Anesthetic Management in Obese Patients Undergoing Laparoscopic Cholecystectomy: A Case Report

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Citation: Pakardian IA, Dewi DAMS. Anesthetic management in obese patients undergoing laparoscopic cholecystectomy: a case report. Medicinus. 2025 June; 14(3):201-212.
Keywords: Anesthesia management in laparoscopy; Laparoscopic complications; Laparoscopy; Obesity.
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Online First: June 2025

Abstract

Background: Obesity is associated with various complications during general anesthesia, including apnea, hypoventilation, and challenges in intubation. In obese patients, these factors increase the anesthetic risks associated with laparoscopic cholecystectomy, a minimally invasive surgery performed to remove the gallbladder. This procedure is often indicated for gallstones causing inflammation, pain, or infection. Laparoscopic cholecystectomy involves small incisions, allowing most patients to recover quickly, return home the same day, and resume normal activities shortly thereafter. Compared to open cholecystectomy, the laparoscopic approach offers advantages such as faster recovery, reduced postoperative pain, and lower risk of complications.

Methods: A 43-year-old female patient with a body weight of 120 kg, height of 155 cm, and a BMI of 49.9 kg/m² (classified as obesity) was initially scheduled for an open cholecystectomy. However, intraoperative evaluation by the surgeon led to a decision to switch to laparoscopic cholecystectomy. Anesthesia was induced using a propofol syringe pump, fentanyl (150 mcg), and atracurium (40 mg) as a muscle relaxant. Intubation was performed with video laryngoscopy, using an endotracheal tube (ETT) with a cuff size of 7.

Result: During the operation, the patient's end-tidal CO2 (ETCO2) levels increased to 40 mmHg due to CO2 insufflation, leading to worsening respiratory acidosis. Complications such as these are common during laparoscopic procedures in obese patients and require timely management to prevent further deterioration.

Conclusions: The patient's condition was stabilized by employing specific intraoperative strategies, including positioning in reverse Trendelenburg, mild hyperventilation, and applying positive end-expiratory pressure (PEEP). These measures successfully reduced ETCO2 levels, demonstrating the importance of tailored anesthetic and ventilatory management in obese patients undergoing laparoscopic cholecystectomy.

Introduction

The global rise in obesity prevalence poses a significant health challenge for both developed and developing nations. Obesity is defined as an excessive accumulation of body fat that negatively impacts health. It is quantified using the body mass index (BMI), calculated by dividing an individual's weight by the square of their height, with a BMI of 30 or higher indicating obesity. This issue is widespread, affecting nearly every country, with the exception of certain regions in sub-Saharan Africa and Asia.[1] In 1997, this condition was officially recognized as a global health issue by the World Health Organization (WHO). By 2016, over 1.9 billion adults worldwide were classified as overweight or obese.[1,2] The prevalence of obesity has risen dramatically across both genders and all age groups, with higher rates observed among older adults and women.[1] A systematic review conducted in 2020 revealed that the prevalence of obesity in Indonesia reached 16.9% among men and 28.6% among women. Across all Southeast Asian countries, women were found to have a higher tendency toward obesity, attributed to lower energy expenditure and reduced physical activity.[3]

Obesity is a significant risk factor for various non-communicable diseases (NCDs) and is associated with higher risks of morbidity, mortality, and disability. It affects nearly all organ systems and increases the likelihood of developing conditions such as diabetes mellitus, cardiovascular diseases, osteoarthritis, hyperlipidemia, sleep apnea, mobility disabilities, a shorter lifespan, and vulnerability to nerve injuries during sedation. These comorbidities contribute to an elevated rate of perioperative mortality.[4,5] In the context of general anesthesia, obesity is linked to several complications, such as apnea, hypoventilation, challenges in intubation, a heightened risk of aspiration, and changes in the pharmacokinetic properties of medications.[4,6,7]

Material And Methods

A 43-year-old female patient with a body weight of 120 kg, height of 155 cm, and a BMI of 49.9 kg/m² (classified as obesity) was initially scheduled for an open cholecystectomy. However, intraoperative evaluation by the surgeon led to a decision to switch to laparoscopic cholecystectomy. Anesthesia was induced using a propofol syringe pump, fentanyl (150 mcg), and atracurium (40 mg) as a muscle relaxant. Intubation was performed with video laryngoscopy, using an endotracheal tube (ETT) with a cuff size of 7.

