The bariatric surgery patient for non-bariatric surgery

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Introduction

Obesity is a complex, multi-system disorder that results from a positive energy imbalance. The World Health Organization (WHO) classifies obesity based on body mass index (BMI), measured as weight (kg) divided by height squared (m²)[1] (Table I).

The overall prevalence of overweight and obesity is high in South Africa, with more than 29% of men and 56% of women being obese.[2] BMI was found to be higher in people living in urban areas and in those with increasing age. An analysis of medical claims data for South Africans during 2010 associated obesity with significantly increased healthcare expenditure.[3]

Objectives of this presentation

In view of the increasing prevalence of this disorder, anaesthesiologists need to be skilled in the perioperative management of this patient population.

This manuscript will highlight the:

- Preoperative assessment of adult obese patients, in particular those requiring further cardiac and respiratory testing.
- Safe perioperative care that encourages better patient outcomes, early mobilisation and shortened length of hospital stay.
- The obese patient for ambulatory surgery.

Table I: Body mass index classification according to the World Health Organization

Weight class	BMI (kg/m²)
Overweight	25-29.9
Obese	> 30
Obesity grade 1	30-34.9
Obesity grade 2 (morbidly obese)	35-39.9
Obesity grade 3 (severe obesity)	> 40
Obesity grade 4 (super obese)	> 50
Obesity grade 5 (super-super obese)	> 60

BMI: body mass index

Preoperative assessment

A preoperative assessment is important in identifying and treating co-morbidities, and allows for the advanced planning of intraoperative and postoperative care. Ideally, it should be performed 6-12 weeks prior to surgery, and must involve a multidisciplinary team approach.

Table II details co-morbidities that are frequently found in obese patients.

The distribution of adipose tissue, rather than absolute weight or BMI, appears to be more clinically relevant in predicting disease. Centrally distributed adipose tissue (android obesity) is associated with a higher morbidity than peripherally distributed adipose tissue (gynaecoid obesity).
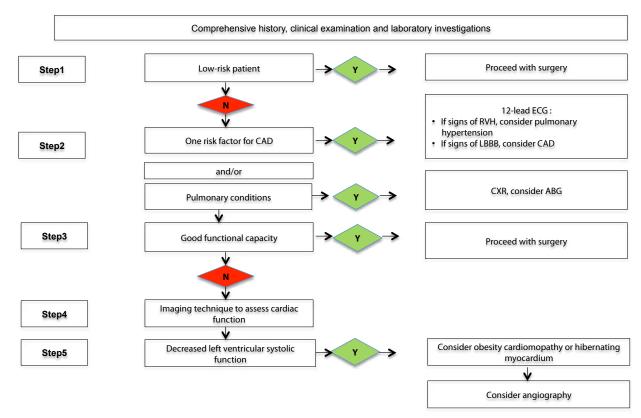
Cardiovascular system

The risk of adverse perioperative cardiac events in obese patients relates to the underlying cardiac disease, the presence of co-morbidities and the type of surgery.[4]

Obesity is associated with increased atherosclerotic cardiac risk, probably contributing to coronary artery disease. Heart failure is also multifactorial and is most evident in severely obese patients.

Table II: Co-morbidities frequently found in obese patients

Cardiovascular system	Systemic hypertension, atherosclerosis, coronary artery disease, heart failure, pulmonary hypertension, arrhythmias, deep vein thrombosis and varicose veins
Respiratory system	Airway changes, obesity hypoventilation syndrome, obstructive sleep apnoea and restrictive lung disease
Gastrointestinal system	Hepatosteatosis, gallstones and hiatus hernia
Metabolic	Metabolic syndrome and diabetes mellitus
Musculoskeletal system	Osteoarthritis of the weight-bearing joints and compression fractures
Neurological system	Cerebrovascular disease, neuropathies (e.g. carpal tunnel syndrome) and psychological problems
Other	Malignancy (e.g. endometrial, breast, colon, oesophageal and renal), skin infections and lymphoedema

ABG: arterial blood gas, CAD: coronary artery disease, CXR: chest X-ray, ECG: electrocardiogram, LBBB: left bundle branch block, N: no, RVH: right ventricular hypertrophy, Y: yes

Figure I: Cardiac and pulmonary algorithm assessment for elective non-cardiac surgery in severely obese patients[4]

Patients with obesity cardiomyopathy (heart failure due to obesity) have diastolic heart failure, but systolic dysfunction may be present. Pulmonary hypertension may lead to *cor pulmonale.*

Cardiac function may be difficult to elicit from the clinical history as patient mobility is often limited. A clinical examination can be unreliable as heart sounds are muffled, jugular venous pressure may be obscured and peripheral oedema occurs commonly. Functional capacity should be assessed according to the patient's ability to undertake daily living activities. Those who are able to perform activities requiring four metabolic equivalents have moderate functional capacity.[1]

The Revised Cardiac Risk Index is used to assess cardiac risk in patients undergoing non-cardiac surgery. The six risk factors identified are high-risk surgery, coronary artery disease (CAD), congestive cardiac failure, cerebrovascular disease, insulin-dependent diabetes mellitus and renal dysfunction. This risk stratification should be applied to obese patients preoperatively.

