Mechanical Ventilation of Obese patient in the Perioperative Period

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JRUR, Marseille, France, 2012
Body mass index (BMI) and Waist measurement
The most common indicators of Obesity

\[
\text{BMI} = \frac{\text{Weight (Kg)}}{\text{Height}^2 (\text{m}^2)}
\]

Underweight: < 20
Normal: > 20 - < 27
Overweight: > 27 - < 30
Obese: > 30 - < 40
Morbidly Obese: > 40

Agenda

- Effects of Anesthesia on the Respiratory Function
  - Intraoperatively
  - Postoperatively

- Effects on Morbidity and Mortality

- Mechanical ventilation:
  - Optimizing pre-oxygenation
  - PEEP and recruitment

- Postoperative period
  - Prediction of PPCs
  - Positioning and Physiotherapy
  - Non invasive respiratory support
Obese’s Grave (III sec. B.C.)
Son of Velthur (“The Rich Man”)
Peri-operative respiratory modifications: Lung volume reduction and atelectasis

Pelosi P and Gregoretti C. Eur Crit Care 2010; 1: 1-8

Effects of anesthesia on lung morphology in obese patients

Lung volume as a function of obesity


$r = 0.86$
$p < 0.01$
IAP is the main determinant of lung volume

Damia, Br J Anaesth 1988; 60:574-578; Pelosi, Anesthesiology 1999; 91: 1221-1231

IAP: Normals 7 cmH2O - Obese 18 cmH2O

*p < 0.01 vs Before induction
Lung volume as a function of obesity


\[ \frac{P_{aO_2}}{P_{A\text{O}_2}} \text{ vs. BMI (kg} \cdot \text{m}^{-2}) \]

\[ r = 0.81, \quad p < 0.01 \]
Cst, rs as a function of BMI


$r = 0.86$

$p < 0.01$
IAP and chest wall mechanics in obese

Pelosi et al. Anesthesiology 1999; 91: 1221-1231

![Graph showing the relationship between intra-abdominal pressure (cmH₂O) and chest wall elastance (cmH₂O/L). The graph compares data from normal subjects (black dots) and obese patients (white circles). The correlation coefficient (r) is 0.94 with a p-value < 0.01.]
Rmax, rs as a function of BMI

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Obesity and post-operative atelectasis
Lung and Chest wall mechanics are impaired in obese
Partitioning of resistance in obese

Expiratory flow limitation in morbidly obese postoperative MV patients

Obesity Increases Post-Op Work of Breathing

Pelosi et al., Anaesth Analg 1998; Pelosi et al., J Appl Physiol 1996
Pelosi et al., Chest 1996; Pelosi et al., Acta Clin Belgica 2007
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Obese patients were more likely to have significant complications (ARDS and AKI) but there were no associations with increased mortality.
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Reverse Trendelenburg
Intubation at risk in anesthesia: the obese patient

Can we improve "the oxygen reserves" during the preoxygenation before a planned intubation in obese patient?

- Standard (balloon)
- CPAP-preOxy
- NIV (PSV+PEEP)-preOxy

VS
Noninvasive Ventilation and Alveolar RM Improve Respiratory Function During and After Intubation of Morbidly Obese Patients: a RCT

Futier E, Pelosi P, Jaber S et al. Anesthesiology 2011 114: 1354-1363
Noninvasive Ventilation and Alveolar RM Improve Respiratory Function During and After Intubation of Morbidly Obese Patients: a RCT

Futier E, Pelosi P, Jaber S et al. Anesthesiology 2011 114: 1354-1363
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Description of anesthesia practice of ventilatory management during general anesthesia in operating room

Prospective multicenter observational French study (Jaber S et al): 2961 patients from 49 anesthesia departments

PEEP and RM are rarely used, whatever the type of surgery
Tidal volume in obese in operating room?

423/2961 obese patients: 16%

VT measured

VT Calculated
Ideal Body Weight (IBW)
Recruitment Maneuvers in Morbidly Obese Patients During General Anaesthesia

Prevention of Atelectasis in Morbidly Obese Patients during General Anesthesia and Paralysis

Anesthesiology 2009; 111:979-987
Intraoperative Recruitment Maneuver Reverses Pneumoperitoneum-induced Detrimental Respiratory Effects in Obese and Non-obese Patients Undergoing Laparoscopy

Beach chair position and PEEP improve respiratory function in obese patients during PNP and general anesthesia

Valenza et al Anesthesiology 2007; 107:725–32
Prone position does not affect respiratory function in obese

Pelosi, Anesth Analg 1995;80:955-960; Pelosi, Anesth Analg 1996;83;578-583

* p < 0.01 supine vs prone

* FRC

* PaO₂

0 50 100 150 200 250

0 1 2 3 4

normal obese normal obese
Which ventilation setting in obese patients during general anesthesia?

