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Identification of significant obstructive sleep apnoea in the obese patient: development of the novel DX-OSA score

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Abstract

Background and objectives. There is a high prevalence of undiagnosed obstructive sleep apnoea (OSA) in obese surgical patients. We investigated the extent to which anthropometric measurements can be used to identify the presence of significant OSA (Apnoea/Hypopnoea Index (AHI) $\geq$ 20) in adult patients.

Materials and methods. We prospectively studied 1357 adult patients scheduled for elective laparoscopic bariatric surgery. Prior to surgery, body mass index (BMI), gender, neck circumference, STOP-Bang score, SpO_2, neck and trunk fat (by dual X-ray absorptiometry) were recorded. All patients with a STOP-Bang score $\geq$ 5 underwent polysomnography. Auto-titrated Positive Airway Pressure (APAP) therapy was instituted when AHI $\geq$ 20/h. Predictors of OSA were identified and their cut-off values determined.

Results: In total, 1357 patients were screened; 345 patients underwent preoperative polysomnography; 190 had AHI $\geq$ 20/h and received APAP treatment. The novel Dual X-Ray-Obstructive Sleep Apnoea (DX-OSA) score was derived from the data. The score included 6 items: the STOP-Bang score, BMI, neck fat, trunk fat, baseline SpO_2, and Expiratory Reserve Volume (ERV), and its sensitivity, specificity, positive-predictive values, negative-predictive values, likelihood ratios, and post-test probabilities determined. At a cut-off of 3, the DX-OSA score had the same sensitivity as the STOP-bang score, but better specificity. The lowest likelihood ratio was found for STOP-Bang and the highest for the DX-OSA score (OSA probability > 83%).

Conclusion: The DX-OSA score may be useful for identifying obese patients with significant OSA who require CPAP (continuous positive airway pressure) treatment, and CPAP could be commenced without the need for polysomnography, therefore, without delaying surgery.

Keywords: obstructive sleep apnoea, obesity, continuous positive airway pressure

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Introduction

Obstructive sleep apnoea (OSA) is common in morbidly obese individuals. Sleep-disordered breathing is often undiagnosed, and its overall prevalence has been estimated as 9% for women and 24% for men aged 30-60 years [1, 2]. Anaesthesiologists must be aware of the high prevalence of undiagnosed OSA in obese surgical patients (> 24%) [3, 4].

OSA patients often have comorbid conditions and may also develop a systemic inflammatory state that predisposes them to cardiac and cerebrovascular events, such as coronary artery disease, heart failure, arrhythmias, strokes, and sudden cardiac death [5-8]. The importance of diagnosing and treating OSA in obese patients prior to surgery is widely recognized [9]. In OSA patients, preoperative CPAP improves exercise tolerance, and reduces daytime sleepiness and negative cardiopulmonary physiological consequences, especially hypertension [10-12].

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For obese patients with OSA, the perioperative period is known to be challenging. The likelihood of post-surgical respiratory complications, including atelectasis, pneumonia, and hypoxia, is increased in all obese patients. OSA prevalence varies according to the type of surgery, peaking among bariatric surgery patients. As the number of patients undergoing weight loss surgery increases, more patients will be at risk for these potentially life-threatening postoperative pulmonary events [3, 13, 14].

The aim of this prospective observational study was to identify the extent to which anthropometric and other objective measurements relevant to OSA can be used for the identification of significant OSA, defined as an Apnoea/Hypopnoea Index (AHI) of ≥ 20.

Materials and methods

With institutional Ethical Committee approval and signed informed consent from patients, we prospectively studied 1357 consecutive patients who were scheduled for elective laparoscopic bariatric surgery in the Ponderas Hospital, Centre of Excellence for Bariatric and Metabolic Surgery, Bucharest, Romania, between January 2013 and December 2015. As an observational study, no intervention in medical protocols was applied and thus we analysed a cohort of obese patients who had agreed to bariatric surgery in that period.

All the patients, with ASA physical status I-IV, were assessed 3-4 weeks before surgery by a multidisciplinary team, which included an anaesthetist. In addition to the routine recording of body mass index (BMI), gender, presence of diabetes, neck circumference (NC), and SpO_2 and administration of the STOP-Bang questionnaire, we measured neck fat, lean neck tissue, trunk fat, and lean trunk tissue using dual X-ray absorptiometry (Lunar iDXA, GE Healthcare Madison, WI). The iDXA system is a high-resolution densitometry that differentiates between bone and surrounding soft tissue, and further distinguishes the latter as fat and fat-free (lean) compartments. We measured the lung volumes by spirometry or lung plethysmography to all patients.

All patients with a STOP-Bang questionnaire score ≥ 5 underwent polysomnography (PSG) with a 12-channel portable PSG CID-LX type III device (CIDELEC, Sainte Gemmes/Loire, France) or SOMNOcheck micro (WEINMANN, Hamburg, Germany) type IIa device, at home.