Result

A 43-year-old Balinese woman (155 cm in height, 120 kg in weight, BMI 49.3 kg/m²) was admitted to our hospital for a planned laparotomy cholecystectomy (LC). She presented with a one-year history of intermittent abdominal pain localized to the right upper quadrant, radiating to the epigastrium and back. The patient reported a history of snoring but denied experiencing nocturnal dyspnea, fatigue, or excessive daytime sleepiness. She was diagnosed with diabetes mellitus four years ago and is currently managed with a regimen of subcutaneous glargine insulin (20 units daily) and subcutaneous Novorapid insulin (14 units administered with each main meal). Her medical history is unremarkable for prior surgeries, hypertension, cardiovascular disease, or asthma. However, she has a 10-year history of smoking 12 cigarettes per day. As a homemaker, she is able to engage in light to moderate physical activities without symptoms of dyspnea or chest discomfort.

Physical examination revealed a blood pressure of 140/90 mmHg, heart rate of 84 beats per minute, respiratory rate of 18 breaths per minute, and an axillary temperature of 36.2°C. The numeric rating scale (NRS) for pain was 0/10 at rest, 0/10 during movement, and 3/10 during exacerbations. The APFEL score was 2/4, and the patient's estimated metabolic equivalent of task (MET) was 5–6. Abdominal examination showed normal bowel sounds, tenderness in the right upper quadrant, absence of palpable masses, and a positive Murphy's sign without evidence of jaundice. Airway management was anticipated to be challenging due to the presence of severe obesity (BMI 49.3 kg/m²), incomplete upper incisors, a history of snoring, a mentohyoid distance of less than three fingers, stage I hypertension, and a neck circumference of 45 cm. The patient's risk assessment included a MOANS score of 3/5, a LEMON score of 1/10, and a STOP-BANG score of 4, indicating a moderate risk of obstructive sleep apnea.

Laboratory evaluations, including a complete blood count, coagulation studies, blood chemistry, arterial blood gas analysis, electrocardiography (ECG), and chest radiography, were within normal limits, except for an elevated HbA1c level of 7.1%. Abdominal ultrasonography of the upper and lower quadrants revealed findings consistent with calculous cholecystitis and choledocholithiasis. The gallbladder was of normal dimensions but demonstrated wall thickening of approximately 0.5 cm. Multiple irregular hyperechoic lesions with posterior acoustic shadowing were identified in the neck of the gallbladder, cystic duct, and common bile duct, with the largest lesion measuring approximately 2.6 × 0.6 cm in the gallbladder neck.

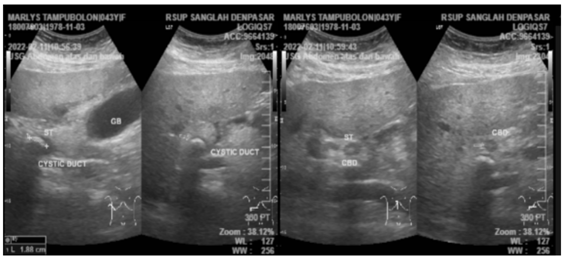

Figure 1. Gallbladder ultrasonographic findings.

The patient was administered amlodipine 5 mg once daily, mefenamic acid 500 mg as needed, and lactated Ringer's solution for fluid maintenance in the ward. Preoperative management included administering amlodipine 5 mg at 22:00, monitoring blood glucose levels at 22:00 and 06:00 the following day, and providing a 500 mL loading dose of lactated Ringer's solution during fasting. Anticipating challenges with airway management, preparations were made for a long bougie, laryngeal mask airway

