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Research Article

Influences of Propofol-Remifentanil and Propofol-Epidural Anesthesia Combination on Dynamic Respiratory Tests in Laparoscopic Morbid Obesity Surgery

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Abstract

Objectives: Morbid obesity (MO) is an important risk factor for respiratory diseases. The aim of this study changes are observed between the preoperative and postoperative pulmonary functions of morbid obese patients undergoing laparoscopic sleeve gastrectomy with propofol-remifentanil infusion anesthesia(TIPA) and propofol-epidural anesthesia(EDIPA) under BIS control.

Methods: A total of 52 patients who were to undergo sleeve gastrectomy for MO were divided into two groups for this prospective randomized double-blind study. Propofol infusion was administered to both groups (initial dose 10 mg kg hour); the bispectral index (BIS) was maintained between 40-50 for the maintenance dose, and the hemodynamic parameters were considered. Remifentanil was administered at a dose of 25 ughour via TCA (target controlled analgesia) pump in Group P. In Group E, additionally, 0.0125% bupivacaine was administered with the TCA device at a dose of 8 ml/hour via the epidural route. PFT was performed 4 hours preoperatively and at the 4th hour beginning from the time when the postoperative modified Aldrete scores (MAS) were 9.

Results: MAS time and the amount of propofol used were found to be significantly lower in postoperative period in Group E. FEV1 and FVC were found to be significantly higher in the postoperative period in Group E.

Conclusion: PFT is better in the early postoperative period in cases whom epidural anesthesia is administered.

Keywords: Morbid obesity, propofol, epidural anesthesia, pulmonary function test

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Morbid obesity (MO) is a risk factor for many respiratory diseases. It is a disease that affects more than one organ systems, particularly the cardiovascular and respiratory systems due to fat deposition in tissues.[1] The body surface area increases together with the increasing weight in morbid obese individuals, and the basal metabolism rate increases compared to lean individuals. As a result, oxygen consumption and carbon-dioxide production also increase.[2]

The ventilation/perfusion ratio changes and an increase in the amount of intrapulmonary shunting may be observed in the respiratory system depending on these changes. Fat deposition impairs the expansion of the diaphragm, and fat depositions between the ribs and the muscles reduce the chest wall compliance.[3,4] Therefore, the metabolic needs and respiration work are increased even during rest. The total lung capacity (LC) and the functional residual capacity (FRC) decrease, and the airway resistance increases. The ex-

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piratory reserve volume (ERV) and FRC also decrease. The residual volume (RV) is usually preserved. The BMI increase and the first second forced expiratory volume (FEV1) decrease, and the forced vital capacity (FVC) decrease are proportional; FEV1 and FVC decrease as the BMI increases.[4,5] A decrease in FEV1 and FVC is prominent in MO patients.[5,6] However, this decrease is usually proportional; therefore, the FEV1/FVC does not change significantly. Hypoxemia becomes evident in the supine position and under general anesthesia. The work of breathing increases together with the increasing abdominal pressure, low pulmonary compliance and increased metabolic need.[4-6]

Although propofol is a frequently used intravenous (iv) anesthetic drug in MO operations, the anesthesia method used for these patients is still a subject of debate.[7] Studies that suggest patient controlled infusion anesthesia in similar patient groups are frequently encountered in the literature.[8,9] The ideal weight or the current weight of the patient may be used for target control when determining the propofol dose.[8] Use of monitoring methods such as EEG or bispectral index (BIS) together with close hemodynamic monitoring comes into the foreground in order to provide an ideal assessment of this condition.[9,10]

The aim of this study, observing of changes, between the preoperative and postoperative pulmonary functions of morbid obese patients undergoing laparoscopic sleeve gastrectomy with propofol-remifentanil infusion anesthesia (TIPA) and propofol-epidural anesthesia (EDIPA).

Methods

A total of 52 patients aged between 18-60 years who were going to undergo sleeve gastrectomy for MO (BMI>40 kg m^2), who were in American Society of Anesthesiology (ASA) I-III, were enrolled in this prospective randomized double-blind study. Patients with asthma, chronic obstructive pulmonary disease and those who did not agree to participate, were not included in the study. This study was done conducted in Şehitkamil State Hospital Anesthesia and Reanimation Clinic, after obtaining approval from the ethics committe of Gaziantep University Ethics Committee with 24/11/2014 dated and 365 numbered decision Written informed consent was obtained from all patients and volunteers.