The polysomnographic recording montage for the CID-LX consisted of a nasal cannula (to measure nasal flow), a PneaVoX sensor, thoracic and abdominal inductive belts, a polygraph placed on the wrist, and pulse oximetry. The Pnea VoX technology allows the recording of various physiological parameters with a single sensor: nose and mouth breathing, and respiratory efforts, discriminating obstructive, central, and mixed sleep apnoea, and snoring. In addition, upper airway resistance is estimated by measuring acoustic intensity. The signals allow detection of sleep apnoea and snoring, and characterization of the apnoea by suprasternal pressure. The device has an additional pressure channel for connecting a pneumotachograph when the patient is treated with CPAP or BiPAP.

The portable PSG device was connected to the patients by a PSG technician in hospital; patients were taught how to use the device at home for overnight recording. The PSG recordings were automatically analysed using CIDELEC or SOMNOlab software, and were further reviewed by a sleep physician. All PSG recordings were scored according to the recommendations of the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea [15].

According to the American Academy of Sleep Medicine, apnoea was defined as an at least 90% decrease in airflow from baseline, lasting at least 10 s. Hypopnoea was defined as an at least 50% reduction in airflow, lasting at least 10 s, and associated with at least a 3% decrease in arterial oxyhemoglobin saturation or associated with arousal [16]. AHI was defined as the average number of apnoea and hypopnoea episodes per hour, and the severity of OSA was graded based on AHI (none 0-5, mild OSA 6-20, moderate OSA 21-40, severe OSA > 40) [15]. The oxygen desaturation index (ODI) was defined as the average number of episodes per hour, with 4% or greater desaturation and lasting 10 s or longer [17]. Minimal saturation during sleep was also recorded.

The anaesthesiologist decided on CPAP and oxygen therapy. CPAP therapy was indicated when AHI was ≥ 20/h, ODI ≥ 5, and minimum saturation during sleep $< 80\%$.

The AutoCPAP (APAP)-GoodKnight 418 (Mallinckrodt Respiratory Group, St Louis, MO) and S8 AutoSet Spirit™ II (ResMed, San Diego, CA) devices were used. Auto-titrated CPAP (APAP) measures the flow breath-by-breath, and adjusts the delivered pressure to the minimal level necessary for maintaining an unobstructed airway [18]; it allows initiation of treatment without in-laboratory CPAP titration [12, 19, 20] and the pressure applied can vary $\pm$ 3 cm H_2O in response to changes in airway resistance. According to our hospital protocol, if pulse oxygen saturation (SpO_2) on oximetry in room air was $< 90\%$, oxygen therapy was provided.

Statistical analysis

Statistical analyses were performed with SPSS version 22, and significance set to $p \leq 0.05$. The patient data are presented with descriptive statistics, as means

and standard deviation or as medians and interquartile ranges, as appropriate. Normality of distribution was tested using the Shapiro-Wilk test. Categorical data were reported as frequencies and percentages, and compared using chi-square tests and odds ratios (ORs).

The relationship between different non-normal parameters was assessed by Spearman correlation. Logistic regression models were employed to identify predictors of OSA and the related probabilities. For each score in the 345 patients, we used 2 × 2 contingency tables to determine the sensitivity, specificity, positive-predictive values, negative-predictive values, likelihood ratios (LR), and post-test probabilities. For each parameter of interest, we constructed receiver operating curves (ROC) to determine the area under the curve (AUC). The cut-off point for each score was assessed using the de Youden Index and Matthew's Correlation Coefficient. After examining the AUC's and cut-off points for each variable, we constructed the new score, the Dual X-Ray-Obstructive Sleep Apnoea (DX-OSA) Score (which included the STOP-Bang score, BMI, neck fat, trunk fat, baseline SpO_2, and Expiratory Reserve Volume [ERV]). If a patient had any parameter value greater or equal to the cut-off, we assigned the point-value 1. The score had a minimal sum of 0 points and a maximum of 6 points (Table 1).

Table 1. DX-OSA score

DX-OSA score	Cut-off	Points
STOP-Bang	≥ 5	1
BMI (kg/m^2)	≥ 45	1
Neck fat (g)	≥ 1330	1
Trunk fat (kg)	≥ 40	1
Baseline SpO_2 (%)	≤ 94	1
Expiratory reserve volume (L) Percent predicted (%)	≤ 0.54 or ≤ 40	1

BMI – body mass index, SpO_2 – pulse oximetry oxygen saturation

Results

A total of 1357 patients gave informed consent, and 345 patients with STOP-Bang scores ≥ 5 (25.4%) underwent PSG, while 190 patients (14%) with AHI > 20/h received preoperative CPAP treatment. Patient assignment and study implementation are shown in the flow chart (Fig. 1) and the Table 2 gives the descriptive statistics for our patients.

