Anaesthesia for bariatric surgery

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Introduction

This discussion will focus on the perioperative anaesthetic considerations for patients undergoing bariatric surgery. The preoperative workup of these patients will be covered separately. However, one needs to emphasise that preoperative evaluation plays a huge role in risk stratification and will therefore be referred to again where it impacts on anaesthetic management.

As a disease of epidemic proportion, obesity is increasingly becoming a target for management by patients and their physicians. Its incidence is increasing. As a concept, ideal body weight (IBW) was conceived in life insurance studies after looking at the occurrence of obesity-related complications and morbidity, and determining maximum life expectancy.[1] The ideal body weight is therefore the body weight at which the patient is at least risk for weight-associated morbidity. Normal body weight ranges between 10% above and below IBW. Body mass index (BMI) (Quatelet's index) is a commonly used ratio of body weight in kilogram to squared height in metre. Patients with a BMI of more than 30 are considered obese, more than 35 with multiple medical co-morbidities, morbidly obese, and more than 50 as super obese. Obesity-related diseases that patients are at risk for in these categories, particularly in the central android distribution, include hypertension, dyslipidaemia, ischaemic heart disease, glucose intolerance and diabetes mellitus. Other than these, the list of medical conditions associated with obesity is long. It includes respiratory (restrictive lung disease and obstructive sleep apnoea), cardiovascular (cardiomegaly, congestive heart failure, peripheral vascular disease, thromboembolism and pulmonary hypertension), endocrine (Cushing's syndrome, hypothyroidism and vitamin deficiencies), gastro-intestinal (hiatal, inguinal and ventral hernia, fatty liver/nonalcoholic steatohepatitis [NASA] and gallstones), musculoskeletal (osteoarthritis and low back pain), and malignant (breast, prostrate, cervical, uterine and colorectal) conditions. It is also associated with socio-economic and psychosocial impairment.

It is important that the management of obesity, whether conservative/medical or surgical, should be carried out with a multimodal team approach, which includes psychological, medical, dietary and surgical interventions. The only two drugs that can be recommended for long-term weight management are orlistat, which reduces the absorption of dietary fat in the upper gastrointestinal tract (GIT), and sibutramine, a centrally-acting sympathomimetic which causes early satiety. There is a lack of data on the interaction of these drugs with anaesthetic agents. Although surgical intervention, at least in the short-to-medium term, seems to show acceptable results, few studies have shown conclusive benefit, particularly of the restrictive type of procedure over intensive medical management in the long term, primarily because control groups in the medical management category were not managed in a consistently intensive multimodal manner. However, weight reduction surgery is seen as the best treatment alternative in extreme obesity where diet and exercise failed to reduce weight, and most of the medical problems associated with extreme obesity are reversed with sustained surgical weight loss. Surgery also reduces the use of medication, outpatient visits and hospitalisations over time and seems to be less costly than the non-surgical treatment currently available.[2]

Surgical treatment of obesity

In the UK, surgery may be considered if a) patients have a BMI of > 40 kg/m^2, or > 35 kg/m^2 with co-morbidities that can be reversed after surgery; b) all non-surgical measures have failed to attain or maintain weight loss for at least six months; c) patients are receiving or will receive intensive specialist management; d) patients are generally fit for anaesthesia and surgery; and e) patients are committed to the need for long-term follow up.[3] It has been shown that initial weight loss is of 5-10%.[4]

No single surgical procedure or technique exists that can be applied to all patients presenting for bariatric surgery, and the individual's BMI, age, co-morbidities and dietary behaviour should be assessed. The advantages and disadvantages should be considered in consultation with the patient.[2] The advent of laparoscopic techniques may reduce perioperative morbidity and enhance postoperative recovery.

Restrictive surgery

These procedures reduce the gastric storage capacity with resultant earlier satiety and reduced caloric intake. The most common procedures are the vertical banded gastroplasty (VBG) and the laparoscopically-adjusted gastric band. Restrictive surgery is easier to perform and has fewer complications, but may not always be successful in the long term. The sleeve gastrectomy has recently been introduced, but is generally accepted to reduce hormonal secretion as well by reducing stomach mass.

