CLINICAL PRACTICE ARTICLE

Anaesthetic Management of Patients Undergoing Bariatric Surgery

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ABSTRACT

Objective: To describe perioperative anaesthetic management with laparoscopic sleeve gastrectomy (LSG).

Study Design: An observational study.

Place and Duration of Study: Department of Anesthesiology, Ondokuz Mayis University, Turkey, between January 2012 and December 2017.

Methodology: Patients who underwent LSG at the study centre were considered. Hospital records were retrospectively reviewed. Information was collected on demographic characteristics, comorbidities, haemodynamic parameters, airway and anaesthetic management and complications.

Results: The study included 95 patients (mean age, 37.4 ±12.1 years; mean body mass index, 46 Kg/m^2). Despite high airway assessment scores in some patients, 93 patients (98%) were conventionally intubated using our modified ramp position. Anaesthesia induction involved propofol, and anaesthesia maintenance involved inhalation anaesthetics (remifentanil supplementation). Additionally, rocuronium and sugammadex were used. Postoperative pain was managed with multimodal analgesia. Dose calculations were mostly based on lean/ideal body weight. Significant differences were found in the mean arterial pressure, heart rate and arterial oxygen saturation before induction and 5 min after induction. Intraoperatively, 3 patients (3.2%) developed bronchospasm and 1 (1.1%) developed bradycardia. There were no post-operative complications.

Conclusion: Inhalational anaesthesia with remifentanil and rocuronium-sugammadex is a safe option in bariatric surgery. Although conventional techniques are sufficient to establish the airway in most cases, preparations for difficult intubation should be made. Furthermore, careful patient selection, preoperative anaesthetic management planning and appropriate postoperative monitoring are necessary.

Key Words: *Anaesthesia, Bariatric surgery, Laparoscopy, Obesity.*

INTRODUCTION

World Health Organization defines obesity as 'abnormal or excess lipid accumulation in the fat tissues as to impair health'. Individuals with a body mass index (BMI) ≥30 Kg/m^2 are considered obese, and those with a BMI ≥40 Kg/m^2 are considered morbidly obese.[1]

Morbidly obese individuals with comorbidities are candidates for weight loss surgeries, which are known as bariatric surgeries. In 2002, Dr. Gagner performed the first laparoscopic sleeve gastrectomy (LSG), a bariatric surgery.[2] LSG is considered effective and safe, with low mortality and morbidity rates.[2-4]

Owing to physiological differences between obese and non-obese individuals, obese individuals have a greater risk of anaesthesia-related complications during LSG. However, the anaesthetic literature on bariatric surgery is quite heterogeneous and recommendations are intricate. Additionally, there is no consensus on strategies for perioperative anaesthetic management.[5,6]

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The present study aimed to report our 5-year experience with LSG and perioperative anaesthetic management, which could help improve quality, simplify and optimise approaches and reduce postoperative complications in bariatric surgery for obesity.

METHODOLOGY

The present study was approved by the Clinical Research Ethics Committee of Ondokuz Mayis University (approval number 2017/173). All patients who underwent LSG at authors' clinic between January 2012 and December 2017 were considered for inclusion in this study. The pre- and intraoperative anaesthesia records and other data in the hospital information system (demographic data, BMI, American Society of Anesthesiologists score [ASA], anaesthesia and surgery durations, comorbidities, smoking habit, haemodynamic parameters, difficult tracheal intubation results [Mallampati and Cormack-Lehane scores], airway and anaesthetic management data, postoperative pain regimens and complications) were reviewed. Patients with incomplete records were excluded. All information was gathered by anaesthesia residents.

Haemodynamic parameters (mean arterial pressure [MAP], heart rate [HR] and arterial oxygen saturation [SpO_2]) of each patient were compared before induction, one minute after induction, five minutes after induction and every five minutes thereafter until the 20th post-operative minute.

