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SCIENTIFIC ARTICLE

Use of positive pressure in pre and intraoperative of bariatric surgery and its effect on the time of extubation

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KEYWORDS
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Abstract
Background and objective: To investigate the influence of intraoperative and preoperative positive pressure in the time of extubation in patients undergoing bariatric surgery.
Method: Randomized clinical trial, in which 40 individuals with a body mass index between 40 and 55 kg/m^2, age between 25 and 55 years, nonsmokers, underwent bariatric surgery type Roux-en-Y gastric bypass by laparotomy and with normal preoperative pulmonary function were randomized into the following groups: G-pre (n = 10): individuals who received treatment with noninvasive positive pressure before surgery for 1 h; G-intra (n = 10): individuals who received positive end-expiratory pressure of 10 cm H_2O throughout the surgical procedure; and G-control (n = 20): not received any pre or intraoperative intervention. Following were recorded: time between induction of anesthesia and extubation, between the end of anesthesia and extubation, duration of mechanical ventilation, and time between extubation and discharge from the post-anesthetic recovery.
Results: There was no statistical difference between groups. However, when applied to the Cohen coefficient, the use of positive end-expiratory pressure of 10 cm H_2O during surgery showed a large effect on the time between the end of anesthesia and extubation. About this same time, the treatment performed preoperatively showed moderate effect.
Conclusion: The use of positive end-expiratory pressure of 10 cm H_2O in the intraoperative and positive pressure preoperatively, influenced the time of extubation of patients undergoing bariatric surgery.

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PALAVRAS-CHAVE
Doenças;
Obesidade;
Cirurgia bariátrica;
Ventilação mecânica: pressão positiva

Utilização da pressão positiva no pré e no intraoperatório de cirurgia bariátrica e seus efeitos sobre o tempo de extubação

Resumo
Justificativa e objetivo: Investigar a influência do uso da pressão positiva intraoperatória e pré-operatória no tempo de extubação de pacientes submetidos à cirurgia bariátrica.
Método: Trata-se de ensaio clínico randomizado, no qual 40 indivíduos com índice de massa corporal entre 40 e 55 kg/m^2, idade entre 25 e 55 anos, não tabagistas, submetidos à cirurgia bariátrica do tipo derivação gástrica em Y de Roux por laparotomia e com prova de função pulmonar pré-operatória dentro da normalidade foram randomizados nos seguintes grupos: G-pré (n = 10): indivíduos que receberam tratamento com pressão positiva não invasiva antes da cirurgia, durante uma hora, G-intra (n = 10): indivíduos que receberam Positive End-expiratory Pressure de 10 cm H_2O durante todo o procedimento cirúrgico e G-controle (n = 20): não receberam qualquer tipo de intervenção pré ou intraoperatória. Foram anotados os seguintes tempos: tempo decorrido entre a indução anestésica e a extubação, entre o término da anestesia e extubação, tempo de ventilação mecânica, e tempo entre a extubação e a alta da Recuperação Pós-Anestésica.
Resultados: Não houve diferença estatística entre os grupos, porém quando aplicado ao Coeficiente de Cohen, o uso da Positive End-expiratory Pressure de 10 cm H_2O no intraoperatório mostrou um efeito grande sobre o tempo entre o término da anestesia e a extubação. Sobre este mesmo tempo, o tratamento realizado no pré-operatório apresentou efeito moderado.
Conclusão: O uso da Positive End-expiratory Pressure de 10 cm H_2O no intraoperatório e da pressão positiva no pré-operatório, pode influenciar o tempo de extubação de pacientes submetidos à cirurgia bariátrica.