We constructed ROC curves for our main variables of interest (Fig. 2). All had an AUC > 0.60 for OSA diagnosis (range: 0.632-0.900; $p < 0.0001$). The AUC for the STOP-Bang score was 0.846 ($p < 0.0001$), for the DX-OSA, 0.902 ($p < 0.0001$) (Table 3). From these ROC curves, we chose the variables for our new score (Table 1). The best possible cut-off values for our parameters were determined (Table 4). The cut-off value for STOP-Bang was 5 points, and for DX-OSA 3 points, and these methods showed a significant agreement ($R^2 = 1$).

Table 3 summarizes the values obtained from the contingency tables for STOP-Bang and DX-OSA scores, at different cut-off values. The sensitivity for DX-OSA for a 3-point cut-off value was 0.768 while

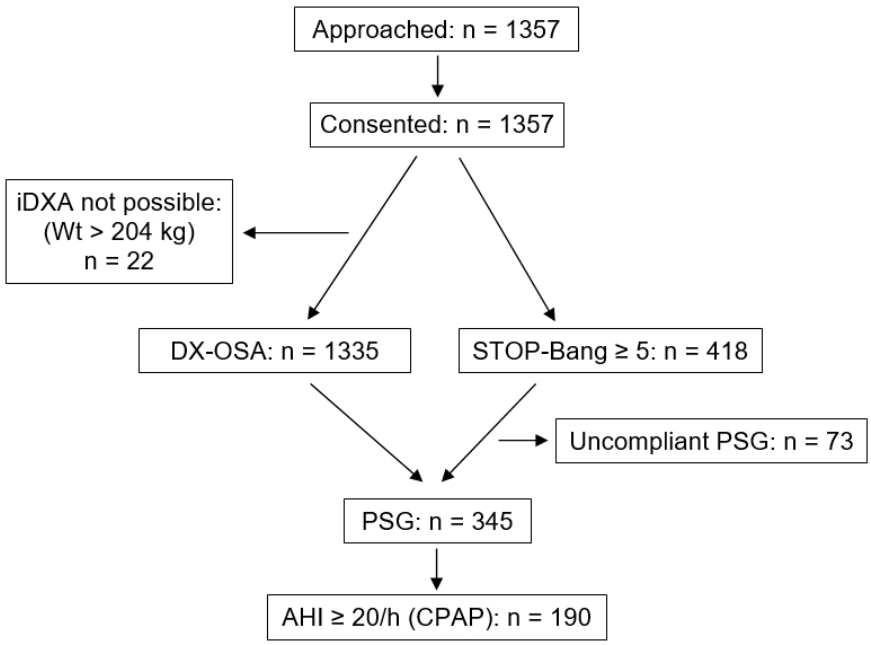

Fig. 1. Patient recruitment and follow-up flow chart. PSG = polysomnography. AHI – Apnea-Hipopnea Index; DX-OSA score = Dual X-Ray-Obstructive Sleep Apnoea score; iDXA = Dual X-ray Absorptiometry; Wt = weight

