Obstructive sleep apnea and perioperative delirium among thoracic surgery intensive care unit patients: perspective on the STOP-BANG questionnaire and postoperative outcomes

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According to the Diagnostic and Statistical Manual of Mental Disease (DSM-5), delirium is an acute fluctuating disturbance in attention and awareness. Due to physiologic perturbations, delirium results in cerebral dysfunction and cognitive impairment (1). Among hospitalized patients delirium is associated with increased morbidity, length of stay (LOS), costs and mortality (2). Moreover, there is evidence that patients who develop delirium experience an accelerated degree of long-term cognitive decline compared to those that do not experience delirium while hospitalized (3). In their paper, "Preoperative STOP-BANG Scores and Postoperative Delirium and Coma in Thoracic Surgery Patients," Wang and colleagues sought to assess the relationships between obstructive sleep apnea (OSA), delirium and postoperative outcomes among thoracic surgery intensive care unit (ICU) patients.

Upwards of 20% of hospitalized patients suffer from delirium and is some series that number is as high as 50% among the surgical population (4). Gross and colleagues documented that patients with delirium maintained a more rapid pace of cognitive deterioration throughout a 5-year period following hospitalization (3). Further, patients who developed delirium had a 62% increased risk of mortality compared to patients without delirium (5). Associated with the loss of life, delirium also significantly effects on the cost of healthcare. Patients over 65 years old who developed delirium have related inpatient and discharge facility costs as high as $143–$152 billion annually (5). Franco *et al.*, assessed the costs associated with delirium among elective surgical patients and found that. patients with delirium had an increased LOS, increased third party payor costs and reduced returns to physicians and hospitals (2).

Due to the substantial costs to patients in terms of increased morbidity and mortality, and to the healthcare system in terms of healthcare expenditures, it is imperative that we identify patients at significant risk of developing postoperative delirium and institute preventive measures. Vasilevskis and colleagues have divided risk factors of delirium into "patient vulnerability factors" and modifiable "precipitating factors" that may occur following surgery. Less easily modified vulnerability factors include a diagnosis of dementia, advanced age and the type of surgery received. Modifiable factors that precipitate delirium include catheter associated urinary tract infections, hospital associated pneumonia, electrolyte abnormalities, medication/substance withdrawal and sleep disturbance (6,7). In a study of postoperative patients, Flink and colleagues identified that among patients 65 years old and older with OSA, 53% developed postoperative delirium compared to 20% of those without OSA (8).

OSA is a breathing disturbance caused by obstruction of the upper airway during sleep. The standard for diagnosis

is overnight polysomnography (PSG). PSG detects the frequency of apneic and hypopneic events and the apnea-hypopnea index (AHI) is the average number of disordered breathing events per h (9). OSA is associated with delirium and poorer outcomes, including increased likelihood of ICU admission, postoperative complications and increased LOS (10). The sequelae of OSA include cardiovascular disease, cerebrovascular disease, diabetes, long term cognitive impairment and increased all-cause mortality. Moreover, sleep apnea is underdiagnosed (11), and hence often untreated. Compared with treated OSA, untreated OSA is associated with arrhythmias, cardiac arrest, myocardial infraction, unplanned reintubation, pulmonary embolism and pneumoniae (10).

STOP-BANG is a validated 8-item questionnaire used to risk stratify patients for OSA. Survey scores range from 0–8 (12). The tool demonstrates a sensitivity of 84–100%, and a specificity of 40% (11,12). There is some evidence that adjuncts, such as bicarbonate levels, can be utilized to improve the predictive probability of the tool (12). Patients with a score of 0–2 are considered low risk. Scores 5–8 are considered high risk. Patients with scores in the midrange are considered moderate or intermediate risk for OSA. Farney and colleagues have demonstrated that STOP-BANG is effective in identifying patients with varying severity of OSA as defined by the AHI (13). Due to the relationship between sleep disturbances and delirium, OSA is a potential modifiable risk factor among thoracic surgery ICU patients at risk of developing delirium in the postoperative period. It is imperative to identify and address risks factors which may decrease the incidence or severity of delirium and mitigate its consequences.

The study by Wang and colleagues was an a priori analysis of the Preventing Postoperative Delirium Trial (PEPOD). PEPOD is a single institution randomized double blind placebo-controlled trial that examined the effects of low dose haloperidol on postoperative delirium among thoracic surgery ICU patients. Briefly, patients undergoing non-cardiac thoracic surgery were randomized to receive prophylactic 0.5 mg of intravenous haloperidol three times daily for 11 doses versus placebo. Among the entire cohort, no statistical differences in the incidence, duration or severity of delirium were identified between the two groups. When patients were stratified by surgery type, esophagectomy patients who received haloperidol were less likely to develop delirium compared to esophagectomy patients who received placebo.

