BARIATRIC SURGERY EDUCATION DAY

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Anesthesia for the obese patient

Dr Juan Rodríguez, MBBS, DESA, FANZCA
1. Introduction

1. Physiological changes
   a. cardiovascular
   b. respiratory

1. Planning anaesthetics
   a. monitoring, positioning
   b. GA
   c. neuraxial
   d. drugs
   e. Pain management

1. Summary
INTRODUCTION

Prevalence of obesity increases worldwide

Increasing number of obese surgical patients will require anesthesia. Obesity is typically defined by body mass index (BMI), the ratio of weight (in kilograms) to the square of height (in meters). BMI = body weight (in kg) ÷ height (in meters) squared

Using the BMI, obesity is then classified as follows:

- **Overweight** – BMI ≥25.0 to 29.9 kg/m².
- **Class I obesity** – BMI of 30.0 to 34.9 kg/m².
- **Class II obesity (formerly known as morbid obesity)** – BMI of 35.0 to 39.9 kg/m².
- **Class III obesity (formerly known as severe obesity)** – BMI ≥40 kg/m². This type of obesity is also referred to as severe or extreme obesity.
Figure 3.10: Prevalence of overweight (BMI 25 to <30) and obesity (BMI 30 or over), 2002

Note: Persons aged 15 years or over.
PHYSIOLOGIC CHANGES

Increasing obesity leads to respiratory and cardiovascular changes that impact the delivery of anesthesia and perioperative analgesia.

Respiratory physiology:

Physical impingement of lung volumes and chest movement

Increased metabolic requirements of excess tissue (increased oxygen (O2) consumption)

Respiratory rate increased.

Functional residual capacity (FRC) and expiratory reserve volume (ERV) are decreased, even in mild obesity.

Supine position and obstructive sleep apnea (OSA) increase the magnitude of these effects.

Decreased time to desaturation during apnea
PHYSIOLOGIC CHANGES

Cardiovascular physiology

- Increased circulating blood volume
- Decreased systemic vascular resistance.
- Increased cardiac output by 20 to 30 mL per kilogram of excess body fat. Stroke index, cardiac index, and heart rate remain normal; the increased cardiac output occurs by means of expanded stroke volume.
- Left ventricular hypertrophy, related to the duration of obesity. The increased cardiac output can lead to either left ventricular failure (especially when associated with hypertension), or right heart failure (especially when associated with the hypoxia and hypercapnia of OSA)
- Hypertension and cardiovascular disease are also more prevalent in obese patients and when present may produce additional structural and hemodynamic changes.
PLANNING THE ANESTHETIC

The guiding principle should be to use short acting and minimally fat soluble agents whenever feasible to allow for rapid recovery of consciousness, protective reflexes, and mobility.

Due to the high prevalence of sleep apnea in obese patients, and consequent sensitivity to sedatives, the use of long-acting respiratory depressants should be minimized in obese patients regardless of technique chosen.
PLANNING THE ANESTHETIC

**Blood pressure monitoring**  Noninvasive blood pressure measurement in obese patients is often complicated by the size and conical shape of their upper arms. May result in inaccurate measurement. Invasive arterial blood pressure monitoring should be considered when surgical and/or patient conditions suggest a critical need for accurate blood pressure monitoring.

Alternate cuff locations (eg, forearm or lower leg) are often used to obtain a better fit. The accuracy of alternate blood pressure monitoring sites during anesthesia has not been well studied. Several studies in nonobese patients that compared noninvasive blood pressure (NIBP) measurement at the forearm with the upper arm have reported a trend towards higher systolic, diastolic, and mean pressures in the forearm.
PLANNING THE ANESTHETIC

Positioning: risks of decreased ventilation, physical injury, including nerve injury and rhabdomyolysis. Risks of developing rhabdomyolysis after bariatric surgery increase with male gender, elevated BMI, and prolonged operating time.

