

IDENTIFICATION OF RESPIRATORY RISK PARAMETERS IN OBESE ORAL SURGICAL PATIENTS

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Obesity, defined as body mass index (BMI) between 30 and 39.9 kg/m², and morbid obesity, with BMI of more than 40 kg/m² is a multisystem, chronic, proinflammatory disorder with a worldwide increasing prevalence called "globesity". There is a known significant increase in perioperative complications in obese patients. Oral surgeries under general endotracheal anesthesia pose special challenge in obese patients. The aim of the study was to evaluate the risk of postoperative pulmonary complications (PPC), preoperative dyspnea score and their correlation with body mass index (BMI) among obese patients scheduled for oral surgical procedures under general anesthesia. Following permission by the Ethics Committee and signed written informed consent, 75 obese patients (age 30-65 and ASA status II-III) were involved. The PPC risk was determined by ARISCAT score and dyspnea by modified Borg score. The mean BMI was 35.6 (SD 5.6), with no gender difference. Patients had the abdominal obesity type with the mean waist-to-hip (W/H) ratio greater than 1.1 (female 0.99±0.19 and male 1.11±0.18). The mean neck circumference was 54.2 (SD 6.9) cm, significantly higher in males (p=0.003). There was significant positive correlation of ARISCAT score (r=0.57; p=0.001) and preoperative degree of dyspnea (r=0.51; p=0.001) with BMI, and of neck circumference with W/H ratio (r=0.37; p=0.01). The results showed positive correlation between the PPC risk determined and preoperative dyspnea level (r=0.34; p=0.002). Identification of respiratory risk parameters in obese patients and their interdependence proved to be of clinical interest. Preoperative assessment of PPC risk and dyspnea level at rest should be part of the standard preoperative protocol for oral surgical procedures, especially in one-day surgery.

Ključne riječi: obesity, oral surgical procedures, postoperative pulmonary complications, general anesthesia, dyspnea

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INTRODUCTION

World and European epidemiological research, as well as recent research in Croatia provide data on an alarming increase in the prevalence of obesity (1-3). Obesity, defined by the World Health Organization as class I with body mass index (BMI) 30-35 kg/m², class II with BMI >35 kg/m² as severe obesity, and class III with BMI >40 kg/m² as morbid obesity, is a multisystem, chronic, proinflammatory disorder with a worldwide increasing prevalence called "globesity". The latest data from the Croatian Institute of Public Health show that 25.3% of men and 34.1% of women have BMI ≥30 kg/m² (3,4). There is a known significant increase in peri-

operative complications in obese patients (5,6). There is an increased incidence of anesthesia complications due to difficult intubation, mechanical ventilation, compression of the lungs with the surrounding fatty tissue, reduced pulmonary functional capacity, increased oxygen consumption, covert pathophysiological effect, and changed immune system (7-9). Due to limited living habits and minimization of daily activities, patients with psychomotor disorders are often overweight, which carries the previously mentioned risks of perioperative complications. There is a high prevalence of undiagnosed obstructive sleep apnea (OSA) among obese surgical patients (10,11).

Oral surgery under general anesthesia poses special challenge in obese patients (12). Any form of regional anesthesia is inadequate and procedures are mostly short-term but require deep level of anesthesia. Patients are released home on the same day in one-day surgery or patient discharge is expected a few days after the operation (13,14).

Dental procedures in adults and children with psychomotor disorders must be performed under general anesthesia due to difficulties in cooperation to perform the procedure in an outpatient setting. These patients are often overweight and with cardiac or metabolic failure that is often associated with some of the syndromes.

The prevalence of obesity as a chronic disease is increasing, thus affecting oral health (15). Increased BMI is associated with poor oral hygiene and thus an increased risk of periodontitis and dentoalveolar abscesses (12,16). Following the above-mentioned, the obese population, particularly the obese with high OSA risk, are at a greater risk of various oral cavity pathologies. Oral and maxillofacial surgical procedures additionally reduce the volume of upper respiratory tract and increase the risk of postoperative hypoxia due to postoperative edema.

