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Original Contribution

STOP-Bang and prediction of difficult airway in obese patients☆

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Abstract
Study Objective: To determine if a high score (≥ 3) on the STOP-Bang screening questionnaire for obstructive sleep apnea (OSA) predicts whether obese patients are at high risk for OSA and increased risk of difficult airway.
Design: Prospective, questionnaire-based clinical assessment.
Setting: University-affiliated hospital.
Patients: 127 ASA physical status 2 and 3 patients, who were scheduled for elective bariatric surgery.
Interventions: Patients were allocated to three groups. Group 1 patients had a previous history of OSA, Group 2 patients had no history of OSA but did have a high STOP-Bang score (≥ 3), and Group 3 patients had no history of OSA but did have a low STOP-Bang score (< 3). Groups 2 and 3 only were assessed using the STOP-Bang questionnaire. After induction and intubation of the patient, an anesthesiologist who was blinded to the three study group allocations completed an airway questionnaire on the three study groups.
Measurements: The frequency of difficult airway, difficult mask ventilation with or without muscle relaxation, poor visualization of the vocal cords, difficulty in blade insertion, and difficult intubation were compared.
Main Results: The group of patients with high STOP-Bang scores (Group 2) and those patients previously diagnosed with OSA (Group1) showed a higher risk for difficult airway than the patients with low STOP-Bang scores (Group 3; *P* < 0.001).
Conclusion: The STOP-Bang score may be used as an effective predictor of difficult airway in obese patients. Obese surgical patients with unknown/undiagnosed OSA status should be evaluated using the STOP-Bang questionaire score.

1. Introduction

Difficult airway is a major factor of perioperative morbidity and mortality in obese patients [1]. Not all obese patients have a difficult airway, and obesity status as a lone factor cannot

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predict difficult endotracheal intubation [2]. There are several predicting factors that can influence the incidence of difficult airway among obese patients. Obstructive sleep apnea (OSA) is one of the predicting factors, and it may influence the incidence of difficult airway among obese patients [3,4].

There is a high prevalence of OSA among patients undergoing bariatric surgery; many of these patients have undiagnosed OSA [5]. The STOP-Bang [ie, acronym for snoring, tiredness, observed apnea, pressure (BP > 140/90 mmHg) (STOP); BMI, age, neck circumference, and gender (Bang)] score may be used to classify obese patients as high risk or low risk for OSA [6]. Patients at high risk for OSA present perioperative concerns similar to those of patients diagnosed with OSA [7]. However, no study has compared high STOP-Bang scores with the risk of difficult airway among obese patients. Therefore, the primary objective of this study was to use the STOP-Bang score as a predictor of risk for difficult airway among obese patients.

2. Materials and methods

After Detroit Medical Center Institutional Review Board approval and written, informed consent, 127 consecutive patients scheduled for bariatric surgery from March 2009 to December 2010, who were intubated by direct laryngoscopy (with appropriate sized Macintosh blades), were enrolled in the study. For patient airway management, all anesthesia providers involved in this study had to have performed at least 100 intubations in morbidly obese patients [body mass index (BMI) ≥ 35 kg/m^2].

Preoperatively, each patient was interviewed by a research resident who completed the first study questionnaire regarding the diagnosis of OSA, based on the polysomnography or self-report by the patient. For patients not previously tested/diagnosed for OSA, the STOP-Bang questionnaire was used to determine a STOP-Bang score (Appendix 1). Based on their history of OSA and STOP-Bang scores, patients were allocated to three study groups, then assessed perioperatively with an Airway Management Questionnaire (Appendix 2). Group 1 patients were previously tested and diagnosed with OSA via polysomnography. Group 2 patients were those not previously tested for OSA, and who had high STOP-Bang scores (≥ 3). Group 3 patients were not previously tested for OSA and had low STOP-Bang scores (< 3).

A STOP-Bang score of ≥ 3 was chosen for this study, as this score had a very high sensitivity and negative predictive value for moderate/severe OSA, and had been suggested as a good cutoff value for high OSA prevalence among surgical populations such as bariatric patients [6].

All anesthesiologists who determined airway difficulty (**Appendix** 2) in this study were blinded to the study group allocations.

Exclusion criteria included any patient with a history of difficult airway or allergies to any medications used in the study protocol; any patient refusal/inability to give written, informed consent; any emergency surgery or primary intubation with another advanced airway device before attempted direct laryngoscopy.

On the day of surgery, each patient was taken to the operating room and positioned on the operating table with a wedge placed under the head and shoulders. A rapid airway management positioner was used with the patient placed in the head elevated laryngoscopy position and the external auditory meatus horizontally aligned with the sternal notch. After attaching standard ASA monitors (electrocardiogram, pulse oximeter, noninvasive blood pressure) for the procedure, the patient was preoxygenated and anesthesia was induced with propofol 1.5 - 2 mg/kg. Once the patient attained jaw relaxation, an oral airway was placed and two manual breaths were given with a bag-mask. Adequacy of mask ventilation was assessed by chest rise and capnograph. After the first two breaths, 2 mg/kg of succinylcholine was administered. Once the neuromuscular monitor showed zero twitches, another two breaths were given with the bag-mask. Adequacy of mask ventilation was again assessed by chest rise and capnograph. The anesthesia provider managing the airway was blinded to study group allocation.

2.1. Airway management parameters

2.1.1. Mask ventilation

Ease of mask ventilation before and after muscle relaxation was assessed by the anesthesia provider managing the airway and graded as follows: Grade M1 = able to mask ventilate with oropharyngeal airway by the anesthesiologist managing the airway; Grade M2 = needed two people to mask ventilate, or unstable to mask ventilate (ventilation difficulty, airway mask requiring an oral airway or other adjuvant); and Grade M3 = unable to maintain oxygen saturation (SpO2 < 90%) during mask ventilation/use of other ventilating devices such as the Laryngeal Mask Airway (LMA)/decide to attempt intubation without mask ventilation.

This mask ventilation grading system was derived from a system used by Han et al [8]. Difficulty of laryngeal blade insertion was graded as: Grade B1 = one attempt and no lip or buccal or pharyngeal mucosal trauma, and Grade B2 = more than one attempt and/or trauma to lips or buccal or pharyngeal mucosa.

2.1.2. Visualization of vocal cords

Visualization of vocal cords was scored based on the Cormack-Lehane (C-L) grading system [9], where the amount of glottis visualized during direct laryngoscopy was graded as V1 (most of the glottis was visualized) to V4 (neither glottis nor epiglottis was visualized). In this study, C-L grades V1 and V2 were considered good vocal cord visualization, and C-L grades V3 and V4 were considered poor vocal cord visualization. Intubation was then performed and the position of the endotracheal tube (ETT) was confirmed by auscultation of equal breath sounds on both