Advantages and disadvantages of different positions include:

- **Supine or head-down (Trendelenburg) positions** – Decreased lung volumes and increased work of breathing (caused by the weight of the intra-abdominal contents on the diaphragm), and increased venous blood return (leading to increased cardiac output); this leads to more rapid oxygen desaturation during apneic periods, increased pulmonary shunt, hypoventilation with spontaneous breathing, and edema of the head and neck after lengthy periods.

- **Head-up position (reverse Trendelenburg, or semi-sitting/"semi-Fowler")** easier to mask ventilate, better view of the airway during direct laryngoscopy compared with those in the supine position.

- **Prone** may have improved respiratory function, with increased FRC, lung compliance, and oxygenation in anesthetized patients compared to supine position. Supports should be placed under the chest and pelvis rather than the abdomen.
**Lateral decubitus** – The lateral position removes the weight of the abdomen from the diaphragm, and increases the diameter of the pharyngeal airway. The lateral decubitus position combined with head and upper body elevation may be helpful during recovery from general anesthesia, unless contraindicated due to the nature of the surgery. It can be challenging to support the head in a neutral position, as the neck is often short and wide; extra pieces of foam and rolled towels can be helpful.

**Lithotomy position** – decreases lung volumes by shifting abdominal contents towards the diaphragm, which may contribute to hypoxia and hypoventilation. Correct positioning and adequate padding of the legs is critical; neurologic injury or compartment syndrome may result from prolonged pressure.

Positioning of the obese patient should be checked regularly during the maintenance phase of general anesthesia, as large patients are prone to shift position when the operating table is tilted, and may need to be repositioned. The use of Velcro to attach the mattress to the bed can help prevent slipping.
SPECIAL EQUIPMENT NEEDS

- Special equipment for positioning

- Large beds and operating tables. Additional arm supports to widen the table, or the use of two operating tables, may be necessary.

- Mechanical transfer mechanisms

- Additional personnel – Assistance may be needed to transfer and position patients safely.

- Extra-long needles – Normal length epidural, spinal, and nerve block needles may be insufficient to access structures in severely obese patients.

- Ultrasound – Ultrasound may be used to assist in vascular access, nerve block, and neuraxial procedures
GENERAL ANAESTHESIA: PRE OXYGENATION

Bag-mask ventilation. The best method is the two-person technique, with oropharyngeal and nasopharyngeal airways in place.

Bed is angled with the head up and foot down (reverse Trendelenburg position) to reduce pressure from the abdominal contents on the diaphragm and to shift the weight of the chest wall inferiorly, thereby improving chest wall and diaphragm excursion.

Preoxygenation — It can be difficult to achieve and maintain adequate oxygenation in morbidly obese patients. Furthermore, oxygen saturation levels fall faster in the obese during RSI.

A systematic review concluded that preoxygenation in morbidly obese adults is more effective when performed with the patient in the head-up position rather than a supine position [Solis A, Baillard C. Effectiveness of preoxygenation using the head-up position and noninvasive ventilation to reduce hypoxaemia during intubation. Ann Fr Anesth Reanim 2008; 27:496]. Among several studies that have investigated the effects of positioning on preoxygenation, one assessed the time necessary for desaturation to occur in 40 obese patients undergoing elective surgery [After preoxygenation, induction, and intubation, patients were left apneic until their Spo2 dropped to 90 percent. Preoxygenation in the sitting position increased the mean time needed to desaturate to 90 percent by almost one minute. Other studies have reported similar results (Dixon BJ, Dixon JB, Carden JR, et al. Preoxygenation in the obese patient: effects of position on tolerance to apnoea. Br J Anaesth 2005; 95:706).]