(LMA), video laryngoscope, and fiberoptic bronchoscope. Emergency medications, EtCO2 capnography, arterial line placement, inotropic agents, and vasopressors were also readily available. Prior to induction of general anesthesia, the patient received dexamethasone 10 mg IV, diphenhydramine 10 mg IV, and midazolam 1.5 mg IV as premedication. Analgesia was provided with fentanyl 150 mcg IV, followed by induction using propofol at a dose of 2–3 mg/kg body weight to achieve hypnosis. Atracurium 40 mg IV was administered to facilitate intubation. The patient was positioned in a ramped posture for intubation, which was performed using a size 7 cuffed endotracheal tube (ETT). An epidural catheter was inserted at the L1–L2 level and advanced 6 cm into the epidural space, targeting the T9–T10 vertebral levels to achieve a dermatomal block from T6 to T12 and a viscerotomal block from T6 to T9. A total of 10 mL of 0.25% plain bupivacaine was administered epidurally. Maintenance anesthesia consisted of oxygen, compressed air, and sevoflurane, with additional doses of atracurium 0.2 mg/kg body weight administered every 30–45 minutes. Intermittent doses of 10 mL of 0.2% plain bupivacaine were given via the epidural catheter every 120–180 minutes.

During re-evaluation by the surgeon in the operating room, the surgical plan was revised to a laparoscopic procedure. LC was performed over a duration of 120 minutes. During the surgery, ETCO2 levels increased to 50 mmHg due to CO2 insufflation, exacerbating respiratory acidosis. The patient was subsequently placed in the reverse Trendelenburg position. To reduce ETCO2 levels, hyperventilation was initiated, and positive end-expiratory pressure (PEEP) was increased to 7 cmH2O during insufflation. After these adjustments, ETCO2 levels decreased and were maintained within acceptable limits throughout the CO2 insufflation period.

Discussion

Obesity is defined as an excess of body fat, typically associated with an increase in body weight relative to height. BMI is the most commonly used method to measure obesity, allowing comparisons between populations and countries.[8] Obesity is defined as a BMI ≥ 30 kg/m². The WHO classifies obesity into Class I (30–34.9 kg/m²), Class II (35–39.9 kg/m²), and Class III (>40 kg/m²). Class III obesity is also referred to as morbid obesity, severe obesity, or extreme obesity.[9] However, BMI values for Asian populations are classified differently. According to the Asia-Pacific cut-off points, obesity is defined as a BMI of 25 kg/m², with Class I (25–29.9 kg/m²) and Class II (≥30 kg/m²).[10] The rate of obesity is increasing in both genders and across all age groups, with a higher prevalence among older adults and women.[1] Considered a major contributor to metabolic syndrome, obesity plays a role in the etiology of various disorders. Adipose tissue, particularly when centrally located, acts as an endocrine and paracrine organ, releasing bioactive chemicals such as chemokines and cytokines. This leads to metabolic dysfunctions associated with obesity, including atherosclerotic events, hypertension, respiratory depression, insulin resistance, and a pro-inflammatory state.[11] Obesity is associated with an increased risk of morbidity, disability, and mortality. Its mortality risk is comparable to that of smoking.[2] Individuals who smoke are 1.73 times more likely to experience obesity compared to non-smokers. It has been observed that exposure to cigarette smoke increases insulin resistance and is associated with central fat accumulation.[3] According to the Asia-Pacific classification, our patient falls into Class II obesity. The patient has a history of smoking 12 cigarettes per day and has had diabetes for the past four years. Random blood glucose levels are within the normal range (73 mg/dL), but there is a slightly elevated HbA1C of 7.1%. Therefore, the patient was treated with 20 units of glargine every 24 hours and 14 units of novorapid for each major meal. The patient was admitted with complaints of upper right quadrant abdominal pain and was diagnosed with calculous cholecystitis and choledocholithiasis based on investigations. The patient's upper abdominal pain is likely due to cholelithiasis, which can be identified using the mnemonic "fat, female, fertile, and forty." One study showed that the incidence of cholelithiasis is significantly higher in women, with 150/198 (75%) of cholelithiasis patients being female (χ^2 = 18.8, $p < 0.001$). The cholelithiasis group had 56/198 (28.3%) obese patients compared to 19/200 (9.5%) in the control group ($p = 0.005$). The mean age of the cholelithiasis group was 45.3 ± 1.01 years, while the control group had a mean age of 46.1 ± 1.02 years.[12]

