Perioperative Management of the Morbidly Obese Patient

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The Challenge – Postoperative pain management of the morbid obese patient

- The number of patients who present for elective surgery, with a BMI of greater than 30 kg/m², has increased significantly.
- Patients who are morbidly obese also present with multiple co-morbid conditions including pulmonary and cardiac disease.

Pulmonary Mechanics in Morbid Obesity

- **Decrease of total pulmonary compliance (up to 70%)**
  - Reduced chest wall compliance (tissue accumulation around ribs, diaphragm, intraabdominal)
  - Reduced lung compliance (increased pulmonary blood volume, ↓ FRC)

- Increase of total pulmonary resistance
  - Mainly due to increased lung resistance (airway resistance)

- Respiratory muscle insufficiency and increased work of breathing
Respiratory Physiology in the Morbid Obese Patient

**Effect on Lung Volumes**
- FRC decreased; declines with increasing BMI (positional)
- ERV and TLC decreased
- RV normal or increased
- Minute ventilation increased


**Respiratory Physiology in the Morbid Obese Patient**

**Pulmonary Gas Exchange**
- Oxygen consumption increased
- Carbon dioxide production increased
- Increased A-aDO2 and shunt fraction
- Oxygen consumption increases sharply with exercise


PRE-OPERATIVE EVALUATION OF RESPIRATORY FUNCTION

- A full set of PFTs will demonstrate the presence of obstructive and/or restrictive lung disease. Use of bronchodilators will help obstructive lung disease. Restrictive lung disease evaluation will determine how the patient will fare in the post-operative period. Generally, PFTs are not indicated.

- ABG may be more useful
Morbid Obesity and the Cardiovascular System

- **Blood Volume**
  Total blood volume is increased and as a result increased resting cardiac output

- **Hypertension**
  High incidence of hypertension in obese patients

- **Ischemic Heart Disease**
  Obesity is independent risk factor for ischemic heart disease. The high incidence of hypertension, diabetes, hypercholesteremia compound the problem

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**Cardiac Function**

- Increased cardiac output
- LVEDP increased with LVH (eccentric)
- Ventricular systolic function impaired
- Cardiomyopathy

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**PRE-OPERATIVE CARDIAC EVALUATION OF THE MORBIDLY OBESE PATIENT**

- Usual preoperative evaluation should include an EKG and a CXR
- If cardiac history yields symptoms and limited exercise tolerance, or if patients are in the New York Heart Association Class III or IV category, then at the very least a trans-thoracic echocardiogram is indicated.
- For stressful surgery where there may be significant blood loss or fluid shifts, a dobutamine echocardiogram may be helpful.
Obstructive Sleep Apnea
- Defined as 10 seconds or more of total cessation of airflow despite respiratory efforts
- Clinically relevant are 5 episodes/hour or >30 episodes/night
- Persistent effort without airflow
- Floppy upper airway
- Profound muscle relaxation during sleep or anesthesia worsens syndrome
- There is a significant association between morbid obesity and sleep apnea.

Diagnostic Criteria for OSA.
- Current a normal cutoff for the AHI is less than 5/hour.
- The severity of OSA can be defined based on the AHI.
  - Mild: AHI = 5-15 per hour
  - Moderate: AHI = 15-30 per hour
  - Severe: AHI >30 per hour

Diagnostic Criteria for OSA.
- Obstruction of airflow in OSA can be incomplete (hypopnea) or total (apnea).
- The diagnostic criterion for OSA is based on the Apnea/Hypopnea index (AHI). The AHI is derived from the total number of apneas and hypopneas divided by total sleep time.
- Apnea is defined as 10 seconds or more of total cessation of airflow despite respiratory efforts

Examination of Patient with OSA.
- The physical examination is frequently unremarkable in OSA, other than the presence of obesity (defined as a body mass index greater than 30 kg/m2) and hypertension.
- The clues to the presence of OSA usually come from family members who complain of snoring at night.
- As in all patients scheduled for surgery, an airway exam is necessary. The upper airway should be evaluated in all patients, particularly in non-obese adults with symptoms consistent with OSA.
Common Features in Patients with Sleep Apnea