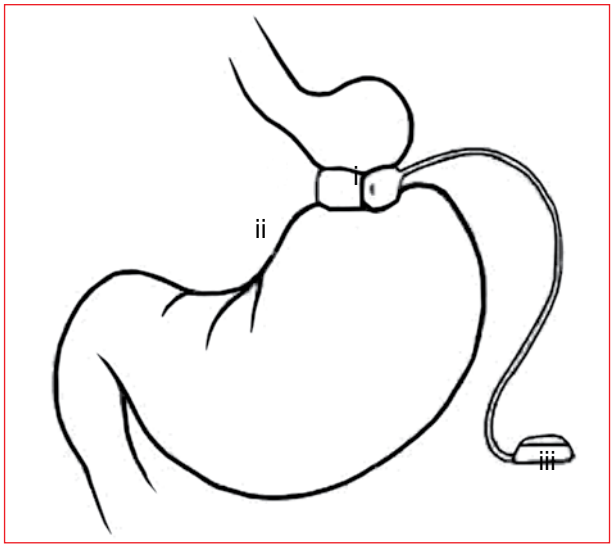

Figure 1: Adjustable gastric band: (i) proximal pouch, (ii) adjustable band, and (iii) needle access port which adjusts the band by injection or removal of saline.

From Sabharwal A, Christelis N. Anaesthesia for bariatric surgery[3]

Malabsorptive surgery

Procedures such as the biliopancreatic diversion and biliopancreatic diversion with duodenal switch reduce the length of the small intestine with resultant decreased absorption of nutrients. The postoperative quality of life can be influenced by protein malnutrition, vitamin and mineral deficiencies and diarrhoea.

Combination restrictive/malabsorptive surgery

The popular 'gold standard' Roux-en-Y gastric bypass (RYGB) technique involves creating a restrictive gastric pouch with jejunal anastomosis for continuity, and is performed laparoscopically. The length of the Roux-en-Y determines the degree of malabsorption. Weight loss usually peaks at 18-24 months post surgery. Obesity-related complications that can be reversed after RYGB include diabetes, hypertension, high cholesterol, venous stasis, gastro-oesophageal reflex disease (GORD), arthritis, liver disease, sleep apnoea and others.

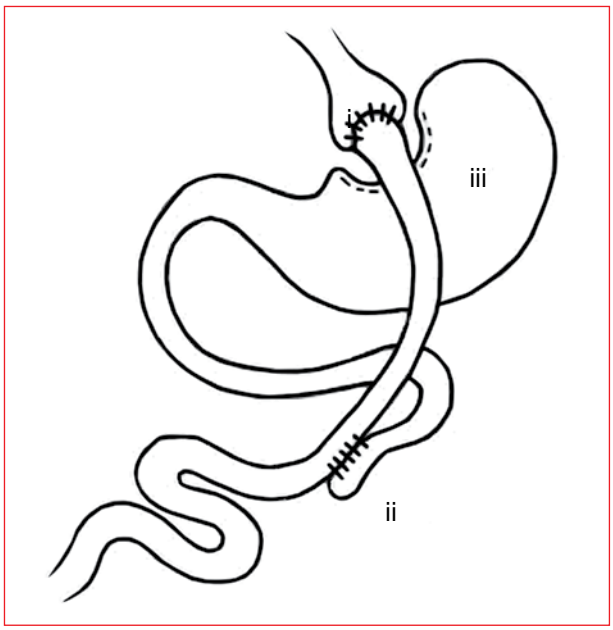

Figure 2: Roux-en-Y gastric bypass: (i) 20-30 ml gastric pouch to the jejunum, (ii) jejunojejunostomy, and (iii) stomach remnant.

From Sabharwal A, Christelis N. Anaesthesia for bariatric surgery:[3]

There exists an inverse relationship between patient volume and mortality and morbidity, and weight reduction surgery should therefore only be performed in experienced centres where the approach can be standardised in a multi-disciplinary fashion. Anaesthesiologists should be more involved in this standardisation.

Contraindications to surgery include a) inflammatory disease of the GIT, such as ulcers or Crohn's disease; b) upper gastrointestinal bleeding; c) portal hypertension; d) liver cirrhosis; e) chronic pancreatitis; and f) as a relative contraindication, laparoscopic surgery in a patient > 180 kg because of technical diifículties.[3]

Anaesthetic considerations

Risk stratification

Risk stratification is a preoperative task of the anaesthesiologist, as part of a multidisciplinary workup of all patients presenting for bariatric surgery, and will be dealt with in more detail in a separate talk.

A clinically useful tool is the obesity surgery mortality risk score to predict mortality in patients undergoing RYGB.[2] Five independent variables correlate with mortality: BMI > 50 kg/m^2, male gender, hypertension, pulmonary embolus risk and age > 45.

