OBESITY – ANESTHETIC CONSIDERATION, COMPLICATIONS, MANAGEMENT – A REVIEW ARTICLE

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ABSTRACT

The anaesthesiologist has numerous obstacles when dealing with obese patients. Obesity's pathophysiologic consequences and anaesthetic implications require a thorough understanding. The anaesthesiologist must recognise and treat the higher risks and comorbidities that come with being obese, optimising multisystem function in the perioperative period to ensure optimal outcomes. Intravenous access, trouble measuring noninvasive blood pressure, problematic spinal, epidural, and difficult airway challenges should all be expected and planned for during surgery.

Keywords: Obesity, anaesthesia, anaesthetic considerations.

Introduction

Obesity is on the rise in both industrialised and developing countries, and anaesthetists are increasingly confronted with complications while treating fat patients. [1] Obese people may need any sort of surgery, including elective, emergency, and obstetric anaesthesia and analgesia. As a result, a thorough grasp of the pathophysiology and consequences associated with obesity can help anaesthetists better manage this group of patients. In these patients, preoperative assessment and preparation, anaesthetic technique selection, patient placement and handling, and postoperative care all require specific consideration.

Definition:

Obesity comes from the Latin word obesus, which meaning "flattened by eating." It is a condition characterised by an excess of body fat. The body mass index (BMI), which is equal to weight/height 2 (kg/m 2) and is also known as Quetelet's index, is the most widely used metric for measuring obesity. Obese, morbidly obese, and super morbidly obese people have BMIs of 30, 35, and 55 kg/m2, respectively. [2]

The World Health Organization divides people into three categories based on their body mass index (BMI): normal (18.9–24.9 kg/m2), overweight (25–29.9 kg/m2), and obese (BMI > 30 kg/m2). Obesity is divided into three categories: class 1 (BMI 30–34.9 kg/m2), class 2 (BMI 35–39.9 kg/m2), and class 3 (BMI > 40 kg/m2). 2 Individuals with class 3 obesity are classified as morbid obese if their BMI is 40–49.9 kg/m2, super obese if their BMI is 50–50.9 kg/m2, and super-super obese if their BMI is greater than 60 kg/m2. Although some organisations have suggested adopting cut-off values 5 kg/m2 higher during pregnancy, there is currently no alternative obesity classification for parturients.

Although the BMI is the most widely used metric for determining the severity of obesity, it is not always the most accurate clinical predictor of disease. The distribution of adipose tissue appears to be more therapeutically significant than absolute weight or BMI. Android obesity, in which fat is spread truncally, is connected to a higher risk of cardiovascular disease, but gynecoid obesity, in which fat is distributed to the thighs and buttocks, is not.

Obesity is a systemic condition with a slew of comorbidities, including an increased risk of obstetric and peripartum problems. Obesity has been linked to protracted labour, which has been linked to difficulties for both the mother and the foetus. Obese pregnant women are also more likely to require a caesarean delivery.[3]

- Common Comorbidities Associated With Obesity Compared To Non-Obese Individuals

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Comorbidity

- ✓ Type 2 diabetes

- ✓ Hypertension
- ✓ Coronary artery disease
- ✓ Congestive heart failure
- ✓ Pulmonary embolism
- ✓ Stroke
- ✓ Asthma
- ✓ Gallbladder disease
- ✓ Chronic back pain

OBESITY - Pathophysiology

Obesity is a multifactorial condition caused by a complex interaction of environmental, genetic, and hormonal variables. [4] Obesity can occur as a result of excessive calorie intake and low calorie expenditure. Interaction between the hypothalamus and peripheral tissues and organs helps to regulate energy balance in the body. The beta-3-adrenergic receptor gene, the peroxisome-proliferator-activated receptor gamma 2 gene, chromosome 10p, and the melanocortin-4 receptor gene have all been implicated as genetic contributions to obesity pathogenesis.

Adipocytes create adipokines, which include tumour necrosis factor-alpha (TNF-), interleukin-6 (IL-6), leptin, and adiponectin. TNF- increases insulin resistance and blood vessel inflammation. In addition, IL-6 increases inflammation, reduces host immunity, and causes tissue damage. Leptin suppresses hunger and is rarely deficient in humans; yet, obese people are sometimes labelled as leptin-resistant. Adiponectin improves insulin sensitivity, decreases inflammation, and prevents atherosclerosis. The expression of adiponectin messenger RNA is found to be lower in the adipose tissues of obese people. Increased levels of IL-6, TNF-, and C-reactive protein, as well as lower levels of adiponectin and interleukin-10, are seen in the presence of central obesity, which contributes to insulin resistance and endothelial dysfunction.