Providing oxygen by nasal cannula during the apneic phase of RSI may improve oxygenation in obese patients. In a small randomized trial, patients (n = 15) provided with oxygen at 5 L/minute by nasal cannula maintained an Spo2 above 95 percent for a mean of 5.29 minutes compared to 3.49 minutes for those not given oxygen [Ramachandran SK, Cosnowski A, Shanks A, Turner CR. Apneic oxygenation during prolonged laryngoscopy in obese patients: a randomized, controlled trial of nasal oxygen administration. J Clin Anesth 2010; 22:164]. Some advocate that the highest flow rate the patient will tolerate should be used, as this ensures a high flow of oxygen with little downside [Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. Ann Emerg Med 2012; 59:165].
Obesity and airway difficulty

Airway management in obese patients should always be considered potentially difficult.

Bag-mask ventilation is more difficult. Redundant upper airway soft tissue + increased BMI = increased airway resistance. Higher pressures are required to ventilate effectively, and this can lead to difficulty maintaining a mask seal. Oxygen consumption is increased in obese patients, and target oxygen saturations may be difficult to achieve or maintain.

Tracheal intubation  Laryngoscopy and tracheal tube placement can be difficult in obese patients. Such patients may have altered upper airway anatomy resulting in a poor view of the glottis despite optimal laryngoscopic technique. In addition, short, thick necks may limit mobility and make it difficult to place the patient in the optimal sniffing position.
Obesity and airway difficulty

● A large retrospective study using the Danish Anesthesia Database found that patients with a BMI above 35 were more likely to be difficult to intubate compared with those with a lower BMI. odds ratio 1.34 (95% CI 1.19-1.51). Lundstrøm LH, Møller AM, Rosenstock C, et al. High body mass index is a weak predictor for difficult and failed tracheal intubation: a cohort study of 91,332 consecutive patients scheduled for direct laryngoscopy registered in the Danish Anesthesia Database. Anesthesiology 2009; 110:266.

● One observational study compared the incidence of difficult endotracheal intubation in consecutive obese (n = 129) and lean (n = 134) patients undergoing elective surgery using a validated difficulty score (The Intubation Difficulty Scale, or IDS). The rate of difficult intubation was 15 percent for obese patients versus 2 percent for lean patients. In obese patients, a Mallampati score of III or IV was the only independent risk factor for difficult intubation (odds ratio [OR] 12.51; 95% CI 2.01-77.81). Hypoxemia occurred more frequently in obese patients despite preoxygenation. Juvin P, Lavaut E, Dupont H, et al. Difficult tracheal intubation is more common in obese than in lean patients. Anesth Analg 2003; 97:595.

● Another study using the IDS to assess 204 elective surgery patients found endotracheal intubation to be more difficult in obese patients a study examining 100 consecutive morbidly obese surgical patients arrived at a similar conclusion. The researchers of the latter study found that large neck circumference and high Mallampati score were the only predictors of difficult intubation in this population. (Lavi R, Segal D, Ziser A. Predicting difficult airways using the intubation difficulty scale: a study comparing obese and non-obese patients. J Clin Anesth 2009; 21:264. Brodsky JB, Lemmens HJ, Brock-Utne JG, et al. Morbid obesity and tracheal intubation. Anesth Analg 2002; 94:732)

Surgical airway Excessive soft tissue in the anterior neck limits access to the cricothyroid membrane and makes it difficult to identify the anatomic landmarks needed to perform a cricothyrotomy. Therefore, surgical airways can be extremely difficult in morbidly obese patients.
Despite anticipated difficulty, intubation of obese patients is generally performed successfully provided appropriate technique is used. As an example, in a prospective but unblinded observational study of 300 consecutive patients undergoing laparoscopic bariatric surgery, the first choice of direct laryngoscopic intubation was successful in 98.6 percent of cases [Navarro Martínez MJ, Pindado Martínez ML, Paz Martín D, et al. Perioperative anesthetic management of 300 morbidly obese patients undergoing laparoscopic bariatric surgery and a brief review of relevant pathophysiology. Rev Esp Anestesiol Reanim 2011; 58:211]. The combination of a McCoy laryngoscope, which features an articulated blade tip, and a short laryngoscope handle was used for intubation.
Tracheal intubation

Positioning: upright or semi-upright position (eg, reverse Trendelenburg). ramped or head-elevated position for direct laryngoscopy. In the ramped position, blankets or commercially available beds are used to elevate the head and torso such that the external auditory meatus and the sternal notch are horizontally aligned.

