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Anesthesiological perspective on the obese patients: challenges and management - literature review

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Abstract
Obesity has become a widespread health problem with important implications for various medical disciplines. Obese patients, particularly those who are extremely obese, present unique challenges to anaesthetic management, requiring specialized approaches to adapt management to their altered anatomy, physiology, and increased risk of complications. These patients are more likely to experience difficulties with the airway, ventilation, and drug pharmacokinetics, complicating standard anaesthetic techniques. The impact of obesity on respiratory mechanics poses additional risks during surgery and in the perioperative period. In addition, the multiple comorbidities associated with obesity further increase the complexity of anaesthetic management. This review aims to outline current anaesthetic approaches to the management of obese patients, with a focus on airway management, ventilation techniques, and use of medications. It also discusses innovative methods such as ultrasound prediction of the risk of difficult airways and strategies to optimize oxygenation during surgery. This article brings together the latest evidence on how these techniques improve patient outcomes, reduce the risk of complications, and enhance the safety of anaesthesia. This review provides valuable insights for anesthesiologists and healthcare providers to improve care for obese patients undergoing surgery.

Key words: obesity, anesthesia, difficult airways, ventilation, perioperative management, ultrasound

Introduction

Obesity (BMI > 30) is one of the greatest health challenges of the 21st century, leading to a number of systemic complications that have significant clinical consequences in many fields of medicine, including anesthesiology and intensive care. As the percentage of obese patients increases, the need to adapt the strategy of anesthesia and perioperative management also increases. Obesity affects the functioning of many body systems, including respiratory and cardiovascular, which requires special caution and individualization of anesthesia treatment.

When anesthesiologists administer anesthesia to obese patients, they must take into account numerous aspects, such as difficulties in maintaining patent airway, altered pharmacokinetics of drugs or an increased risk of postoperative complications. Excess adipose tissue can lead to impaired respiratory mechanics, increased oxygen demand, and more frequent problems with intubation and ventilation. In addition to the challenges associated with the patency of the airway, an important aspect of anesthesia in obese patients is the proper dosing of drugs.
A particular issue is the appropriate management of obese pediatric patients. Obesity in the pediatric population is steadily increasing, which means that more obese children will require anesthesia at some point. This review will discuss key aspects of anesthesia in obese patients, including airway management, choice of anesthesia methods, drug dosing, and specifics of pediatric management. Particular attention is paid to the latest recommendations and management strategies that may help improve the safety and effectiveness of anesthesia in this group of patients.

Objective of the article

The aim of this article is to review and present the current principles of management of obese patients, who are increasingly undergoing anaesthesia for various reasons. The analysis focuses on the management and challenges that must be faced during the treatment of obese patients.

In addition, the review aims to provide anaesthesiologists and others with knowledge about methods that can reduce the risk of complications and improve patient outcomes during surgical procedures. The article discusses the anaesthetic challenges related to airway management and ventilation in obese patients, including morbidly obese. It focuses on presenting the latest methods of noninvasive and invasive ventilation, intubation strategies and techniques that can improve the safety and effectiveness of airway management in these patients. In addition, the article analyzes the impact of obesity on respiratory mechanics, pharmacokinetics of anaesthetic drugs and the role of ultrasound in assessing risk factors and assisting with anaesthesia.

Methodology

To create this review, a thorough search of scientific publications was conducted. The aim was to include the latest, most up-to-date and most useful data on the principles of management of obese patients by anesthesiologists during anesthesia and beyond.

The literature search was conducted in February and March 2025 using the PubMed database and included combinations of the following key words: morbid obesity, bariatric anesthesia, anesthetic complications, anesthesia, childhood obesity, mechanical ventilation, perioperative period, difficult airway.

Only articles published in English were included. Initially, based on the title and abstract, articles that were incomplete, not directly related to the anesthetic management of obese patients or did not meet the inclusion criteria were excluded.