After admission to the hospital, all patients underwent 6-hour (h) fasting for solid food and 2-h fasting for clear liquids before surgery. All patients received oral ranitidine (300 mg) the night before surgery. Ondansetron and dexamethasone (4 mg) were administered intravenously as routine antiemetic prophylaxis. On arrival in the operating room, the patients were monitored with electrocardiography, a non-invasive blood pressure monitor, a pulse oximeter and an end-tidal CO_2 monitoring system, if needed. Additionally, invasive blood pressure and central venous pressure monitoring were adopted in patients with severe cardiovascular diseases. Before induction, patients were pre-oxygenated with 100% oxygen *via* a face-mask for 5 mins. Anaesthesia was induced with propofol (1.5-2.5 mg/Kg) and remifentanil (1 mcg/Kg). Intubation was performed after administration of rocuronium (0.6 mg/Kg) in the modified ramp position. Mechanical ventilation was performed with an inspiratory oxygen fraction of 0.5, positive end-expiratory pressure of 5 cm H2O, respiratory rate of 12 breaths/min and tidal volume of 6 mL/Kg. Desflurane or sevoflurane (1 minimum alveolar concentration) was used for anaesthesia maintenance, supplemented with remifentanil infusion (0.1-0.25 mcg/kg/min). Rocuronium (0.15 mg/kg every 30 min) was administered subsequently. The neuromuscular block was reversed with sugammadex (2-4 mg/Kg). Postoperative pain control was achieved with a combination of acetaminophen, non-steroidal anti-inflammatory drugs and opioids.

Data are presented as mean ± standard deviation or median (interquartile range) for quantitative variables and as number (%) for qualitative variables. Distributions of quantitative outcomes were analysed using the Shapiro-Wilk test. The nonparametric Wilcoxon signed-rank test was used to compare non-normal data for two dependent groups. All statistical analyses were performed using Statistical Package for the Social Sciences Version 21.0 software (IBM Corp., Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

RESULTS

A total of 132 patients underwent LSG at our clinic between 2012 and 2017. Of these patients, only 95 had complete records. These 95 patients (65 female patients [68%]) were assessed in this study. Table I presents the demographic data of the patients. The mean patient age was 37.4 ±12.1 years, the mean patient BMI was 46 kg/m2 and the anaesthesia and surgery durations (median [interquartile range]) were 135 (75) and 115 (65) minutes, respectively. Among the 95 patients, 86 (90.5%) were classified as ASA II, and 44 (46.2%) had cardiovascular and endocrine system-related comorbidities. Table II presents data related to airway assessment and anaesthetic management. Among the

Table I: Demographic and clinical characteristics of the study patients (n = 95).

Characteristic	Value
	Mean ±SD
Age (years)	37.4 ±12.1
	Median (IQR)
BMI (kg/m^2)	46 (9)
Anaesthesia time (min)	135 (75)
Surgical time (min)	115 (65)
Mallampati classification score	2 (1)
Cormack-Lehane grade	1 (1)
	Number (%)
ASA classification II-III	86-9 (90.5-9.5)
Sex (male/female)	30/65 (31.6/68.4)
Comorbidities	
Cardiovascular system-related*	24 (25.2)
Endocrine system-related†	20 (21)
Smoking habit	11 (11.5)
None	40 (42.1)

*Data are presented as mean ± standard deviation, median (interquartile range) or number (%). *Hypertension and ischaemic heart disease; †Diabetes mellitus (mostly non-insulin dependent) and thyroid disorders.*
ASA = American Society of Anesthesiologists; BMI = Body mass index.

Table II: Data on airway assessment, intubation attempts and anaesthetic drugs used in the study patients (n = 95).

	Number	%
Mallampati score		
1	41	43.2
2	45	47.3
3	7	7.3
4	2	2.2
Cormack-Lehane grade		
1	55	57.9
2	33	34.7
3	5	5.3
4	2	2.1
Intubation		
Successful first attempt *via* Macintosh blade	91	95.8
Successful second attempt *via* Macintosh blade	2	2.1
Awake fiberoptic intubation	2	2.1
Intravenous induction agent		
Propofol	95	100
Maintenance of anaesthesia		
Inhaled anaesthetic agent + nitrous oxide	33	34.7
Inhaled anaesthetic agent + remifentanil infusion	62	65.3
Maintenance volatile anaesthetic agents		
Sevoflurane	38	40
Desflurane	57	60
Neuromuscular blocking agent		
Rocuronium	95	100
Reversal agent		
Sugammadex	95	100
Postoperative analgesic drugs		
Acetaminophen	39	41.1
NSAIDs	56	58.9
Opioids	95	100
Tramadol	29	30.5
Pethidine	42	44.2
Morphine	24	25.2

Data are presented as number (%).
NSAIDs = Non-steroidal anti-inflammatory drugs.