Several studies have compared the positions used to optimize the glottic view and improve intubation success:

● In a blinded, randomized trial, 60 morbidly obese patients were assigned to either the ramped or to the sniffing position (7 cm head elevation) for direct laryngoscopy and endotracheal intubation prior to surgery. The authors reported that the ramped position provided a significant improvement in the glottic view. (Collins JS, Lemmens HJ, Brodsky JB, et al. Laryngoscopy and morbid obesity: a comparison of the "sniff" and "ramped" positions. Obes Surg 2004; 14:1171)

● A randomized trial of direct laryngoscopy in 40 anesthetized patients found that the glottic view improved by over 50 percent when the head-elevated position was used compared with supine positioning. (Lee BJ, Kang JM, Kim DO. Laryngeal exposure during laryngoscopy is better in the 25 degrees back-up position than in the supine position. Br J Anaesth 2007; 99:581)

● A retrospective study of 528 intubations performed outside the operating room found that a backup and head elevated (ie, ramp) position was associated with significant reductions in multiple airway complications, including hypoxia, esophageal intubation, and intubation failure, compared with supine, neutral head positioning. (Khandelwal N, Khorsand S, Mitchell SH, Joffe AM. Head-Elevated Patient Positioning Decreases Complications of Emergent Tracheal Intubation in the Ward and Intensive Care Unit. Anesth Analg 2016; 122:1101)

● A study using fresh cadavers found significant improvement in the glottic view during direct laryngoscopy with the head in a fully elevated position compared with either a supine or partially elevated position. (Frappier J, Guenoun T, Journois D, et al. Airway management using the intubating laryngeal mask airway for the morbidly obese patient. Anesth Analg 2003; 96:1510)
Optical and video laryngoscopes – Preliminary studies suggest that optical and video laryngoscopes are useful for intubating the morbidly obese patient and have advantages over standard laryngoscopes. These devices can also be used for awake intubation.


In a randomized trial, 79 morbidly obese patients were randomly assigned to intubation using an optical stylet (Levitan FPS) or a videolaryngoscope, and in all cases the study devices improved laryngeal visualization compared with direct laryngoscopy and allowed for rapid intubation [Gaszynski T, Pietrzyk M, Szewczyk T, Gaszynska E. A comparison of performance of endotracheal intubation using the Levitan FPS optical stylet or Lary-Flex videolaryngoscope in morbidly obese patients. ScientificWorldJournal 2014; 2014:207591].
Devices for airway management

● **Laryngeal mask airway (LMA)** excessive resistance to ventilation in the obese may overcome the seal pressure of the LMA cuff, reducing the effectiveness of ventilation. Proper positioning is identical to that used for bag-mask ventilation.


● **Combitube**

● **Endotracheal tube introducer (ETTI)**

● **Fiberoptic stylets**

● **Flexible endoscopic laryngoscopes**
Providing adequate ventilation and oxygenation to the intubated obese patient can be difficult.

Tidal volumes are calculated based upon the patient's ideal body weight (obesity does not change underlying lung volumes) and then adjusted according to the clinical response, using airway pressures, oxygen saturation, and blood gas results.

Oxygenation and ventilation can be improved in the morbidly obese by placing them in a more upright position (eg, reverse Trendelenburg).

**Mechanical ventilation**
DOSING ANESTHETIC DRUGS

Medication dosing  Optimal dosing for many drugs in the obese patient remains controversial. Obesity alters the pharmacokinetics and pharmacodynamics of many medications, including some of those used for rapid sequence intubation.