The final analysis included 21 publications that met both substantive and methodological criteria. The review covered a wide range of issues in the management of obese patients, from airway management, pharmacokinetics of anesthetic drugs to new techniques for predicting difficult airways using ultrasound and induction of anaesthesia.

Results

In the course of obesity, there are numerous changes in the anatomy and physiology of a person, which results in numerous differences in the treatment of such patients by an anesthesiologist. During anesthesia and in the perioperative period, the doctors must take into account such aspects as difficult airways, changed pharmacokinetics of drugs or a higher risk of complications.

Airway management

Blood oxygen tension, such a key parameter related to breathing, can be reduced by excess body fat. The study by *Hedenstierna et al. (2019)* showed that the oxygenation ratio Pao2/Fio2 (partial pressure of oxygen in arterial blood/oxygen content in the breathing mixture) deteriorated during anesthesia, and this deterioration was more pronounced in people with a higher BMI and in older people. Furthermore, it was shunt, related to atelectasis (collapse of the lung parenchyma), and not a low ventilation to perfusion ratio (V/Q), that increased with increasing body weight. This raises concerns about how to intubate and ventilate these patients safely.

Furthermore, obesity increases the risk of difficult face mask ventilation and intubation *(Brodsky, 2018)*, especially in patients with grade III (extreme) obesity and coexisting obstructive sleep apnea *(Von Thaer et al., 2024)*.

It is essential to preoperatively identify the risk factors for difficult airways, to be prepared for them before surgery. *Thota et al. (2022)* presented important risk factors for difficult airways such as Mallampati score, neck circumference, and thyromental distance. Additionally, *Liew et al. (2022)* listed aspects such as male gender, higher BMI, and the presence of obstructive sleep apnea. Although obesity may increase the risk of difficult airways, BMI alone is not always a sufficient predictor.

Effective and rapid intubation is the key to success during surgery. Although videolaryngoscopy may seem better for intubation of obese patients, it has not been found to be superior to traditional laryngoscopy *(Brodsky, 2018; Thota et al., 2022; Liew et al., 2022).* In the case of difficult intubation, it is also possible to use techniques such as fiberoptic intubation (FOI), which has proven benefits in difficult airways *(Thota et al., 2022)*. In crisis situations, airway rescue devices such as SAD (supraglottic airway devices) or FONA (front-of-neck access) should be used *(Liew et al., 2022)*.

Many studies have addressed the impact of patient positioning during the procedure on the patient's ventilation and oxygenation. "Ramped position", in which the head, shoulders and the entire upper body of the patient are raised, improves airway visualization and pre-oxygenation of the patient, which prolongs the safe apnea time and facilitates intubation *(Thota et al., 2022; Liew et al., 2022; Brondeel et al., 2022)*.

Von Thaer et al. (2024) suggested that prophylactic positioning of the patient in the reverse Trendelenburg position, in which the whole body is positioned at a 30° head-up angle, and adequate ventilation can improve the oxygenation level of patients. In the case of obese patients with severe ARDS in intensive care units, the prone position effectively helps with their ventilation *(Brondeel et al., 2022)*.

In their work, *Pépin et al. (2019)* found that obesity affects respiratory mechanics, responsiveness to the respiratory stimulus, and patency of the upper airway, which can lead to numerous difficulties, especially in the perioperative period. In the context of respiratory mechanics, obese patients often have reduced functional residual capacity (FRC) and tidal volume (TV) of the lungs, which increases the risk of hypoventilation and desaturation, especially during general anesthesia. This indicates the need to use different techniques to prevent this.

Brodsky (2018) suggests that rapid flow oxygenation (THRIVE) can effectively prolong safe apnea time by preventing desaturation. In addition, apneic oxygenation prolongs apnea time

without desaturation. This involves delivering oxygen through the nose when the patient is not breathing, which significantly increases the safe apnea time and increases the chance of successful intubation *(Thota et al., 2022)*.

