MANAGING THE OBESE – LESSONS FROM BARIATRIC SURGERY

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Obesity has reached epidemic proportions globally and it has become one of the biggest challenges facing healthcare today. The incidence of obesity has tripled in the developed world over the past 25 years. Well over one third of adults in developed countries are obese and the data regarding children is even more sobering.[1] New Zealand is unfortunately at the forefront of this epidemic, regularly ranking in the top 10 countries in the obesity world. The crisis now involves the developing world and the prevalence of severe and morbid obesity is increasing more rapidly than other degrees of obesity.[2]

Obesity is defined as a body mass index of more than 30 and severe (morbid) obesity as greater than 40. Body mass index is calculated as weight in kilogram / (height in metres squared): and expressed in the units kg/m^2.

Obesity impacts on nearly every organ system, resulting in a multitude of co-morbidities and issues that are important to anaesthetists in the perioperative period. These include airway management, obstructive sleep apnoea, obesity hypoventilation syndrome, postoperative respiratory failure, postoperative pneumonia, metabolic syndrome, diabetes mellitus, cardiac failure, ischaemic heart disease, hypertension, dyslipidaemia, hypercoagulability and venous thromboembolism and pharmacokinetics of anaesthetic agents.

Bariatric surgery is emerging as the only sustainable option for managing the obesity epidemic, with a favourable impact on all of the related co-morbidities.[2] There is increasing evidence that bariatric surgery provides a survival benefit over time, presumably due to the dramatic improvement in almost all co-morbidities associated with obesity. The cost effectiveness of the surgery to the health system is one of the reasons that our health department has embraced the surgery.

The incidence of obesity in the South Auckland population is alarmingly high, and our hospital has developed a bariatric surgery service to deal with the problem. We perform approximately 160 bariatric procedures annually. The service has published outcomes over the past three years.[3,4,5]

I aim to outline some of the perioperative issues related to caring for these patients, including relevant evidence from the literature.

Bariatric Surgery

In spite of all the challenges associated with anaesthetising obese patients, the fact remains that thousands of bariatric patients are undergoing surgery around the world each year, and it is relatively safe, especially from an anaesthetic perspective.[6] The fact that the surgery is so successful has resulted in a dramatic increase in the numbers of bariatric procedures worldwide.

The 30-day mortality ranges from 0.1% to 2%. Mortality rates depend on several factors – complexity of the surgery, patient co-morbidities, experience of the surgeon and the centre. Gastric banding has the lowest mortality rate (0.1%), but a high rate of long-term complications with the least favourable weight loss. Gastric sleeves have a mortality rate of 0.3-0.5%, but fewer late complications with a very favourable weight loss record, Gastric bypasses have a slightly higher mortality at 0.5%[6] but very good weight loss.

The perioperative complications are mostly surgical in nature, the most feared being an anastomotic leak (1-2.5%), and the other being a haemorrhage (1%). Pulmonary emboli occur in < 0.5% and postoperative respiratory dysfunction occurs in 0.6% of patients. Obesity is associated with atherosclerotic disease, left ventricular hypertrophy and cardiomyopathy however the incidence of perioperative coronary events and cardiac failure is very low.[6] The bariatric patients at very high risk of cardiac events are presumably screened out and advised against surgery. A recent review of 400 patients published by my hospital revealed one death, on day 19, which was of unknown cause and thought to be a cardiac arrhythmia.

Strategies used to minimise perioperative problems in bariatric surgery include –[5]

1. Thorough preoperative preparation including psychological preparation, exercise programs, nutrition with dietician involvement, and a three week anorectic supplementation preoperatively. No smoking and minimal alcohol in take
2. Laparoscopic surgery rather than open surgery
3. Intravenous glucocorticoids
4. Active warming
5. Multimodal analgesia thereby minimizing opiates
6. Head-up position post-op (30 degrees)
7. Most problems manifest in the first two hours post-op, ie in PACU. Pay close attention to patients during this time[7]
8. Postoperative O_2 is used until SpO_2 levels are back to normal
9. Early mobilisation (staff need help with large patients!)
10. Early physiotherapy
11. Early enteral fluid / feeding
12. Thromboprophylaxis with foot pumps, calf compression devices and low molecular weight heparin
13. Minimal use of drains / nasogastric tubes