Evidence supporting the use of any particular calculation of body weight to determine the dosing of induction or neuromuscular blocking agents (NMBAs) is limited. based primarily upon clinical experience and pharmacologic considerations.

In summary, it is recommended to use dosing based upon lean body weight (LBW) for most induction agents, ideal body weight (IBW) for propofol, given its propensity to cause hypotension, and total body weight (TBW) for neuromuscular blocking agents.
DOSING ANESTHETIC DRUGS

Modified drug dosing is required because of obesity-related increases in LBW, cardiac output, and blood volume, as well as changes in regional blood flow; these can affect peak plasma concentration, clearance, and elimination half-life of many drugs.

The volume of distribution (\(V_d\)) is the principal determinant of loading dose of drugs. The \(V_d\) of relatively lipophilic drugs is increased by obesity; less lipophilic drugs have little to no change in \(V_d\) in obese patients, as blood flow to fat tissue is lower than that to vessel-rich or lean tissue.

- Drug clearance is generally higher in obese individuals than non-obese individuals. This is largely controlled by hepatic and renal physiology. Obesity affects hepatic metabolic pathways in different ways, with some only slightly and others significantly enhanced in obesity. Renal elimination includes glomerular filtration, tubular secretion, and tubular reabsorption; changes are observed in obesity, but vary by drug and are not completely understood.

The elimination half-life (\(t_{1/2}\)) impacts dosing interval and dosing of continuous infusions. The \(t_{1/2}\) of a drug varies directly with \(V_d\), and inversely on the clearance, both of which are altered in obesity.
## Anesthetic drug dosing in obesity

<table>
<thead>
<tr>
<th>Drug</th>
<th>Weight for dosing</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sedative/hypnotics</strong></td>
<td></td>
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<tr>
<td>Propofol bolus doses</td>
<td>LBW</td>
<td>The dose required for loss of consciousness in obese patients (BMI &gt;40 kg/m²)²¹. Due to substantial interindividual variability, continuous infusions should be titrated to a clinical endpoint. A reasonable initial dose is based on LBW and titrated to achieve the desired clinical result. Several different dose calculation models have been used for target-controlled infusion systems (not available in the United States)²².</td>
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<tr>
<td>Propofol maintenance infusions</td>
<td>LBW</td>
<td>Pharmacokinetic studies have not been done in obesity²³.</td>
</tr>
<tr>
<td>Etomidate</td>
<td>LBW</td>
<td>Recommendation is based on computer models of plasma concentrations. Doses should be adjusted for high or low cardiac output, and rapid redistribution may result in more rapid awakening after a single bolus dose than in lean patients²⁴.</td>
</tr>
<tr>
<td>Thiopental</td>
<td>LBW</td>
<td>As a sedative, usually dosed in small increments (e.g., midazolam 1 mg IV) that are repeated until the clinical endpoint is reached. Caution should be exercised as patients with OSA may have increased central sensitivity to the sedative and respiratory effects of benzodiazepines. TBW is used for bolus dosing (e.g., to induce general anesthesia) due to the significant increase in Vₐ in these highly lipophilic drugs²⁵.</td>
</tr>
<tr>
<td>Midazolam (and other</td>
<td>TBW</td>
<td>Although clearance is not substantially different from that in non-obese individuals²⁶, there is substantial individual variability, so continuous infusions should be titrated to a clinical endpoint. A reasonable initial dose is based on LBW and titrated to achieve the desired clinical result.</td>
</tr>
<tr>
<td>benzodiazepines) bolus doses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midazolam (and other</td>
<td>LBW</td>
<td>There are no specific dosing recommendations available in the obese, but as with other infusions, doses should be titrated to a clinical endpoint. The drug is highly lipophilic. Bolus (0.5 to 1 mcg/kg) and infusion dosing (0.2 to 0.8 mcg/kg) based on TBW (without a scalar) have been used in several studies²⁷⁻²⁹. This is within the manufacturer-suggested dose range. Dose adjustments may be required for other comorbidities or other sedative or anesthetic drugs used concomitantly.</td>
</tr>
<tr>
<td>benzodiazepines) continuous infusions</td>
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<tr>
<td><strong>Opioids</strong></td>
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<tr>
<td>Synthetic opioids (fentanyl, sufentanil, alfentanil, and remifentanil)</td>
<td>LBW</td>
<td>On the basis of clinical pharmacokinetic studies in lean patients, physiologic changes in obesity, and supratherapeutic plasma levels with TBW dosing²⁶.</td>
</tr>
<tr>
<td>Morphine</td>
<td>IDW</td>
<td>Initial dosing should be based on IDW and titrated to effect. This is a reasonable initial dose, as postoperative opioid consumption was 30 percent less in obese versus normal weight patients (on a morphine equivalent to kg basis)³⁰.</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>IBW</td>
<td>As with morphine, initial dosing is based on IBW and titrated to effect.</td>
</tr>
<tr>
<td><strong>Neuromuscular blocking agents</strong></td>
<td></td>
<td>Generally polar compounds³¹. The dosing scalar will depend on the clinical circumstance. In general, a higher (i.e., closer to TBW) intubating dose will result in faster onset and shorter time to complete NMB, but a longer duration of action. An IBW-based dosing will prolong the time to ideal intubating conditions, but assure a faster recovery from NMB³².</td>
</tr>
<tr>
<td>Non-depolarizing agents (e.g., vecuronium, rocuronium)</td>
<td>IBW</td>
<td></td>
</tr>
<tr>
<td>Succinylcholine</td>
<td>TBW</td>
<td>This is based on superior intubating conditions when succinylcholine 1 mg/kg TBW was compared with dosing on the basis of IBW or LBW³³.</td>
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</table>
**Preparation for induction**  Pre-oxygenation is ideally performed in head-up (reverse Trendelenburg) position A head-up or ramped position also improves laryngoscopic view.