Most preoperative issues are related to respiratory function due to excess adipose tissue stored in various areas, including the chest wall, ribs, diaphragm, and abdomen. Obese patients are more likely to experience reduced lung capacity, lung collapse, abnormalities in lung and chest wall compliance, and varying degrees of hypoxemia.[13] Obesity is a major risk factor for obstructive sleep apnea (OSA), as it leads to upper airway collapse and episodes of apnea. The metabolic activity of fat results in significantly higher oxygen consumption in obese individuals compared to those with normal weight, nearly three times higher. Consequently, airway management can be challenging due to faster oxygen desaturation times and issues with excess fat complicating ventilation and intubation.[14] Predictors of difficult intubation are described by the mnemonic "LEMON," and predictors of difficult bag-mask ventilation are described by the mnemonic "MOANS."[15] In this patient, the MOANS score is 3/5 (BMI 49.3 kg/m², incomplete incisive teeth, history of snoring), and the LEMON score is 1/10 (mentohyoid distance of 2 finger widths). In a cohort study, the LEMON features were found to be poor predictors of intubation failure. The tendency to administer paralytic drugs decreases as the number of positive LEMON features increases.[15] A positive STOP-BANG (SB) score is also correlated with a higher incidence of hypoxemia and the need for airway maneuvers such as chin lift or nasopharyngeal airway placement.[5,16] Our patient has a history of snoring, hypertension, and a neck circumference of 45 cm, meeting the intermediate risk criteria for OSA. Several studies have shown that patients with OSA are at significantly higher risk for postoperative respiratory complications (respiratory failure, aspiration pneumonia, increased emergency postoperative endotracheal intubation, and the need for postoperative ventilation), atrial fibrillation, neurological complications, and prolonged hospital stays.[17] Excess adipose tissue increases total blood volume, which subsequently increases cardiac output. As cardiac output continues to rise, left ventricular hypertrophy occurs, leading to diastolic dysfunction. Left ventricular enlargement can also cause systolic dysfunction, potentially resulting in atrial hypertrophy and pulmonary hypertension.[13] In our patient, the blood pressure is 140/90 mmHg (grade I hypertension), with both the ECG and chest X-ray results within normal limits.

In a meta-analysis comparing LC and open cholecystectomy, there was no significant difference in mortality. All trials revealed that the LC group experienced fewer complications, shorter hospital stays, and faster recovery times compared to the open cholecystectomy group.[18] Historically, obesity has been regarded as a relative contraindication for laparoscopic surgery, with technical challenges thought to be associated with increased morbidity, mortality, and higher rates of conversion to open surgery. The thickened abdominal wall, along with elevated levels of intraperitoneal and visceral fat in overweight and obese patients, can impair visualization and limit the ability to maneuver within the abdominal cavity.[19] However, the use of LC in obese patients has evolved due to advancements in equipment and experience. Tiong et al. compared the safety of LC in obese patients and found a significant difference in the average duration of surgery across three BMI groups: BMI <26 (64 minutes), BMI 26-40 (72 minutes), and BMI >40 (82 minutes). However, there were no statistically significant differences in length of hospital stay, perioperative complication rates, open conversion, or bile duct injury among the three groups. This study suggests that LC can be safely performed in morbidly obese patients.[20]