Difficult intubation

It is now generally accepted that morbid obesity per se does not predict difficult intubation, and that, according to work done by Brodsky et al, neck circumference > 40 cm (probability about 5%) and a Mallampati score of III and more combined with obesity are more accurate predictors of difficulty. A neck circumference > 60 cm relates to a probable difficult intubation in 35% of cases. Having said this, the ease of intubation definitely depends on proper positioning of the patient, with support ('stacking') under the chest, neck and head in such a way that the external meatus of the ear is in a horizontal line with the sternum. There is no clear evidence on the need for awake fibre-optic intubation or on the probability of difficult bag-mask ventilation in these patients. Videolaryngoscopy is often used routinely to assist with intubation in morbidly obese patients.[5]

Gastric aspiration

Some authors feel that medical prophylaxis (prokinetics, H_2-blockers or proton pump inhibitors) for gastric aspiration is imperative even in patients with no symptoms of GORD, while others find that patients without symptoms of GORD have normal lower oesophageal sphincter tone and faster gastric emptying time.[6] Diabetics are at risk for gastroparesis. Patients at risk for aspiration need a rapid sequence intubation technique after adequate pre-oxygenation.

Obstructive sleep apnoea

Approximately 5% of morbidly obese patients will have obstructive sleep apnoea (OSA). The possibility should be assessed in history taking and the diagnosis confirmed with a polysomnographic study. Preoperative intervention with continuous positive airway pressure, for example, may be able to reverse associated pulmonary hypertension, decreased exercise tolerance and other complications of OSA.

Cardiovascular

Hypertension, ischaemic heart disease and cardiac dysfunction merit a detailed and thorough evaluation.

Deep vein thrombosis is the most common postoperative complication of bariatric surgery with an incidence of 2.4-4.5%. Morbid obesity is a major independent risk factor for sudden death from acute postoperative pulmonary embolism. Adequate thromboprophylactic measures are therefore imperative.

Side-effects of pharmacologic agents used for weight control must be considered (valvular disease, pulmonary hypertension, arrhythmia and coagulation disturbances due to fat-soluble vitamin deficiency).

Positioning

The ideal is possibly to have the unpremedicated patient position themselves on the theatre table before induction of anaesthesia. The theatre table should be able to take the weight of the patient, and tables designed for additional load bearing are available. The reverse Trendelenburg position with diaphragmatic unloading and a left lateral tilt for inferior vena cava decompression is reasonable. Care should be taken to protect against pressure sores and nerve injury with proper padding. The patient is also at risk for stretch injuries. A bean bag with suction line attached that moulds along the body contours when a vacuum is created in the bag is invaluable in these situations. During laparoscopic surgery, the modified Lloyd Davis position (steep reverse Trendelenburg with legs spread apart and both arms out on boards or in gutters) is commonly used. A foot rest is needed to prevent patients slipping from the table in steep reverse Trendelenburg position.

The patient should be nursed in a 45° head-up position postoperatively. This also reduces the risk of reflux and aspiration.

Monitoring

Standard monitoring includes ECG, NIBP, pulse oximetry, end-tidal capnometry/capnography and temperature. Cuff application for blood pressure can be problematic and radial arterial line placement

is common. Central venous access is useful in major cases, and for reliable venous access, but may be difficult to place. Pulmonary atrery catheters may be indicated in serious cardiopulmonary disease. Bariatric surgery demands good neuromuscular blockade for surgical access and monitoring with a nerve stimulator is important. Depth of anaesthesia monitoring is useful in titrating anaesthetic drugs in morbidly obese patients. By monitoring respiratory mechanical parameters, the anaesthesiologist aids in establishing safe and effective mechanical ventilation.

Pharmacology

Obese patients have:

- Smaller than normal fraction of total body water;
- Increased blood volume and cardiac output;
- Greater than normal adipose content;
- Increased lean body weight (LBW);
- Changed tissue protein binding due to increased free fatty acids, triglycerides, lipoproteins and cholesterol;
- Increase in renal blood flow and glomerular filtration rate;
- Suboptimal cardiopulmonary function;
- Increased esterase levels.

Highly lipophilic drugs, such as barbiturates and benzodiazepines, have increased volume of distribution and need higher loading doses, but maintenance doses should be calculated according to IBW because elimination half-lives are longer. Exceptions to this rule include digoxin and remifentanil, which are highly lipophilic, but exhibit no correlation between lipophilicity and volume of distribution in obese patients. The doses should therefore be calculated according to IBW.

Non- or weakly lipophilic drug dosing should be calculated according to LBW (in morbidly obese patients, 20-30% should be added to IBW to calculate LBW).

Inhalation agents

Sevoflurane and desflurane have both been suggested as the ideal agent for obese patients because of the rapid and consistent profile for emergence. Titration, with the help of depth of anaesthesia monitoring, enhances rapid recovery.

Induction agents

Theoretically speaking, induction doses of propofol, for example, should be based on actual weight, but morbidly obese patients are very sensitive, especially to the cardiovascular effects, and the dose should be administered according to LBW, and maintenance doses according to total body weight (TBW).

Benzodiazepines

Benzodiazepines are highly lipophilic. Bolus doses should be calculated according to TBW, but infusions to IBW, because total clearance is not substantially changed compared to lean subjects.