Obesity appears to be linked to reduced vitamin levels, such as vitamins A, D, and E. Furthermore, B vitamin deficits have been linked to obesity. Mineral deficiencies, such as zinc, iron, calcium, and selenium, can contribute to weight gain and obesity. [5] Evidence reveals that people who are morbidly obese have lower amounts of vitamins C and E, and there is also evidence that adults who are overweight or obese have lower levels of beta-carotene and vitamin C. These vitamins and minerals may prevent obesity in a variety of ways, including preventing adipogenesis, triggering apoptosis in adipocytes, controlling the synthesis of specific hormones such as leptin, reducing oxidative stress and inflammation, blocking lipogenesis, and boosting lipolysis. [6]

Changes in various systems in obesity:

Respiratory system:

Obesity is linked to lower lung and chest wall compliance, higher airway resistance, and lower functional residual capacity. Atelectasis, ventilation/perfusion mismatch, and decreased oxygenation are common when functional residual capacity falls below closure capacity. These effects are exacerbated by the supine position and the introduction of anaesthesia.

Obstructive sleep apnoea (OSA):

Obesity is linked to obstructive sleep apnoea, which is described as apnoeic episodes caused by pharyngeal collapse during sleeping. Obstructive sleep apnoea has the following characteristics:

1. Sleep apnoea or hypopnoea occurrences on a regular basis. Despite continuing respiratory effort against a closed airway, an obstructive apneic episode is defined as 10 seconds or longer of total cessation of airflow. Hypopnoea is defined as a 50% decrease in airflow or a reduction sufficient to cause a 4% drop in arterial oxygen saturation. Clinically relevant episodes are estimated to be five or more per hour or >30 per night.
2. Snoring
3. Daytime somnolence linked to poor concentration and headaches in the morning.

4. Pathophysiological changes-hypoxia resulting in secondary polycythemia, which is linked to an increased risk of ischemic heart disease and cerebrovascular disease, hypercapnia, systemic or pulmonary vasoconstriction, and right ventricular failure.

BMI > 30 kg/m2, hypertension, observable episodes of apnoea during sleep, polycythemia, hypoxia/hypercapnia, and right ventricular hypertrophy are all factors that contribute to detect OSA. Polysomnography in a sleep laboratory is used to get a definitive diagnosis.
Hypoventilation syndrome in obesity (OHS) It is a long-term consequence of OSA that is linked to a progressive desensitisation of the respiratory centres to hypercapnia, which is first limited to sleep but eventually progresses to type II respiratory failure with a greater reliance on hypoxic drive for breathing. Pickwickian syndrome, which includes obesity, hypersomnolence, hypoxia, hypercapnia, right ventricular failure, and polycythemia, is the end result of OHS [8]. OSA is linked to difficulties with mask breathing and hypoxemic episodes.
Preoperatively, these patients can be given nightly continuous positive airway pressure (CPAP). Patients with OSA who use home CPAP should bring their device with them for immediate usage postoperatively, and their CPAP device should be on standby during anaesthetic recovery.

Cardiovascular system:
Ischemic heart disease, hypertension, and cardiac failure are all linked to obesity. Increases in blood volume and cardiac output are linked to obesity. Volume expansion is caused by increased activity in the renin-angiotensin system and secondary polycythemia, which results in increased blood volume. The distribution of blood is mostly to tissues with increased fat accumulation, whereas cerebral and renal blood flows remain essentially stable. Ventricular dilatation and an increase in stroke volume cause an increase in cardiac output. Increased left ventricular wall stress causes hypertrophy as a result of ventricular dilatation.
Eccentric left ventricular hypertrophy causes decreased compliance and left ventricular diastolic function, or ventricular filling impairment, resulting in higher left ventricular end diastolic pressure and pulmonary oedema. Because the dilated ventricle's ability to hypertrophy is limited, systolic dysfunction occurs when left ventricular wall thickening fails to keep up with dilatation. Hypoxia, hypercapnia, diuretic-induced electrolyte disturbance, coronary artery disease, OSA, cardiac hypertrophy, and fatty infiltration of the conduction system can all cause arrhythmias in these patients.

