Problems of the Morbidly Obese Patient

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The term obesity comes from the Latin word ‘obesus’ which means ‘fattened by eating’. It describes a condition of excess body fat. Morbid obesity can be defined as twice the ideal body weight or a body mass index > 35. Body mass index (BMI) is calculated as weight (kg)/ height $^2$(m). Normal BMI is <25. People who are morbidly obese have morbidity and mortality rates up to twice that of the non-obese.

Pathophysiology

Respiratory System:
There is increased oxygen consumption and carbon dioxide production. Minute ventilation generally increases to maintain normocarbia especially in young obese patients. In older or more obese patients hypoventilation can occur resulting in high carbon dioxide levels. Inspiratory (IRV) and expiratory reserve volumes (ERV) are decreased leading to reduced functional residual capacity (FRC) and vital capacity (VC). Residual volume (RV) is normal. (FRC = RV + ERV). ERV is further reduced by lying down and even more by the Trendelenburg position. The decrease in FRC may fall within the closing volume resulting in gas trapping especially in dependent lung regions. Chest wall compliance is always decreased because of the weight of the chest wall leading to a reduction in total lung compliance. Lung compliance itself may be reduced secondary to increased pulmonary blood flow. The work of breathing is increased. The end result of these changes is ventilation perfusion mismatching leading to hypoxemia. Intrapulmonary shunt is always increased.

Obstructive sleep apnea syndrome (OSAS) is common in the obese patient. 60-90% of patients with OSAS are obese. Typical history includes snoring and/or apnea during sleep, frequent arousals and daytime fatigue or sleepiness. Apneic episodes may result in bradycardia or arrest, dysrhythmias, pulmonary and systemic hypertension, myocardial infarction and respiratory arrest.

A small percentage of obese patients have obesity hypoventilation syndrome in which they have abnormal respiratory control leading to nocturnal hypoventilation, daytime hypoxia and hypercarbia and increased pulmonary artery pressure. The respiratory centre responds abnormally to hypoxia and hypercarbia.

Common findings in morbidly obese patients are large tongue, increased palatal and pharyngeal soft tissue and increased fatty neck tissue. These can result in limited neck extension, limited mouth opening and difficult airway access.

Cardiovascular System:
Cardiac output and total blood volume increase to meet the metabolic demand. There is increased preload and afterload, increased mean pulmonary arterial pressure and increased right and left ventricular stroke work. Cardiac diameter has been shown to increase by 20-55%. In the normotensive obese patient total peripheral resistance may actually decrease slightly. However there is an increased incidence of hypertension in morbidly obese patients. There is a higher incidence of pulmonary and systemic vascular congestion. Congestive heart failure occurs in about 10% of morbidly obese patients. Changes of posture
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Preparation of the patient includes the optimization of all medical conditions such as diabetes and hypertension. Pulmonary hypertension is reflected in exertional dyspnea, fatigue and syncope. These result from a failure of cardiac output to increase with activity. Echocardiography may show tricuspid regurgitation. EKG may show right ventricular hypertrophy and the chest X-Ray prominent pulmonary arteries.

Assessment of the airway should be very thorough, looking specifically to see whether endotracheal intubation will be possible following induction of anesthesia. If there is any doubt the plan should include awake intubation. This should be discussed with the patient and reassurance given. A cooperative patient is essential for success. In the operating room, all needed equipment should be set up including a fibreoptic bronchoscope, intubating LMA and whatever tools the anesthesiologist favours. Good topical anesthesia of the airway and appropriate sedation are mandatory. Some recent reports advocate the use of remifentanil for sedation during awake intubation. Care must be taken with combinations of sedatives and narcotics as obese patients are very sensitive to their respiratory depressant effects.

If the patient has OSAS, he should bring his CPAP mask to the hospital for use in the postoperative period.
The patient should be warned that a tracheostomy may be necessary. There may also be a need for postoperative ventilation especially until the effects of the anesthetics has worn off.

Morbid obesity is a major independent factor for sudden death from acute postoperative pulmonary embolus therefore thromboprophylaxis is essential. A survey of members of the American Society for Bariatric Surgery regarding practices for thromboprophylaxis showed that 50% use heparin 5000 IU every 8-12 hours, 33% use pneumatic compression stockings, 13% use low molecular weight heparin (LMWH) and 4% use other methods. The use of LMWH must be taken into consideration if regional anesthesia is planned. Placement and removal of epidural catheters must be carefully timed with heparin doses.

Antibiotic prophylaxis is routinely used because of an increased risk of postoperative wound infection.