- Loud snoring
- Disrupted sleep
- Nocturnal gasping and choking
- Witnessed apnea
- Daytime sleepiness and fatigue

Diagnosis of OSA

Typical parameters in a sleep study, *(Nocturnal Polysomnography)* include:

- eye movement observations (to detect rapid-eye-movement sleep),
- an electroencephalogram (to determine arousals from sleep)
- chest wall monitors (to document respiratory movements)
- nasal and oral air flow measurements,
- an electrocardiogram
- an electromyogram (to look for limb movements that cause arousals) and oximetry (to measure oxygen saturation).
- Apneic events can then be documented based on chest wall movement with no airflow and oxyhemoglobin desaturations

Diagnosis of OSA

Nocturnal polysomnography is the gold standard for diagnosing obstructive sleep apnea.

In this technique, multiple physiologic parameters are measured while the patient sleeps in a laboratory.

Sleep vs Anesthesia

- **Sleep** Unlike anesthesia, sleep is a state of *rousable* unconsciousness
- **Anesthesia** In contrast to sleep, anesthesia is a state of *unrousable* unconsciousness.

So why are we concerned about the perioperative risks for morbidly obese patients with sleep apnea?
The Obesity Hypoventilation Syndrome

The obesity hypoventilation syndrome (OHS) is defined by extreme obesity and alveolar hypoventilation during wakefulness. In its classic form, it is also characterized by the following findings:

- Hypersomnolence
- Dyspnea
- Hypoxemia, with resulting cyanosis, polycythemia, and plethora
- Pulmonary hypertension, leading to right ventricular failure and peripheral edema

Arterial Blood Gases and Nocturnal Oximetry

<table>
<thead>
<tr>
<th>Variables</th>
<th>OSA</th>
<th>OHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.42</td>
<td>7.4</td>
</tr>
<tr>
<td>PaO₂ mmHg</td>
<td>75</td>
<td>59</td>
</tr>
<tr>
<td>PaCO₂ mmHg</td>
<td>38</td>
<td>49</td>
</tr>
<tr>
<td>Sat. O₂ %</td>
<td>94</td>
<td>86</td>
</tr>
<tr>
<td>t Sat. &lt;90%</td>
<td>9</td>
<td>52</td>
</tr>
</tbody>
</table>

Jean Krieger and Emmanuel Weitzenblum, Romain Kessler, Ari Chaouat, Philippe Schonholz, Michele Fatir, Simon Casini. 2011;120:360-374 Chest

Perioperative Concerns for Morbidly Obese Patients with Obstructive Sleep Apnea

- Sedative and analgesic agents will aggravate or precipitate OSA
- by decreasing pharyngeal tone,
- depressing ventilatory responses to hypoxia and hypercapnia
- inhibiting arousal responses to obstruction, hypoxia and hypercapnia.
- The end result is that varying degrees of central respiratory depression can occur.
- This problem is compounded in the morbidly obese patient with OSA

The Obesity Hypoventilation Syndrome

Pathophysiology Of Alveolar Hypoventilation. Alveolar hypoventilation associated with OHS occurs as a result of one or both of the following factors:

- An increase in the work of breathing to a level that is inconsistent with maintenance of normal alveolar ventilation.
- A decrease in the "drive" to breathe
The Airway in Morbid Obesity

- Assessment
- Who deserves a rapid sequence intubation?
- Who deserves an awake intubation?

Patient Characteristics Stratified by Problematic and Easy Intubation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Problematic intubation (n = 12)</th>
<th>Easy intubation (n = 88)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>Median 44 25th pct 39.5 75th pct 49.5</td>
<td>Median 44 25th pct 36 75th pct 51.5</td>
<td>0.9957</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168 159.7 176.9</td>
<td>168 160.3 171.2</td>
<td>0.6471</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>124.8 124 144.1</td>
<td>137 122.3 156.8</td>
<td>0.858</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>46.5 42.5 47.3</td>
<td>48.9 44.2 58.1</td>
<td>0.9393</td>
</tr>
<tr>
<td>Neck circumference (cm)</td>
<td>50.0 50.0 (54.0 54.0)</td>
<td>46 42 48</td>
<td>0.0326</td>
</tr>
<tr>
<td>Sternoental distance (cm)</td>
<td>13.5 12.7 16.2</td>
<td>12 14 17</td>
<td>0.4979</td>
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<tr>
<td>Thyromental distance (cm)</td>
<td>9.5 7.7 10</td>
<td>9.5 8 11</td>
<td>0.6556</td>
</tr>
<tr>
<td>Mouth opening (cm)</td>
<td>5 4.1 5.2</td>
<td>5.5 4 6.5</td>
<td>0.1264</td>
</tr>
</tbody>
</table>

Assessment of the Airway.

- Limited information in the literature.
- Most recently:
  - Morbid Obesity and Tracheal Intubation
    - Jay B. Brodsky, MD*, Harry J. M. Lemmens, MD PhD*, John G. Brock-Utne, MD PhD*, Mark Vierra, MD, and Lawrence J. Saidman, MD*
    - (Anesth Analg 2002;94:732–6)

Neck Circumference and Probability of Problematic Intubation
Association of Neck Circumference and Other Risk Factors With Problematic Airway Intubation.

**Post-Operative Analgesia for Morbid Obese Patients.**

- Intravenous Opioids via Patient Controlled Analgesia or health care worker administration
- Potential Problems
  - Large amounts of opioids needed for operations with large incisions.
  - Increased incidence of respiratory depression which may require emergent tracheal intubation.

**Why Morbidly Obese Patients Merit Special Consideration for – Postoperative Pain Management**

- High incidence of myocardial disease and increased susceptibility to post-operative events.
- Changes in respiratory physiology limits tolerance to opioids and other analgesics that cause respiratory depression.
- The high incidence of Sleep Apnea and the Obesity Hypoventilation Syndrome also makes Morbid Obese patient intolerant of respiratory depression.
- Challenge for securing the airway outside the OR

**Pre-Emptive Analgesia**

- Preemptive analgesia is an antinociceptive therapy whose aim is to prevent both peripheral and central sensitization, thereby attenuating (or, ideally, preventing) the postoperative amplification of pain sensation.
- Treatment can be aimed at the periphery, at inputs along sensory axons, or at CNS sites using single or combinations of analgesics applied either continuously or intermittently.
Pharmacological Agents and Techniques of Preemptive Analgesia

Regional anesthesia induced prior to surgical trauma and continued well into the postoperative period is effective in attenuating peripheral and central sensitization.

Pharmacologic agents:
- NMDA (N-methyl-D-aspartate) antagonists
- alpha-2-receptor agonists
- NSAIDs (non-steroidal anti-inflammatory drugs)
- GABA – like compounds

Ketamine As An Adjunct To Opioids For Postoperative Analgesia

Ketamine
- Phencyclidine act by blocking NMDA receptor
- Molecular weight = 238
- The commercial preparation being a racemic mixture of both isomers [S-(+)] and [R-(-)] in equal amounts
- Ketamine produces profound analgesia, patients keep their eyes open and maintain many reflexes. Patients who receive ketamine alone appear to be in a cataleptic state

Ketamine As An Adjunct To Opioids For Postoperative Analgesia

Advantages of using Ketamine:
- In low doses Ketamine reacts synergistically with opioids to produce analgesia.
- The use of Ketamine allows for use of decreased amounts of opioids.

Disadvantages of using ketamine:
- Hallucinations

Dexmedetomidine As An Adjunct To Opioids For Postoperative Analgesia

- An alpha2-agonist similar to clonidine but with 10 times the potency
- Used in the operating room, PACU and ICU for sedation and analgesia.
- The drug does not cause significant cardiovascular instability.
- Dexmedetomidine also possesses several properties that may additionally benefit post-operative patients who have opioid tolerance or who are sensitive to opioid-induced respiratory depression.

What about NSAIDs???

![Diagram showing NSAIDs (left) and opioids (right) leading to pain relief](image)

Current use of dexmedetomidine

- In spontaneously breathing volunteers, intravenous dexmedetomidine caused marked sedation with only mild reductions in resting ventilation at higher doses.
- This quality makes dexmedetomidine an ideal analgesic drug for patients who will not tolerate respiratory depression.
- The best use of dexmedetomidine is as an adjunct to opioids.