Regarding the current study, all patients completed the STOP-BANG questionnaire prior to surgery, but only 18 patients had a prior documented diagnosis of OSA confirmed by a sleep study. Three of these patients experienced resolution of their prior OSA following weight loss or surgery and 8 admitted that they were non-compliant with their home continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP). Of the remaining 7 patients who were receiving active treatment, five were using CPAP and 2 were using BiPAP at home. Unfortunately, the use of inpatient CPAP and BiPAP in the 15 patients with known active OSA was not included in the study model as a covariate. The remaining 117 patients on the study were not assessed for evidence of occult OSA, even though, as the authors point out, rates of undiagnosed OSA in surgical patients may be as high as 80% (14,15). Patients were stratified by OSA risk. STOP BANG [consist of Snoring, Tired, Observed (to stop breathing), Pressure (high blood pressure), Body mass index (BMI >35 kg/m^2), Age (>50 years old), Neck size (≥40 cm), and Male] scores 0–2 were considered low risk, 3–4 defined as intermediate and 5–8 high risk (14). Based on the STOP-BANG tool 31 patients were low risk, 60 were intermediate risk and 37 high risk. The authors first noted that there were no differences in the incidence of delirium and coma between the intermediate and high-risk groups so they combined the two into a "intermediate-high-risk" group for purposes of statistical analysis.

Following surgery, patients were screened for coma and delirium twice a day using the Richmond Agitation Sedation Scale (RASS) and the confusion assessment method for the ICU (CAM-ICU). RASS and CAM-ICU are both validated tools utilized to assess level of consciousness, agitation and delirium (15,16). Data were collected by blinded assistants. The management of delirium in the PEPOD treatment protocol, included narcotics for pain control and propofol, dexmedetomidine, haloperidol and other anti-psychotics were used for agitation and sedation. There was no information regarding medication frequency or dosing for patients who required these medications in the current article, including for the subject of the study haloperidol.

Regarding risk factors for OSA, the study identified that a high risk of OSA was associated with older age, male gender, higher BMI (all assessed by the STOP BANG scale) and a higher number of comorbid conditions. There were no measurable differences in the incidence of delirium between the intermediate-high risk and low risk groups (P=0.7). However, patients in the intermediate-high risk group were significantly more likely to develop

the combined outcomes of delirium and coma compared to the low risk group, 80.4% versus 45.2%, respectively (P=0.032). They also suffered more days of delirium, 1.7±1.3 versus 0.9±1.4 (P=0.042), respectively. The mean daily delirium rating was higher among patients with an intermediate-high risk of OSA, however this did not reach statistical significance, 1.5±0.8 versus 0.7±0.6, respectively (P=0.101). Those in the intermediate-high risk OSA group had a trend toward increased postoperative complications including arrythmias, however this did not reach statistical significance. Overall there were no significant differences in length of ICU stay, number of mechanical ventilator days or length of overall hospital stay.

The findings of this study, however, must be interpreted with caution for a number of reasons. First, failure to quantify statistically significant differences between the low risk and intermediate-high risk group regarding postoperative delirium and complications may be simply an artifact of the original study design (not intended to address the STOP BANG risk of delirium) and of the relatively small sample size. Furthermore, the actual variable that the STOP BANG scores attempts to measure, i.e., OSA, is an uncontrolled and unmeasured variable in this study, which easily could be unbalanced between the experimental groups. The authors admit that only 18/135 (13.3%) patients had a prior documented diagnosis of OSA confirmed by PSG and that the true prevalence of OSA in their study population was likely much higher. Although the need for thoracic surgery is defined as a "vulnerability factor", an accurate diagnosis of OSA in this patient population is an important modifiable "precipitating factor" for delirium, which should be addressed both preoperatively and postoperatively through techniques for maintenance of airway patency, medication optimization, and management of related comorbid conditions (6). Finally, the reported findings relate only to thoracic surgery patients who are managed in the ICU. The management setting of postoperative thoracic surgical patients varies significantly between institutions and between surgeons. Similar patients may be managed on monitored surgical floors, in step-down units, or in the ICU, depending on institution and surgeon. The risk of delirium in each of these other hospital settings may be substantially different from the ICU; and therefore, as a single institution study, these results cannot be generalized due to these as well as other differences in practice patterns and culture. A prospective, multi-institutional study on the utility of STOP-BANIG scores in thoracic surgery patients could address these issues. Ideally in such a study, the diagnosis of OSA would be confirmed with a preoperative sleep study followed by appropriate therapeutic interventions, and standardized postoperative management in a variety of hospital management settings. Only then will evaluation of STOP BANG predicted postoperative outcomes including delirium, agitation, coma, ICU days and LOS be truly possible.

Acknowledgements

Footnote

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