Postoperative pulmonary complications (PPCs) are a major contributor to the overall risk of surgery (17). They are associated with a substantially longer time spent in the hospital and higher in-hospital postoperative mortality (18). Recent research has shown that assessing the seven easily recordable and clinically accessible factors identified by the ARISCAT (Assess Respiratory rIsk in Surgical patients in CATalonia) score is useful and clinically practical for differentiating three levels of PPC risk (19,20). The three predicted risk groups are defined according to the cutoffs identified in the ARISCAT study by means of the minimum description length principle: <26 (low), ≥26 and <45 (intermediate), and ≥45 (high risk) (Table 1).

Table 1
 ARISCAT risk predictors and points assigned

Risk predictor	Score
Age (yrs)	
<50	0
51-80	3
>80	16
Preoperative SpO ₂	
>96%	0
91%-95%	8
<90%	24
Preoperative anemia (Hb <100)	
No	0
Yes	11

Respiratory infection in the last month	
No	0
Yes	17
Surgical incision	
Peripheral	0
Upper abdominal	15
Intrathoracic	24
Duration of surgery (h)	
<2	0
2-3	16
>3	23
Emergency procedure	
No	0
Yes	8

Three levels of risk were indicated by the following 3 cutoffs: <26 points, low risk; 26-44 points, moderate risk; and >45 points, high risk; ARISCAT = Assess Respiratory rIsk in Surgical patients in CATalonia; Hb = hemoglobin; Spo₂ = arterial oxyhemoglobin saturation by pulse oxymetry

Dyspnea is very common in obese patients (21). However, its assessment is rare in clinical practice. One of the easy tests for clinical evaluation of respiratory function in obese patients is the modified Borg scale (22) that consists of 10 descriptive and 12 numerical vertically positioned categories of dyspnea, one of which is associated with the severity of breathing of the examined patient (Table 2).

Table 2
 Modified Borg dyspnea scale

0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight
3	Moderate
4	Somewhat severe
5	Severe
6	
7	Very severe
8	
9	Very, very severe (almost maximal)
10	Maximal

Levels of dyspnea at rest by answering the question: How much difficulty is your breathing causing you right now?

AIM OF THE STUDY

The objective of this prospective study in obese patients scheduled for oral and maxillofacial surgical procedures under general anesthesia was to determine the PPC risk, preoperative dyspnea score, and correla-

tion between risk parameters and obesity. Therefore, the primary aim was to evaluate correlation between preoperatively confirmed respiratory risk parameters and obesity and to involve results into clinical practice, particularly in the area of oral surgery where the risk of surgery complications is mainly low and disproportionate to the risk of anesthesia in obese patients.

PATIENTS AND METHODS

This prospective study was performed at Dubrava University Hospital, Zagreb, Croatia, Department of Anesthesiology, Resuscitation and Intensive Medicine and Department of Maxillofacial and Oral Surgery. The study included 75 obese patients scheduled for oral and maxillofacial surgical procedures under general endotracheal anesthesia. This clinical study was approved by the Health Sciences Research Ethics Board of Dubrava University Hospital and Zagreb School of Dental Medicine (protocol 05-PA-26-1/2016) and conducted according to the principles of the Declaration of Helsinki. The criteria for patient inclusion in the study were as follows:

- BMI ≥ 30 kg/m²;
- surgical procedures in the oral cavity under general endotracheal anesthesia, i.e. cystectomy, alveotomy, mandibular and maxillary osteosynthesis after jaw trauma, removal of impacted teeth, orthodontic surgical treatment of jaw deformity, and benign tumor surgery;
- adult patients aged 30-65 as working active population, American Society of Anesthesiologists (ASA) classification II-III;
- duration of surgery up to 2 hours;
- no documented heart (NYHA class II-III) and lung diseases (asthma, chronic obstructive pulmonary disease);
- no postoperative mechanical ventilation in intensive care unit (ICU); and
- written informed consent for study enrolment signed.