Shultz MJ et al Anesthesiology 2007; 106;1226.1231


- Tidal Volume < 10 ml/Kg PBW
- Increase RR to control pHa/PaCO₂
- Plateau Pressure < 25-30 cmH₂O
- PEEP > 5 cmH₂O
- RM 35-40 cmH₂O – PEEP/VT – PC/VC
- Monitor Paw-Time/Check PEEPi
Recruitment Maneuver and PEEP are not effective during laparoscopic bariatric surgery

Whalen et al Anesth Analg 2006;102:298-305

- Vasopressors treatments were larger in RM/PEEP group
- The effects of RM/PEEP were promptly dissipated in the immediate postoperative period
Intraoperative Ventilatory Strategies for Prevention of Pulmonary Atelectasis in Obese Patients Undergoing Laparoscopic Bariatric Surgery

Alveolar-to-arterial oxygen gradient (mm Hg), 22 pts per group
Rationale and study design of PROVHILo - a worldwide multicenter randomized controlled trial on protective ventilation during general anesthesia for open abdominal surgery.

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**How to evaluate the risk of PPCs?**


13 % (score 26-44) – 54 % (score >45) risk to develop PPCs

<table>
<thead>
<tr>
<th>ARISCAT inclusion criteria</th>
<th>Criteria values</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative SpO2 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory infection (last month)</td>
<td>yes/no</td>
<td></td>
</tr>
<tr>
<td>Preoperative anemia (≤ 10 g/dL)</td>
<td>yes/no</td>
<td></td>
</tr>
<tr>
<td>Emergency procedure</td>
<td>yes/no</td>
<td></td>
</tr>
<tr>
<td>Surgical incision*</td>
<td>peripheral</td>
<td></td>
</tr>
<tr>
<td>Duration of surgery (hrs)</td>
<td>≤ 2/ &gt; 2 to 3/ &gt; 3</td>
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</tbody>
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*any procedure for open abdominal surgery requiring an incision up umbilicus, totally or in part. It includes either mid-line, subcostal, lumbotomy or any other.

Total risk score: [ ]

High or intermediate risk: ≥ 26
Eliminating respiratory intensive care unit stay after gastric bypass surgery

Hallowell PT et al Surgery 2007;142:608-12

Mandatory OSA screening and aggressive preoperative treatment have eliminated the need for respiratory-related ICU stays after bariatric surgery.

![Graph showing patients recovered in ICU (in %) for No OSA Screening and OSA Screening]
EuSOS: European Surgical Outcomes Study
Rupert M. Pearse, Andrew Rhodes, Rui Moreno, Paolo Pelosi, Claudia Spies, Benoit Vallet, Philip Metnitz, Peter Bauer and Jean-Louis Vincent

PERISCOPE study: predicting post-operative pulmonary complications in Europe
Jaume Canet, Jonathan Hardman, Sergi Sabaté, Olivier Langeron, Marcelo Gama de Abreu, Lluis Gallart, Javier Belda, Klaus Markstaller, Paolo Pelosi and Valentin Mazo
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Positioning at 45° promotes better VC (avoid 0° or 90°)

Conventional Physiotherapy


- Early Mobilization
- Deep-Breathing
- Cough
Early Mobilization
Efficacy of chest physiotherapy (coughing, deep breathing, early mobilization) after major abdominal surgery in obese


* p< 0.01 vs Control
Room and bed dedicated for morbidly obese patients
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Short term non-invasive ventilation post-surgery improves arterial blood-gases in obese subjects compared to supplemental oxygen delivery - a randomized controlled trial

Zoremba et al. BMC Anesthesiology 2011, 11:10
### Noninvasive ventilation for prevention of postextubation respiratory failure in obese


<table>
<thead>
<tr>
<th></th>
<th>NIV n=62</th>
<th>Control n=62</th>
</tr>
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<tbody>
<tr>
<td>Respiratory Failure (n, %)</td>
<td>6(10)</td>
<td>16(26)</td>
</tr>
<tr>
<td>ICU Stay (Days)</td>
<td>11.8</td>
<td>18.2</td>
</tr>
<tr>
<td>Hosp Stay (Days)</td>
<td>20.6</td>
<td>26.0</td>
</tr>
<tr>
<td>Hosp Mortality (%)</td>
<td>16(4/25)</td>
<td>50(11/22)</td>
</tr>
</tbody>
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*in hypercapnic pts*
Thou seest I have more flesh than another man, and therefore more frailty

King Henry the Fourth, Part I - Act III, Scene III

Thanks!