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SCIENTIFIC ARTICLE

Correlation between obstructive apnea syndrome and difficult airway in ENT surgery



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KEYWORDS

Sleep apnea syndrome;
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Risk factors;
Surveys and questionnaires

Abstract

Introduction: ENT patients with obstructive sleep apnea syndrome have a tendency of collapsing the upper airways in addition to anatomical obstacles. Obstructive sleep apnea syndrome is related to the increased risk of difficult airway and also increased perioperative complications. In order to identify these patients in the preoperative period, the STOP Bang questionnaire has been highlighted because it is summarized and easy to apply.

Objectives: Evaluate through the STOP Bang questionnaire whether patients undergoing ENT surgery with a diagnosis of obstructive sleep apnea syndrome have a higher risk of complications, particularly the occurrence of difficult airway.

Casuistry and methods: Measurements of anatomical parameters for difficult airway and questionnaire application for clinical prediction of obstructive sleep apnea syndrome were performed in 48 patients with a previous polysomnographic study.

Results: The sample detected difficult airway in about 18.7% of patients, all of them with obstructive sleep apnea syndrome. This group had older age, cervical circumference > 40 cm, ASA II and Cormack III/IV. Patients with obstructive sleep apnea syndrome had higher body mass index, cervical circumference, and frequent apnea. In subgroup analysis, the group with severe obstructive sleep apnea syndrome showed a significantly higher SB score compared to patients without this syndrome or with a mild/moderate obstructive sleep apnea syndrome.

Conclusions: The STOP Bang questionnaire was not able to predict difficult airway and mild obstructive sleep apnea syndrome, but it identified marked obstructive sleep apnea syndrome.

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PALAVRAS-CHAVE

Síndromes da apneia do sono;
Orofaringe;
Intubação;
Fatores de risco;
Pesquisas e questionários

All patients with difficult airway had moderate and marked obstructive sleep apnea syndrome, although this syndrome did not involve difficult airway. The variables Cormack III/IV and BMI greater than 35 kg.m^{-2} were able to predict difficult airway and obstructive sleep apnea syndrome, respectively.

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Correlação entre síndrome da apneia obstrutiva e via aérea difícil na cirurgia otorrinolaringológica

Resumo

Introdução: Os pacientes cirúrgicos otorrinolaringológicos portadores da síndrome da apneia obstrutiva do sono apresentam, além de obstáculos anatômicos, tendência ao colapso das vias aéreas superiores. Síndrome da apneia obstrutiva do sono está relacionada ao maior risco de via aérea difícil e também aumento de complicações perioperatórias. A fim de se identificar esses pacientes no período pré-operatório, tem se destacado o questionário STOP *Bang*, por ser resumido e de fácil aplicação.

Objetivos: Avaliar se pacientes submetidos à cirurgia otorrinolaringológica com diagnóstico de síndrome da apneia obstrutiva do sono pelo questionário STOP *Bang* apresentariam maior risco de complicações, particularmente ocorrência de via aérea difícil.

Casística e métodos: Feitas medidas de parâmetros anatômicos para via aérea difícil e administrado questionário para predição clínica de síndrome da apneia obstrutiva do sono em 48 pacientes com estudo polissonográfico prévio.

Resultados: A amostra detectou via aérea difícil em 18,7% dos pacientes, todos portadores de síndrome da apneia obstrutiva do sono. Esse grupo apresentava maior idade, circunferência cervical $> 40 \text{ cm}$, ASA II e Cormack III/IV. Os pacientes com síndrome da apneia obstrutiva do sono apresentaram maior índice de massa corpórea, circunferência cervical e frequência de apneia observada. Na análise de subgrupos, o grupo com síndrome da apneia obstrutiva do sono acentuada mostrou significativamente maior pontuação no SB quando comparado com pacientes sem síndrome da apneia obstrutiva do sono ou com síndrome da apneia obstrutiva do sono leve/moderada.

