Anaesthesia in patients with severe obesity: An uncharted journey

Nitin Kapoor[1], Mouleeswaran Sundaram[2], Sanjay Kalra[3]

Abstract

Administration of anaesthesia to patients with severe obesity comes with its own challenges. This has become even more relevant in current day times as the number of people with severe obesity is increasing rapidly. There is a need for all treating doctors, including the referring physician, the anaesthetist, the operating surgeon, and the post-operative intensivist, to understand and counsel about these risks to patients with obesity in the perioperative period. In this paper, the authors highlight the risks associated with anaesthesia in a patient with severe obesity. In addition, the risk assessment and the impact of obesity on the usage of different anaesthetic agents are also highlighted.

Keywords: Anesthesia & Obesity; Obesity Surgery Mortality Risk Score (OSMRS); Bariatric surgery; Obesity-related perioperative mortality.

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Introduction

With the rising prevalence of obesity, the number of individuals with severe obesity who undergo surgery has significantly increased in the past decade.[1] Many a time, these individuals have multiple comorbidities that need evaluation and optimization prior to surgery, despite which significant challenges persist at the time of anaesthesia induction, during the procedure and in the post-operative recovery period.[2] In this article, the authors have highlighted some of the challenges that the management team, including the operating surgeon, anaesthetist, and the treating physician, should be aware of during the management of a patient with severe obesity. Moreover, it is imperative that counselling of these patients is done in a comprehensive manner covering all aspects of the associated risks prior to administrating the informed consent for a particular procedure.

[1]Department of Endocrinology, Diabetes and Metabolism, Christian Medical College, Vellore, India; Non communicable disease unit, Baker Heart and Diabetes Institute, Melbourne, Victoria, Australia; [2]Department of Neuroanesthesia, Christian Medical College, Vellore, India; [3]Department of Endocrinology, Bharti Hospital, Karnal, India; University Center for Research & Development, Chandigarh University, India

Correspondence: Sanjay Kalra. e-mail: brideknl@gmail.com

ORCID ID: 0000-0003-1308-121X

Problem statement

In a study by Palmer et al, who analyzed data of 14,000 patients from the 2013 United Kingdom anaesthesia Activity Survey found that when Body Mass index (BMI) exceeded 35kg/m^2 the safety-based practices changed markedly.[3] Moreover, for patients receiving GA there was an increase in immediate (operative) mortality per BMI increment. In another study by Mizuno et al, Obesity was also cited as one of the key factors that increases the risk of pre anaesthesia hypertension among other risk factors like advancing age and presence of dyslipidaemia.[4] The NAP7 audit found that airway, breathing, circulatory and metabolic complications increased with BMI and it is highest in patients with BMI > 50kg/m^2.[5]

Specific anesthesia-related concerns in patients with obesity

There are several challenges posed to the anaesthetist in patients with obesity. They begin from the preoperative period (assessment of preoperative health status and optimization of the deranged physiology) to the post-operative period. These challenges, in general, are due to the impact of obesity on various organ systems, which results in physiological changes and predisposes them to multisystem diseases, the increasing complexity of surgical procedures, and limited exposure of the health care personnel involved in the perioperative care to this sub-set of patients. Given the growing prevalence of obesity, this may need to evolve into a core competency/separate subspecialty of anaesthesia not only to cater to patients with bariatric surgery but also to manage other surgeries in patients with severe obesity. It is also clear that not only the quantum of fat but the distribution of fat has more severe consequences of obesity.[6] Table 1 summarizes the specific anaesthesia-related concerns in obese patients and the perioperative measures that can be used to counter them. Moreover, obesity impacts the pharmacokinetics of anaesthetic drugs, making dosing difficult.[7]

The standard weight-based dosing of anaesthetic drugs in obese patients results in under or overdosing. This is due to increased lean body weight, cardiac output, blood volume, and variable regional blood flow. Dosing of an anaesthetic drug depends on the volume of distribution (loading dose) and clearance (maintainance dose), which is different in obese patients due to the above-mentioned reasons.[8] Following patterns are generally observed in the

Table-1: Specific anesthesia-related concerns in obese patients and its countermeasures.