Introduction

Obesity is currently considered a public health problem that is reaching epidemic proportions.[1] In 2008, over 1.4 billion adults were overweight and, of these, over 200 million men and nearly 300 million women were obese.[1] Considered to be of multifactorial origin, the probable causes of obesity include a combination of genetic, endocrine, behavioral, socioeconomic, psychological, and environmental imbalances and, consequently, the emergence of multiple comorbidities.[2] Conservative treatment involves nutritional therapy, drug therapy, and physical activity. When conservative treatment is unsuccessful and obesity becomes morbid, the bariatric surgery is indicated.[3]

Most surgical procedures requiring general anesthesia may trigger the onset of postoperative complications, such as atelectasis, due to a decrease in functional residual capacity (FRC).[4] Moreover, the loss of abdominal muscle integrity due to the incision and the need for neuromuscular blockers, sedatives, and analgesics also interfere with muscle contractility, which in turn triggers the inadequate respiratory muscle performance after surgery.[5]

These effects of general anesthesia when associated with morbid obesity may further worsen the development of intraoperative and postoperative complications.[6] Thus, the longer the duration of surgery, and consequently the anesthetic procedure, the greater the chances of postoperative pulmonary complications.[7]

Respiratory physiotherapy with re-expansion techniques has proven benefits in reducing complications after abdominal surgery,[8] but there are no well-designed clinical trials in the literature to prove that there is superiority between the proposed treatment forms for the preoperative, intraoperative and post-operative periods of abdominal surgery.

Literature on the use of noninvasive mechanical ventilation postoperatively is vast and shows good results.[9–11] Some ventilatory strategies have been used postoperatively in an attempt to improve gas exchange through the use of positive pressure maneuvers aiming at alveolar recruitment and even reducing the surgical time.[12,13] However, the literature on the use of positive pressure preoperatively as a prophylactic manner is still scarce.

Thus, the hypothesis of the study was that positive pressure applied during both pre- and intraoperative periods may influence the extubation time of patients undergoing bariatric surgery.

Therefore, the aim of this study was to investigate the influence of intraoperative 10 cm H_2O positive end-expiratory pressure (PEEP) and preoperative positive pressure on extubation time of patients undergoing Roux-en-Y gastric bypass bariatric surgery.

Method

Study design

Randomized clinical trial approved by the Ethics Research Committee, Universidade Metodista de Piracicaba (UNIMEP), under protocol 54/11, and all patients provided written informed consent.

Participants

Individuals with body mass index (BMI) between 40 and 55 kg m^{-2}, aged between 25 and 55 years, undergoing Roux-en-Y gastric bypass bariatric surgery by laparotomy, and with normal preoperative pulmonary function tests were included. Smokers or those with hemodynamic instability or surgical complications were excluded.

Sample size calculation

The sample size calculation was based on a pilot study, considering the difference of the expiratory reserve volume (ERV) values obtained between the preoperative and postoperative periods. The least significant difference (0.18 L) and the error standard deviation (0.11 L) were used for the calculation. ANOVA test was used, adopting a statistical power of 80% and an alpha of 0.05. Thus, a number of 10 volunteers per group was determined. Sample size calculation was performed using the BioEstat software version 5.3 (Belém, Brazil).

Investigators

The study included three researchers: one responsible for the patient initial evaluation and inclusion, one blind to initial data of volunteers and responsible for randomization, and one responsible for treatment application. After patient eligibility, randomization was performed and a sealed envelope was handed to the investigator responsible for treatment application.

Screening of volunteers

The initial screening of volunteers was performed by searching the patient registration form for possible inclusion in the study. Volunteers were divided into three different groups after randomization in blocks of five using Microsoft Excel® software.

Treatment application

Subjects in preoperative group (PO) group received treatment with bilevel positive airway pressure (BiPAP Synchrony II – Respironics®) via facial mask for one hour before surgery. The inspiratory positive airway pressure (IPAP) was started at 12 cm H_2O and adjusted according to the individual tolerance, maintaining a respiratory rate below 30 breaths per minute and a tidal volume about 8–10 mL kg^{-1} of ideal weight. Positive end-expiratory pressure (PEEP) was set at 8 cm H_2O.

Subjects in intraoperative group (IO) group received 10 cm H_2O PEEP throughout the surgical procedure.

Subjects in control group received no preoperative or intraoperative intervention.

All patients underwent bariatric surgery performed by the same surgical team under general anesthesia and standard ventilation with the Dräger Fabius GS ventilator, in volume control mode, with tidal volume of 6–8 mL kg^{-1}, PEEP of 5 cm H_0O (except for IO group), and fraction of inspired oxygen between 0.4 and 0.6.