Gastrointestinal system:
Obese people are more likely to develop diabetes. They should be evaluated for glucose management, such as glycosylated haemoglobin, as well as the existence of diabetes consequences, such as heart disease, renal disease, and autonomic dysfunction. Because of the combination of increased intraabdominal pressure, high volume and low pH of gastric contents, and an increased incidence of gastro-oesophageal reflux, these patients are at an elevated risk of aspiration of gastric contents after induction of anaesthesia. H2 receptor antagonists, antacids, prokinetics, rapid sequence induction with cricoid pressure, and tracheal intubation with the patient fully awake should all be used to prevent aspiration.

Thromboembolism:
In these patients, prolonged immobilisation, in addition to polycythemia, increased abdominal pressure, and decreased fibrinolyticactivity, increases the risk of thromboembolism, and preventative measures should always be implemented.

Anatomical airway changes in obese patients
Due to the large quantity of adipose tissue deposited in places such as the chest walls, ribs, diaphragm, and belly in obese patients, normal breathing may be impaired. The diaphragm contracts during normal breathing, moving abdominal contents inferiorly and anteriorly. The ribs are additionally pulled superiorly and anteriorly by the external intercostal muscles. Obese people's usual activities are hampered mechanically by the presence of excess adipose tissue in the thoracic and abdominal areas, and their lung compliance is reduced. Maximum inspiratory pressure (MIP) and maximal expiratory pressure (MEP) measurements can be used to assess the strength of respiratory muscles, and these values have been found to be lower in obese people. [7]
Furthermore, weight from the abdomen travels superiorly into the thoracic cavity when an obese person rests flat on their back. This causes laboured breathing and impairment in the normal function of main respiratory muscles by compressing and occluding tiny airways at the lung bases.
Obese people have a variety of abnormalities in lung volume. Individuals suffering from obesity have lower expiratory reserve volume (ERV), functional residual capacity (FRC), and overall total lung capacity (TLC).

These alterations arise as a result of pressure imbalances within the lungs, which cause aberrant lung inflation and deflation.
Despite the fact that the majority of obese people have normal arterial partial pressures of oxygen (PaO2), morbidly obese people have modestly expanded alveolar-arterial oxygen gradients [P(A-a) O2]. This is caused by ventilation perfusion imbalances in the lungs of morbidly obese people as a result of partial lung collapse. The lungs of morbidly obese people have increased ventilation and perfusion in the upper areas but decreased ventilation and perfusion in the lower regions, according to observations. [8,9]

Perioperative Care of Obese Patients undergoing surgery
Obese patients, especially those with comorbidities, may have a higher risk of problems during surgical procedures. For the assessment of patients undergoing gastric bypass surgery, the Obesity Surgery Mortality Risk Stratification score (OS-MRS) was developed. This score is important because it aids in the isolation and identification of risk variables that may lead to increased mortality in obese individuals undergoing bariatric surgery. Despite its implications for usage in gastric bypass surgeries, this screening tool may also be useful in evaluating obese individuals having routine procedures. [10]
Surgical procedures should be extensively evaluated for patients with an OS-MRS score of 4-5. As obese individuals prepare for surgery, it's critical that their BMI be measured and the results reported to the operating team so that essential preparations may be taken to keep the patient safe and comfortable during the procedure. Patients should also be thoroughly evaluated to discover any pre-existing comorbidities and to determine any potential surgical complications. Proper guidance should also be offered through counselling, emphasising important alterations such as quitting smoking before surgery and early mobilisation following surgery to assist limit the occurrence of problems. A thorough examination of main body systems is also necessary prior to surgery. [11]

Respiratory Assessment
The determination of arterial saturation in obese patients having surgery is critical because patients with an arterial PCO2 (Partial Pressure of Carbon Dioxide) greater than 6 kPa have a higher risk of complications since respiratory failure is frequently present. It is also crucial to inquire about sleep-disordered breathing while conducting the general respiratory assessment, which can be done using the STOP-BANG questionnaire. This screening procedure yields a score of 5 or higher, indicating the existence of sleep-disordered breathing. [12]
Patients with an arterial PCO2 (Partial Pressure of Carbon Dioxide) more than 6 kPa have a higher risk of problems because some degree of respiratory failure is frequently present. It's also crucial to ask about sleep-disordered breathing while doing the general respiratory evaluation, which you may perform with the STOP-BANG questionnaire. The existence of sleep-disordered breathing is indicated by a score of 5 or more obtained from this screening approach. [13]
It's vital to remember that obese patients have a higher risk of difficult or failure intubation. The patient's neck circumference should be measured because a circumference of more than 60 cm increases the risk of difficult intubation. Obese individuals had a higher risk of difficult or failed intubations, as well as problematic bag-mask ventilations. Anaesthesiologists should inquire about the following from the patient's past medical history as part of the preoperative airway assessment: [14]
(1) a history of obstructive sleep apnea (OSA),
(2) a history of gastro-oesophageal reflux disease (GERD), and
(3) a history of problematic anaesthesia or airway treatment
When performing a preoperative airway assessment, keep in mind that patients with a short distance between the chin and the tip of the thyroid cartilage, flattened anterior-posterior craniofacial features, narrowed oropharynx, and relative macroglossia are more likely to have airway obstruction during general anaesthesia.

When performing a preoperative respiratory assessment in obese patients, take note of the following:
(1) the circumference of the patient's neck,
(2) the distance between the mentum and the upper boundary of the thyroid cartilage,
(3) the extent of mouth opening and jaw protrusion,
(4) neck mobility,
(5) the presence of excessive adipose tissue in the cervical region of the neck, and (6) the general features of the patient's head and face.
Assessments for the existence of OSA should also be performed.

Cardiovascular Assessment

It's critical to pay special attention to any signs of metabolic syndrome during the cardiovascular assessment phase, as this could be a major indicator of cardiovascular problems. ECGs are especially important in the cardiovascular assessment because they allow for the detection of previously undetected cardiac problems. This is especially essential since obese and overweight patients are more likely to develop arrhythmias, notably atrial fibrillation and ventricular tachycardia, which can be diagnosed by an ECG. [15]
Cardiac arrhythmias in obese or overweight persons are caused by a variety of circumstances, including hypoxia and pre-existing heart disease. The development of arrhythmias in these patients may be influenced by mechanical factors such as obstructive sleep apnea. Obesity and the development of atrial fibrillation have been linked in recent research. Furthermore, people who are overweight or obese are at a 50% higher risk of getting cardiac arrhythmia. Remodeling of the atrium, increased blood volume, raised left atrial pressure, and neurohormonal variables, among other considerations, could all play a role in this occurrence. [16]
Obesity-related hemodynamic abnormalities create structural and physiological changes in the heart, which can lead to atrial fibrillation. Excess adipose tissue deposition raises overall blood volume, which improves cardiac output (increases mainly due to an increase in stroke volume). Hypertrophy (eccentric or concentric) of the left ventricle occurs as cardiac output rises, increasing left ventricular filling pressures and producing diastolic dysfunction. Enlargement of the left ventricle can potentially cause systolic dysfunction. Furthermore, left atrial hypertrophy occurs, resulting in increased pressures and volumes within the left atrium. Pulmonary hypertension develops as a result of this.
Furthermore, obesity is linked to OSA, which has the potential to alter autonomic tone due to hypoxia, acidosis, and sleep cycle disruptions. Changes in autonomic tone may raise pulmonary arterial pressures, leading to right ventricular hypertrophy and ultimately cardiac failure. These changes in the left and right hearts, as well as the hemodynamic abnormalities, play a crucial role in the development and maintenance of atrial fibrillation in obese people. As a result, it's critical to check obese patients for atrial fibrillation and other common arrhythmias such ventricular and supraventricular tachycardia, as well as premature atrial and ventricular contractions. Furthermore, these individuals should be constantly monitored for the development of arrhythmias following surgery, especially if they have a history of heart illness. [17]
Cardiopulmonary exercise testing can also be used as part of the cardiovascular assessment phase since it aids in predicting postoperative prognoses, including potential problems and the average length of hospital stay. Because it is sometimes difficult to accurately measure blood pressure in obese patients using standardised equipment, direct arterial monitoring can be used instead.

Knowing about the following conditions can help you determine the risk of cardiovascular-related morbidity:
(1) the type of surgery, including whether it is considered high-risk or not,
(2) the presence of coronary artery disease,
(3) an existing history of congestive heart failure,
(4) the presence of cerebrovascular disease,
(5) a history of insulin use prior to surgery, and
(6) plasmacreatinine levels >2 mg/dl prior to surgery. [18]

Pre-oxygenation

Morbidly obese patients may desaturate more quickly during apnoea than non-obese ones. As a result, precautions should be made to avoid or minimise a drop in oxygen saturation after pre-oxygenation. The following steps should be taken: (a) while pre-oxygenating the patient, maintain an upright head position of about 25 degrees;
(b) while inserting the laryngoscope, oxygen should be passively administered through the nasopharynx at a rate of about 5 L/min; and

3) during pre-oxygenation, the application of 10cmH2O of positive end-expiratory pressure (PEEP) should be considered.
In order to limit the risk of pre-oxygenation induced atelectasis, maintain an inspiratory pressure of roughly 55 cmH2O for 10 seconds after applying 10 cmH2O of PEEP. [19] Once the airway is secured in morbidly obese patients, the inspired oxygen fraction should be lowered to around 0.4. [20]

Pre-anaesthetic medication

Pre-anaesthetic medications may be used to prevent surgical problems such as infections, gastrointestinal disturbances, postsurgical discomfort, hypercoagulation, and anxiety in obese patients undergoing surgery. Antimicrobials such as cefazolin can be used as a prophylactic measure to prevent infections after surgery. Obese persons weighing more than 120 kg will require a 3 g cefazolin prophylactic dose to avoid surgical-site infections.
Gastrointestinal problems such as nausea and vomiting are prevalent. Preoperative treatment of dexamethasone coupled with ondansetron and haloperidol can be considered to prevent postsurgical nausea and vomiting. Pregabalin, gabapentin, and melatonin can be used to relieve postoperative pain as a prophylactic. [21] To avoid thromboembolisms after surgery, thromboembolic stockings or low-dose subcutaneous unfractionated heparin or low molecular weight heparin (LMWH) can be utilised. Oral benzodiazepines should also be tried for the relief of surgical anxiety.[22]

Assessment for required postoperative care

Other factors, in addition to obesity, may combine to define the scope and type of the postoperative treatment plan necessary in an obese patient. The following are some of these factors:
(1) the presence of pre-surgery comorbidities,
(2) an OS-MRS score of 4-5, which indicates an increased risk,
(3) the type of surgical procedure used during surgery,
(4) the presence of untreated OSA and a need for postoperative opioids administered parentally, and
(5) the competency level of the postoperative management team.
The type of surgery and the location of the surgery are both important factors that impact the amount of postoperative care that may be necessary. Patients who require the administration of long-acting opioids would need to be properly watched for any potential problems.

Intra-operative Care

Positioning

Excess fat in the cervical area of the neck forms a fat pad, causing increased flexion in obese patients. As a result, the patient's upper body, head, and neck must be elevated above chest level until the external auditory meatus is in the same horizontal plane as the sternal notch. This position is known as the ramp-up position, and it aids intubation outcomes in these patients greatly. [23]
This position allows for improved laryngoscopic viewing as well as simpler breathing. Folded blankets, pre-manufactured elevation pillows, or inflated pillows can all be used to create the ramp-up position. Furthermore, operating tables may be provided with various elements that aid in the proper positioning of the obese patient with his or her trunk elevated.

Intraoperative Fluid Management

Patients may endure fluid loss during open surgery due to evaporation. Obese patients who have surgery have a higher risk of developing postoperative renal failure because they frequently appear with prolonged volume. This prolonged volume could be related to prolonged fasting prior to surgery or increased urine production from anti-hypertensive and hypoglycemic medications. Pre-existing renal illness, a BMI of higher than 50 kg/m2, and extensive surgical operations are also risk factors. Fluid control is therefore critical in obese people to prevent renal damage. [24]
A goal-directed therapy (GDT) approach, which is led by the patient's reaction/responsiveness to supplied fluids, is one proposed method for fluid management during surgery of morbidly obese patients. The ability of the heart to respond to an increase in volume by increasing stroke volume is referred to as fluid responsiveness. Fluid responsiveness can be examined while maintaining sinus rhythm by analysing arterial waveforms, a method that offers information on pulse pressure variation (PPV) and stroke volume variation (SVV).
The pulse oximetry waveform's plethysmographic waveform variation (PWV) is also recommended as a non-invasive way for assessing fluid responsiveness. This approach, however, has been shown to be more helpful at

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higher levels of hypovolemia [84]. The ccNexfin is yet another non-invasive approach for determining fluid responsiveness by analysing CO, PPV, and SVV.

A minimally invasive approach called the FloTrac can also be used to measure fluid responsiveness in obese patients with substantial cardiovascular comorbidities. The examination of arterial line waveforms can be used to calculate vascular tone and CO using this method. It also delivers information on SVV and CO, and when connected to a central venous line, it also gives information on central venous oxygen saturation (ScvO2).

Patients who are morbidly obese and considered high-risk during surgery can be monitored utilising pulse-contour analysis-based approaches like PiCCO. This method analyses (1) the Global End-Diastolic Index, (2) intrathoracic blood volume, and (3) extravascular lung water in addition to PPV, SVV, and CO. Despite its utility, it is primarily used in critically ill patients who require extensive surgery due to its high cost.

Awake tracheal intubation

When tracheal intubation appears to be challenging, conscious tracheal intubation is one approach [86]. Because obesity is linked to more difficult intubations, this approach can be used in these patients as well. The upper airway should be suitably anaesthetized with nerve blocks or aerosolized anaesthetics when employing awake tracheal intubation. When doing awake intubations, two modalities are used: flexible fiberoptic bronchoscopy (FOB) and video laryngoscopes.

FOB can be used for nasal or oral intubations while the patient is in the ramp-up position. With the use of FOB, excessive pharyngeal adipose tissue may make appropriate visualisation difficult, and the positioning of the bronchoscope in these instances may restrict spontaneous breathing even more. When using FOB, a laryngeal mask airway can be used to keep the airway open and facilitate breathing after the patient has been induced.

In emergency situations, however, video laryngoscopes are preferred over FOB. Obese patients with neck damage, or obese patients who are unable to appropriately extend their necks or have narrowed oral apertures, can benefit from the use of curved blade video laryngoscopes. The use of video laryngoscopes in obese people with considerable breast tissue may be challenging. [25]

Induction and maintenance

The same anaesthetic medications that are used to induce non-obese persons can be utilised to induce obese patients. Despite this, the presence of extra fat in obese persons has an impact on the pharmacokinetics of anaesthetic medicines, which are affected by their liposolubility and tissue distribution. In comparison to non-obese patients, obese patients metabolise lipophilic drugs more quickly. [26]

Hypnotics

Thiopental sodium

Thiopental sodium is a regularly used medication in the delivery of general anaesthetics. Because it is highly lipophilic, it causes an increase in the volume of distribution when administered in obese patients. Thiopental sodium levels in the blood rapidly decrease when it is administered. Thiopental is eliminated through the liver, and the clearance rate in fat patients is twice as rapid as in non-obese patients.

Propofol

Because propofol is highly lipophilic, it has a large volume of distribution and is rapidly removed from the bloodstream after delivery. Propofol is the chosen medication for induction in morbidly obese patients because of these characteristics. Continuous infusions of this anaesthetic drug in obese patients result in increased volume of distribution and elimination in proportion to total body weight (TBW).

Servin et al. found no significant differences in the initial volume of distribution of propofol in grossly obese study subjects compared to non-obese study subjects in a study that looked at recovery rates and pharmacokinetics of propofol infusion in morbidly obese individuals. However, this research found that as TBW increased, the volume of distribution at steady state and clearance increased linearly.

Etomidate

Because etomidate does not significantly suppress the cardiovascular system, it is advised for people who are experiencing hemodynamic instability. Its use, however, may be cause for concern because it has been linked to adrenal insufficiency, which can lead to organ failure. When used for induction, appropriate dosage changes should be made according to non-fat body weight, as propofol and thiopental sodium have similar pharmacokinetic and pharmacodynamic properties.

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Opioids

Obese patients who have surgery may experience respiratory depression in addition to airway obstruction. In obese patients, using opioids increases the risk of obstructive and central sleep apnea, hypoxia, and upper airway obstruction. As a result, it's critical to note that the therapeutic window for opioids in obese persons is limited.

Fentanyl

Fentanyl, which is around 100 times more strong than morphine, is one of the most commonly utilised opioids for anaesthetic induction. Fentanyl's activity in the circulation is brief; nevertheless, peripheral compartment saturation is attained by continuous administration. Because this medication is very lipophilic, it has a large distribution volume. Following a single dose of fentanyl, plasma levels of this drug are much lower in obese people because obese patients have a higher volume of distribution. Obese patients remove fentanyl at a faster pace. There is a non-linear relationship between fentanyl clearance and body weight, however there is a linear rise in fentanyl clearance with "pharmacokinetic mass," which has a strong relationship with lean body weight.

Alfentanil

Alfentanil has a lesser volume of distribution than fentanyl because it is less lipophilic. In comparison to fentanyl, alfentanil is also less powerful. The presence of a greater CO reduces alfentanil plasma levels in obese people during the early distribution phases. As a result, it's thought that obese people will have higher alfentanil distribution volumes, longer half-lives, and longer elimination times than non-obese patients.

Sufentanil

Sufentanil is the most lipophilic opioid and is more powerful than fentanyl. Sufentanil's volume of distribution and rate of elimination increase with obesity, but its clearance in obese patients is comparable to that of non-obese patients.