Conclusões: O questionário STOP *Bang* não foi capaz de prever via aérea difícil e nem síndrome da apneia obstrutiva do sono leve e moderada, mas identificou síndrome da apneia obstrutiva do sono acentuada. Todos pacientes com via aérea difícil apresentaram síndrome da apneia obstrutiva do sono moderada e acentuada, apesar desta síndrome não implicar em via aérea difícil. As variáveis Cormack III/IV e IMC maior do que 35 Kg.m^{-2} foram capazes de prever via aérea difícil e síndrome da apneia obstrutiva do sono respectivamente.

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Introduction

Obstructive sleep apnea syndrome (OSAS) is a condition in which intermittent airflow obstruction occurs, leading to sleep fragmentation and repeated drops in oxygen saturation with consequent awakening of the patient.¹ The OSAS prevalence is 9–24% in the general population, more present in the surgical population. It affects 11–24% of men and 7–10% of women in the age group of 40–50 years old and overweight or obese individuals.²

The most common symptoms are: snoring, daytime drowsiness, and breathing pauses during sleep. Snoring is loud and intermittent and, in most cases, accompanied by apnea and/or hypopnea, which may progress to feeling of suffocation, choking, and awakening from sleep. Therefore,

OSAS is related to restless sleep, fatigue, irritability, and cognitive disorders.³

Several episodes of nocturnal apnea result in cycles of hypoxia, hypercapnia and sympathetic activation, leading to systemic arterial hypertension (SAH), increased heart rate, arrhythmias, acute myocardial infarction, heart failure, and stroke.⁴ Intermittent hypoxia associated with increased sympathetic activity may change glucose metabolism, resulting in insulin resistance or diabetes mellitus (DM), which is possibly associated with the worldwide obesity epidemic.⁵

Diagnosis of OSAS is based on patient's clinical signs and symptoms, along with objective data provided through sleep monitoring. Polysomnography is the gold standard diagnostic tool for OSAS due to its high sensitivity and specificity.⁶ Treatment of OSAS will depend on the degree of

disease and also on the anatomical abnormalities present, which accentuates airway obstruction. Otorhinolaryngologic surgical procedures, such as septoplasty, turbinectomy, tonsillectomy, and uvulopalatopharyngoplasty, act positively on OSAS related-symptoms,⁷ improve nostril airflow, and allow the use of continuous positive airway pressure (CPAP) with lower pressures, thus facilitating the patient's adaptation.⁸

Sixty percent of patients with moderate-to-severe OSAS are not diagnosed preoperatively.⁹ OSAS patients, regardless of severity, have a higher risk for difficult airway compared to the general population⁹ and increased perioperative complications, as the drugs used in sedation or general anesthesia have a depressant effect that leads to worsening of upper airway obstruction and increased arousal threshold by hypoxic and hypercarbia stimuli.¹⁰

Several screening models have been proposed to identify OSAS patients; the STOP-Bang (SB) questionnaire is highlighted due to its good sensitivity and easy memorization, besides being validated for surgical patients.⁶ It consists of a 8-item, yes/no response questionnaire with a positive point assigned for each affirmative answer. There are four questions about snoring, daytime drowsiness, observed apnea, and SAH diagnosis, plus four questions concerning measurements of cervical circumference, BMI, age, and sex. Two or fewer affirmative responses indicate a low risk of OSAS and three or more affirmative responses indicate a high risk of OSAS.¹¹

The aim of this paper was to compare the STOP-Bang questionnaire with other assessments to predict OSAS and difficult airway in patients undergoing ear, nose, and throat (ENT) surgery.

Methods

A prospective study conducted through field research at the *Hospital Paulista* (São Paulo, Brazil), specialized in ENT surgeries, from March to December 2014. Patients enrolled in the study gave written informed consent, approved by the Research Ethics Committee (CEP N° 503,581) of *Universidade Federal de São Paulo (Unifesp)*.

The minimum sample size established was 40 patients, based on the calculation of the estimated population mean for incidence of difficult laryngoscopy.¹²

The inclusion criteria were patients of both sexes, aged 18–70 years, with physical status ASA I or II according to the American Society of Anesthesiologists, who underwent a polysomnographic study. Exclusion criteria were presence of craniofacial changes or patients unable to provide information.