Standard monitoring (electrocardiogram, pulse oxymeter and non-invasive blood pressure) was applied to the patients who were taken to operating room before anesthesia induction. 0.09% saline solution infusion was begun via the intravenous route. Randomization was carried out through the computer. The patients were randomly divided into two groups (group E and group P) with 26 patients in each group. The ideal weight for all drug intake was considered. Ideal body weight formula was used for ideal weight calculation.Ideal body weight formula: [for males: 50+((2.3xheight(inch))-60; for females: 45.5+((2.3xheight inch)-60)]. Bispectral index (BIS) (BIS- VISTA, Covidien,USA) monitoring was applied in both groups for monitoring the anesthesia depth. Anesthesia induction was provided with 2 mg kg iv propofol (propofol 1%™, Fresenius kabi, İstanbul, Turkey), 0.5 ug kg iv fentanyl (fentanyl™, Johnson & Jonhson, Belgium), 0.5 mg kg iv rocuronium bromide (esmeron™, N.V. Organon, Netherlands) in both groups. Endotracheal intubation was applied when sufficient anesthesia depth and muscle relaxation had been obtained. Propofol infusion was administered to both groups (initial dose 10 mg kg hour but in the continuation of operation rate of propofol infusion was determined by BIS (it would be between 40-50) and hemodynamic parameters). In group P propofol infusion was applied via the PCA device for the anesthesia depth BIS index so that it would be between 40-50 and hemodynamics parameters and Remifentanil was also administered via PCA in the dose of 25 ug hour iv at the begining of operation but in the continuation of operation rate of propofol infusion was determined by BIS (it would be between 40-50) and hemodynamic parameters. In group E an epidural catheter was placed between the T8-T9 ribs before anesthesia induction and 10 ml 0.0125% bupivacaine was given via the catheter. 0.0125% bupivacaine was applied via the PCA device at a rate of 8 ml/hour following the anesthesia induction. Propofol infusion was applied via the PCA device for the anesthesia depth BIS index so that it would be between 40-50 and hemodynamics parameters. During the operation both groups received administration of 0.3 mg kg hour ip of rocuronium bromide infusion.

The hemodynamic parameters (heart rate, non-invasive blood pressure, saturation) and the BIS values of all patients were recorded by the anesthetist who followed-up the patient intra-operatively and who did not participate in the study.

Postoperative pain control was provided with 1 mg kg intra-muscular diclofenac sodium (Diclomec®Abdi İbrahim, İstanbul, Turkey) 20 minute before the end of the operation. Postoperative pain was followed up with the Visual Analogue Scale (VAS) (1: No pain….10: The worst pain I have ever felt). Analgesic was used when VAS was 4 or above. Follow-up was recorded by an anesthetist who did not participate in the study.

Respiratory function tests were performed 4 hours before the operation and at 4^{th} hour beginning from when the postoperative modified Aldrete scores were 9 or above. The

records were made by an independent anesthetist.

The analysis of the results was carried out by the software SPSS 17®. The level of statistical significance was set at <0.05. The tests used were Student's t-test for the duration of operation, body mass index, age, pain intensity, propofol infused; Fisher's exact test for ASA; chi-squared test for gender; Mann–Whitney U test for total dose of propofol. Categorical variables were compared using Chi-square test. The haemodynamic variables were compared using repeated measures of ANOVA. The P value <0.05 was considered to be statistically significant.

Results

The demographic data and the operative times of the patients have been presented in Table 1. No statistically significant difference was found between the groups with regard to the demographic data and the operative times.

The BIS value has been given in Figure 1. The fifth minute BIS value was statistically significant in Group E (44.8±3.7, 54±2.9 [p≤0.05]).

The intraoperative heart rate has been presented given in Figure 2. The fifth minute value was statistically significant in Group E (72.7±1.5, 74.5±1.7 [p≤0.05]).