Remifentanil

Remifentanil is a fast-acting anaesthetic that is rapidly metabolised by tissue and plasma esterases, resulting in a brief action in the bloodstream. When used as a sedative, this anaesthetic is usually given as a continuous infusion. General anaesthetics can also be administered using a combination of remifentanil and inhalation agents or intravenous hypnotic drugs. One study that looked at the impact of body weight on the pharmacokinetics of remifentanil found no significant differences in the observed pharmacokinetics of remifentanil in obese and non-obese people.

This study also found that ideal body weight (IBW) or lean body mass should be used to establish the needed dose of remifentanil, as these values are more closely connected to the pharmacokinetic characteristics of this medication than TBW. Another study by Bidgol et al. compared the use of sufentanil and remifentanil tight control infusions in morbidly obese patients undergoing laparoscopic gastroplasty surgery and found that sufentanil tight control infusions were associated with better quality of recovery in morbidly obese patients than remifentanil tight control infusions.

Inhalation agents

The presence of excess fat tissue in obese patients combined with high lipophilicity causes increased release of inhalation agents. Furthermore, evidence suggests that obese patients take longer to recover from anaesthesia due to the delayed release of inhaled anaesthetic medications from adipose tissues. Because different breathing treatments have varying degrees of liposolubility, they may have varying effects on recovery rates in obese persons.

Isoflurane and Sevoflurane

Sevoflurane, desflurane, and isoflurane are the three agents that are the most lipophilic. As a result, this anaesthetic is not indicated for people who are extremely obese. When isoflurane is used, blood flow to fat areas is reduced in obese people, and it takes longer for the blood to reach equilibrium. Sevoflurane's effects in the circulation are usually shorter and it is eliminated more quickly in morbidly obese patients because it is less lipophilic and soluble than isoflurane.

Despite the lack of information confirming sevoflurane's precise effects in patients with renal impairment, this anaesthetic medication should be administered with caution in these patients. One of the metabolic by-products of sevoflurane, inorganic fluoride, is toxic to the kidneys when blood levels surpass 50 mmol litre1. When sevoflurane is broken down, compound A is generated, which might cause kidney injury. Despite the fact that animal studies have shown this effect, further information is needed to assess compound A's effects on human kidneys.

Desflurane

BMI has no effect on the amount of desflurane absorbed in the body. Desflurane is the least lipophilic and soluble of the inhalant agents, making it the ideal choice for anaesthetic induction in morbidly obese patients. Desflurane permits obese and non-obese patients to recover more quickly than isoflurane; however, studies comparing desflurane with sevoflurane recovery rates yields inconsistent results.

<u>Neuromuscular Blockers</u>

Polar and hydrophobic characterise neuromuscular blockers. These compounds are not well dispersed in fat tissues due to their characteristics.

Succinylcholine

Succinylcholine is a non-depolarizing neuromuscular blocker. Pseudocholinesterase deactivates and breaks it down. Because obese persons have higher levels of pseudocholinesterase, when this medicine is used for anaesthetic induction, the onset and duration of effects are very quick, and a higher dose of the drug may be required to get the desired outcomes. Succinylcholine is used in obese people because of its quick onset and brief duration of action, which makes tracheal intubations easier and encourages rapid restoration of spontaneous ventilation.

Vecuronium

Vecuronium is a non-depolarizing aminosteroid neuromuscular relaxant. Obese people have higher vecuronium levels in extracellular fluid, although this has minimal effect on the drug's distribution volume. Vecuronium is removed from the body through the hepatic and biliary systems, and inadequate clearance may extend the drug's effects. Furthermore, when TBW is used to estimate doses, the required amounts may be overstated, resulting in drug overdose.

As a result, in obese patients, the needed dose of vecuronium should be calculated using IBW rather than TBW. Schwartz and colleagues investigated how fat affects vecuronium deposition and activity. From a total of fourteen volunteers, seven obese and seven control people were recruited. Both groups of people were administered vecuronium 0.1 mg/kg. Because recovery was delayed due to medication overload when dosage was calculated using TBW, this study suggested that when vecuronium is provided to obese individuals, dosage should be assessed using IBW rather than TBW.