A number of centres have published fast track or ERAS (enhanced recovery after surgery) programme where bariatric patients are being discharged close to 24 hours after the surgery. These programmes aim to optimise patient care during the perioperative period thereby minimising morbidity and also decreasing time in hospital. My institution has just completed a randomised controlled trial of ERAS for bariatric surgery and showed that using a comprehensive ERAS programme reduces hospital stay with no increase in morbidity. Patients randomised to the ERAS group went home on the day after their laparoscopic sleeve gastrectomy. The studies from the US and Europe concur that "expert" teams caring for these patients regularly is one of the key factors for maintaining patient safety.[7,8]

Obstructive Sleep Apnoea (OSA)

This is one of the most challenging of the perioperative issues facing anaesthetists. The obese population has a much higher than normal incidence of OSA (70-80% in bariatric patients).[9] Despite a better understanding of the pathophysiology of OSA, there are no validated management strategies for these patients. Most patients with OSA have not been formally diagnosed and while there are many theoretical benefits of preoperative sleep studies and subsequent CPAP there is no evidence that this improves perioperative outcomes, and it is not feasible to test all the patients.

There are several preoperative scoring tools to ascertain the severity of OSA and therefore guide referrals. An example is the STOP-BANG questionnaire formulated by Chung et al[10] which includes four questions with yes / no answers – Snoring, Tiredness during the daytime, Observed apnoea and high blood Pressure. Sensitivity is improved by incorporating questions regarding – BMI, Age, Neck circumference and Gender. A positive screen (more than three yes answers) indicates a high risk. This is validated for screening severe OSA, but not for ascertaining perioperative risk.

Other dilemmas include the postoperative setting and monitoring of these patients, when to send patients home, and whether perioperative risk is altered by anaesthetic technique (eg inhalational verse intravenous). The answers to these questions are not clear from the literature and we are guided by expert opinion and our own experience.[11]

Our threshold for referring the suspected OSA patients for polysomnography studies has risen with experience as we have found that the majority of patients with mild / moderate OSA get through their bariatric surgery with no complications. Weingarten et al set out to determine whether there is an association between perioperative complications and the severity of OSA in bariatric patients and they found no association.[12] Ahmad et al showed that in morbidly obese patients, in the first 24 hours after laparoscopic bariatric surgery, OSA did not increase the risk of hypoxaemia.[13]

Obesity Hypoventilation Syndrome (OHS)

It is imperative to ascertain which patients have a particularly high risk of perioperative problems, and these would certainly include the patients with OHS. This effects 0.15-0.3% of the general population but up to 8% of the bariatric surgery population.[13]

OHS is defined as a combination of obesity and chronic daytime hypoxaemia (P_{O_2} < 65mmHg) and hypoventilation(P_{CO_2} > 45mmHg) in patients without COPD or other causes for hypoventilation. These patients have worsened airway obstruction, a blunted respiratory drive, restrictive chest physiology, and they may develop pulmonary hypertension, right ventricular hypertrophy, and eventually right-sided failure. It is useful to screen patients by checking oxygen saturation, blood Hb levels (polycythaemia is a clue to chronic hypoxia) and perform blood gas analysis if these are concerning. Blood HCO_3 levels are useful for picking up chronic hypercapnia. Once the diagnosis is made, ECG, CXR, echo and sleep studies may be necessary to assess the degree of OHS. These patients should be managed with perioperative CPAP if warranted.

Patients with OHS experience higher morbidity and mortality than those who are obese with eucapnia. Surgical mortality rate in high risk OHS patients undergoing gastric bypass surgery is higher (2-8%) than the usual risk of 0.5-2% in other bariatric surgery patients.[14]

Monitoring

There is no evidence that obese patients or those with OSA require more invasive perioperative monitoring than other patients. The type of surgery and co-morbidities dictate the intensity of monitoring, and we very rarely use arterial lines for our bariatric patients undergoing laparoscopic sleeve gastrectomies.[15]

Pharmacokinetics of Obesity

With increasing obesity, fat mass accounts for an increased percentage of total body water and the lean body weight (LBW) / total body weight (TBW) ratio decreases. The majority of the cardiac output is still directed to the vessel rich or lean tissue groups. Therefore administration of a drug based on TBW in an obese patient may result in an overdose. Ideal body weight can be calculated according to BMI and height, but this has shortcomings as obese people often have a high LBW for their height, and so this may result in under dosing. LBW is the TBW minus the fat mass. This is ideal for calculating most anaesthetic drug doses, however it is difficult to accurately measure under normal clinical circumstances, and the equations proposed to calculate it are estimates based on gender and BMI and are therefore not particularly accurate.[16]

It is useful to have an understanding of the pharmacokinetic principles and then follow guidelines for the different groups of anaesthetic drugs –

- Induction doses of propofol should be based on approximate LBW rather than TBW, although in practice this is titrated to effect. Infusions of propofol should be based on TBW, as the drug is so lipophilic that it distributes rapidly from the plasma to peripheral tissues, including fat.[1,15]

- Dexmedetomidine is useful as an adjunct for anaesthesia and analgesia in morbidly obese patients. It reduces opiate requirements postoperatively.[16] The pharmacokinetic effects are yet to be described in morbid obesity, however we have found that giving a loading dose of 0.5mcg/kg over 10 minutes, followed by an infusion of between 0.2 and 0.4mcg/kg/hr is effective.