95 patients, 9 (9.5%) had a high Mallampati score, and 7 (7.4%) had a high Cormack-Lehane grade. Nevertheless, 93 patients (98%) were conventionally intubated using our modified ramp position.

In all patients, anaesthesia was induced with propofol, inhalation anaesthetics were used for anaesthesia maintenance (supplemented with remifentanil), rocuronium was used as a muscle relaxant and sugammadex was used as a reversal agent. Postoperative pain was managed with multimodal analgesia.

On assessing haemodynamic parameters, we found significant differences in MAP, HR and SpO_2 before induction and 5 mins after induction (MAP, median [inter-quartile range]: 100 [14] mmHg *vs*. 90 [17] mmHg, p <0.001; HR: 80 [16] bpm *vs*. 80 [17] bpm, p = 0.04; SpO2: 98 [3] *vs*. 99 [2], p <0.001). Intraoperatively, 3 patients (3.2%) developed bronchospasm and 1 (1.1%) developed bradycardia. Postoperatively, no complications were observed.

DISCUSSION

Obesity is a global epidemic and involves several organ systems, causing major health issues. The Turkish Statistical Institute reported that the prevalence of obesity has rapidly increased in Turkey over the last decade (approximately 30%) and is higher among women than men (female/male: 23.9/15.2).[7] Consistent with these findings, in this study, the proportion of obese female patients was higher than the proportion of obese male patients.

Anaesthetists should pay close attention to airway management in obese patients undergoing bariatric surgeries, as difficult or unsuccessful intubation attempts are more common in these patients than in non-obese individuals (15.5% *vs*. 2.2%).[8] Obesity is an independent risk factor for difficult intubation; therefore, preoperative airway assessment is important.[9] In the present study, 9.5% of patients had a Mallampati score of 3-4. A previous study found that 6.7% of non-obese individuals had a relatively high score.[9] This difference might be explained by the increased oropharyngeal fat tissue in obese patients, which impairs airway visualisation. In this study, 7.4% of patients had a Cormack-Lehane grade of 3-4. Neligan *et al*. found a similar rate (8.3%) among 180 morbidly obese patients, and this rate was not significantly different from the present rate (p = 0.775).[10] In addition, there was no significant difference in the conventional intubation rate between the study by Neligan *et al*. (96.7%) and this study (97.9%) (p = 0.537). However, it should be noted that the study by Neligan *et al*. involved ≤2 intubation attempts.[10] Despite the presence of patients with high Cormack-Lehane grades, a high success rate was achieved using conventional intubation techniques, and this might be related to the routine use of the ramp position during induction.[11] In fact, a previous study found a linear correlation between BMI and improvement in the laryngoscopic visualisation rate when using the ramp position.[12]

In this study, propofol was used for induction. Propofol is a short-acting intravenous anaesthetic agent with a very good recovery profile. It is highly lipophilic and is primarily metabolised in the liver. Obese patients have a high volume for the distribution of lipophilic drugs and increased clearance of propofol in proportion to the body weight. Therefore, the elimination half-life of propofol remains unchanged, and no accumulation is observed following infusion. When the propofol induction dose is adjusted according to the total body weight, excessively deep anaesthesia and serious haemodynamic instability might occur. Therefore, dose adjustments should be based on lean body weight (LBW), and the dose should be titered.[13]

The present study revealed that halogenated inhalation anaesthetics are preferred for maintenance of anaesthesia. Desflurane and sevoflurane are preferred for bariatric surgeries, because they show rapid and consistent recovery owing to low blood solubility, do not cause haemodynamic instability and shorten hospital stay.[14] However, a previous retrospective study in patients who underwent bariatric surgery found no differences in the postoperative course and outcomes among patients who received desflurane, sevoflurane and propofol infusion.[15]

In this study, inhalation anaesthetics were mostly used in combination with remifentanil, a highly lipophilic opioid with a very short terminal half-life (10 minutes) owing to rapid metabolism by plasma and tissue esterase, although nitrous oxide was used for a certain period owing to limited availability of remifentanil. There is no clinically relevant metabolite accumulation in infusion applications. Despite the highly lipophilic profile of remifentanil, its distribution volume is unaltered in obese patients. Therefore, dose calculation is based on ideal body weight or LBW. Remifentanil is preferred in obese patients because it has the shortest elimination half-life and context-sensitive half-life among all opioids, is an easily titratable potent agent and has minimal cardiovascular effects.[6]