Figure 1 depicts the cardiac and pulmonary algorithm assessment necessary for elective non-cardiac surgery in severely obese patients.[4]

The presence of cardiovascular symptoms, functional capacity and cardiac risk analysis will determine whether or not formal testing, beyond a chest X-ray and electrocardiography is required.[4]

Role of further testing

Cardiopulmonary exercise testing is useful in patients who can exercise. Morbid obesity may be associated with a reduced $V0_2$ max (maximal aerobic capacity), exercise-induced hypertension and a slower heart rate recovery (decreased vagal tone).[5] Tests used in patients with restricted exercise capacity have limitations. Transthoracic dobutamine echocardiography has a high negative predictive value, but obtaining an adequate window may be difficult in obese patients. Transoesophageal stress echocardiography accurately assesses the heart, but requires patient sedation. Cardiac catheterisation to diagnose CAD may be limited by weight restrictions and image quality, and should be performed in patients in whom the results will alter management.

Respiratory system

Airway

An enlarged tongue and excessive adipose tissue deposition within the pharyngeal structures, face, neck and thorax may result in difficulty in mask ventilation, airway lumen narrowing and difficult surgical airway access.[6] However, there is poor correlation between difficult intubation and BMI alone. The most significant predictors of difficult laryngoscopy and tracheal intubation include a reduced mouth opening, limited neck extension and temperomandibular joint movement, a large neck circumference (> 40cm), a Mallampati score > 3 and a thyromental distance < 6 cm.

Respiratory system

Obese patients have an increased basal O_2 consumption, CO_2 production and minute ventilation. Their lung volumes are reduced, most notably functional residual capacity (FRC), which approaches residual volume. If the FRC falls below closing

capacity, it may lead to atelectasis, a ventilation/perfusion mismatch and impaired oxygenation. There is also reduced chest wall compliance and increased airway resistance.

Respiratory function should be established from the history and examination. A chest X-ray, arterial blood gas analysis and pulmonary function tests (PFT) should be selectively performed where clinically indicated. PFT is typically associated with a restrictive pattern, but may also demonstrate an obstructive pattern. Any reversible obstructive deficit should be optimised preoperatively, and smoking cessation for > 8 weeks encouraged.

Obstructive sleep apnoea (OSA) is the complete cessation of airflow for > 10 seconds, and is strongly associated with obesity. The STOP-Bang [snoring, tiredness during daytime, observed apnoea, high blood pressure, body mass index, age, neck circumference (> 40 cm for females and 43 cm for males) and gender (males)] score is validated in obese patients when identifying OSA.[7] A score of > 3 has been shown to have a high sensitivity for detecting OSA and a score of 5-8 identifies a high probability of moderate to severe OSA.[7] Patients should then be referred for polysomnography, and if positive for OSA, optimised with continuous positive airway pressure (CPAP), weight loss and the use of mandibular advancement appliances for 6-12 weeks prior to surgery.[8]

Obesity hypoventilation syndrome (OHS) is defined as a combination of obesity (BMI > 30 kg/m²), daytime hypercapnia ($PaCO_2$ < 45 mmHg) and sleep-disordered breathing.[9] A serum bicarbonate of > 27 mmol/l is associated with OHS. Treatment of OHS with noninvasive ventilation preoperatively may decrease patient morbidity.

Other baseline investigations

Baseline blood tests in obese patients include a full blood count, electrolyte profile, and renal, liver and thyroid function tests.

Perioperative management of the bariatric patient

Premedication

In view of the high incidence of OSA, sedative premedication should be avoided. If administered, continuous patient monitoring must then be ensured. If there is a history of reflux or co-morbidities such as diabetes, it may be prudent to prescribe antacid prophylaxis. The risk of venous thromboembolism in obese patients warrants the use of appropriately sized compression stockings, low-molecular-weight heparin and pneumatic compression devices throughout the perioperative period.