On preanesthetic evaluation, the demographic variables recorded were: age, sex, BMI, and ASA physical status. The anatomical parameters investigated for difficult airway were: voluntary mandibular protrusion, mouth opening, thyromental distance, cervical circumference, cervical mobility, and Mallampati index.¹³

In this research we used:

a) STOP-Bang questionnaire;

- b) International Classification of Sleep Disorders, proposed by the American Academy of Sleep Disorders for OSAS diagnosis. It is necessary that the patient presents with at least one of these symptoms: daytime sleepiness, fatigue, high snoring and episodes of apnea/hypopnea, apnea/hypopnea index (AHI) of more than five events per hour (h) in polysomnography. For $AHI \geq 15$, regardless of any complaint, the diagnosis of OSAS is established¹⁴;
- c) Epworth Sleepiness Scale, Pittsburgh Questionnaire (Question 8), Chalder Fatigue Scale, and Berlin Questionnaire (Questions 2 and 5) to diagnose OSAS in patients with AHI between 5 and 14.9; as previously described.^{15–17}

Patients were allocated into four groups, according to the American Academy of Sleep Medicine criteria: absence of OSAS ($AHI \leq 5$), mild OSAS ($5 < AHI < 30$ h), moderate OSAS ($15 \geq AHI \leq 30$), and severe OSAS ($IAH > 30$ h).¹⁴

Patients were not premedicated and a single anesthesiologist was responsible for airway management. At the operating room, patients were monitored with cardioplex, pulse oximeter, capnography, and noninvasive automatic blood pressure. All patients were positioned with occipital cushion associated with hyperextension of the head. Face mask preoxygenation was performed for three minutes (min), followed by anesthetic induction with fentanyl ($2-3 \mu\text{g} \cdot \text{kg}^{-1}$), propofol ($2.5-3 \text{mg} \cdot \text{kg}^{-1}$), lidocaine ($0.5-1 \text{mg} \cdot \text{kg}^{-1}$), and rocuronium ($0.5-1 \text{mg} \cdot \text{kg}^{-1}$). Laryngoscopy with Macintosh blade size 3 was used as standard. Difficult glottic view on laryngoscopy was defined by the Cormack-Lehane classification.¹⁸ Difficult airway was defined as presence of difficult lung ventilation and adequate oxygen saturation with face mask or difficult orotracheal intubation (OTI); need for more than three intubation attempts or time greater than 10 min for tracheal intubation under direct laryngoscopy. The time from the beginning of laryngoscopy to the correct location of the endotracheal tube as seen by the first capnography curve was considered the OTI time. More than one attempt for tracheal intubation, external laryngeal compression, laryngoscope blade replacement, or bougie use were duly recorded as events requiring assistance.¹⁹ Maintenance of anesthesia was performed with 50% nitrous oxide, 1% sevoflurane, and remifentanyl ($0.5-1.0 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) through continuous infusion.

For statistical analysis, data collected for difficult airway and OSAS were transcribed to an Excel spreadsheet and presented as proportions or medians. Fisher's exact test was used to compare the categorical variables between groups.²⁰ The non-parametric Mann-Whitney test was used to compare the minimum and maximum values of systolic and diastolic pressures, in addition to heart rate. The same test was applied to compare groups regarding duration of surgery and OTI. Kruskal-Wallis analysis of variance was used to compare STOP-Bang scores of the groups of patients who underwent ENT surgery without OSAS and with mild or moderate OSAS. A p -value < 0.05 was considered statistically significant. Prisma software, version 3.0, was used for statistical analysis.

Results

Of the 50 patients selected, two were excluded for being under age 18. Of the 48 patients, 38 (79.2%) were male. Mean age was 34 ± 10.6 years and BMI was $28.8 \pm 5.4 \text{ kg m}^{-2}$. Regarding associated diseases, 39 patients (81.2%) were ASA I, nine patients (18.8%) ASA II; seven patients had SAH, one patient had DM, and one patient had hypothyroidism.