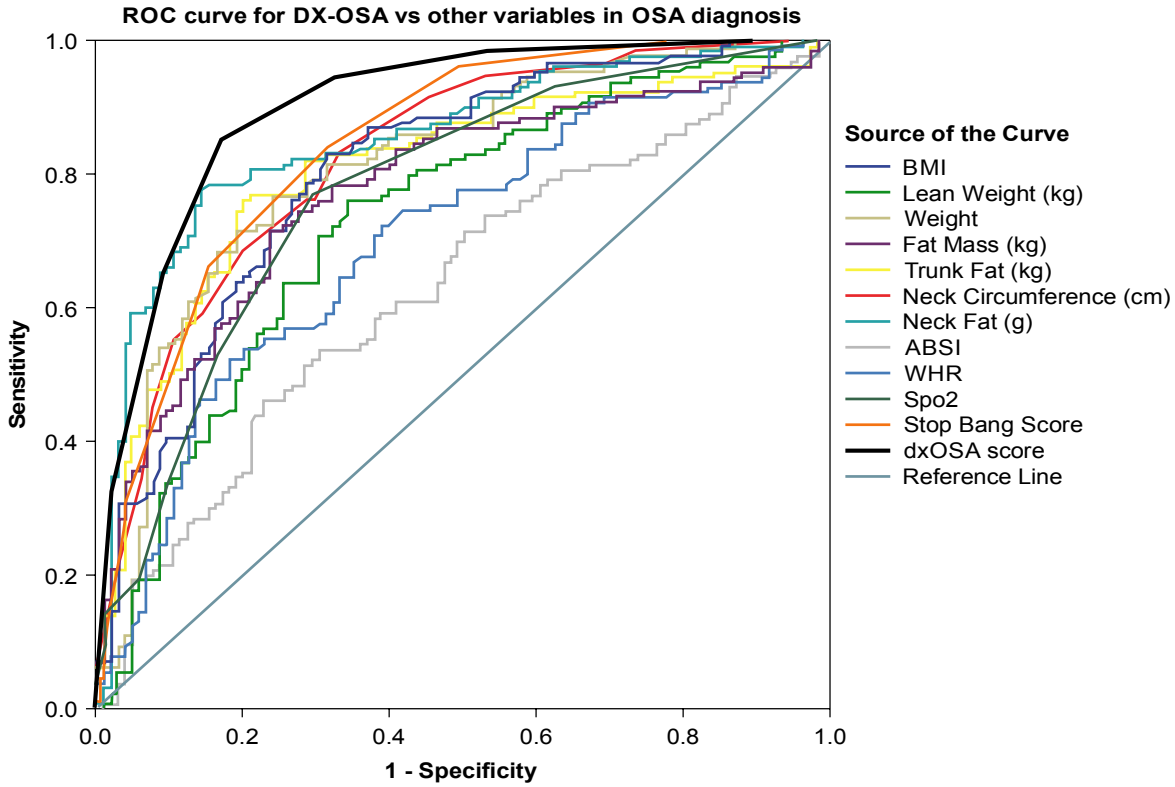

Fig. 2. Receiver operating characteristic curves for DX-OSA score vs main variables of interest in OSA. (BMI – body mass index, lean weight, fat mass, trunk fat, neck circumference, ABSI – A Body Shape Index; WHR – Waist-Hip Ratio, SpO_2 – oxygen saturation, STOP-Bang score). The AUC for the DX-OSA was the highest – 0.902 vs AUC for the STOP-Bang score – 0.846

Table 2. Descriptive statistics

Variable	Median	25%-75% percentile	IQR
Age (yr)	42	34.0-49.0	15.0
BMI (kg/m^2)	40.9	36.3-46.0	8.8
Height (cm)	170	164-177	14
SpO_2 baseline (%)	0.97	0.96-0.98	0.02
Lean weight (kg)	54.9	47.36-67.40	19.70
Fat mass (kg)	56.4	46.6-67.2	20.0
Trunk fat (kg)	32.3	25.7-40.5	13.5
Neck fat (g)	1212.5	923.0-1579.7	676.5
Lean neck (kg)	2.1	1.8-2.6	0.96
Expiratory reserve volume Percent predicted (%)	40.7	24.0-63.0	39.7

BMI = body mass index; IQR = interquartile range; SpO_2 – pulse oximetry oxygen saturation

Table 3. Cut-off values for different parameters in OSA diagnosis

Variable(s)	AUC	Std. Error	Cut-off value	P-value
BMI (kg/m^2)	0.809	0.029	43.80	< 0.0001
Lean weight (kg)	0.735	0.033	62.40	< 0.0001
Actual weight (kg)	0.816	0.028	134.60	< 0.0001
Fat mass (kg)	0.778	0.030	66.08	< 0.0001
Trunk fat (kg)	0.809	0.029	39.22	< 0.0001
Neck fat (g)	0.857	0.025	1329.50	< 0.0001
SpO_2 (%)	0.777	0.031	0.95	< 0.0001
Expiratory reserve volume (%)	0.661	0.079	0.55	0.050
DX-OSA Score	0.902	0.021	3.00	< 0.0001
STOP-Bang Score	0.846	0.026	5.00	< 0.0001

BMI = body mass index; SpO_2 – pulse oximetry oxygen saturation

the specificity was 0.787. Compared to the STOP-Bang score, the sensitivity for DX-OSA was 4.2% lower and the specificity was improved by 13.5% (Table 5).

The positive likelihood ratios for our chosen cut-off points ranged from 2.33 (STOP-Bang) to 3.61 (DX-OSA), and the negative likelihood ratios from 0.25 to 0.29. The LR+/LR- of the DX-OSA score was 3.61/0.29, and of the STOP-Bang, 2.33/0.29 (Table 5, Fig. 3).