Intraoperative management

Infrastructure and equipment

Bariatric patients should be managed at a facility that is appropriately equipped and staffed, and ideally, local guidelines should be in place. Obesity-specific equipment includes ward equipment, trolleys for transport and in theatre, an operating table with side extensions, hoists, prone turners, sheet sliders and padding equipment. The maximum table weight must be known and adhered to. If a bariatric table is unavailable, two operating tables could be placed together.

Routine monitoring may be difficult. Even when appropriately sized blood pressure (BP) cuffs are used, the readings may be inaccurate due to a poor upper arm fit. Alternative sites for BP cuff placement (the wrist or ankle) should be considered. An ultrasound should be available to facilitate possible difficult intravenous (peripheral or central) access and regional anaesthesia.

Induction and airway management

The safest transfer is one where the unpremedicated patient positions him- or herself on the operating table. The primary modifiable factors to optimise induction and the airway are patient position, preoxygenation and apnoeic oxygenation.[10] The head-elevated laryngoscopy position or ramp-up position is encouraged. This position, which uses 25° back or head elevation, ensures that the sternal notch and external auditory meatus lie in the same horizontal plane. This, in conjunction with the reverse Trendelenburg position (to allow for downward displacement of the abdomen and breasts), facilitates airway management and ventilation. Preoxygenation for at least five minutes using a close-fitting mask, with a fraction of inspired oxygen concentration of 0.8-1, and CPAP up to 10 cmH₂O increases apnoea time.[6] Rapid sequence induction is not routine practice in the absence of co-morbidities, as obesity itself has not been associated with an increased risk of pulmonary aspiration.

Awake intubation, using fibre-optic bronchoscopy or video laryngoscopy is recommended in patients with an anticipated difficult airway. Judicial use of sedation and nebulised local anaesthetics (4% lignocaine) has been successful. Nerve blocks may be challenging, but ultrasound may assist.

Supraglottic devices are advocated for use in the moderately obese patient undergoing peripheral surgery, and are well established in the failed airway algorithm. However, owing to high peak inspiratory pressure during ventilation, laryngeal mask airway (LMA) leak pressure should guide the decision on which of these to use:[10] LMA Classic® < i-gel™ < LMA Supreme® < LMA Proseal®.

Ventilation

The evidence base concerning the most efficacious ventilation strategy in this patient population is weak. However, there is evidence that an improvement in oxygenation and respiratory system compliance occurs when multiple recruitment manoeuvres with ventilation are combined with positive-end expiratory pressure.[11] Furthermore, lung-protective ventilation strategies should be employed, with tidal volumes based on ideal body weight (IBW), rather than total body weight (TBW).

Positioning

The supine position is not well tolerated by obese patients, and has been associated with cardiorespiratory decompensation (obesity supine death syndrome). A left tilt of the bed or the placement of a wedge will prevent compression of the

inferior vena cava.[12] The Trendelenburg position reduces lung compliance and results in patient autotransfusion, which places further strain on the heart. The prone and lateral decubitus positions are well tolerated, provided the upper chest and pelvis are well supported, and there is appropriate padding of the soft tissue and pressure points. Prolonged surgery in the lithotomy position places patients at risk of venous stasis, compartment syndrome of the legs and transient neurological symptoms.

Anaesthetic pharmacology and obesity

Owing to the changes in the pharmacokinetic and pharmaco-dynamic properties of drugs, dosing scalars other than TBW must be considered.[13]

Lean body weight (LBW) is the most appropriate dosing scalar for the majority of anaesthetic agents.[14] LBW is correlated to cardiac output and drug clearance, and is approximately 20-30% of IBW. IBW (kg) is approximately calculated using the Broca formula: height (cm) – 100 (males) and height (cm) – 105 (females).[15] James and Janmahasatian devised the LBW equations.[16,17]

Table III details the recommended dosing scalars for morbidly obese patients.[13]

Desflurane and sevoflurane are associated with faster recovery times in bariatric patients, compared to other volatile agents. This is because of the lower blood-gas and oil-gas partition coefficients. Any clinical advantage of desflurane over sevoflurane has not been found in studies.

The use of dexmedetomidine has not been investigated in this patient population. However, in view of the co-morbidities, a lower induction dose may be prudent. Sugammadex has been shown to be significantly faster in reversing rocuronium-induced neuromuscular blockade than neostigmine.[18] At a train of four ratio of 2:4, a dose of 2 mg/kg of IBW + 40% is recommended.[19]

Postoperative nausea and vomiting prophylaxis should be given.

There is no consensus in obese patients, but a recent study suggests that the use of adjusted body weight with the Schnider and Marsh models is more clinically accurate, compared to other propofol target-controlled infusion (TCI) models.[20] However, the use of propofol TCI in obese patients should be guided by bispectral index monitoring and haemodynamic effect.