The intraoperative mean arterial pressure has been presented given in Figure 3. The fifth minute value was statistically significant in Group E (87.6±2.3, 89.5±1.1 [p≤0.05]).

Propofol consumption has been displayed given in Figure 4 and Table 2. It was found to be statistically significant in Group E when the amounts of consumption at the 5.,10., 20., 30., 40., 50., 60., 70., 80., 90. min were analyzed (9.1±0.9, 5.1±0.6; 7.9±0.5, 4.8±0.8; 6.7 ±1, 4.5±0.5; 6.4±0.5, 4±0.7; 6±0.6, 3.5±0.5; 5.8±0.8, 3.3±0.4; 5.8;0.6, 3.1±0.4; 5±0.8, 3.1±0.4; 4.5±0.5, 2.1±0.4; 3±0.4, 2±0.3 [p≤0.05]) (Fig. 4). The mean values of infusion rate were seen to be significantly lower in Group E (5.44±0.71, 3.57±0.54 [p≤0.05]) (Table 2).

The peroperative and postoperative changes of FEV1, FVC and FEV1/FVC values have been demonstrated in Table 2. No statistically significant difference was observed between the groups with regard to preoperative FEV1 and FVC values. However, the postoperative FEV1 and FVC values were statistically significantly higher in Group E (2.4, 2.8 [p≤0.05]; 2.7, 3±0.1 [p≤0.05]). The FEV1/FVC increased

Table 1. Comparison of the Demographic Data of the Groups

	Group P	Group E	p
Age (Years)	33.5±9.8	36.7±8.7	0.2
Male/Female	7/19	6/20	0.1
BMI (Body Mass Index)	46.5±1.3	46.1±1.2	0.2
ASA II/III	14/12	13/13	0.8
Duration of Operation (Minutes)	93.1±2	92±6.4	0.4

p>0.05 when compared the groups. n=26.

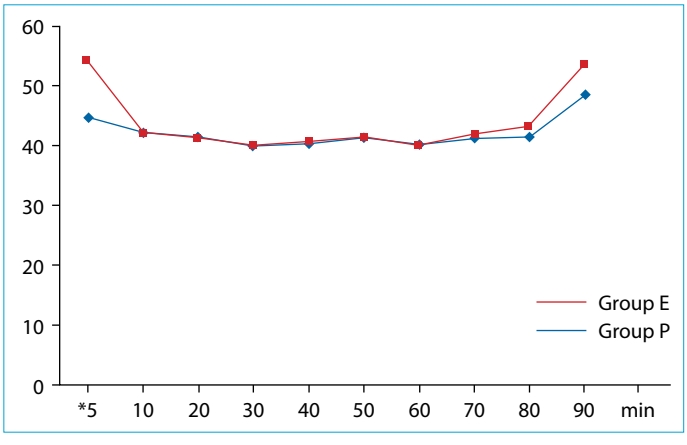

Figure 1. Comparison of the BIS of the Groups. *p≤0.05.

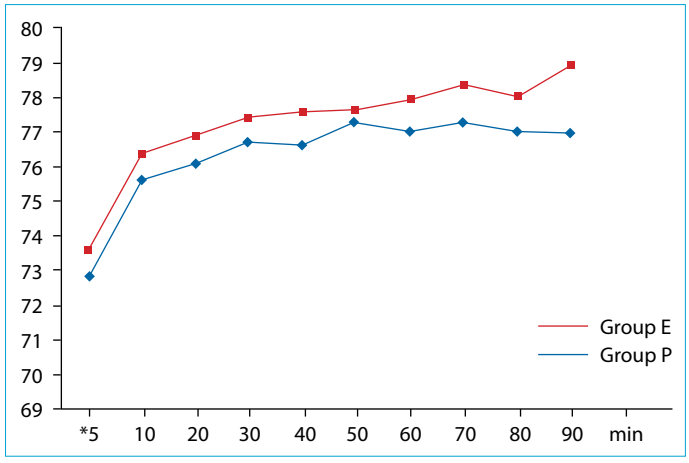

Figure 2. Comparison of the Mean Heart Rate of the Groups. (beats/min); *p≤0.05.

