sensitivity. The variables were entered into a logistic regression model, and statistically significant variables were further examined in all possible two- to four-term combinations. Among these, a subgroup of statistically significant characteristics producing the model with greatest estimate precision (narrowest CIs) was