Of the total, nine patients (18.7%) had difficult airway and all of them had OSAS (moderate/severe). The group with difficult airway was significantly older compared to the group without difficult airway (median/percentile 37/34.5–45.5 years vs. 32/26–39 years, $p=0.04$, Mann–Whitney test) and greater cervical circumference (median/percentile 44 cm/43–47 vs. 41 cm/38–43, $p=0.004$, Mann–Whitney test), in addition to a higher frequency of Cormack grade III/IV (77.8% vs. 2.6%; $p<0.0001$; Fisher's test) and ASA II (44% vs. 12.8%, $p=0.04$, Fisher's test) (Table 1). Multivariate analysis showed association only between difficult airway and Cormack III/IV (OR=133.000 and $p=0.000$). There was no difference between groups with and without difficult airway regarding the other parameters evaluated, including STOP-Bang score and OSAS diagnosis.

When the group of 48 patients was analyzed according to the International Classification of Sleep Disorders, 38 patients (79.2%) were diagnosed with OSAS. These patients, when compared to the non-OSAS group, had BMI (median/percentile $29 \text{ kg m}^{-2}/26\text{--}33$ vs. $23 \text{ kg m}^{-2}/20\text{--}28$; $p=0.002$; Mann–Whitney test), cervical circumference (median/percentile 42 cm/40–44 vs. 38 cm/33–41, $p=0.001$; Mann–Whitney test) and polysomnography apnea/hypopnea index (median/percentile 19/11–28 vs.

2/0.9–3; $p<0.0001$; Mann–Whitney test) significantly higher, as well as higher observed apnea frequency (57% vs. 10%, $p=0.01$, Fisher's test) and systolic blood pressure (median/percentiles 120 mmHg/112–122 vs. 110/106–115; $p=0.01$; Mann–Whitney test) (Table 2). Through multivariate statistics, it was observed that OSAS was associated only with BMI $> 35 \text{ kg m}^{-2}$ (OR = 1.39 and $p=0.016$). There was no difference between groups with and without OSAS regarding the other parameters evaluated, including STOP-Bang score.

The group of patients with severe OSAS had STOP-Bang scores significantly higher than those observed in non-OSAS group, with mild and moderate OSAS (5 vs. 3, 4 and 3; $p=0.001$, Kruskal–Wallis test).

Discussion

ENT patients had anatomical obstacles that reduced airflow and if OSAS is also present there is a tendency for airway collapse. These abnormalities, which predispose to airway obstruction during sleep, are also related to difficult airway in anesthesia. This situation, together with the use of sedative, anesthetic and analgesic drugs and edema and/or bruising due to surgical manipulation may aggravate or precipitate these patients' airway obstruction.²¹

Difficult airway occurred in about 20% of the patients in our study, all diagnosed with OSAS. OSAS and difficult airway are related because they share common anatomical characteristics. However, the STOP-Bang questionnaire was not able to predict difficult airway in the present sample. This frequency of difficult airway was similar to that of Siyam et al. (2002), who found difficult airway in 21.9% of patients with OSAS undergoing ENT surgery.⁹ Patients with OSAS have a higher risk of difficult airway compared to the general population; 13–24% of patients with OSAS have difficult intubation, requiring intubation without sedation in 8% of cases.⁹ It is estimated that 35% of all deaths during anesthetic procedures are due to poor management of difficult airway, which emphasizes the importance of studies on risk factors and predictive questionnaires in order to adopt appropriate strategies to avoid being faced with an unforeseen difficult airway.

More advanced age, cervical circumference >40 cm, physical status ASA II, and Cormack III/IV were more frequent in difficult airway, but only the latter predicted difficult airway. The Cormack and Lehane classification for glottic view is widely used to determine the quality of laryngoscopy. However, this classification alone is an incomplete reflection of difficult intubation, as the patient may have a good glottal exposure, but still present a difficult intubation. On the other hand, Cormack Grade III/IV is associated with difficult airway in most patients.²²

OSAS was more frequent in patients with higher BMI, cervical circumference, and observed apnea frequency, but only BMI $>35 \text{ kg m}^{-2}$ was able to predict OSAS. In several studies, obesity has been pointed out as a risk factor for OSAS. Kulkarni et al. (2014) in a retrospective study of patients undergoing general anesthesia classified the group as high and low risk for OSAS using the STOP-Bang questionnaire; patients classified as high risk for OSAS had a mean

Table 1 Difficult airway (DA): values presented as median and 25th and 75th percentile or absolute number and percentages.