H2 blockers, antacids and proton pump inhibitors should be administered preop to reduce the risk of acid aspiration. If the endotracheal tube is going to be placed following induction then a rapid sequence induction is mandatory. Proper positioning of the patient can be achieved with a variety of pillows so that the tip of the chin is at a higher level than the chest to facilitate laryngoscopy and intubation. The probability of a difficult intubation with a 40 cm neck circumference is 5% compared with a probability of 35% with a 60 cm neck circumference.

Peripheral intravenous access can prove difficult as can central venous cannulation. Ultrasound guidance is sometimes used to facilitate these. Arterial line placement is generally less problematic and may be useful for monitoring of blood pressure especially if an appropriate sized cuff is not available.

Postoperative pain management must be discussed with the patient. If OSAS is present, this presents extra challenges in the use of narcotics as obese patients with OSAS have an increased risk of opioid induced upper airway obstruction. Probably the best choice is thoracic epidural analgesia with local anesthetics and minimal short acting narcotics such as fentanyl. Patient controlled thoracic epidural analgesia has been shown to be effective. However it is recognized that it may be difficult to place an epidural catheter or perform other regional anesthetics in these patients so patient controlled intravenous analgesia may be required. For laparoscopic surgery this may be the method of choice as there is significantly less pain than following open procedures.

**Intraoperative Management:**

Obesity leads to alterations in the distribution, binding and elimination of many drugs. The distribution of a drug between fat and lean tissues differs among individuals. Therefore the net pharmacologic effect may be variable. A drug that is lipid soluble, such as thiopentone, will concentrate in the tissues resulting in a low plasma concentration. Such drugs have a large volume of distribution and should be dosed on total body weight. Most anesthetic drugs fall into this group. Remifentanil is highly lipophilic but no consistent relationship has been shown between its lipophilicity and volume of distribution. The pharmacokinetics are
similar between obese and non-obese patients. Drugs that are weakly lipophilic, such as non depolarizing muscle relaxants, can be dosed based on lean body mass or ideal body weight.

Desflurane and sevoflurane have both been shown to provide rapid recovery in this group of patients. The wash-in and wash-out of sevoflurane is faster than isoflurane and discharge from the recovery room occurs sooner. Immediate recovery from desflurane is more rapid than with propofol or isoflurane. This advantage persists for at least two hours postoperatively. Improved patient mobility and reduced incidence of postoperative desaturation episodes have also been noted.

Alfentanil, remifentanil and fentanyl have been shown to have similar effects in controlling the hemodynamic response to intubation. Remifentanil has been successfully used in the superobese patient. Use of easily titratable drugs such as remifentanil, propofol and desflurane has facilitated prompt emergence from anesthesia. Combined regional and general anesthesia is effective.

Ventilation with large tidal volumes is not recommended as it has not been shown to improve oxygenation. Tidal volumes of 10-12 ml/kg and a rate of 10-14 breaths/minute are quite adequate. Occasionally some PEEP must be applied to maintain oxygenation. Compliance has been found to increase significantly while the abdomen is open during laparotomy so alterations may need to be made in the ventilation parameters.

Obese patients behave similarly to normal patients with carbon dioxide insufflation during laparoscopic surgery. There is an increased sympathetic discharge resulting in increased cardiac output, stroke volume and cardiac index. In terms of respiratory mechanics there seems to be little difference between obese patients undergoing laparoscopic and open surgery.

Postoperative Management:

Proper postoperative placement of these patients is essential. They need careful monitoring especially if narcotics must be used for pain control and if OSAS is present. If the BMI is high and the OSAS severe then an ICU environment is required. If there is no OSAS and pain control can be managed with low dose or no narcotics then management on the ward is probably appropriate. The majority of patients fall somewhere in the middle and are best managed in an observation unit. CPAP is essential for those patients with OSAS. It reduces the incidence of postoperative acute airway obstruction.

There is a higher incidence of postoperative atelectasis in morbidly obese patients compared to the general population. This is probably related to the decreased FRC to begin with which worsens in the supine position. Contributing factors are slow immobilization and longer surgical time. The atelectasis is noted to persist longer in the obese than in normal patients. BiPAP has been shown to improve pulmonary function. Early ambulation, chest physiotherapy and effective management of pain are of paramount importance.

In summary, morbidly obese patients present many challenges not only to the anesthesiologist but also to the
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surgeon, the nurses and the system. Advance planning and teamwork are essential if a successful outcome is to be achieved.

References: