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Original Article

Obstructive sleep apnea screening and postoperative mortality in a large surgical cohort

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ABSTRACT

Objective: A recent investigation at Barnes-Jewish Hospital located in St. Louis, Missouri, found that an estimated 22% of adults presenting for inpatient surgery screened as high risk for obstructive sleep apnea (OSA). Surgical patients with OSA have multiple comorbidities and are at increased risk for perioperative complications. Our objective was to determine if a prior diagnosis of OSA or a positive screen for OSA was associated with increased risk for 30-day and one-year mortality.

Methods: B-J APNEAS (Barnes-Jewish Apnea Prevalence in Every Admission Study) was a prospective cohort study. Unselected adult surgical patients at Barnes Jewish Hospital were prospectively enrolled between February 2006 and April 2010. All patients completed preoperative OSA screening and those who were at risk for OSA according to a combination of the Berlin and Flemons screening tools received targeted postoperative interventions. STOP (loud Snoring, daytime Tiredness, Observed apneas, and high blood Pressure) and STOP-BANG (STOP, plus body mass index [BMI], age, neck circumference, and gender) scores also were obtained.

Results: Overall, the sample included 14,962 patients, of whom 1939 (12.9%) reported a history of OSA. All four screening tools identified a high prevalence of undiagnosed patients at risk for OSA (9.5%–41.6%), but agreement among screens was not strong with κ statistic ranging from 0.225 to 0.611. There was no significant difference in 30-day postoperative mortality between patients with possible OSA (based on their history or on a positive OSA screen with any of the four instruments) and the rest of the surgical population. Significant differences in one-year mortality were noted between the low-risk and high-risk groups as identified by the Flemons' (4.96% vs 6.91%; $p < 0.0001$), STOP (5.28% vs 7.57%; $p < 0.0001$) and STOP-BANG (4.13% vs 7.45%; $p < 0.0001$) screens. After adjusting for risk factors, none of the OSA screening tools independently predicted mortality rate up to one year postoperatively.

Conclusion: Neither a prior diagnosis of OSA nor a positive screen for OSA risk was associated with increased 30-day or one-year postoperative mortality. Differences in 1 year postoperative mortality were noted with three of the screening tools. The results of our study highlight uncertainties and research priorities for the medical community.

1. Introduction

Obstructive sleep apnea (OSA) is associated with cardiovascular manifestations such as hypertension [1], congestive heart failure (CHF) [2], stroke [3,4], coronary artery disease (CAD) [5], atrial fibrillation [6], and deep venous thrombosis [7]. OSA also is associated with sleepiness-related motor vehicle accidents [8]. Recent reports also demonstrate a high prevalence of chronic renal disease in patients with severe OSA without hypertension or diabetes mellitus (DM) [9,10]. Furthermore, OSA has been associated with increased all-cause mortality [6]. Apart from the concerns relating to OSA itself, the frequent comorbidities associated with this condition are important considerations for all healthcare providers caring for patients with OSA [11].

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There is a growing body of evidence suggesting that OSA may be an independent risk factor for perioperative morbidity. Patients with diagnosed OSA have an increased incidence of postoperative oxygen desaturation [12], cardiac ischemia, hemodynamic instability, and arrhythmias [13]. Furthermore, there are specific concerns that people with OSA might have increased sensitivity to the respiratory depressant effects of opioid analgesics, general anesthetics, and sedative medications [13–15]. Patients with OSA have been estimated to have twice the rate of hospitalization in the three years before OSA is diagnosed [16]. A recent investigation at Barnes-Jewish Hospital located in St. Louis, Missouri, found that an estimated 22% of adults presenting for inpatient surgery screened as high risk for OSA. Three quarters of these patients had not previously been diagnosed with OSA [17]. Therefore, the addition of a sleep apnea risk assessment to other screens commonly performed on hospital admission might be an appropriate public health initiative.

Many OSA screening tools that have been utilized in surgical patients, including the STOP (loud Snoring, daytime Tiredness, Observed apneas, and high blood Pressure) [18] STOP-BANG (STOP, plus body mass index [BMI], age, neck circumference, and gender) [18,19], and American Society of Anesthesiologists (ASA) Checklist [20], and have been validated in this population against apnea–hypopnea index values from in-laboratory polysomnography. The Flemons [17], the Berlin [20,21], and the Epworth Sleepiness Scale also have been used in this population [22]. As a whole, these screening tools are easy to use and vary in length, focus, and method of scoring. Presently, there is no convincing evidence to suggesting that any of these screening tools are superior in identifying patients at risk for perioperative morbidity or mortality. Because of the hypothesized potential for increased perioperative complications and treatment costs [23] associated with undiagnosed OSA, the ASA recommends preoperative evaluation for OSA prior to surgery [23]. The ASA further recommends that specific perioperative safety measures be implemented for patients with probable OSA.

In accordance with these ASA guidelines, routine preoperative screening for OSA was implemented and perioperative precautions were introduced at Barnes-Jewish Hospital for patients who screened as high risk. This initiative was followed by the B-J APNEAS (Barnes-Jewish Apnea Prevalence in Every Admission Study) investigation, which was designed as a prospective cohort study to test the hypothesis that either a prior diagnosis of OSA or a positive screen for OSA would be associated with an increased risk for early or intermediate postoperative morbidity and mortality from all causes. The primary purpose of our investigation was to compare the prognostic performance of the Berlin, Flemons, STOP, and STOP-BANG screening tools for sleep apnea among the B-J APNEAS patient population. Our study also examined the association of the performance of these four screening tools with key risk factors for postoperative morbidity and mortality. Specifically, we asked if screening positive on any of the four OSA screening tools was independently associated with an increased mortality rate up to one year post-operatively.

2. Materials and methods

2.1. Study population

Unselected adult surgical patients at Barnes-Jewish Hospital between Feb 2006 and Apr 2010 who underwent preoperative OSA screening were prospectively enrolled. The Human Research Protection Office at Washington University School of Medicine (St. Louis, MO) approved the study. Because screening for OSA and the perioperative safety interventions were adopted as standard of care quality improvement initiatives, informed consent was not required. Obstetric patients and those under the age of 18 years were excluded.

2.2. Protocol and design

Patients were asked to fill out the OSA risk evaluation form (Appendix 1) during preoperative assessment. Licensed healthcare professionals completed the form by scoring it, measuring neck circumference, and assigning the patient to an OSA risk category. The evaluation form comprises three sections and assesses the presence of nighttime symptoms (Section 1); daytime symptoms (Section 2); and comorbidities such as hypertension, heart disease, and DM (Section 3). For the purposes of clinical management, patients were deemed to be at high risk for OSA if they screened positive on a combination of the Berlin questionnaire and the Flemons' Index, which are both well-established clinical screening tools for OSA. Data also were prospectively collected from all patients for scoring on the STOP and STOP-BANG STOP-BANG (STOP, plus body mass index [BMI], age, neck circumference, and gender) screening tools [18,20]. The screening form became a part of the patient's medical record, and patients who either screened high risk or reported a prior diagnosis of OSA received additional targeted interventions. These interventions consisted of an "OSA RISK" alert bracelet, an "OSA RISK" sign affixed to the patient's bed, elevation at the head of the bed, and continuous pulse oximetry with an alarm at the central nursing station (Appendix 2). There also were options for additional postoperative monitoring, use of oxygen on the postsurgical unit, and use of home continuous positive airway pressure (CPAP) or bilevel positive airway pressure devices while in the hospital.

2.3. Mortality data

All-cause mortality data were obtained from the Social Security Administration's Death Master File (SSA DMF) by using a third party application ("Blinds" by CareEvolution, Inc, Ann Arbor, Michigan). Several reports have validated online versions of the SSA DMF for clinical research purposes [24,25]. This service returns the date of death using an algorithm that incorporates the patient's Social Security number, the patient's name, the patient's date of birth, and the last date the patient was known to be alive. For the date known to be alive, the date of surgery was used in our study. The generation and handling of SSA DMF data was in compliance with the Health Insurance Portability and Accountability Act and stringent efforts were undertaken to ensure the protection of all patient information.

2.4. Data collection

Data for our investigation were entered into an Access™ (Microsoft Corporation, Redmond, WA) database. The necessary information was obtained from preoperative, intraoperative, and postoperative medical records. The Barnes-Jewish Hospital Information Technology Section provided data on postoperative complications and intensive care admissions. Beginning in May 2009, electronic preoperative and intraoperative data were acquired from the anesthesia information management system (MetaVision MVOR, iMDsoft, Tel-Aviv, Israel).

2.5. Data preparation and statistical analyses

All data were prepared and analyzed using SAS® proprietary software (SAS version 9.2, SAS Institute NC, USA). Commonly used risk factors for morbidity and mortality found in the literature were analyzed in our study, including the patient's gender, age, race, BMI, physical status as defined by the ASA index, comorbid conditions at intake (eg, if the patient had experienced hyperten-