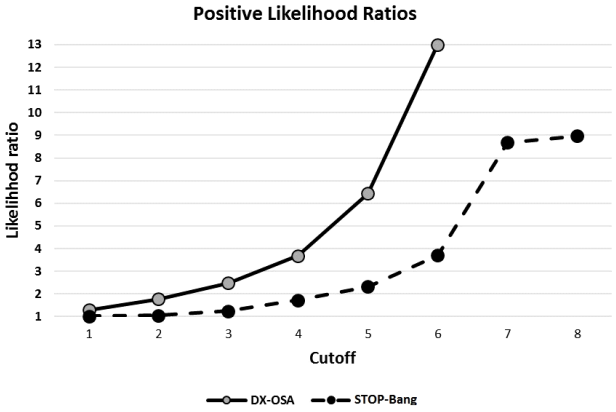

Fig. 3. The Positive Likelihood Ratios for OSA of DX-OSA score and STOP-Bang score. The positive likelihood ratios for our chosen cut-off points ranged from 2.33 (STOP-Bang), 3.61 (DX-OSA)

The positive-predictive values at the set cut-off points ranged from 0.74 (STOP-Bang) to 0.82 (DX-OSA). The post-test probability for OSA diagnosis was 8% greater for the DX-OSA than for the STOP-Bang (post-test probability 0.74) (Table 5, Fig 4).

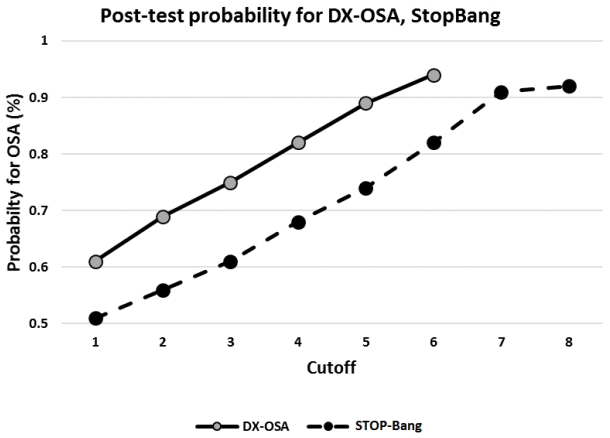

Fig. 4. The post-test probability for OSA of DX-OSA score and STOP-Bang score. The post-test probability for OSA diagnosis for: STOP-Bang – 0.74; DX-OSA (cut-off of 3) – 0.83

In terms of ORs for identifying OSA, the DX-OSA had the greatest value (OR 15.02, $p < 0.0001$, 95% CI

Table 4. Correlation between Youden Index and Matthew's Correlation Coefficient in choosing the best cut-off score

Youden Index vs Matthew's Correlation Coefficient	R^2 Linear*	Correlation equation
STOP-Bang	1	Y = 2.78E-17 + 0.71x
BMI	1	idem
Neck fat	1	idem
Trunk fat	1	Y = -3.33E-16 + 1.41x
Baseline SpO_2	1	Y = 1.41x
Expiratory reserve volume	1	idem
Neck circumference	1	idem
Waist circumference	1	Y = -8.33E-17 + 0.71x

BMI = body mass index; *R^2 = 1, suggests perfect correlation

Table 5. Predictive scores for AHI > 20

	Cut-off	Sensitivity	Specificity	LR+	LR-	PPV	NPV	Post-test probability
DX-OSA	3	0.768	0.787	3.61 (2.64-4.93)	0.29 (0.22-0.39)	0.816	0.735	0.82 (0.76-0.86)
	4	0.551	0.843	3.51 (2.38-5.17)	0.53 (0.45-0.63)	0.814	0.606	0.83 (0.74-0.86)
	5	0.235	0.978	11 (3.63-31)	0.78 (0.72-0.85)	0.938	0.512	0.93 (0.82-0.97)
STOP-Bang	4	0.937	0.458	1.73 (1.49-2.01)	0.14 (0.08-0.24)	0.679	0.855	0.68 (0.65-0.71)
	5	0.811	0.652	2.33 (1.86-2.92)	0.29 (0.21-0.40)	0.740	0.737	0.74 (0.70-0.78)
	6	0.621	0.832	3.70 (2.56-5.35)	0.46 (0.37-0.55)	0.819	0.642	0.82 (0.76-0.87)

LR+/LR- = positive- and negative-likelihood ratios, PPV = positive-predictive value, NPV = negative predictive value

8.51-26.1), and the STOP-Bang (OR 8, p < 0.0001, 95% CI 4.99-13.1). The Phi value, which presented additional information regarding the strength of association between the scores and OSA diagnosis, was 0.56 for DX-OSA, and 0.47 for STOP-Bang (Table 6), suggesting a strong association between the scores and OSA diagnosis.

Table 6. Odds ratios for DX-OSA, and STOP-Bang ($\div^2$ test) in OSA diagnosis

	Odds ratio	95% CI	Phi Correlation	P-value
DX-OSA	15.02	8.519-26.05	0.558	< 0.0001
STOP-Bang	8.00	4.89-13.07	0.470	< 0.0001

We used a logistic regression model to determine whether our new score could predict OSA and found that the DX-OSA score was good predictor of OSA diagnosis (p < 0.0001) (Fig. 5). We extracted the polynomial regression equation from the model, and calculated the increase in the probability of OSA with each point increase for the DX-OSA score, and found that each additional point increased the mean probability of OSA diagnosis by approximately 20%.