Procedures

Respiratory evaluation consisted of anthropometric data collection and pulmonary function test by spirometer micro-Quark Pony-FC (Cosmed, Rome, Italy).

Spirometry was performed in accordance with standards of the American Thoracic Society (ATS) and European Respiratory Society (ERS).[14] Volunteers with normal pulmonary function were included in the study.

Patients were followed-up by the investigator in the operating room, and the surgical procedure was performed as follows: the patient positioned on the surgical table was subjected to induction of anesthesia with inhaled sevoflurane and intravenous propofol, and anesthesia maintenance with remifentanil by continuous infusion pump. After induction of anesthesia, the patient underwent orotracheal intubation and was placed on mechanical ventilation. Bariatric surgery began with a midline incision in the upper abdomen and during the surgical procedure the patient was treated with neuromuscular blockers and analgesics, according to need evaluated by the surgeon and the anesthesiologist. After surgery, remifentanil was discontinued and considered as the end of anesthesia. Subsequently, the patient could be extubated and transferred to the post-anesthesia care unit (PACU) using oxygen mask. A score of 10 on the Aldrete and Kroulik scale,[15] used as hospital protocol, was required for patient discharge from PACU.

Outcome measurements

The following outcomes were recorded during surgical procedure: time between induction of anesthesia and extubation, time between the end of anesthesia and extubation, time of mechanical ventilation, and time between extubation and PACU discharge.

Statistical analysis

The SPSS version 17.0 was used for statistical analysis. Quantitative data are presented as mean and standard deviation (SD) and qualitative data as frequencies. Not satisfied the assumption of normality and homoscedasticity by Shapiro–Wilk and Levene's tests, the Kruskal–Wallis test was performed. A 5% level of significance was considered.

Treatment influence on variables was tested using an effect size to compare treatment groups with control group. For this, the Cohen's *d* pooled or weighted was used.

Cohen's *d* pooled is calculated as follows: Cohen's d = mean 1 − mean 2 weighted SD^{-1}, with weighted SD = (SD1 + SD2) 2^{-1}.

Results are interpreted as follows: less than 0.3 is considered a small effect; from 0.4 to 0.7, a moderate effect; and from 0.8, a great effect.

