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STOP Questionnaire Warrants CAUTION Sign

To the Editor:—Chung and colleagues are to be commended for simplifying the screening process for obstructive sleep apnea (OSA) by developing the STOP questionnaire using an apnea hypopnea index (AHI) derived during polysomnography as the "gold standard" for OSA.[1] Having recently used the AHI in evaluating high-resolution pulse oximetry as a perioperative screening tool for OSA in surgical patients, we would like to draw attention to several limitations of the AHI.

In their methods, Chung and colleagues score the AHI according to "standard criteria," referencing the 1999 recommendations of the American Academy of Sleep Medicine Task Force on definitions and measurement techniques during polysomnography. Unfortunately, the American Academy of Sleep Medicine stated in the revised *Manual for Scoring Sleep and Associated Events* as recently as 2007 that there is as yet no consensus on scoring the AHI.[2] Redline's group has shown that the median value of AHI rendered by polysomnography can vary as much as 10-fold, depending on the definition of hypopnea used in scoring the AHI.[3] Manser and colleagues demonstrated that three different but acceptable scoring systems yielded significantly different disease prevalence and severity estimates.[4] Differences in signal averaging times of pulse oximeters used during polysomnography can also affect the AHI, and standardization of oximetry techniques during polysomnography remain lacking.[5] It is thus possible that Chung's predictive parameters for disease severity (table 6) may "shift" significantly between severity classifications if correlated with AHI measured in other centers. This may partly explain the decline in specificity and positive predictive value of all three tools (STOP, Berlin, and American Society of Anesthesiologists Screen) with increasing severity of disease.[6] More clarity could be brought to the severity data by presenting nonoverlapping categories ($5 < AHI < 15 < AHI < 30 < AHI$) and including sample sizes. Were the low specificity and positive predictive value demonstrated a result of small sample size in the moderate and severe categories, or do these findings simply corroborate the low specificities from the other studies cited? While we agree that high sensitivity is the primary goal of a screening tool, specificity (and positive predictive value in a low-prevalence population) must also be considered in this setting, as extensive monitoring of patients mistakenly identified as being at higher risk of complications is expensive, and leads to reduced vigilance by postoperative caregivers.

Lastly, the inability to demonstrate an increase in postoperative complications in patients with severe OSA may not be entirely attributed to their postoperative intensive care monitoring, or to ambiguity in defining AHI thresholds. The AHI is simply the sum of the number of apneas and hypopneas during polysomnography, averaged per hour of total sleep time. It provides no information as to the events' duration, magnitude or rate of desaturation, adequacy of ventilation recovery in response to apneas, or the level and stability of the arousal threshold during sleep. For example, Patient A shows 8 apneas per hour, a high arousal threshold in response to hypoxemia, a mean event duration of 50 s, and a rapid desaturation rate of 0.8% per second (falling to a mean Spo_2 nadir of 56%). This patient has an AHI of 8, and is deemed to have "mild" OSA. In contrast, patient B shows 35 hypopneas per hour, with a very low arousal threshold such that each hypopnea is reversed by an electroencephalographic arousal, without oxygen desaturation. Patient B is calculated to have an AHI of 35 ("severe" OSA). Yet patient A is at much higher risk of a postoperative respiratory complication than patient B, even though the AHI suggests the inverse. The AHI may lack the discriminating power to stratify risk in the postoperative environment, where, unlike the sleep laboratory, patients' respiratory function is challenged by opiates, sleep deprivation, and rapid eye movement sleep rebound. Even sleep specialists are weary of relying on the AHI as a surrogate of disease severity.[7]

The STOP questionnaire is a practical step forward in identifying patients with OSA ($AHI > 5$). It will require refinement and supplementation before we have a tool that can quantify risk, guide postoperative monitoring, and predict outcome in our expanding population of surgical patients with OSA.

Frank J. Overdyk, M.S.E.E., M.D.,* Qanta A. Ahmed, M.D., F.A.A.S.M., F.C.C.P., Philip F. Rust, Ph.D. *Medical University of South Carolina, Charleston, South Carolina. overdykf@musc.edu

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In Reply:—In the letter to the editor titled "STOP Questionnaire Warrants CAUTION Sign," Dr. Overdyk and colleagues raised some interesting issues regarding the apnea-hypopnea index (AHI) and our papers.

With the variation between different sleep centers, and even different nights for the same patient at the same sleep center,[1,2] there have been different opinions regarding the definition and interpretation of the AHI. Considering the feasibility and cost, we chose the result of one night of in-laboratory polysomnography as the gold standard to validate the STOP questionnaire. When we started our study in early 2006, there were no widely accepted mandatory agreements on the definition of the different measurements in polysomnography. The majority of sleep laboratories followed the recommendations of the Academy of Sleep Medicine Task Force, published in 1997.[3] The Academy of Sleep Medicine has since published a new manual for the scoring of sleep and associated events in 2007.[4] The new manual is mandatory to be followed in United States after July 1, 2008.*

* American Association of Sleep Technologist, 30th Anniversary Meeting, Berverly Garcia, R.P.S.T.G., C.R.T., Living with the New AASM Scoring Manual. http://www.aastweb.org. Accessed September 12, 2008.