Postoperative management

Patients should be extubated in the semi-upright position when fully awake, following complete reversal of neuromuscular blockade. Immediate CPAP post extubation maintains lung function in patients with OSA. The principles of postoperative pain management are the use of opioid-sparing multimodal analgesic strategies which include local anaesthetics, paracetamol, nonsteroidal anti-inflammatory drugs, transcutaneous electrical nerve stimulation and other modalities.[21] Patient-controlled analgesia with intravenous morphine (dosed to IBW) is safe and effective, provided that background infusions are avoided. Pregabalin is playing an increasing role as a component of multimodal analgesia.

Table III: Recommended dosing scalars for morbidly obese patients[13]

	Dosing scalar	Comments
Induction agents		
Thiopental	LBW	Use TBW for continuous infusion or maintenance dosing
Propofol	LBW	
Etomidate	LBW	Use in septic patients is controversial
Opioids		
Fentanyl	LBW	Titrate to effect
Alfentanil	LBW	
Sufentanil	LBW	
Remifentanil	LBW	TBW dosing may result in significant hypotension and/or bradycardia
Muscle relaxants		
Succinylcholine	TBW	The incidence of myopathy is low in morbidly obese patients
Rocuronium	LBW/IBW	IBW dosing results in a shorter duration of action
Vecuronium	LBW/IBW	
Cisatracurium	LBW/IBW	
Atracurium	LBW/IBW	Fast administration may result in histamine release
Pancuronium	BSA	Do not use. The duration of action is too long.
Heparins	There is uncertainty as to whether or not LBW is the appropriate dosing scalar	Still controversial. Dose reponse in the obese has not been established.

IBW: ideal body weight, LBW: lean body weight, TBW: total body weight, BSA: body surface area

Regional anaesthesia

Technical challenges and local anaesthetic drug dosing are important considerations. The identification of appropriate landmarks, positioning of the patient prior to performing the block and use of the correct length equipment provide challenges. The sitting position facilitates landmark location for neuraxial techniques. Palpating on a line between the cervical vertebrae and gluteal cleft should identify the midline. Ultrasonography assists in the identification of the midline by visualisation of the spinous process and estimated depth from the skin to the epidural space. When changing from the sitting to the lateral position, epidural catheters pull back from the epidural space, and therefore should be advanced at least 4 cm into the epidural space.[22] Ultrasonography also assists in the performance of peripheral nerve blocks.

Neuraxial techniques for the obese parturient include epidural or combined spinal epidural for labour analgesia. These should be initiated early in labour, and can be used for anaesthesia if the patient requires a Caesarian section.[23]

The dose of local anaesthetics in neuraxial techniques is reduced owing to the reduced epidural space and cerebrospinal fluid volume. This is exaggerated in the obese parturient. There is no consensus over the appropriate dose to be used.

Bariatric patient for ambulatory surgery

Factors that contribute to appropriate patient selection for ambulatory surgery include patient-related, surgery-related, anaesthesia-related and venue-related factors.[24] Therefore, BMI alone should not be the sole determinant of suitability for ambulatory surgery.

Patient factors

Patients with a BMI > 50 kg/m^2 may have a higher risk of perioperative complications. However, ambulatory surgery appears to be safe in patients with a BMI < 40 kg/m^2 with controlled co-morbidities. Patients with severe cardiorespiratory pathology are unsuitable. Patients with OSA and optimised co-morbidities may be considered if pain relief postoperatively can be provided with simple analgesics and minimal opioid use, and the patients are compliant with CPAP post discharge.[24]

Surgical factors

Surgical factors include invasiveness of surgery, surgical experience and duration. Antibiotic and venous thrombo-embolism prophylaxis must be prescribed. There is a paucity of evidence for ambulatory surgery in obese patients. Hence, an individualised patient approach should be utilised.

Conclusion

The "obesity paradox" is a recent phenomenon that has been highlighted. It implies that although obesity is associated with the development of many disease processes, after a person has acquired a disease state, a higher BMI may protect against downstream adverse outcomes in acute and chronic disease states.[25] This obesity survival advantage is known as the obesity paradox. The presence of this and its relevance on morbidity and mortality in obese patients is currently the subject of much debate in the medical field.

However, the number of morbidly obese patients presenting for non-bariatric surgery is increasing, and this population is at an increased risk of perioperative complications. Preoperative assessment and optimisation of associated pathological conditions, in conjunction with perioperative management by a multidisciplinary team, are essential to optimise patient outcome and reduce healthcare costs.

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