Preoxygenation should be performed via a tight-fitting facemask using 100 percent oxygen (O₂) at a flow rate high enough to prevent rebreathing (10 to 12 L/min), aiming for an end-tidal concentration of O₂ greater than 90 percent in order to maximize safe apnea time.


When high concentration oxygen is used during induction of anesthesia, resorption atelectasis may occur, particularly in obese patients. Use of a recruitment maneuver and prompt application of positive end expiratory pressure after intubation may prevent or reverse resorption atelectasis.
GENERAL ANAESTHESIA

Ventilation management

- Set tidal volume of 6 to 8 mL/kg IBW
- Adjust respiratory rate to maintain normocapnia (permissive hypercapnia is acceptable in patients without pulmonary hypertension)
- Keep FiO₂ below 0.5 to 0.8, to prevent resorption atelectasis and oxygen toxicity
- Use RMs repeatedly during anesthesia (6 to 20 seconds duration; plateau pressure 40 to 55 cm H₂O)
- Institute PEEP 10 to 15 cm H₂O following RMs
- Maintain head-up (reverse Trendelenburg) position, whenever feasible
In a trial of 400 non-obese adults having major abdominal surgery, patients were randomized to lung-protective ventilation (TV 6 to 8 mL/kg IBW, PEEP 6 to 8 cmH₂O, RM after intubation and every 30 minutes) or traditional ventilator settings (TV 10 to 12 mL/kg IBW, no PEEP, no RM) (Futier E, Constantin JM, Paugam-Burtz C, et al. A trial of intraoperative low-tidal-volume ventilation in abdominal surgery. N Engl J Med 2013; 369:428.)