Extensive surgery and surgery of long duration were not included in the study because they require longer postoperative recovery. The aim of the study was to obtain data that could be implemented in the perioperative procedure of shorter oral surgical procedures under general anesthesia, especially in one-day surgery.

Data on the seven risk factors for PPC described in the ARISCAT model (20) were collected preoperatively, as follows: age; peripheral oxyhemoglobin saturation measured by pulse oxymetry (SpO₂); respiratory infection in the last month; hemoglobin concentration;

surgical incision site; surgical duration in hours; and type of surgery (scheduled or emergency) (Table 1).

Modified Borg score (22) was used to assess preoperative and postoperative dyspnea level.

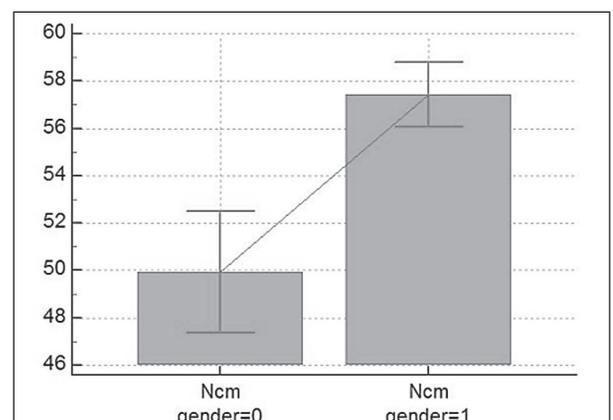
Statistical analysis

Data are presented in tables and graphs. Student's t-test was used for normal distribution and Man Whitney U test for non-normal distribution data. Data were expressed as mean \pm standard deviation (SD) or median (interquartile range), as appropriate. Differences in categorical values were analyzed by χ^2 -test. We calculated Pearson's correlation coefficients between preoperative values of dyspnea compared to the clinical variables observed. Relationship between the anesthetic risk and other clinical parameters was calculated by Kendall tau_b coefficients (given the ordinal structure of the observed variables). All p values less than 0.05 were considered statistically significant. The IBM SPSS Statistics version 24.0.0.1 (www.spss.com) software was used on the analysis.

RESULTS

Seventy-five obese patients completed the study protocol, including 33 (44%) women and 42 (56%) men. The mean patient age (\pm SD) was 49.5 \pm 10.6 years, with no statistically significant gender difference (p=0.61). According to the mean BMI of 35.6 \pm 5.6, patients were mostly categorized in class I and II (severe obesity). Abdominal type of obesity was recorded according to the mean waist-to-hip (W/H) ratio, which was >1.1 (women 0.99 \pm 0.19 and men 1.11 \pm 0.18). The mean neck circumference was 54.1 \pm 6.9 cm, greater in men (p=0.003) (Fig. 1a, b).

Fig. 1. Neck circumference in obese patients
a) box and plot



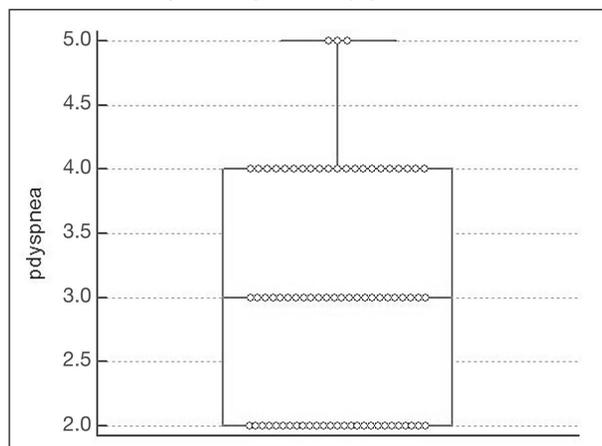
Gender 0 = female; gender 1 = male; Ncm = neck circumference (cm)

b) p value

	Sample 1	Sample 2
Sample size	33	42
Arithmetic size	49.9394	57.4286
95% CI for the mean	47.3733 to 52.5055	56.0501 to 58.8071
Variance	52.3712	19.5679
Standard deviation	7.2368	4.4236
Standard error of the mean	1.2598	0.6826
F-test for equal variances	P=0.003	

According to the preoperative Borg dyspnea score, patients had moderate dyspnea at rest (mean 3, range 2-5) (Fig. 2).