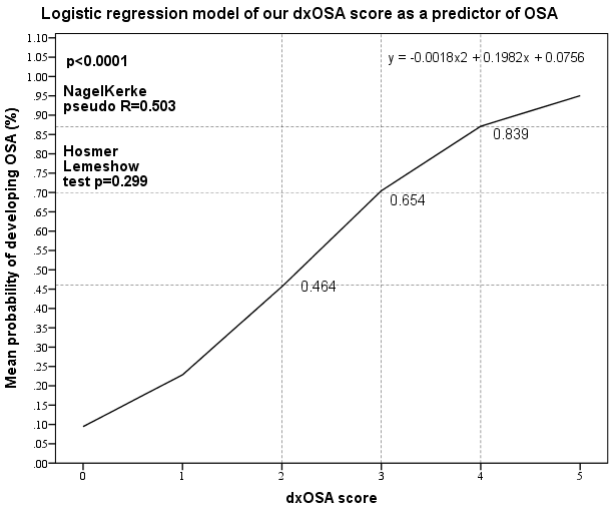

Fig. 5. Logistic regression model for DX-OSA score as a predictor of OSA (AHI > 20/h)

Discussion

In morbidly obese individuals, a presumptive clinical diagnosis of OSA should be verified and its severity determined to establish the perioperative risk [14, 21]. Three screening tools for identifying OSA in a preoperative setting [22] have been validated in surgical patients: the Berlin Questionnaire [4], the American Society of Anesthesiologists' Checklist [15], and the STOP-Bang Questionnaire [23-25]. Their sensitivity varies from 50 to 90%, depending upon the OSA severity targeted, but all have suboptimal specificity (30-60%) [26, 27]. The STOP-Bang Questionnaire is the fastest to implement [23], and has a high sensitivity for identifying OSA in a preoperative setting [24]. However, given its moderate specificity, particularly for predicting moderate-severe OSA, the STOP-Bang questionnaire may produce a high number of false-positives, leading to unnecessary referrals for sleep studies and increased cost [27]. Methods for improving its specificity, such as by combining it with elevated serum bicarbonate levels [28] or emphasizing more predictive items, such as male sex and BMI > 35 have been proposed [29, 30]. Obesity is the most important factor in adult OSA, and OSA severity appears proportional to weight changes [1, 31]. Farney et al. found that a weighted model for each STOP-Bang response can slightly improve prediction over a linear model [32]. Corso et al. used a STOP-Bang with cut-off of 5 to identify high-risk OSA patients; such patients had a higher rate of postoperative complications, difficult intubation, and difficult mask ventilation [33]. The cut-off of 5 was also considered by Chung et al. as the best compromise between specificity and sensitivity [26]. We therefore referred all the patients with a recorded STOP-Bang score $\geq$ 5 for sleep studies to confirm OSA [34, 35].

In-laboratory PSG remains the gold-standard for OSA diagnosis [36]. Overnight polysomnography in a sleep laboratory over a period of 2 nights is recommended by the American Thoracic Society and the American Academy of Sleep Medicine for diagnosing OSA and initiating CPAP [16]. Portable home sleep-testing devices [37] or night oximetry [17] are possible alternatives for OSA diagnosis. However, cost, low availability in hospitals, and poor patient compliance, reduce their applicability for verifying an OSA diagnosis [33].

The utility of obtaining a formal preoperative OSA diagnosis by PSG and CPAP therapy, rather than by screening, remains unclear [38, 39]. Moreover Mulgrew at al. demonstrated, in 2007, in a randomized validation study, that during the initial management of patients with a high OSA probability of OSA likelihood, PSG confers no advantage over the OSA patients approach [20]. However, increasingly studies have shown the benefits of preoperative PAP therapy, particularly in the morbidly obese. In a randomized control trial, nasal CPAP has been shown to reduce

the need for intubation, incidence of pneumonia, infection, and sepsis in patients who developed acute hypoxemia after elective major abdominal surgery [5, 11]. Liao et al. conducted the first trial that showed the feasibility of perioperative APAP for surgical patients with untreated OSA. Perioperative APAP treatment effectively decreases AHI and improves postoperative oxygen saturation in surgical patients with moderate and severe OSA [10]. APAP is equivalent to CPAP in efficacy, adherence, and functional outcomes, but delivers significantly lower pressure and has lower average leak values in the morbidly obese [12].

We here derived the clinical score – DX-OSA – based on clinical objective measurements, to obtain more accurate diagnosis of moderate-severe OSA for referring patients for APAP without PSG testing. In our clinic, pre-anaesthetic assessment is performed by the same anaesthesiologist over a 1-week period, and 10-15 patients are seen per day. The anaesthetists screen the patients using the STOP-Bang questionnaire and have observed that some STOP-Bang items (STO) are subjective, and depend on patient-reporting; hence, many patients who could have been sent for PSG may therefore provide unreliable answers to such STO questions.