| Variable | Without DA (n=39) | With DA (n=9) | p |
|------------------------------|-------------------|----------------|------------------------|
| Age (years) | 32 (26–39) | 37 (34.5–45.5) | 0.004 ^a |
| ASA | | | 0.0049 ^b |
| I | 34 (87.2%) | 5 (55.5%) | |
| II | 5 (12.8%) | 4 (44.4%) | |
| Cervical circumference (cm) | | | 0.043 ^b |
| ≤ 40 | 14 (35.9%) | 0 (0%) | |
| >40 | 25 (64.1%) | 9 (100%) | |
| Cormack | | | <0.0001 ^b |
| 1 and 2 | 38 (97.4%) | 2 (22.2%) | |
| 3 and 4 | 1 (2.6%) | 7 (77.8%) | |
| OSAS | | | 0.17 (ns) ^b |
| Present | 29 (74.4%) | 9 (100%) | |
| Absent | 10 (25.6%) | 0 (0%) | |
| STOP-Bang (original version) | | | 0.18 (ns) ^b |
| <3 | 9 (23.1%) | 0 (0%) | |
| ≥ 3 | 30 (76.9%) | 9 (100%) | |

p, probability of significance.

^a Mann–Whitney.

^b Fisher.

Table 2 OSAS (obstructive sleep apnea syndrome): values presented as median and 25th and 75th percentile or absolute number and percentages.

| Variable | Without OSAS (n = 10) | With OSAS (n = 38) | p |
|------------------------------|-----------------------|--------------------|------------------------|
| BMI (kg m^{-2}) | 23.5 (20.5–28.0) | 29.2 (26.5–33.4) | 0.002 ^a |
| Observed apnea frequency | | | 0.01 ^b |
| Rarely | 9 (90%) | 16 (42.1%) | |
| At least once a week | 1 (10%) | 22 (57.9%) | |
| Cervical circumference (cm) | | | 0.045 ^b |
| ≤40 | 6 (60%) | 8 (21%) | |
| >40 | 4 (40%) | 30 (79%) | |
| IAH (events/sleep hours) | 2.0 (0.9–3.8) | 19.9 (11.4–28.9) | <0.0001 ^a |
| SBP (mmHg) | 110 (106.3–115) | 120 (112.5–122.5) | 0.01 ^a |
| STOP-Bang (original version) | | | 0.07 (ns) ^b |
| <3 | 4 (40%) | 5 (13.2%) | |
| ≥3 | 6 (60%) | 33 (86.8%) | |

BMI, Body Mass Index; kg m^{-2} , weight in kilograms by height squared; mmHg, millimeter of mercury; p, probability of significance; SBP, systolic blood pressure.

^a Mann–Whitney.

^b Fisher.

BMI $>35 \text{ kg m}^{-2}$, while low-risk patients had a mean BMI of 27 kg m^{-2} .²³

Patients with severe OSAS had higher STOP-Bang scores compared to patients without OSAS or patients with mild or moderate OSAS. Faced with this finding, the STOP-Bang questionnaire would be a useful tool to detect patients with severe, but not moderate or mild OSAS. Similar results found in the literature show that the higher the STOP-Bang score the greater the probability of diagnosing severe OSAS.²⁴

The present study presents as a limitation the selective recruitment of patients undergoing ENT surgery, as an altered nasal physiology by itself is an important mechanism in the pathogenesis of OSAS.²⁵ Although we did not find a correlation between the STOP-Bang questionnaire and anatomical parameters for detection of difficult airway in ENT patients, new studies must be performed with different groups of surgical patients, searching for new predictors that aid in the detection of difficult airway.

We concluded that although difficult airway is more frequent with older age, cervical circumference greater than 40 cm, ASA II, and Cormack III/IV, only the latter predicted difficult airway. OSAS is more frequent with higher body mass indexes, cervical circumference, and observed apnea frequency, but only BMI >35 predicted OSAS. Difficult airway in patients undergoing ENT surgery was associated with moderate or severe OSAS, confirmed by polysomnography in the present sample. The STOP-Bang questionnaire was not able to predict difficult airway or mild or moderate OSAS, but was able to predict severe OSAS.

Conflicts of interest

The authors declare no conflicts of interest.

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