As non-depolarising muscle relaxants are polarised drugs with a hydrophilic structure, their distributions are unaltered in obese patients.[6] Therefore, these drugs should be dose-adjusted according to LBW.[16] There is no evidence of the superiority of these non-depolarising muscle relaxants. Neuromuscular recovery time was similar between obese and non-obese individuals who received rocuronium.[17] Rocuronium, a muscle relaxant used in this study, may be preferred because of its very low volume of distribution, absence of active metabolites and rapid recovery with sugammadex.[17]

Obese patients have a high risk of developing post-operative respiratory complications, such as airway obstruction, hypoventilation, hypercapnia, hypoxia and acute respiratory failure.[18] The presence of post-operative residual block can increase the risk of developing these complications.[19] Postoperative residual block is more frequent in obese than in non-obese individuals (33% *vs.* 26%).[18, 20] Sugammadex is an effective reversal agent of neuromuscular block. It permanently binds to rocuronium and inhibits its effect. Acetylcholinesterase-blocking agents, such as neostigmine, have a different mechanism of action. Sugammadex was used because of the lack of side effects that are observed with acetylcholinesterase-blocking agents (especially bradycardia), its superiority in preventing postoperative residual block and the rapid reversal of neuromuscular block.[19]

Laparoscopic surgery is associated with less pain when compared with open surgery; therefore, patients typically do not require neuraxial analgesic techniques (*i.e.*, intrathecal or epidural analgesia) in laparoscopic surgery. However, optimal analgesia should be achieved to reduce pulmonary complications.[5] At a carefully adjusted dose, a patient-controlled intravenous opioid analgesia technique can successfully minimise opioid-related side effects, such as respiratory depression, increased postoperative nausea and vomiting and late recovery of gastrointestinal function.[21] Nevertheless, multimodal analgesia is an ideal option in these patients. In this study, non-opioid analgesics and opioids were used in combination for postoperative analgesia.

In this study, none of the patients had serious comorbidities because they were meticulously selected. Careful patient selection and close postoperative monitoring can reduce the risk of serious complications.[22] Karaman *et al*. reported nausea/vomiting (32.3%) and bronchospasm (11.4%) as the most frequent complications during the perioperative period.[23] In this study, only bronchospasm (3.2%) and bradycardia (1.1%) were observed perioperatively. Combined antiemetic prophylaxis adminis-