Protective ventilation led to: Decreased incidence of major pulmonary and extrapulmonary complications in the first week (10.5 versus 27.5 percent, relative risk [RR] 0.40 [95% CI 0.24-0.68]); Lower incidence of acute respiratory failure requiring noninvasive ventilation or intubation (5.0 versus 17.0 percent, RR 0.29 [95% CI 0.14-0.61]); Shorter median hospital stay (11 versus 13 days, between-group difference 2.45 days [95% CI 0.72-4.17 days]).

In a 2012 meta-analysis of studies of ventilation strategies (pressure- or volume-controlled ventilation, tidal volumes, PEEP or RM) in obese patients (BMI >30 kg/m²), RMs added to PEEP improved intraoperative oxygenation and compliance, compared with PEEP alone; there was no increase in adverse effects and no difference between pressure-controlled and volume-controlled ventilation (Aldenkortt M, Lysakowski C, Elia N, et al. Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis. Br J Anaesth 2012; 109:493.)
GENERAL ANAESTHESIA

Extubation — The head-up position is ideal at emergence, to improve oxygenation and decrease work of breathing. Some obese patients may be slow to emerge from anesthesia and should remain intubated until they are awake and meet standard extubation criteria. Avoiding premature extubation is particularly important in the obese patient, as swelling and edema can further complicate an already challenging intubation.
FLUID MANAGEMENT

There is very little evidence addressing perioperative fluid management specifically in obese patients, and euvolemia in this population is poorly defined; consequently clinical judgment based upon available measures of volume status and tissue perfusion should be used to guide fluid administration.
MANAGEMENT OF NEURAXIAL ANESTHESIA

In general, neuraxial anesthetic techniques with local anesthetic (ie, without opioids) minimally affect respiratory drive, and are safe and appropriate choices for obese patients.

Spinal and epidural anesthesia at higher dermatomal levels (ie, thoracic levels) may lead to respiratory difficulty; in one study, the onset of spinal anesthesia decreased spirometric lung volumes, to a greater extent in more severely obese patients.

Neuraxial medication should be given incrementally whenever possible, to avoid excessively high blockade; the same dose of spinal and epidural local anesthetics can spread to higher levels in obese compared with normal weight patients.

Landmarks tend to be more difficult to identify in obese patients and a greater number of attempts are required to place spinal and epidural anesthetics, preprocedure ultrasound determination of spinal anatomy may improve identification of the needle insertion site and successful placement for selected obese patients.
A multimodal, opioid sparing approach to analgesia should be used for all patients, including the obese.

Paracetamol reduces postoperative opioid use and may have an intrinsic antiemetic effect.

Other agents that may be used to augment analgesia include ketamine, alpha-2 agonists (e.g., clonidine and dexmedetomidine), magnesium, systemic lidocaine and antiepileptic drugs (pregabalin and gabapentin); these may reduce the need for intraoperative and postoperative opioids.
SUMMARY AND RECOMMENDATIONS

- Respiratory physiologic changes in obese patients include an increase in oxygen consumption and a decreased functional residual capacity, leading to a rapid decrease in oxygen saturation during apneic periods. Increased blood volume, decreased systemic vascular resistance, and increased cardiac output may lead to either left or right heart failure or both.

- Drug doses in obese patients depend on the pharmacokinetic and pharmacodynamic parameters of the specific drug; when specific recommendations are not available, it is reasonable to base drug doses on lean body weight.

- Opioid administration should be minimized to decrease the risk of respiratory depression, particularly in patients with obstructive sleep apnea. In severely obese patients, pain control with opioid-sparing multimodal analgesia may reduce the risk of respiratory depression and other opioid-related side effects.

- When general anesthesia is used in obese patients, it is recommended adequate pre-oxygenation (with continuous positive airway pressure [CPAP] if tolerated) and induction in a head-up (reversed Trendelenburg) position to improve oxygenation and tolerance for apneic periods without desaturation.

- Prior to transfer to an unmonitored setting, oxygen saturation on room air should return to preoperative baseline, and when left undisturbed, the patient should not develop clinical hypoxemia or airway obstruction.