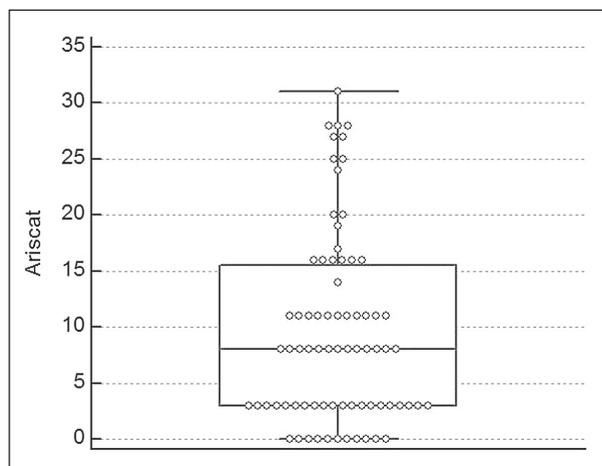
Fig. 2. Preoperative dyspnea level



* dyspnea Borg level 0-10

Patients did not have an increased risk of PPC, since ARISCAT score was less than 26 (mean 9, range 0-31) (Fig. 3).

Fig. 3. ARISCAT score



ARISCAT score >26 = high risk of postoperative pulmonary complications

Positive correlations were statistically significant between:

- neck circumference and W/H ratio ($r=0.36$; $p=0.001$)
- ARISCAT score and BMI ($r=0.57$; $p=0.001$); pre-operative Borg dyspnea score and BMI ($r=0.51$; $p=0.001$)

These results are shown in Tables 3 and 4.

Table 3

Correlation between body mass index and patient parameters

		BMI (kg/m ²)	W/H
Age	Correlation coefficient	-0.158	0.138
	P	0.175	0.239
	N	75	75
Neck circumference	Correlation coefficient	0.148	0.368
	P	0.204	0.001
	N	75	75
ARISCAT score	Correlation coefficient	0.576	-0.061
	P	0.000	0.603
	N	75	75
Tooth number	Correlation coefficient	-0.063	-0.002
	P	0.594	0.986
	N	75	75
Difficult intubation	Correlation coefficient	0.066	0.181
	P	0.572	0.120
	N	75	75
Dyspnea level	Correlation coefficient	0.508	0.070
	P	0.000	0.550
	N	75	75

BMI = body mass index; W/H = waist-to-hip ratio; n = number of patients; p values less than 0.05 were considered statistically significant

Table 4

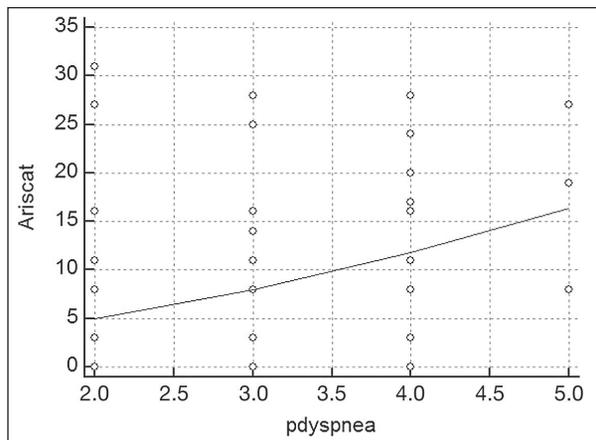
Correlation between dyspnea level and patient parameters

		Dyspnea preoperatively
Age	Correlation coefficient	-0.005
	P	0.965
	N	75
Neck circumference	Correlation coefficient	0.139
	P	0.234
	N	75
ARISCAT score	Correlation coefficient	0.347
	P	0.002
	N	75

n = number of patients; p values less than 0.05 were considered statistically significant