In the case of postoperative acute respiratory failure, noninvasive ventilation (NIV) is the first-line therapy *(De Jong et al., 2020),* and preoxygenation with positive pressure before intubation is the standard of care. In the case of mechanical ventilation, the use of low tidal volume and moderate to high PEEP (positive end-expiratory pressure) is recommended *(De Jong et al., 2020; Thota et al., 2022)*.

A new method of induction of anesthesia was proposed and discussed by *Wang et al. (2019)*, which consists of using sevoflurane in inhalation anesthesia with spontaneous breathing, followed by the insertion of a supraglottic airway device (SAD) and endotracheal intubation after standard intravenous anesthesia and neuromuscular blockade. They showed that the use of this strategy allows for effective ventilation, a lower risk of desaturation, which progresses faster in obese patients, a lower risk of aspiration of food content, and proper oxygenation at each stage of ensuring the patency of the airway The procedure itself is safe and comfortable, which makes it feasible in patients with extreme obesity.

Methods of anaesthesia

In obese patients with excess adipose tissue, it is more difficult to insert a vascular catheter or locate the injection site. *Kim's (2021)* review showed that the epidural anesthesia technique, although effective, may be more difficult to perform in obese patients due to the increased distance from the skin to the epidural space. Spinal anesthesia and combined anesthesia (CSE) technique is recommended, especially for longer surgeries such as cesarean section.

Many substances used in anesthesia are lipophilic, so their use in obese patients with excess adipose tissue must be appropriate *(Lang et al., 2017).*
Brodsky (2018) noted that the dosing of anesthetic drugs such as propofol should be based on lean body weight (LBW), which provides safer anesthesia in obese patients. The use of sugammadex in obese patients, with dosing based on ideal body weight (IBW), improves efficiency and reduces the risk of postoperative complications.

Obese pediatric patients

The increasing prevalence of obesity in the pediatric population requires anesthesiologists and the entire medical team to be vigilant and thorough in managing such children, whose management may differ from the general population.

In the case of anesthesia for obese children, preoperative clinical assessment is crucial, taking into account common comorbidities associated with obesity, such as hypertension, obstructive sleep apnea, asthma, and glycemic disorders. An important aspect is also the precise adjustment of the drug and its dose, due to their changed pharmacokinetics caused by the increased amount of adipose tissue *(Hashim et al., 2022)*. It should be borne in mind that increasingly used antiobesity drugs may affect gastric emptying, which may increase the risk of aspiration of food *(Manupipatpong et al., 2024)*.
The pediatric airway is anatomically different from that of an adult, for example in terms of the amount and laxity of connective tissue, and obesity-related changes, which pose a challenge in intubating such a child. A detailed preoperative clinical assessment for difficulty in intubation is necessary, during which ultrasound can be helpful *(Hashim et al., 2022).*

To reduce the risk of complications, which increases with increasing BMI, ERAS (Enhanced Recovery After Surgery) protocols are effective, which use an opioid-sparing approach, thereby reducing the risk of respiratory depression, especially in those with obstructive sleep apnea *(Manupipatpong et al., 2024).* As an opioid replacement, *Hashim et al. (2022)* suggest the use of epidural anesthesia and NSAIDs.

Use of medications

The study by *Von Thaer et al. (2024)* highlighted that it is necessary to adjust the dosage of drugs such as opioids and benzodiazepines to the patient's body weight. Regional anesthesia may be beneficial to avoid manipulation of the airway, but it is associated with difficulties in

determining the precise location of anatomical structures. In the context of bariatric surgery and new drugs for weight loss, such as GLP-1 agonists, careful monitoring of the patient's condition is necessary to avoid the risk of aspiration of food.

In case of obesity, the current medication should be continued, except for insulin and antidiabetic drugs. It is also worth remembering that obese patients are at greater risk of aspiration, so anti-aspiration prophylaxis should be considered, using a combination of metoclopramide and PPI or an H2 blocker *(Brondeel et al., 2022)*.