Obesity-related issues in organ systems	Anaesthesia concerns	Perioperative measures
Respiratory System		
Anatomically difficult upper airway	Difficult airway (Oxygenation, Intubation, Supraglottic device placement & Front of neck access)	Using regional anaesthesia whenever appropriate. Appropriate assessment & planning for airway management (Rescue devices & oxygenation aids)
Obstructive sleep apnoea	Post-operative upper airway obstruction & hypoxia (Postoperative pulmonary complications)	Preoperative Screening with STOP-BANG Questionnaire & sleep studies in high-risk patients (STOP-BANG > 5/8) Commencement & Optimization of CPAP in the preoperative and immediate post-operative period.[9]
Reduced pulmonary compliance	Increased airway & driving pressures	Lung protective ventilation.[10] Avoiding extremes of positioning
Basal atelectasis Ventilation-perfusion mismatch Reduced Vital capacity & Functional residual capacity	Reduced safe apnoea time during airway management	Pulmonary rehabilitation with Chest physiotherapy & Incentive spirometry Adequate positioning (RAMP position)[11] Preoxygenation Apnoeic oxygenation[12]
Cardiovascular System		
Hypertension	Haemodynamic fluctuations & Hypertensive crisis	Adequate preoperative and intraoperative control
Left & Right ventricular hypertrophy LV&RV failure Cardiomyopathy Conduction abnormalities Coronary artery disease	Reduced exercise tolerance Increased risk of major adverse cardiac events (MACE) like Myocardial Infarction, heart failure & arrhythmias	Preoperative testing (ECG, Echocardiography, Biomarkers, Exercise testing including Stress Echocardiography, Six-minute walk test, and CPET)[13] Optimization of anti-failure and anti-arrhythmic drugs Invasive Blood pressure and advanced hemodynamic monitoring.[13]
Gastrointestinal System		
GERD Delayed gastric emptying Non-alcoholic fatty liver disease	Perioperative pulmonary aspiration Alteration in the metabolism & elimination of anesthetic drugs Delayed recovery Dyselectrolytaemias	Anti-aspiration prophylaxis Preoperative optimization of liver function Choosing anaesthetic drugs with organ-independent elimination Depth of anaesthesia monitoring for titrating anaesthesia.[14] Perioperative monitoring and correction
Endocrine issues		
Diabetes Metabolic syndrome	Perioperative hyperglycaemia, including ketoacidosis Increased risk of MACE Poor wound healing (Surgical site infections) Sepsis	Monitoring of glycaemic profile & optimization throughout the perioperative period
Musculoskeletal System		
Muscle wasting	Post-operative pulmonary complications Difficult venous access	Prehabilitation Dietary modification
Subcutaneous fat deposition	Difficult neuraxial & peripheral nerve blocks	Ultrasound guidance
	Skin fragility leads to breaks, peels, and pressure sores	Proper positioning with aids Frequent assessment of skin fragility
Alteration of lean body mass	Anaesthetic drug dosing adjustments	Appropriate weight-based dosing of anaesthetic drugs
Degeneration of bones & joints	Positioning related injuries.[15,16]	Careful positioning with appropriate aids, training the health care team with aids, operating theatre workflow in obese patients
Fluid & Electrolyte imbalance	Anesthetic drug dosing adjustments Acute kidney injury Risk of MACE Dyselectrolytaemia	Appropriate weight-based dosing of anaesthetic drugs Perioperative urine output & electrolyte monitoring Judicious fluid administration using goal-directed fluid therapy.[17]
Haematological issues		
Polycythemia Hypercoagulability Deep venous thrombosis & pulmonary embolism	Increased risk of MACE	Perioperative screening for DVT Adequate hydration Mechanical & Pharmacological Prophylaxis for DVT Early ambulation

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Table-1: *Continued from previous column.*

pharmacokinetics of anaesthetic drugs in obese patients

- The volume of distribution of lipophilic drugs is increased
- Drug elimination is generally increased due to increased blood supply to the liver and kidneys and cytochrome enzyme activation
- With respect to drug infusions of lipophilic drugs, the elimination half-life is prolonged despite the augmented clearance because of greater volume of distribution

Keeping these principles in mind, the drug dosing should be carefully calculated, and it is best if it is titrated to the effect. Also, instead of using actual body weight (TBW) for all calculations, other scalars like lean body weight (LBW), adjusted body weight (ABW), and ideal body weight (IBW) are used. Table 2 shows the dosing principles of commonly used anaesthetic drugs in morbidly obese patients.

Assessment of Obesity-related Anaesthesia Risk

Currently, the most commonly used tool to stratify the risk

Table-2: Dosing principles of commonly used anaesthetic drugs in morbid obesity.

Drug	Scalar for dosing	Remarks
Sedatives/Hypnotics		
Propofol	ABW (Bolus & Maintenance)	Best titrated to effect
Thiopentone	ABW	Best titrated to effect
Ketamine	ABW	Best titrated to effect
Etomidate	ABW	Best titrated to effect
Midazolam	TBW(Bolus), ABW(Maintenance)	Increased volume of distribution
Clonidine, Dexmedetomidine	TBW	Best titrated to effect
Opioids		
Morphine	IBW	
Fentanyl & Congeners	TBW	Best titrated to effect
Neuromuscular blockers		
Suxamethonium	TBW	Increased levels of plasma cholinesterase
Non-depolarizing agents	IBW	IBW is best to predict recovery not intubation
Reversal agents		
Neostigmine	ABW	
Sugammadex	ABW	

Table-3: Obesity Surgery Mortality Risk Score (OSMRS).

One point is attributed to the presence of each of the following risk factors:
1. BMI >50 kg m^2
2. Male gender
3. Presence of arterial hypertension
4. Age >45 yr
5. Presence of risk factors for pulmonary emboli (Previous DVT or PE, Pulmonary hypertension, Hypoventilation (sleep apnoea or obesity hypoventilation syndrome), Immobility)

associated with anaesthesia in patients with obesity is the Obesity Surgery Mortality Risk Score (OSMRS). This tool (Table 3) was developed in the year 2007 for the assessment of risk in patients undergoing bariatric surgery but may equally be applicable to other patients with severe obesity as well. It comprises a simple five-point scale to determine the likelihood of mortality after elective bariatric surgery.[18] Patients scoring 0–1 points had a predicted 90-day postoperative mortality of 0.2%, while those who scored 4–5 had a 12-fold increase in mortality at 2.4%.

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