Rocuronium

Rocuronium is a neuromuscular blocker that is an aminosteroid with a quaternary ammonium group in its chemical composition. Rocuronium is not readily transported to peripheral tissues, and the substantial amounts of extracellular fluid seen in obese people have no effect on its pharmacokinetics. It is critical to calculate the provided dose based on IB in order to avoid the drug's effects being prolonged in the body. W. Puhringer et al. investigated the pharmacokinetics and pharmacodynamics of 0.6 mg kg1 rocuronium in six obese and six normal weight (control) subjects. The time it took for rocuronium to start working in obese patients was shorter than in the control group; however, the duration of effect was longer.

Reversal of Neuromuscular Blocking Agents

Neuromuscular inhibition can be reversed, which is a common occurrence in obese patients. Obesity is frequently linked to an increased risk of respiratory problems following surgery.

When compared to non-obese patients, obese patients exhibit a drop in diaphragmatic tone as well as a reduction in end-expiratory lung volumes during sleep induction. The pharmaceutical reversal of neuromuscular blockade may aid in the prevention of serious consequences.

Neostigmine

The drug neostigmine is an acetylcholine receptor blocker. The use of neostigmine to reverse neuromuscular inhibition has been observed to take longer in obese patients. This medication can be given in doses ranging from 0.04 to 0.08 mg/kg, but no more than 5 mg should be given.

Sugammadex

Sugammadex is a very potent agent used for the reversal of neuromuscular blockage. It is derived from cyclodextrin, has varying degrees of affinity for the different neuromuscular blockers and provides quick and complete recovery from neuromuscular blockage. For the sufficient and total reversal of intermediate or deep blocks, it is recommended that the administered dose of sugammadex be calculated based on TBW or IBW plus 40%.

Postoperative care

Obese people, as contrasted to non-obese patients, have a higher risk of respiratory problems such as acute respiratory failure and pneumonia after surgery. Following extubation, obese people are more likely to experience lung collapse. Patients who are not obese may develop atelectasis following surgery; however, this condition will improve quickly. On the other hand, atelectasis takes longer to resolve in obese people and might lead to respiratory problems after surgery.

Once the postoperative care team is aware of the potential complications, they can take steps to mitigate them. Obese patients should be closely monitored in the post-anaesthesia care unit (PACU) after surgery, and the following steps should be taken: the patient should be nursed with the head in an upright position, and standard oxygen therapy as well as CPAP or non-invasive positive pressure ventilation (NIPPV) should be considered after extubations. Patients who require opioids may benefit from high-flow oxygen administered through a nasal cannula, as well as CPAP.

These considerations are critical because they help to (1) prevent airway obstruction, (2) ensure proper ventilation, (3) prevent lung collapse, (4) support better gaseous exchange within the lung, (5) restore and preserve normal respiratory functions, (6) improve the patient's breathing, and (7) reduce the risk of postsurgical respiratory failure. The patient should be administered oxygen therapy after surgery until preoperative arterial oxygen saturation levels are met and the patient is fully mobile. The likelihood of the obese patient requiring artificial breathing following surgery is higher. Peak inspiratory pressure should be kept below 35 cm/H2O for mechanical ventilation, and 5–7 ml/kg of tidal volume calculated based on optimum body weight should be given.

Continuous infusions are not suggested for pain management in obese individuals who require opioids after surgery. Instead, opioid analgesics like fentanyl or morphine can be administered to control pain depending on the surgery. It's also worth noting that myopathies like rhabdomyolysis might develop in the obese after surgery, necessitating vigilant monitoring for the development of deep tissue aches.

If signs of rhabdomyolysis appear after surgery, action should be taken right away to treat this illness and prevent acute renal impairment (AKI). Furthermore, evidence suggests that obese people are more likely to experience postoperative cognitive dysfunction (POCD). Despite the fact that there is only a weak link between obesity and this postsurgical complication, it is critical to be aware of this potential development. Obese patients should be followed for at least 1 hour before being discharged to the surgical ward to ensure that normal breathing parameters are restored and maintained.

CONCLUSION

To summarise, obesity raises the risk of surgical and postsurgical complications; nevertheless, the occurrence of these issues can be significantly minimised with effective collaboration among medical specialties. Certain examinations of the cardiovascular and respiratory systems must be performed prior to surgery. In addition to good airway maintenance and fuid management, optimal placement of the obese patient is critical during surgery. The choice of anaesthetic agent, as well as the route of administration, is critical, as these drugs can cause a variety of difficulties both intraoperatively and postoperatively, depending on their qualities. More research on the usage of these anaesthetics in emergency situations is required. Following surgery, the required actions should be followed to ensure the patient's safety is entirely recovered with few side effects.

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