Muscle relaxants

Muscle relaxants are polar and hydrophilic drugs with limited distribution to fat and doses are calculated to IBW or LBW. Pseudocholinesterase activity is increased in obese patients and, accordingly, succinylcholine dosage should be adjusted upwards.

Opioids

All opioids should be carefully titrated according to patient needs to avoid respiratory depression.

Dexmedetomidine

Dexmedetomidine may be a useful sedative adjunct perioperatively in bariatric surgery[7] due to the lack of respiratory depression, but there is lack of evidence on the dosage in morbidly obese patients

Ventilation

Tidal volumes of 12-15 ml/kg IBW have been advocated in an attempt to improve functional residual capacity (FRC) in the anaesthetised obese patient, but large tidal volumes constitute injurious ventilation without significantly improving oxygenation. Rather, it is prudent to use moderate levels of positive end-expiratory pressure (PEEP) (low enough not to cause cardiovascular instability) to improve oxygenation. Pressure-targeted ventilation is a safe alternative. The respiratory rate should be adjusted to maintain normocapnoea. Alveolar recruitment manoeuvres may improve intraoperative oxygenation, but are associated with an increased use of vasopressors.[8] Repeating the recruitment manoeuvre during laparoscopic surgery may also improve oxygenation.[9]

Postoperatively, supplemental humidified oxygen should be administered at an appropriate inspiratory fraction. Postoperative incentive spirometry and/or continuous positive airway pressure (CPAP) may facilitate am earlier return to preoperative pulmonary function and decrease respiratory complications.

Analgesia

Proper postoperative pain control in bariatric surgery enhances pulmonary function and decreases the risk of chest infections. Laparoscopic procedures can be managed with local anaesthetic infiltration and patient-controlled analgesia (PCA), while open procedures warrant placement of

Table I. Weight bases dosing for bariatric patients

Agent	Dosing	
Propofol	Induction - LBW Maintenance – TBW	Systemic clearance and Vd, at steady state correlates with TBW; high affinity for excess fat; high hepatic extraction and conjugation relates to TBW
Thiopental	Induction - LBW	Increased Vd, increased blood volume, cardiac output and muscle mass means increased absolute dose; prolonged duration of action; cardiovascular depression – limits dosage
Midazolam	TBW	Increased Vd, prolonged sedation because larger initial doses are needed to achieve adequate serum concentrations
Succinylcholine	LBW	Plasma cholinesterase activity increases with TBW
Vecuronium	IBW	Recovery may be delayed if given according to TBW because of increased Vd and impaired hepatic clearance
Rocuronium	IBW	Faster onset and longer duration of action, pharmacokinetics and pharmacodynamics are not altered in obese subjects
Atracurium, cisatracurium	TBW	Absolute clearance, Vd, and elimination half-life do not change; unchanged dose per unit body weight without prolongation of recovery because of organ-independent elimination
Fentanyl	TBW	Increased Vd, and elimination half-life, which correlates with TBW
Sufentanil	TBW Maintenance – IBW	Increased Vd, and elimination half-life, which correlates with degree of obesity; distributes as extensively in excess body mass as in lean tissues; dose should account for total body mass
Remifentanil	IBW	Pharmacokinetics are similar in obese and non-obese patients

Modified from Ogunnaike BO, et al: Anesthetic considerations for bariatric surgery. Anesth Analg 2002;95:1793-805
LBW = lean body weight; IBW = ideal body weight; TBW = total body weight; V_d = volume of distribution
(From Brodsky, Jay. Anesthesia for Bariatric Surgery.[1])

epidural catheters. Opioid PCA doses should be calculated according to IBW. Large doses of opioids should be avoided and non-opioid adjuncts used. In all cases, a multimodal analgesic regime that includes paracetamol and short-term nonsteroidal anti-inflammatory drugs (NSAIDs) (if no contraindications) can be adopted. Spinal and epidural dose in morbidly obese patients should be reduced by 20-25% due to decreased compliance of the epidural space after venous congestion and fat infiltration.

Other considerations

Gastric decompression with a drainage tube needs to be managed in such a way as to optimise surgical conditions, and the tube needs to be withdrawn during anastomotic repair. The integrity of the anastomosis can be verified during RYGB, with the injection of air or methylene blue through the tube.

Antibiotic prophylaxis is important because of the increased risk of postoperative wound infection.

Postoperative admission to high-care units or intensive care depends on the level of specialisation in the hospital setting, the type of surgery and patient risk factors. In specialised centres, admission to intensive or high care is decreased as experience increases.

Conclusion

Best practice recommendations for perioperative care in weight loss surgery have been published.[10] It is reasonable to suggest that anaesthesia for bariatric surgery should be performed by anaesthesiologists

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