- Remifentanil should be dosed according to IBW or LBM. Fentanyl is the most commonly used drug and it has been suggested that the dose be based on LBM, one study suggested that a pharmacokinetic correction is made when using fentanyl, and for patients weighing 140kg to 200kg the pharmacokinetic mass should be 100 to 108kg.[17]

- Non-depolarising neuromuscular blockers are polar hydrophilic drugs and their volume of distribution is limited to the vessel rich organs, meaning that we should use IBW to calculate doses for these agents. Succinylcholine, on the other hand needs to be dosed based on TBW. This is thought to be due to the

excess of pseudocholinesterase in obese patients, and an increase in ECF. Studies have shown better intubating conditions after a dose based on TBW than IBW, or LBW.[16]

- Sevoflurane and desflurane are the obvious volatile agents to use because of their lower solubility in fat.
- The use of target–controlled intravenous infusion (TCI) systems in anaesthesia is based on normal weight subjects and some of the models (eg the Marsh TCI model for propofol) yield unacceptable concentrations for morbidly obese patients. One needs to adjust the TCIs based on the principles we discussed, and bare in mind that the TCI may not be accurate. We await models based on morbidly obese patients for accurate delivery of TCIs.[16]

Metabolic Syndrome and Diabetes

This is a distinct obesity related syndrome characterised by truncal obesity, insulin resistance, dyslipidaemia and hypertension. It is important for anaesthetists to recognise these patients, as there is an increased incidence of coronary artery disease, congestive heart failure, obstructive sleep apnoea, pulmonary dysfunction and deep venous thrombosis in these patients. We need to concentrate on all these associated risk factors and try to minimise patient's perioperative risk with relevant preoperative work-up and careful intra and postoperative management.[18]

Airway Management

It is well known that obesity is associated with difficulty in airway management, both in terms of bag mask ventilation, and intubation. The NAP4 audit of airway morbidity and mortality in the UK showed that obese patients were over represented with 45% of patients having obesity listed as one of the reasons for the complication.[19]

There are good explanations for why morbidly obese patients desaturate and become hypoxic. It is important to minimise the problems at induction and extubation with positioning, planning and preparation of equipment and staff.

Positioning the patients in a "ramped" head-up position has been shown to decrease the desaturation at induction, and difficulty with bag mask ventilation and intubation. The upper body and head should be elevated, with the sternal notch and the ear in the same horizontal plane.[20]

The study by Neligan et al[21] showed that in morbidly obese patients in the ramped position, there was no relationship between the presence and severity of OSA, BMI, neck circumference and difficulty of intubation or laryngoscopy grade. Videolaryngoscopes are a particularly useful alternative tool for difficult intubation in the morbidly obese population.[22]

Postoperative Respiratory Dysfunction

Postoperative pneumonia and respiratory failure are relatively common non-wound complications after bariatric surgery. In over 32,000 patients followed up by the American College of Surgeons National Surgical Quality Improvement Program, 0.6% of patients developed PP and PRF. These accounted for less than 20% of all complications at 30 days.[23] Factors associated with increased risk of developing these complications included CHF and stroke for PP, and coronary interventions and dyspnoea at rest for PRF.

There are a number of studies published in the last three years showing how intraoperative ventilation strategies can decrease the atelectasis associated with PP and PRF: including intraoperative PEEP levels of at least 8cm of water, and other alveolar recruitment manoeuvres during the surgery. Talab et al showed how intraoperative recruitment with a vital capacity manoeuvre followed 10cm of intraoperative PEEP was effective at preventing lung atelectasis as measured on post CT scans, improved oxygenation, shortened PACU stay and resulted in fewer post-op pulmonary complications.[24]

Conclusion

Obesity and the related co-morbidities pose numerous perioperative challenges for anaesthetists but experience with bariatric surgery has helped us deal with many of these issues effectively.

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