Comparing the criteria that we used with the 2007 manual, there is no difference regarding the definition of apnea. However, there are some changes in the definition of hypopnea. In the criteria we used, an episode of hypopnea was defined as a reduction of nasal air flow ≥ 50% with a drop in pulse oxygen saturation ≥ 3% which last more than 10 s. In the 2007 manual, either a drop of pulse oxygen saturation ≥ 4% with a decrease of nasal air flow ≥ 30% or a drop of pulse oxygen saturation ≥ 3% with a decrease of nasal air flow ≥50% which last ≥ 10 s will be defined as 1 episode of hypopnea. The definition in the 2007 manual for hypopnea is broader than the definition we used for our study.

In our 177 study patients for validating the STOP questionnaire, the severity classification based on the AHI and number of patients in each group can be found on page 817;[5] AHI ≤ 5:55, AHI > 5 and ≤ 15:52, AHI > 15 and ≤ 30:31, and AHI > 30:39. When doing the analysis of predictive parameters, we had to classify patients into either smaller or bigger than the cutoff value and use this classification to evaluate the screening tools. That is the reason why we combined patients with moderate and severe obstructive sleep apnea (OSA) in one group to evaluate the capacity of screening tools to identify this group of patients.

We agree with Dr. Overdyk and colleagues that the duration of oxygen desaturation, apnea and hypopnea, rate of desaturation, adequacy of ventilation recovery, and level and stability of the arousal threshold are very important factors in evaluating the severity of OSA, especially for assessing the potential to trigger other perioperative adverse events. However, there is no agreement yet on how to incorporate these factors into the severity classification of OSA patients.

Our main focus was to develop and validate a concise and easy-to-use screening tool for preoperative clinics. We agree with Dr. Overdyk and colleagues that the STOP questionnaire is a practical step forward in identifying patients with OSA, and it bears the same limitations as other questionnaires. To more accurately stratify the perioperative risk, guide postoperative monitoring, and predict outcome, we need to combine the score of the STOP questionnaire with the other information such as the need for narcotics and the invasiveness of the surgery. These points were illustrated in the American Society of Anesthesiologists guideline on the perioperative management of OSA patients.[6]

Frances Chung, F.R.C.P.C.,† Pu Liao, M.D. †University of Toronto, Toronto Western Hospital, University Health Network, Toronto, Ontario, Canada. Frances.Chung@uhn.on.ca

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Concerns about the Validation of the Berlin Questionnaire and American Society of Anesthesiologist Checklist as Screening Tools for Obstructive Sleep Apnea in Surgical Patients

To the Editor:—In the May 2008 issue of ANESTHESIOLOGY, Chung *et al.* published an article where they describe the validation of the Berlin questionnaire and the American Society of Anesthesiologist checklist as screening tools for obstructive sleep apnea in surgical patients, and compare them with the STOP questionnaire.[1] The authors conclude that both the STOP and American Society of Anesthesiologists checklist were able to identify patients who were likely to develop postoperative complications. However, after taking a look at the results, I believe that it would have been more accurate to mention respiratory complications in particular. Moreover, when reviewing the odds ratios for effectors on the incidence of postoperative complications, I am concerned to find that the confidence intervals for both the STOP and American Society of Anesthesiologists checklists include the null value.[2] In contrast, the odds ratio for the STOP-Bang questionnaire presents a confidence interval that does not comprise the null value.

With reference to the potential limitations for this study described by the authors, I agree with them about the possible bias associated with self-selection of patients. Only 416 (17%) of 2,467 patients gave consent to participate in a polysomnographic study, whereas finally 211 (8.6% of the total population) showed up to undergo it. Another issue is, when reading the analysis of those 211 patients, there is little valuable information left about their preexisting conditions, such as number of smokers, type of surgery and anesthesia technique given,[3] or patients suffering from asthma or other pulmonary diseases, which could have been desirable to discuss when comparing the higher incidence of respiratory complications among patients with higher scores in the questionnaires. Knowing more about preexisting morbidities might have allowed classifying patients to make comparisons between them in further multivariate analyses.

At the same time, following the requirement in one hospital to closely monitor patients with an apnea-hypopnea index greater than 30, the authors did not find this variable to be a risk factor for postoperative complications. I would want to know what result would have been obtained had those patients been excluded from the analysis.

To sum up, I believe that this study presents some unsatisfactory points that hamper the conclusions given and deserve to be addressed in more detail.

Jose Ramon Perez Valdivieso, Ph.D., M.D.,* Maira Bes-Rastrollo, Pharm.D., Ph.D. *Clinica Universitaria, University of Navarra, Spain. jrpvaldi@unav.es

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