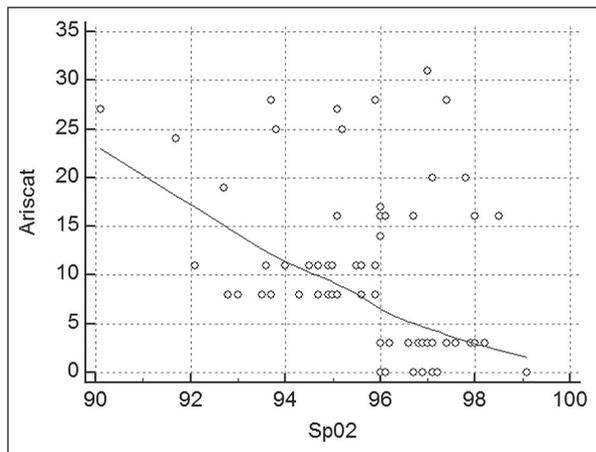
Positive correlation was found between ARISCAT score and preoperative Borg dyspnea score ($r=0.34$, $p=0.002$) (Fig. 4). Negative correlation was found between ARISCAT score and preoperative SpO₂ ($r=-0.43$; $p=0.001$) (Fig. 5).

Fig. 4. ARISCAT score – dyspnea correlation



Positive correlation

Fig. 5. ARISCAT score – SpO2 correlation



Negative correlation

DISCUSSION

Obesity as a multifactorial factor of chronic diseases affects the socio-economic standard of the population and has adverse effects on oral health, thus increasing oral pathology. This study included obese patients whose mean BMI of 35.6 (SD 5.6) classified them mostly in the obese and severely obese population groups. We did not expect such results since obese patients are mostly involved in abdominal surgery.

The mean W/H ratio >1.1 (women 0.99 ± 0.19 and men 1.11 ± 0.18) signified abdominal type of obesity. BMI >35 and W/H ratio >1.1 imply an increased anesthesiological perioperative risk, which has to be taken into account during dental surgery, primarily decisions on the type of anesthesia for the procedure in oral cavi-

ty. As Marciani *et al.* showed, dental medical doctors must be aware of the risk of general anesthesia in obese patients and carefully decide on the method and conditions for performing the procedure (12).

According to the preoperative moderate score of dyspnea, postoperative recording of dyspnea level should be performed in obese patients, in particular during one-day oral surgery under general anesthesia.

Our patients did not have an increased PPC risk since ARISCAT score was less than 26 (mean 9, range 0-31). The reason for the relatively low values of ARISCAT score could be the fact that oral and maxillofacial interventions are not included in any scale of risk assessment of perioperative complications as a type of surgery (19,20). However, ARISCAT score showed a very negative correlation with preoperative SaO₂ and therefore should be taken into account in preoperative risk screening. Finally, ARISCAT score showed very positive correlation with the preoperative degree of dyspnea, suggesting the need for regular preoperative assessment of ARISCAT scores in obese patients.

Patients with psychomotor disorders were not included in our study, but it is important to note that patients with psychomotor disorders are mostly obese. Therefore, they are at an increased risk of perioperative complications during oral and maxillofacial surgery procedures under general anesthesia (12). Thus, the risk *versus* benefit of treatment must be carefully considered and results of this study could help in decision making. The requirement for preoperative sedation, post-surgical admission, or both should be assessed to reduce the risk of postoperative complications.

The above results in obese and extremely obese patients related to anesthetic approach to the patient during oral surgery are the first data in the Croatian scientific literature.

This research had certain limitations. It was a single-center study that needs further validation. The study included obese patients according to BMI, but did not take into account anatomical distribution of body fat, which could also affect the diversity of respiratory mechanisms. Future studies could elaborate the pathophysiological fact and categorize obese patients according to the W/H ratio or degree of obesity.