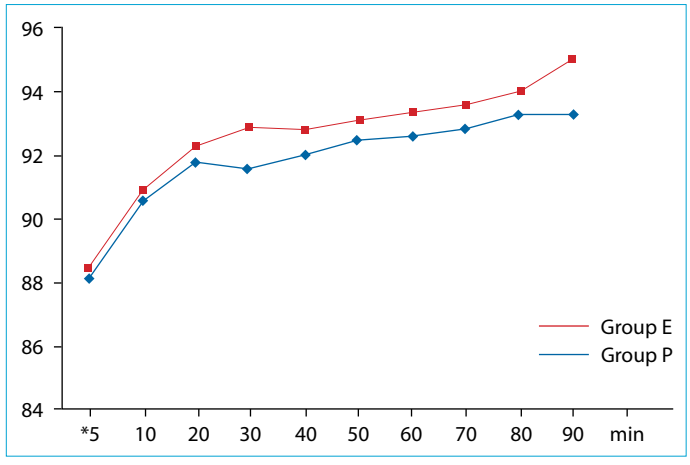

Figure 3. Comparison of the Mean Arterial Blood Presure of the Groups. (mmhg) *p≤0.05.

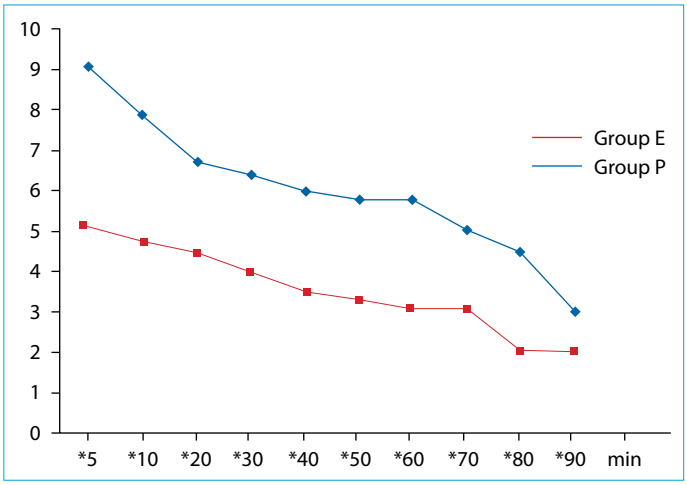

Figure 4. Comparison of Rate of propofol infusion the Groups (mg/kg/hr).*p≤0.05.

in the postoperative period; however, the difference was not statistically significant.

The duration of the modified Aldrete score's being 9 or above has been given in Table 2. It was statistically significantly higher in Group P (13.3±1.25, 9.11±0.86 [p≤0.05]). Post-operative VAS score of four or above was observed in both groups; neither group required analgesic use between the time when the post-operative MAS was 9 or above and pulmonary function tests were applied.

Discussion

In this study, we investigated the effects of adding epidural anesthesia to intra-venous general anesthesia on propofol consumption as intra-venous general anesthetic and the pulmonary functions of the patients in morbid obesity operations. Significant changes occur in the pharmacokinetic and pharmacodynamic properties of the anesthetic drugs in morbid obese patients.[10,11] Considering this condition, a patient target-controlled drug regimen and BIS-controlled anesthetic drug management use is recommended in anesthetic drug dose management of morbid obese patients.[10-13] In our study, one group received administration of propofol remifentanil anesthesia of the iv general anesthesia method. The ideal body weight was calculated for the initial doses, and patient target control, hemodynamic changes and BIS monitoring were used for maintenance doses. In another group, epidural anesthesia was added to iv propofol anesthesia, and patient target control, hemodynamic changes and BIS parameters were considered for the propofol infusion rate.

Table 2. Comparison of the Data of the Groups

	Group P	Group E	p
FEV1 (Preop)(L)	2.8	2.8	0.2
FVC (Preop)(L)	3.2	3.2	0.08
FEV1/FVC (Preop)(%)	87.3±1.2	87.1±1	0.6
FEV1 (Postop)(L)	2.4	2.8	0.01*
FVC (Postop)(L)	2.7	3±0.1	0.01*
FEV1/FVC (Postop)(%)	91.5±2.6	91.8±2.8	0.6
Average Consumption Rate of Propofol (mg/kg/h)	5.44±0.71	3.57±0.54	0.03*
Time of MAS's 9	13.3±1.25	9.11±0.86	0.001*

*: p≤0.05 when compared the groups. n=26.