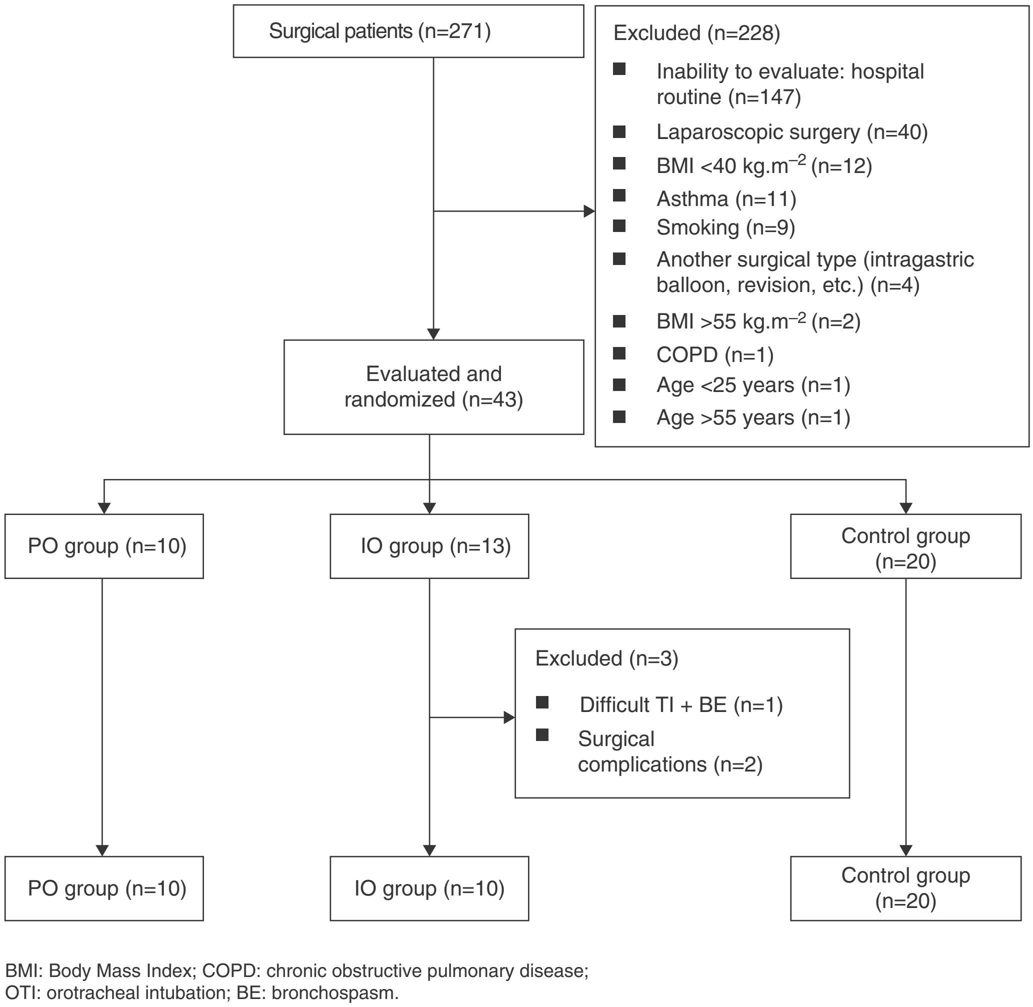

Figure 1 Flowchart of patients included.

Results

Within 20 weeks of the study, 271 patients underwent surgery, and of these, 228 were excluded for not meeting the criteria previously established. Forty-three patients were evaluated and, of these, three were excluded during the study, leaving 40 patients: 20 in control group, 10 in IO group, and 10 in PO group (Fig. 1).

Table 1 shows the anthropometric characteristics of volunteers, with no statistical difference, indicating the sample homogeneity.

Table 2 summarizes the findings regarding intraoperative measurements, with no statistical differences between groups.

Table 3 summarizes the values obtained from the treatment effect size analysis using Cohen's coefficient applied to the duration of surgery variables, revealing that the

Table 1 Age, gender, and anthropometric data of groups, presented as mean and standard deviation.

	Control	IO	PO	*p*
n	20	10	10	
Sex (F/M)	16/4	9/1	8/2	0.773
Age (years)	40.7 ± 10.6	37.3 ± 11.4	42 ± 11.2	0.622
Weight (kg)	120.8 ± 20.26	119.7 ± 17.8	120.9 ± 17.0	0.894
Height (cm)	162 ± 27.7	163.1 ± 8.2	163.9 ± 9.07	0.973
BMI ($kg\,m^{-2}$)	45.72 ± 4.08	44.8 ± 4.7	44.8 ± 2.8	0.534
Ideal body weight (kg)[a]	60.59 ± 4.52	60.6 ± 4.9	60.9 ± 6.1	0.980

F, female; M, male; BMI, body mass index; IO, intraoperative group; PO, preoperative group.
[a] Value based on the Metropolitan Life Foundation.[16]

Table 2 Time points presented in minutes.

Time point	Mean ± SD			
	Control	IO	PO	*p*
n	20	10	10	
Induction of anesthesia – extubation	132.2 ± 12.71	128.5 ± 14.3	131 ± 14.2	0.58
End of anesthesia – extubation	23.8 ± 7.85	17 ± 6.74	19.3 ± 6.2	0.07
MV time	128.4 ± 12.03	126.2 ± 13.9	127.3 ± 14.2	0.65
Extubation – PACU discharge	213.5 ± 65.7	249.5 ± 77.8	218.4 ± 83.1	0.52

SD, standard deviation; MV, mechanical ventilation; PACU, post-anesthesia care unit; IO, intraoperative group; PO, postoperative group.

intraoperative PEEP application showed great effect on the time between the end of anesthesia and extubation, as well as the preoperative application of positive pressure, with moderate effect.

Discussion

Results show that there was no statistical difference between groups when the respective times were evaluated. However, when applied to the Cohen coefficient, which evaluates the treatment effect, the preoperative use of 10 cm H_2O PEEP showed a large effect on patient extubation time from the end of anesthesia. Thus, patients who have undergone this treatment reduced the time spent in tracheal intubation. Regarding this same time, the preoperative treatment showed moderate effect.