In LC, the predominant anesthetic technique is GA with endotracheal intubation.[21] In the case of our patient, a combined approach of general anesthesia and epidural anesthesia (CEGA) was utilized. Due to its high lipophilicity, propofol exhibits a large volume of distribution and is quickly cleared from the circulatory system. Propofol is considered the drug of choice for induction in obese patients.[13] A study by Bandewar et al. found that the CEGA approach required a lower dose of propofol after induction compared to general anesthesia (GA) alone, with an average propofol requirement of 0.503 mg/kg versus 1.717 mg/kg ($p<0.01$). During the post-pneumoperitoneum period, heart rate and systolic blood pressure were statistically lower in the CEGA group.[22] In line with previous findings, Zhu et al. also observed lower systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate in the CEGA group in patients with gallbladder cancer.[23] The Steward recovery score for the CEGA group showed significantly better scores at 4 minutes (4.5±0.6 vs. 2.8±0.4, $p<0.05$) and 6 minutes (5.7±0.2 vs. 4.1±0.5, $p<0.05$). Based on these results, the authors concluded that patients receiving CEGA typically experience faster, pain-free recovery. Additionally, the visual analog scale (VAS) pain score was lower in the CEGA group compared to GA (1.7±0.5 vs. 3.4±0.6, $p<0.01$), suggesting that the use of an epidural catheter provides adequate pain control.[22] The epidural catheter should be inserted at least 5 cm into the epidural space to reduce migration. Neuraxial anesthesia in obese patients must be performed with caution, as they are prone to hypotension due to decreased tolerance to being in a supine position.[24]

The supine position and anesthesia can negatively affect functional residual capacity (FRC), potentially leading to airway closure.[8] To mitigate this, our patient was positioned in the ramp position, as previous studies have indicated that this positioning extends the safe apnea duration before significant hypoxemia occurs and improves the view for direct laryngoscopy.[24,25] During the procedure, the patient's end-tidal CO2 (ETCO2) level increased to 50 mmHg following the creation of pneumoperitoneum. Laparoscopic surgery requires CO2 insufflation to achieve pneumoperitoneum, which can lead to CO2 absorption into the circulation, resulting in hypercapnia and respiratory acidosis. However, PaCO2 levels typically return to baseline after desufflation.[26] A study by Hassan et al. demonstrated an increase in PaCO2 levels following CO2 pneumoperitoneum, rising from 35 mmHg to a peak of 47 mmHg at 180 minutes. Both PaCO2 and ETCO2 levels showed significant increases after insufflation, but returned to baseline postdesufflation, with an average postoperative $PaCO_2$ of 39.4 mmHg. $PaCO_2$ increases can be minimized by enhancing minute ventilation throughout the procedure.[27] The Trendelenburg position in patients undergoing pneumoperitoneum can exacerbate atelectasis, particularly in obese individuals with poor health. Mazinari et al. found that setting PEEP at 2 cmH_2O above the intraperitoneal pressure reduced transpulmonary pressure compared to the standard PEEP setting of 5 cmH_2O.[28]

Before extubation, patients should be positioned in reverse Trendelenburg to enhance functional residual capacity (FRC) and optimize oxygenation. Obese patients may experience delayed recovery due to the accumulation of lipophilic drugs in adipose tissue, necessitating careful monitoring to ensure adequate respiration, full muscle strength, and complete recovery of airway reflexes.[9] Obese individuals have higher oxygen consumption and an increased respiratory depressant response to opioids.[9,14] Therefore, a multimodal approach to pain management is preferred for these patients. In our case, a combination of epidural bupivacaine 0.1% and morphine 1 mg was administered every 10-12 hours, intravenous ibuprofen 400 mg every 8 hours, and oral paracetamol 500 mg every 6 hours for postoperative analgesia.

Conclusion

The rising incidence of obesity among patients is influencing various fields of medicine. Managing obesity and morbid obesity is expected to become a more frequent scenario in the future. Contrary to previous reports, laparoscopic procedures can now be performed safely and effectively in obese individuals. When compared to laparotomy, minimally invasive surgery leads to lower pain scores, faster recovery, and fewer postoperative complications. Obese patients face an increased risk of intraoperative and postoperative complications, such as respiratory and cardiovascular issues, as well as heightened sensitivity to sedative medications. Consequently, it is essential to carry out a comprehensive preoperative evaluation to minimize the risk of potential anesthetic complications. This assessment should include a review of the patient's comorbidities, airway, and possible drug interactions. Research indicates that a combination of general anesthesia and epidural anesthesia is preferable to general anesthesia alone, offering benefits such as more stable hemodynamic parameters, reduced opioid consumption, improved recovery scores, and effective pain management. Multimodal pain control is also employed postoperatively to prevent respiratory depression in obese patients.

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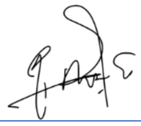

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