CONCLUSION

1. ARISCAT score as a tool for predicting postoperative pulmonary complications and preoperative modified Borg dyspnea level showed good correlation with BMI.
2. ARISCAT score had very positive correlation with the preoperative degree of dyspnea in obese patients determined by modified Borg scale.
3. Postoperative pulmonary complication risk and preoperative dyspnea level screening are clinically indicated in obese patients undergoing oral surgical procedures.

Finally, we can conclude that identification of respiratory risk parameters in obese patients and their interdependence are of clinical importance. The risk of oral surgery complications is mainly low and disproportionate to the risk of anesthesia in obese patients during oral surgical procedures. Therefore, further research in obese population is required considering the alarming increase in the prevalence of obesity, along with the expanding indications for general anesthesia, especially sedation during oral surgical procedures.

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S A Ž E T A K

IDENTIFIKACIJA RIZIKA OD RESPIRACIJSKIH KOMPLIKACIJA KOD PRETILIH ORALNOKIRURŠKIH BOLESNIKA

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Poznato je da pretili bolesnici imaju povišeni rizik perioperacijskih komplikacija. Kirurški zahvati u području usne šupljine u pretilih bolesnika mogu dodatno povećati rizik poslijeoperacijskih respiracijskih komplikacija. *Cilj:* Pretilim oralnokirurškim bolesnicima procijeniti rizik poslijeoperacijskih plućnih komplikacija (PPK), prijeoperacijski stupanj dispneje, te utvrditi razinu povezanosti s indeksom tjelesne težine (ITT). *Ispitanici i metode:* Nakon odobrenja Etičkog povjerenstva Kliničke bolnice Dubrava te Etičkog povjerenstva Stomatološkog fakulteta Sveučilišta u Zagrebu 75 pretilih bolesnika predviđenih za oralnokirurški zahvat u općoj anesteziji sudjelovalo je u prospektivnom istraživanju. Rizik poslijeoperacijskih plućnih komplikacija određivao se bodovnom tablicom ARISCAT, stupanj dispneje modificiranom Borgovom ljestvicom. Kriteriji za uključivanje bolesnika u studiju bili su: indeks tjelesne mase ≥ 30 kg/m²; kirurški zahvat u području usne šupljine u općoj endotrahealnoj anesteziji – cistektomije, alveotomije, osteosinteze mandibule i maksile nakon trauma čeljusti, operacije retiniranih i impaktiranih zubi, ortodontsko kirurška terapija deformiteta čeljusti, operacije benignih tumora; ASA (*American Society of Anesthesiologists*) klasifikacija bolesnika II-III ; trajanje opće endotrahealne anestezije do dva sata. *Rezultati:* Značajna pozitivna povezanost parametara povezanih s pretilošću nađena je između opsega vrata i omjera struka i bokova ($r=0,37$, $p=0,01$); skora za procjenu poslijeoperacijskih plućnih komplikacija Ariscat i ITT ($r= 0,57$, $p=0,001$) te prijeoperacijske ljestvice dispneje i ITT ($r= 0,51$, $p=0,001$). Statistički je u bolesnika bila značajna negativna povezanost skora za procjenu poslijeoperacijskih plućnih komplikacija Ariscat i prijeoperacijske saturacije krvi kisikom ($r= -0,43$, $p= 0,001$), a s druge strane skor Ariscat je jako dobro pozitivno korelirao s prijeoperacijskim stupnjem dispneje ($r=0,35$, $p=0,02$). *Zaključak:* Pretili oralnokirurški bolesnici u općoj anesteziji nisu rijetkost. Pretilim bolesnicima potrebno je prijeoperacijsko procjenjivanje rizika PPK i prijeoperacijskog stupnja dispneje, budući da su rezultati pokazali njihovu međuovisnost. Identificiranje anesteziološkog rizika važan je parametar prijeoperacijskog protokola oralnokirurških zahvata posebice u jednodnevnoj kirurgiji, budući da incidencija pretilih bolesnika raste, a zahtjevi za sedacijom tijekom oralnokirurških zahvata se proširuju.

Ključne riječi: debljina, oralnokirurški zahvati, poslijeoperacijske plućne komplikacije, opća anestezija, dispneja