The use of weight loss medications such as phentermine or orlistat may affect the perioperative management of other medications, and some of these medications may interact with other agents. Patients who have undergone weight loss surgery, such as gastric banding or gastrectomy, are at increased risk for acid reflux and require appropriate pre-anesthetic preparations, including the use of proton pump inhibitors and rapid induction of anesthesia *(Varbanowa et al., 2022).*

The role of ultrasound

Morbidly obese patients are more likely to experience difficulty with mask ventilation and intubation. *Akin et al. (2024)* found ultrasonography to be an effective, noninvasive method for airway assessment to predict difficulty with ventilation and intubation.

In particular, tongue volume, anterior neck soft tissue (ANS) at different levels, hyomental distance (from the hyoid bone to the inferior border of the chin, HMD), and the the ratio of preepiglottic distance to distance between the epiglottis and the midpoint of vocal cords (PE/E-VC) are effective predictors of difficult mask ventilation and intubation. ANS tissue thickness at the level of the thyrohyoid membrane and the PE/E-VC ratio were found to be the most significant indicators of difficult intubation *(Akin et al., 2024)*.

Review by *Diab et al. (2022)* demonstrated that ultrasound enables precise vascular access, which is particularly important in patients with obesity, where difficulties in locating veins are more common.

In addition, intraoperative echocardiography is a valuable tool in detecting pulmonary embolism, especially in obese patients, who are more susceptible to such complications. In particular, FOCUS (focal cardiac ultrasound) has shown high efficiency in detecting pulmonary embolism, with a sensitivity of 52% and a specificity of 96%, which is a major advance in diagnostics and improves intraoperative safety *(Diab et al., 2022)*.

In bariatric surgery, the TAP block (transverse abdominal plane block) is particularly important, as it reduces the duration of procedures, reduces the risk of complications, and improves the effectiveness of postoperative analgesia. These blocks, performed using ultrasound, allow for precise administration of the anesthetic, which reduces the need for opioids and minimizes their negative side effects, such as respiratory depression *(Diab et al., 2022).*

Pain management

Eipe and Budiansky (2022) discussed a modern approach to perioperative pain management in bariatric anesthesia. During the procedure, which is usually performed laparoscopically, the role of non-addictive adjuvant infusions such as ketamine, lidocaine, and dexmedetomidine, and modern regional anesthesia techniques such as intraperitoneal local anesthesia (IPLA) and laparoscopic transverse abdominis plane block (LapTAP) are emphasized, which help reduce pain and opioid requirements.

Postoperative pain management strategies focus on patient safety and minimizing opioid use, which is supported by ERAS protocols. With such solutions, bariatric laparoscopy is becoming a standard in the treatment of obesity, and pain management becomes more effective, reducing the risk of chronic pain and opioid abuse. Patients with morbid obesity and obstructive sleep apnea require special attention and longer follow-up, but the use of modern regional anesthesia techniques and non-addictive adjuvants shows promising results *(Eipe and Budiansky, 2022)*.

Complications and prevention

Obese patients are at increased risk of postoperative complications, which is why it is important to identify risk factors and implement prevention as early as possible. Proper

identification of these factors and adjustment of anesthetic techniques is a key element of their prevention. Preoperative anesthetic evaluation of patients with obesity should include: medical history, physical examination, airway assessment, comorbidities, functional status of the patient, risk factors, medications used for weight loss, and analysis of previous weight loss surgeries. Such evaluation should be performed well in advance to allow for modification of the preoperative plan without the need to delay the surgery. *(Varbanowa et al., 2022)*