Although BMI alone is not a good predictor of sleep apnoea, BMI and OSA incidence are directly related. In severely obese patients (BMI > 40 kg/m^2) undergoing bariatric surgery, the prevalence of OSA is > 70% (range: 40-90%) [21, 26, 40]. After bariatric surgery and weight reduction, OSA significantly improves and may even be resolved [41, 42].

Gender also affects sleep apnoea. Males have a two- to threefold increased risk of OSA as compared to women [2], which may be related to differences in the distribution of adipose tissue in men [21, 43-45], who have a predominantly central fat deposition pattern around the neck, trunk, and abdominal viscera [46, 47].

For a given BMI, risk is affected by body shape, as a marker of central abdominal fat deposits [46-50] around the neck, trunk and abdominal viscera. Thus, BMI is augmented by other simple biometrics, as neck and trunk fat. We used iDXA for measuring neck and trunk fat [51, 52], which were included in the DX-OSA score. iDXA is considered the gold standard for body composition measurements, easy and cheap, providing excellent precision for total body and regional fat distribution in severely obese individuals.

Simpson et al. first described sex differences in the associations between the severity of OSA [53, 54] and measures of obesity in body regions defined using both iDXA and traditional anthropometry. They found an association between regional obesity and OSA severity. In women, neck fat directly influenced upper airway patency, while in men, abdominal obesity was the predominant influence. iDXA measures of fat mass were more predictive of OSA severity than were anthropometric measures [3, 54]. Similarly, in our study, iDXA measurements well predicted OSA, as demonstrated the logistic regression model (Fig. 5). We found a strong association between neck and trunk fat, measured by iDXA and AHI as demonstrated the AUCs from Table 3.

Obesity affects ERV (expiratory reserve volume) due to premature closure of the small peripheral airways [55-58]. In turn, the reduction in end-expiratory lung volumes, which are accentuated in sleep, may lead to a reduction in the tracheal traction on the pharynx, increasing its collapsibility [3, 13, 59]. Therefore, we used ERV as an objective, easy-to-measure factor associated with severe OSA requiring pre- and postoperative PAP treatment.

Obesity is likely to be an important predictive variable for hypoxemia. The reduced ERV in obese subjects, especially in the recumbent posture, together with high tissue O_2 consumption rates, cause more rapid depletion of lung O_2 stores during apnoea, resulting in more severe arterial O_2 desaturation for any given apnoeic length [60]. Patients with severe OSA have higher desaturation during wakefulness, non-REM sleep, REM sleep, and during obstructive events [61]. Paradoxically, the severity of OSA was not quantified using indices of hypoxemia during sleep, which may predict hypertension risk more accurately than does AHI. Overnight hypoxemia is considered to underline the cardiovascular impact of OSA, involving increased morning catecholamine levels and increased thrombotic risk [60-62]. We considered baseline SpO_2 measurement and hypoxemia (daytime or nocturnal) the best outcome-indicators of OSA severity where intervention with PAP is crucial and included SpO_2 in the new scores.

In our study, we used a cut-off of 5 for the STOP-Bang score [33, 63]. Three-hundred-and-forty-five from 418 patients (82%) with a STOP-Bang $\geq$ 5 were studied with formal PSG, but only 190 patients had OSA requiring CPAP treatment. Thus, > 50% of the results were false-positives or significant OSA (AHI > 20/h).

We evaluated the predictive performance of DX-OSA score for diagnosing OSA in obese and morbidly obese surgical patients. The DX-OSA score has a weight limit, due to the practical drawbacks of the iDXA measurements: there are physical limits to body weight (204 kg), length, thickness, and width that can be determined with the type of DXA machine, while availability may be another limitation [46]. Twenty-two of the patients in this study had body weight > 204 kg; they could not be screened and were considered high risk on clinical grounds.

Hence all results for this score were even lower, as 22 patients with a weight > 204 kg were included in the CPAP treatment cohort. The score (with a cut-off of 3) improved specificity to 80% at the same sensitivity as a STOP-Bang score of 5, with an increased likelihood ratio and a better post-test probability (80%). We included the STOP-Bang in the score, which may have biased our objective approach. However, we tested all combinations of the new score items to assess the statistical significance, and found promising results. We also tested for correlation between parameters within our scores, all of them being statistically significant with a Spearman correlation coefficient that ranged from 0.161 to 0.535. DX-OSA score boosted the AUC, sensitivity and specificity, thus allowing a better selection of patients who received preoperative CPAP. The DX-OSA score consists of objective measurements related to morbid obesity such as BMI, neck fat, trunk fat, ERV and baseline SpO_2, except the STOP-Bang score that is used to screen the OSA in general. If the STOP-Bang is equivocal (3-4), any three associated items could improve the accuracy of the diagnosis of significant OSA that requires CPAP treatment. Therefore the score may be useful to find among the morbidly obese with OSA who need preoperative CPAP.

