Objectives

- Definition
- Epidemiology
- Perioperative Outcomes in Patients with PHTN
- Link Between OSA, Obesity and PHTN
- Effect of Surgery on PHTN
- Potential Efficacy of Disease Specific Interventions
- Conclusions
Definition and Classification

Definition

- PHTN = mean PAP at or above 25mmHG at rest or 30mmHG with exercise
  - Mild = 25-40mmHg
  - Moderate = 41-55mmHg
  - Severe = > 55mmHg


Epidemiology

The link between OSA, Obesity and PHTN

- Risk Factors include advanced age, OSA and obesity
- All very prevalent in orthopedic pts
- Prevalence
  - 6% of pts over 50 years
  - 5% of pts with BMI over 30kg/m2
  - 17-52% of OSA pts
  - Among those with PHTN 45% have OSA
- Estimates suggest that 2.5Million pts with OSA have PHTN in US alone

Bach F. Thorax 2003;58:954-959
Krieger J. Chest 2006;130:226-237
Cianciulli A. Chest 2006;130:1863-1866

Pathophysiology
Mechanism

- TEE in N=112 overweight or obese and referents (BMI <25 kg/m²), with or without OSA.

- RV systolic (sm) and diastolic (em) velocities and strain indexes.

Conclusions:

- Increasing BMI is associated with increasing severity of RV dysfunction in obese subjects, independent of sleep apnea.

- OSA decreases RV dysfunction in setting of obesity.
Table 8. Changes of pulmonary artery systolic pressure in OSA patients

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of patients, n</th>
<th>Pulmonary artery systolic pressure (mmHg)</th>
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</thead>
<tbody>
<tr>
<td>Control</td>
<td>35</td>
<td>12±5</td>
</tr>
<tr>
<td>Mild</td>
<td>33</td>
<td>28±6</td>
</tr>
<tr>
<td>Moderate</td>
<td>47</td>
<td>30±6*</td>
</tr>
<tr>
<td>Severe</td>
<td>41</td>
<td>35±11**</td>
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</table>

*P<0.05 (vs. mild) **P<0.01 (vs. moderate)

70% PTHN

Perioperative Outcomes
Perioperative Mortality in Patients with Pulmonary Hypertension Undergoing Major Joint Replacement

Perioperative Outcomes after Unilateral and Bilateral Total Knee Arthroplasty

Table 1. Risk factors for Bernoulli mortality after Total Knee Arthroplasty

Perioperative Insults Worsening PHTN
Perioperative Insults Worsening PHTN

- Hypoxemia
- Hypercapnia (hypoventilation, CO2 peritoneum)
- Acidosis
- Hypothermia
- Hypervolemia
- Increase in intrathoracic pressure (mechanical ventilation/pneumoperitoneum)
- Insufficient anesthesia and analgesia/sympathetic surges

PHTN in Orthopedic Patients
Pathophysiology

Orthopedic Pathophysiology

Almost 100% of the time

**Perioperative Pulmonary Circulatory Changes During Bilateral Total Hip Arthroplasty Under Regional Anesthesia**


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**Urine Desmosine as a Marker of Lung Injury Following Total Knee Arthroplasty. A Pilot Study**

Memtsoudis et al., *HSS J* 2009;5:154-8

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**Hemodynamic Response to Dynamic Changes in Upper Airway Impedance – A Volunteer Study**

*J Anesth Clin Res* 2015, 4:5
So what do I do?

Difficulty diagnosing

- “Double occult disease” – majority of OSA patients is undiagnosed at time of surgery
- and PHTN is an occult disease
- Technically difficult to do echo in obese patients
- Ortho patients often physically not able to tolerate exercise, i.e. 6 min walk test.
Preoperative Treatment
Impact of Disease Specific Interventions on PHTN in OSA and Obese Patients

- N=23 OSA patients, 10 PHTN
- 3 months CPAP

- 20% with OSA had PHTN that was clinically mild (mean PAP, 25.6 mm Hg).
- PHTN pts were older and increased BMI
- 6 months of CPAP treatment was associated with reductions in mean PAP in OSA pts with PHTN (25.6 ± 4.0 to 19.5 ± 1.5 mm Hg) and those without PHTN (14.9 ± 2.2 to 11.5 ± 2.0 mm Hg).

**Effect of continuous positive airway pressure treatment on pulmonary artery pressure in patients with isolated obstructive sleep apnea: a meta-analysis**

<table>
<thead>
<tr>
<th>Study name</th>
<th>Baseline</th>
<th>Lower</th>
<th>Upper</th>
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<th>Lower</th>
<th>Upper</th>
<th>Total</th>
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<th>Upper</th>
<th>Total</th>
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<td>Cohen et al. 2012</td>
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<td>Melamed et al. 2015</td>
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<td>Paganini et al. 2005</td>
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</table>

*Correlation results: correlation coefficient for study slope was 0.33 (p = 0.33)*

**Effect of Bariatric Surgery on Obstructive Sleep Apnea and Hypopnea Syndrome, Electrocardiogram, and Pulmonary Arterial Pressure**

*Matilde Valencia-Flores, PhD; Arturo Orea, MD; Miguel Herrera, MD, PhD; Victorio Santiago, MS, Verónica Rebollar, MD; Lidia A. Castella, MS; Jorge Oseguera, MD; Jorge Pérez, MD; Jorge Samano, MS; Montserrat Rosadó, MS; Guillermo García-Costa, MD*

**Pulmonary Artery Pressure**

Before surgery, 28 patients (96.5%) presented pulmonary arterial hypertension (range 31.0-89.5 mmHg). After surgery, it completely resolved in only 4 patients. However, mean SPAP significantly decreased in the group of obese patients in whom OSAHS resolved after surgery from a mean of 61.4±15.8 mmHg to a mean of 42.0±9.2 mmHg. In

**Anesthetic Care**
Neuraxial vs. General

Neuraxial/General vs. General

Table 1: Patient recommendations for the human and social and ethical considerations for the postoperative management of patients with severe pulmonary hypertension.

- Established cooperation with cardiologists and pulmonologists
- Achieve specific evaluation for the treatment of pulmonary hypertension
- Experience in all areas of general surgical outpatient services
- Expertise in dealing with pulmonary arterial hypertension and the use of inhalation drugs for selective pulmonary vasodilators
- Invasive hemodynamic echocardiography
- Intermittent arteriography in the ICU
- Interval examinations in the ICU
- Intensive care with special experience in the treatment of pulmonary hypertension
- Regular patient and family follow-up for the perioperative period
Summary

- PHTN is common in patients with OSA and obesity.
- The underlying pathophysiology of each disease process may be synergistic and potentially additive in the development of PHTN.
- A high level of suspicion is needed for diagnosis and referral to expert care is advised.
- PHTN is associated with adverse perioperative outcomes.
- PHTN can worsen perioperatively due to a number of mechanisms.
- The treatment of obesity and OSA may reduce the severity of PHTN and potentially cure it.