Anesthesia for a patient with morbid obesity using dexmedetomidine without narcotics.

Roger E. Hofer, MD, Juraj Sprung, MD PhD, Michael G. Sarr, MD and Denise J. Wedel, MD. Anesthesia 52:176-180 (2005)

What about NSAIDs???

Currently the only available NSAID that can be administered by an IV or IM route is Toradol (Ketorolac)

- Toradol 60 mg IM or 30 mg IV is equivalent to Morphine 12 mg IM or 6 mg of Morphine IV.
- Toradol has longer duration of action than Morphine and does not cause respiratory depression.

What about NSAIDs???
Problems with Toradol:
- Inhibits platelet aggregation
- May increase bleeding
- May cause ulceration of the gastric mucosa
- May impair renal function

Gabapentin.
Gabapentin is structurally related to the neurotransmitter, GABA (gamma-aminobutyric acid).
- Gabapentin does not modify GABAα or GABAβ radioligand binding.
- Gabapentin is not converted metabolically into GABA or a GABA agonist, nor is it an inhibitor of GABA uptake or degradation.
- The mechanism of action of gabapentin has been established as binding to the α2δ sub unit of the presynaptic voltage gated calcium channel in spinal nociceptive neurons. Binding results in inhibition of calcium influx and a commensurate reduction in release of excitatory transmitters in the pain pathway.

Gabapentin.
- Used as adjunct analgesics for the treatment of perioperative pain.
- There have been several studies which have shown that the anticonvulsant gabapentin is very effective as an adjunct analgesia and that use of the drug reduces the opioid requirement after several types of surgeries including mastectomies and hysterectomies.

Post-Operative Care of the Morbidly Obese Patient
- Patients with challenging airways or with airway edema should be cared for in the ICU, these patients may merit post-operative intubation.
- For morbidly obese patients receiving post-operative opioid analgesia, a step down unit with pulse oximetry may be helpful.
- Reduction of use of opioid analgesia and increasing the use of non-opioid analgesia may be helpful.

Problems with NSAIDs:
- Inhibits platelet aggregation
- May increase bleeding
- May cause ulceration of the gastric mucosa
- May impair renal function

May impair renal function

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May impair renal function
Same Day Surgery

Should patients with morbid obesity and obstructive sleep apnea be scheduled at same day surgery centers?
No unanimous consensus, however, for certain procedures which involve local anesthesia, same day surgery may be appropriate.
Increased postoperative monitoring may be necessary.

In Summary

*Perioperative management of the patient with morbid obesity should include:*
Detailed preoperative assessment.
Using good judgment with regards to the type of procedures performed in an outpatient setting.
Limiting the use of opioids in the operating theater and use of pre-emptive analgesia.
Post operative use of devices such as CPAP

Consultant Opinions Regarding Procedures That May Be Performed Safely on an Outpatient Basis for Patients at Increased Perioperative Risk from OSA

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Anesthesia</th>
<th>Consultant Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial surgery/local or regional anesthesia</td>
<td>Agree</td>
<td></td>
</tr>
<tr>
<td>Superficial surgery/general anesthesia</td>
<td>Equivocal</td>
<td></td>
</tr>
<tr>
<td>Airway surgery (adult, e.g., UPPP)</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>Tonsillectomy in children less than 3 years old</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>Tonsillectomy in children greater than 3 years old</td>
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</tr>
<tr>
<td>Minor orthopedic surgery/local or regional anesthesia</td>
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<td></td>
</tr>
<tr>
<td>Minor orthopedic surgery/general anesthesia</td>
<td>Equivocal</td>
<td></td>
</tr>
<tr>
<td>Gynecologic laparoscopy</td>
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<tr>
<td>Laparoscopic surgery, upper abdomen</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>Lithotripsy</td>
<td>Agree</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion

- Patients with morbid obesity are a challenge with significant risk factors and hence good preoperative preparation is important.
- Intraoperative management should include a reduction of opioid use in favor of non-opioid analgesics.
- Careful post-operative management is important.
- Pain management is key to recovery from surgery and individuals may have different thresholds for pain, every effort should be made to reduce pain after surgery.