Our study has limitations. Although we included a large number of patients, this was a single-center observational study, and needs further validation. Nevertheless, this is the first study to identify a combination of objective clinical items that by themselves can provide a post-test probability of OSA > 80% and an increased likelihood ratio of moderate-severe OSA amongst the obese surgical population. Although the STOP-Bang score was clinically validated as a triage tool for OSA diagnosis, it cannot be used alone for implementing CPAP therapy without PSG, as it can under- or overestimate the presence of OSA requiring PAP therapy.

Once the patients have been screened using the STOP-Bang questionnaire, the routine use of the DX-OSA score can indicate a very high probability of moderate OSA, requiring immediate APAP treatment, which can resolve problems, such as inefficient allocation of resources, access to or compliance of patients with PSG, and thereby save time. The DX-OSA score can form part of strategies for expediting diagnosis and safe CPAP treatment for OSA in obese surgical patients.

Conclusions

Obese surgical patients can be screened for OSA severity using the STOP-Bang questionnaire, which has been validated and is easy to use. The clinical objective measurements in the DX-OSA score could more specifically predict the presence of significant OSA, reducing false-positives and unnecessary referrals for PSG or overcrowding postoperative care units. Moreover, in conjunction with STOP-Bang screening, this score could improve the accuracy of decision-making for patients in the grey zone (STOP-Bang score of 3-6). Ultimately, if the combined clinical scales of the DX-OSA score are applied in a preoperative setting, a pre-test probability of OSA $\geq$ 85% can be derived, and CPAP can be implemented without the need for PSG, avoiding surgical delay. The new anthropometric score should be prospectively validated in future larger studies.

Conflict of interest

Nothing to declare

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Identificarea sindromului de apnee în somn de tip obstructiv semnificativ la pacientul obez: elaborarea noului scor DX-OSA

Rezumat

Obiective. Constatăm o prevalență crescută a sindromului de apnee în somn de tip obstructiv (OSA) la pacienții chirurgicali obezi. Am studiat în ce măsură măsurătorile antropometrice pot fi utilizate cu scopul identificării OSA semnificativ (Index de Apnee/Hipopnee (AHI $\geq$ 20) la pacienții adulți chirurgicali.

Material şi metodă. Am studiat în mod prospectiv 1357 de pacienţi adulţi programaţi pentru chirurgie bariatrică laparoscopică. S-au înregistrat preoperator: indicele de masă corporală (BMI), sexul, circumferinţa gâtului, scorul STOP-Bang, SpO_2, şi grăsimea gâtului şi trunchiului cu absorbţiometrie dual㠠cu raze X (DX). Toţi pacienţii cu scor STOP-Bang $\geq$ 5 au fost supuşi ulterior polisomnografiei. Ventilaţia cu presiune pozitivă auto-titrată (APAP) a fost instituită când AHI $\geq$ 20/h. Au fost identificaţi predictorii OSA şi au fost stabilite valorile prag, predictive.

Rezultate. Au fost înregistraţi un total de 1357 pacienţi din care 345 au efectuat polisomnografie preoperatorie, iar 190 au avut AHI $\geq$ 20/h şi au fost supuşi terapiei APAP. Noul scor RX dual – sindrom de apnee în somn de tip obstructiv (DX-OSA) a fost elaborat prin utilizarea datelor măsurate la aceşti pacienţi. Scorul a inclus 6 criterii: scorul STOP-Bang, BMI, grăsimea gâtului, grăsimea trunchiului, valoarea SpO_2 bazală şi volumul expirator de rezervă (ERV). S-au determinat apoi senzitivitatea şi specificitatea acestui scor, valorile predictive pozitive şi negative, rapoartele de risc şi probabilităţile post-test ale acestui scor calculat. La o valoare prag de 3 scorul DX-OSA a prezentat aceeaşi senzitivitate ca şi scorul STOP-Bang, dar cu o specificitate superioară. Cel mai redus raport de risc a fost decelat pentru STOP-Bang, iar cel mai ridicat pentru scorul DX-OSA (probabilitate OSA > 83%).

Concluzii. Scorul DX-OSA ar putea fi util pentru identificarea pacienţilor obezi cu OSA semnificativ care necesită CPAP (presiune pozitivă continuă în căile aeriene). Astfel CPAP ar putea fi demarat fără a mai efectua polisomnografia şi fără a mai întârzia intervenţia chirurgicală.

Cuvinte cheie: sindrom de apnee în somn de tip obstructiv, obezitate, presiune pozitivă continuă în căile aeriene