Among the respiratory changes resulting from obesity, the obese individual presents changes in breathing mechanics, decreased respiratory muscle strength, decreased gas exchange, and decreased lung volume and capacity (mainly ERV and FRC) due to fat deposition on the thorax and abdomen.[17] Thus, when undergoing a surgical procedure, they are exposed to higher risks of complications.

In the study by Blouw et al.,[18] an increased percentage of respiratory failure was found in patients with BMI above 43 kg m^{-2} after bariatric surgery. Similar works highlight the need for prophylactic interventions, in order to prevent respiratory complications in patients undergoing bariatric surgery.

Regarding postoperative pulmonary complications, it is known that many of them are related to the type of surgery, incision site, type and duration of anesthetic and surgical procedure, which interferes with the patient's recovery.[7]

Table 3 Treatment effect size of both groups compared to control group.

Time point	Cohen's *d*	
	IO group	PO group
Induction of anesthesia – extubation	0.27	0.08
End of anesthesia – extubation	0.93	0.64
MV time	0.16	0.08
Extubation – PACU discharge	0.50	0.06

VM, mechanical ventilation; PACU, post-anesthesia care unit; IO, intraoperative group; PO, postoperative group. Cohen coefficient of less than 0.3 is considered a small effect, of 0.4–0.7 as moderate, and higher than 0.8 as large.

The search for physical therapy resources that can help to reduce the time of tracheal intubation is of great value, as prolonged duration of surgery or anesthesia may lead to more pronounced pulmonary complications.[19] A surgical time lasting more than 210 min is an independent risk factor for the onset of pulmonary complications after upper abdominal surgery and is also associated with higher mortality rate.[7] In the present study, the mean duration of surgery was significantly lower, but they were morbidly obese patients who already have previous pulmonary alterations associated with obesity and, in fact, it is very important to recognize resources that may minimize postoperative complications for these patients.

As for duration of surgery (anesthesia induction–extubation), there was similarity between groups. In the present study, the duration of surgery showed no significant difference between groups because all study subjects underwent the same surgical procedure, anesthetic protocol, and mechanical ventilation, as well as surgery performed by the same team. However, even with the proposed treatment showing a weak effect, the intubation time and consequently the MV time were higher in the control group. Although a significant effect of the treatments proposed in this study cannot be shown, the study by Remístico et al.[13] showed shorter duration of surgery in the group receiving alveolar recruitment with 30 cm H_2O PEEP.

Perhaps the results of this study regarding intraoperative treatment did not show a strong effect on extubation time reduction due to the lower PEEP values used. This fact may also be corroborated by a study that evaluated the effects of the alveolar recruitment maneuver in bariatric surgery using intraoperative PEEP values of 5, 20 and 30 cm H_2O, showing better blood oxygenation with higher values of arterial oxygen pressure in subjects who underwent the maneuver with 30 cm H_2O PEEP.[12] However, in Schuman[20] literature review, the use of 10 cm H_2O PEEP is recommended for these patients.

As for extubation time, considered from the maintenance anesthetic drugs discontinuation to patient extubation, it was shorter in subjects ventilated with 10 cm H_2O PEEP, and subsequently in subjects who used the positive pressure preoperatively. Another study evaluated the effects of an alveolar recruitment maneuver with different PEEP values during bariatric surgery and concluded that the subjects using the maneuver with 10 cm H_2O PEEP not only have lower pulmonary complications, but spent less time in PACU.[21]

Thus, with the extubation time reduction, the intraoperative use of 10 cm H_2O PEEP, besides benefiting the patient, may be an alternative to reduce hospital costs, a major concern for hospital administration, as intensive care account for up to 25% to 30% of all hospital resources.[22]

In the study by Erlandsson et al.,[23] it was demonstrated that obese patients who are ventilated with higher PEEP during bariatric surgery tend to prevent lung collapse and have better gas exchange during surgery.

Therefore, it is concluded that the intraoperative use of 10 cm H_2O PEEP and preoperative positive pressure influenced the extubation time of patients undergoing bariatric surgery.

Conflicts of interest

The authors declare no conflicts of interest.

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