The initial propofol dose was 10 mg kg hour for all patients. While the mean propofol infusion rate was observed as 5.44 mg kg hour in the propofol remifentanil group, the same rate was observed as 3.57 mg kg hour in the epidural propofol group. The hemodynamic parameters were kept within normal ranges and BIS values were kept between 40-50 when propofol dose was being adjusted.

No statistically significant difference was observed between the hemodynamic values. Van Kralingen et al.[14] did not observe a significant difference with regard to the effects of the combination of epidural anesthesia and intra-venous propofol infusion, and combination of intravenous propofol infusion and epidural anesthesia, on the intra-operative hemodynamic effects in MO patients, similar to our study. In the same study, a significant difference was observed between the groups with regard to propofol infusion. However, the ideal body weight was not calculated considering the total weight in propofol induction and the initial dose of infusion in that study. However, studies conducted with MO patients have demonstrated that the total propofol dose would decrease in patient target controlled propofol intra-venous infusion anesthesia where the lean body weight is calculated, drawing attention to the lipophillic property of propofol.[12, 14] We also observed that the amount of intra-venous propofol dose decreased when epidural anesthesia was applied in our study in which we calculated the drug doses using the ideal body weight.

In recent years, obesity has been reported to be one of the most important causes of post-operative pulmonary complications.[15,16] Attaur-Rasool et al.[17] emphasized this issue and reported that the decrease in FVC and FEV1 was inversely proportional with the BMI increase and may lead to restrictive pulmonary diseases. Mafort et al.[18] and Melo et al.[19] emphasized the inversely proportional correlation between increasing obesity and FEV1, FVC. The anesthesia method used in this patient group is important also for pulmonary preservation.[10] The functional residual capacity (FRC) and the vital capacity (VC) decrease and recover

between 1-14 days when compared with the preoperative values in upper abdominal surgeries due to the affected diaphragm beside anesthesia methods.[20] Pulmonary function tests were not examined during the days following the operation as the ideal anesthesia method, which preserves the lungs in laparoscopic bariatric surgery, was focused considering the preoperative period. This is a limitation of our study.

Furthermore, also in this study, FEV1 and FVC were observed to be affected to a statistically significantly lower extent in low dose intravenous propofol anesthesia supported by epidural anesthesia compared to total intravenous propofol anesthesia in the early period.

Studies recommend using MAS during recovery follow-up and transferring the patients to the ward when the MAS value is 9 and above.[21] We applied respiratory function test when the MAS value is 9 or above for all patients. No statistically significant change occurred in the post-operative FEV1/FVC rate in our study. The increase in FEV1 and FVC is directly proportional and this is an expected result.

Pain is an important factor that affects the respiratory functions.[22] We monitored the postoperative pain with VAS considering full pain control. No patients required additional analgesia.

Studies have drawn attention to the impairment in pulmonary functions in MO patients and the improvement in pulmonary functions have been demonstrated in the mid-term and long-term when they were treated.[23,24] We observed that the FEV1 and FVC levels in the early postoperative period were statistically significantly better in the epidural anesthesia group when intravenous propofol anesthesia was supported with epidural anesthesia and the amount of anesthetic drug was reduced during the operation of MO patients.

Conclusion

When we compared the total intravenous anesthesia and intravenous anesthesia supported by epidural anesthesia in laparoscopic sleeve gastrectomy for MO patients, and we observed that the amount of propofol used for intravenous anesthesia decreased and furthermore, the pulmonary function tests were significantly better in the early postoperative period.

Disclosures

Ethics Committee Approval: The study protocol was approved by Gaziantep University Ethics Committee with 24/11/2014 dated and 356 numbered decision.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – E.K.; Design – E.K., B.D.; Supervision – S.G.; Materials – E.K., B.D.; Data collection &/or processing – B.D.; Analysis and/or interpretation – E.K., S.G.; Literature search – E.K., B.D.; Writing – E.K., B.D.; Critical review – S.G.

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