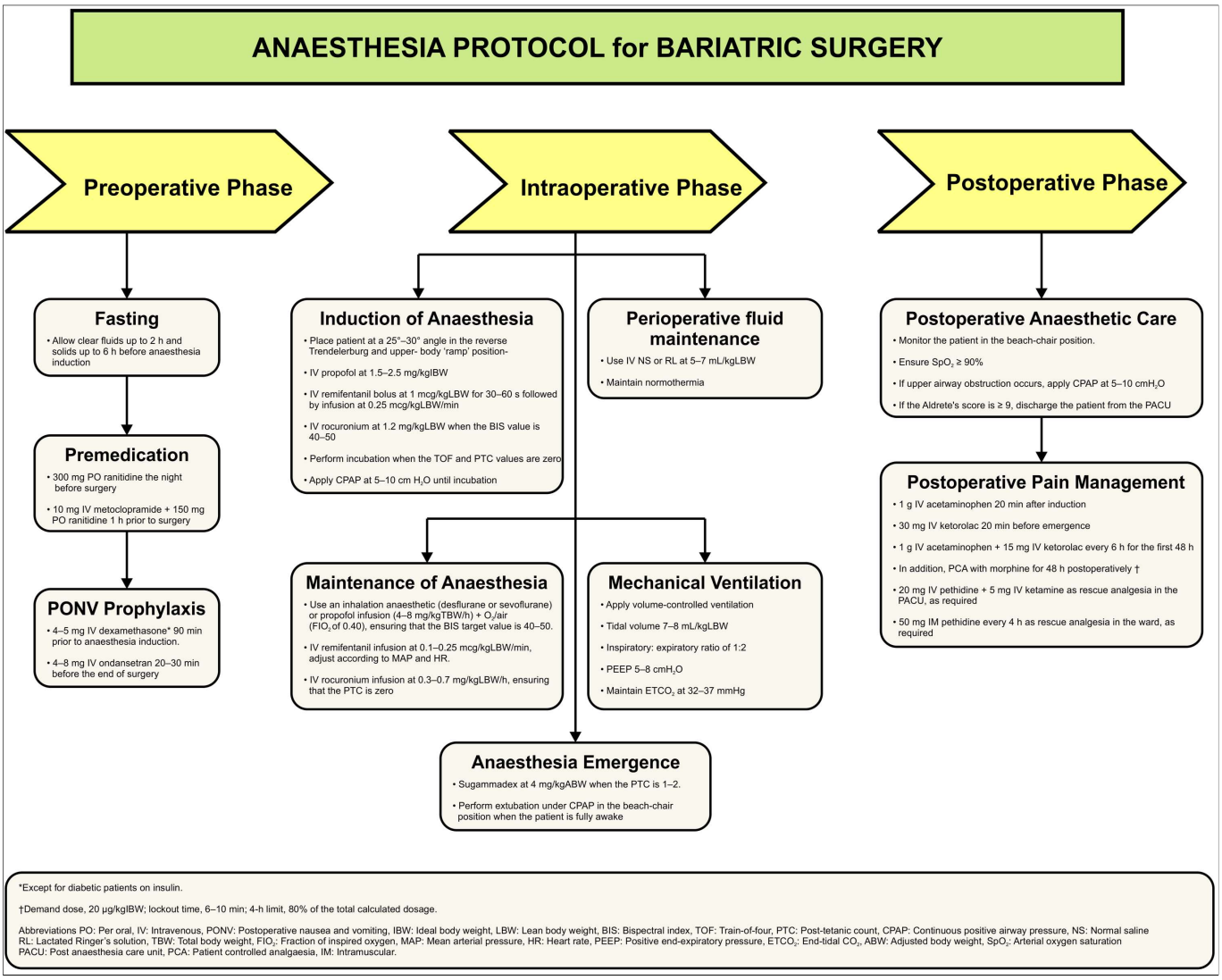

Figure 1: Anaesthesia protocol for bariatric surgery.

tration (5-HT3 receptor antagonist, dopamine D2 receptor antagonist and dexamethasone) helped prevent nausea/vomiting in these patients. Old age (>65 years), male gender, high BMI and surgeon inexperience are known to be independent risk factors for postoperative mortality.[24,25] Two systematic reviews reported that the mortality rate in the first 30 days following bariatric surgery was 0.35%.[24,25] In this study, mortality was not noted within the first 30 days. This might be explained by the meticulous patient selection and by the fact that the surgical team and anaesthesia approach were the same for all patients.

Owing to increased anaesthesia- and surgery-related risks in obese patients, anaesthetists require sufficient knowledge regarding the clinical management of these patients. The lack of a consensus on a perioperative anaesthetic management strategy further complicates the situation. In addition, in the literature, there are limited applicable and comprehensible recommendations in bariatric surgery with regard to anaesthesia management. Within this context, we have developed an up-to-date anaesthetic protocol for use during bariatric surgeries in our hospital (Figure 1).

The limitations of this study include the lack of data on long-term postoperative outcomes, the non-evaluation of postoperative analgesia using a numeric rating scale and the non-inclusion of old and sick morbidly obese patients and super-obese patients. Elderly patients, patients with severe comorbidities, and super-obese patients should be evaluated in terms of anaesthesia management. Additionally, future studies should include a large series of patients and a prolonged follow-up duration. Moreover, the effectiveness of postoperative pain management should be assessed in future studies.

CONCLUSION

Inhalation anaesthetics with low blood solubility, ultra-short-acting remifentanil, rocuronium together with sugammadex and multimodal analgesia are important in bariatric surgeries among obese patients. In this study, despite high airway assessment scores, almost all patients could be intubated conventionally by the same experienced anaesthesia team. Thus, the experience and skills of anaesthesiologists are probably the most important factors for securing the airway in this patient group. Nevertheless, preparations for difficult intubation should be made. Additionally, the anaesthetic management approach ensured a safe and stable perioperative period, preventing the development of serious post-operative complications. These observations will help improve quality and reduce postoperative complications in bariatric surgery among obese patients.

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