Lebuffe et al. (2010) distinguished risk factors such as age, degree of obesity, and experience of the medical team. Correct positioning of the patient, maintaining a patent airway, appropriate pre-oxygenation, and selection of the anesthetic in terms of mechanism of action and dose are important. *(Seyni-Boureima et al., 2022)*
It is necessary to assess patients with a higher BMI for comorbidities such as obstructive sleep apnea, heart disease, or airway difficulties. For patients with a BMI > 40, anesthesiologists should consider a comprehensive health assessment, including cardiopulmonary and endocrine function, to provide appropriate care and minimize the risk of complications. *(Lee, 2018).*

Bariatric surgery carries a risk of complications such as pulmonary embolism, which is the most common cause of postoperative death in the studied group of patients, surgical site infections, heart attacks, atrial fibrillation, or rhabdomyolysis *(Lebuffe et al., 2010)*. Patients with morbid obesity, especially those with obstructive sleep apnea, have a significantly higher risk of pulmonary complications, such as respiratory failure, hypoxia, and apnea *(Hardt and Wappler, 2023)*.

Intensified postoperative care should depend on the patient's comorbidities, type of anesthesia, and the procedure performed. Intraoperative care includes the use of lung protective ventilation, a semi-sitting position, and intraoperative monitoring of consciousness. Postoperatively, hypoxia should be avoided, continuous positive airway pressure (CPAP) therapy should be considered, and regional anesthesia should be used to minimize the risk of complications *(Hardt and Wappler, 2023)*.

Hardt and Wappler (2023) recommended the use of short-acting, low-lipophilic anesthetics to prevent complications, as well as multimodal analgesic therapy to avoid high doses of opioids. The more difficult healing of postoperative wounds and their higher risk of infection encourage the use of infection prophylaxis *(Lang et al., 2017)*.

Postoperative care of obese patients includes the use of noninvasive positive pressure ventilation (NPPV), which reduces the risk of respiratory complications. In patients with obstructive sleep apnea, the use of CPAP in the postoperative period reduces the risk of pulmonary complications, and bilevel positive airway pressure (BiPAP) used after extubation may be beneficial in maintaining lung volume. The use of a high-flow nasal cannula (HFNC) immediately after extubation is less invasive and easier to use, so it should be used more often *(Thota et al., 2022).*

Pépin et al. (2019) emphasize the prevention of perioperative atelectasis, which is common in obese patients. It is important to start positive pressure ventilation (e.g. CPAP or BiPAP) already in the preoperative period to improve ventilation and reduce the risk of its occurrence. The setting of tidal volume during mechanical ventilation should be adjusted to the patient's height, not body weight, which is an important factor to avoid excessive lung stretching and barotrauma. In obese patients, especially those with chronic respiratory failure, long-term use of non-invasive ventilation (NIV) after returning home is recommended.
Lang et al. (2017) noted that tools such as the STOP-BANG scale are effective in helping to diagnose obstructive sleep apnea, and the use of CPAP or BiPAP before surgery can reduce the risk of respiratory complications in such patients. (Lang et al., 2017; Brondeel et al., 2022)

Due to the higher risk of deep venous thrombosis (DVT), prophylaxis should be considered, e.g. subcutaneous heparin or enoxaparin and sequential compression devices. *(Liew et al., 2022; Brondeel et al., 2022)*

Risk assessment in bariatric surgery is performed using tools such as the Obesity Surgery Mortality Risk Score (OS-MRS) and the Edmonton Obesity Staging Systems (EOSS), which help determine the risk of death and postoperative complications *(Varbanowa et al., 2022)*.

It is worth encouraging patients with obesity to lose even 5-10% of their body weight before surgery, as this reduces the risk of complications and has a positive effect for the recovery period after the procedure.

Discussion

Obesity poses challenges for physicians in terms of airway management, pharmacotherapy, and risk of complications. Changes in the anatomy and physiology of obese patients, including weight gain, result in changes in respiratory function as well as altered drug response.

In the context of the airway, obesity impairs blood oxygenation, which complicates ventilation and increases the risk of hypoxemia. According to the study by *Hedenstierna et al. (2019)*, individuals with a higher BMI and older age show worse blood oxygenation parameters during anesthesia, which can lead to serious complications during the procedure. Furthermore, obesity is associated with difficulties in intubation, especially in morbidly obese patients and those with coexisting obstructive sleep apnea *(Brodsky, 2018)*. These difficulties, although they can be minimized by a thorough preoperative assessment, including airway risk assessment *(Thota et al., 2022)*, pose a significant challenge to the anesthesiologist.

Ramped positioning and reverse Trendelenburg positioning *(Thota et al., 2022; Liew et al., 2022; Von Thaer et al., 2024)*, which improve airway visibility and facilitate intubation and ventilation, appear to be effective solutions to improve pre-oxygenation and reduce the risk of desaturation during induction of anesthesia. In addition, intubation techniques such as videolaryngoscopy and fiberoptic intubation can be particularly helpful in difficult airway cases, ensuring safe and effective intubation *(Thota et al., 2022).*

In the context of anesthesia, the modern approach using sevoflurane and a supraglottic device can help to ensure optimal ventilation and reduce the risk of desaturation, especially in cases of extreme obesity *(Wang et al., 2019).*

Altered pharmacokinetics of drugs in obese patients, including changes in the absorption, distribution, and elimination of anesthetic substances, pose additional challenges. Lipophilic drugs such as propofol require dosing based on lean body weight (LBW) to avoid accumulation of these substances in the body *(Brodsky, 2018)*. The use of sugammadex, based on ideal body weight (IBW), improves its efficiency and safety of anesthesia in obese patients *(Brodsky, 2018)*. The need for appropriate adjustment of drug dosing and the use of regional anesthesia, such as spinal or combined anesthesia (CSE), is a useful method for longer surgical procedures *(Kim, 2021)*.

In pediatric patients with obesity, special consideration should be given to comorbidities such as hypertension or obstructive sleep apnea, which may influence the choice of anaesthesia method and management strategy. In the context of obese children, ultrasound assessment of intubation difficulties is a helpful diagnostic tool, allowing appropriate preparation for the procedure *(Hashim et al., 2022).*

All these challenges indicate the need for a multifaceted assessment of the obese patient before surgery, taking into account both anatomical and physiological specificity. It is crucial to adapt the anaesthesia methods and anaesthetic techniques to minimize the risk of complications and ensure patient safety. Future studies should focus on optimizing intubation techniques and preventive airway management strategies, especially in the context of patients with morbid obesity and their comorbidities.

Conclusions

Obesity significantly affects anaesthetic management, requiring adjustments to both airway management strategies and the choice of anaesthetic method. The anatomical and physiological changes in obese patients lead to an increased risk of difficult ventilation and intubation, which underscores the need for a thorough preoperative assessment and the use of appropriate techniques. Studies indicate that effective oxygenation and optimal patient positioning can improve the safety and effectiveness of procedures, extending the safe apnea time and facilitating intubation.

In the aspect of airway management, strategies such as use of the ramped position or the reverse Trendelenburg position are crucial. In addition, techniques such as video laryngoscopy, fiberoptic intubation, and the use of supraglottic devices play an important role in difficult airways. In the postoperative period, noninvasive ventilation and positive pressure ventilation are essential elements of management in cases of risk of respiratory failure.

The choice of anaesthetic method also requires an individual approach. Regional anaesthesia, although effective, can be more difficult to perform due to anatomical conditions. New techniques, such as the use of sevoflurane for induction of anesthesia or ultrasound in assessing risk factors for difficult intubation, may improve the safety and effectiveness of anesthesia in obese patients. Ultimately, optimizing anesthesia strategies in obese patients requires a comprehensive approach that includes preoperative assessment, appropriate preparation, and intra- and postoperative monitoring of the patient. Further research in this area, especially in the context of new diagnostic technologies and ventilation methods, will be necessary to further improve clinical practice and improve outcomes in patients with obesity.

Disclosure

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