



Perioperative Medicine Summit

Evidence Based Perioperative Medical Care

Rapid Fire

Answering challenging,
common clinical questions

Perioperative Management of Pulmonary Hypertension

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Disclosures

- Dr. Smetana reports no potential financial conflicts of interest

Learning Objectives

- What perioperative risks are associated with pulmonary hypertension?
- What perioperative evaluation and risk reduction strategies are recommended for pulmonary hypertension patients?

ARS Question

Which of the following statements regarding pulmonary hypertension is true?

1. It does not impact postop mortality rates
2. The impact on surgical risk depends on the etiology of the pulmonary hypertension
3. Morbidity rates are high even when surgery performed in specialized center
4. 6 minute walk test identifies patients at higher risk

Classification of Pulmonary HTN: Selected Etiologies

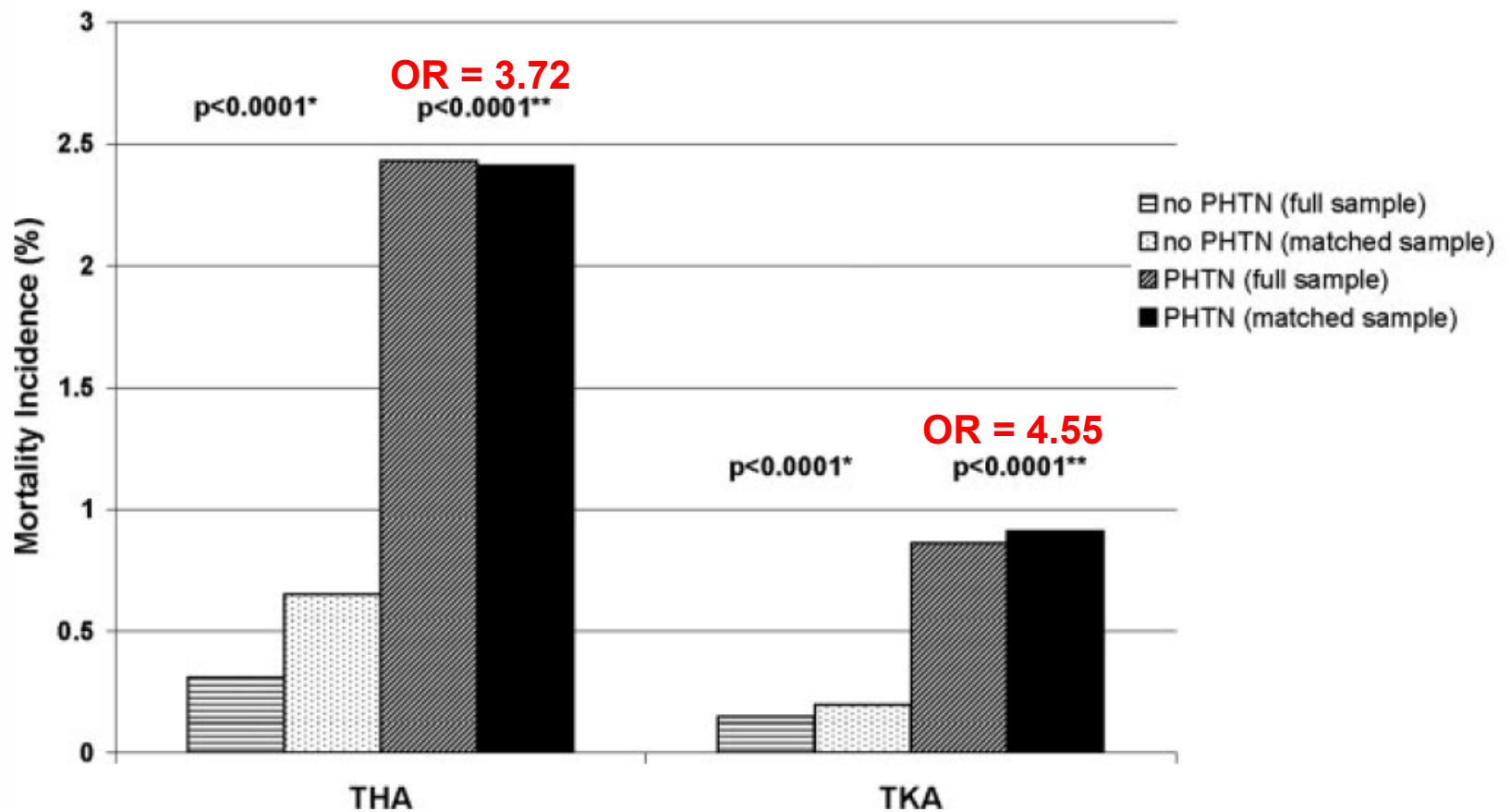
1. Pulmonary artery hypertension
 1. Idiopathic
 2. Congenital heart disease
 3. Connective tissue dz or other systemic illness
2. Left heart disease
3. Pulmonary disease and/or hypoxemia
 1. COPD
 2. OSA
4. Thromboembolic disease

The Initial Flag Raised: What is the Impact of Pulmonary Hypertension on Surgical Morbidity?

- National Inpatient Sample (NIS) data
- 20% stratified sample of patients in ~1000 hospitals
- All admissions from 1998-2006
- Procedure code for TKR or THR
- Categorized patients as primary or secondary pulmonary HTN by ICD-9 codes
- Matched sample of patients without disease (1:3 matching)
- Patient data on comorbidity index, demographics
- Health care system data
- Inpatient mortality as 1^o outcome
- 2^o outcomes ARDS, PE, DVT
- Multivariable analysis

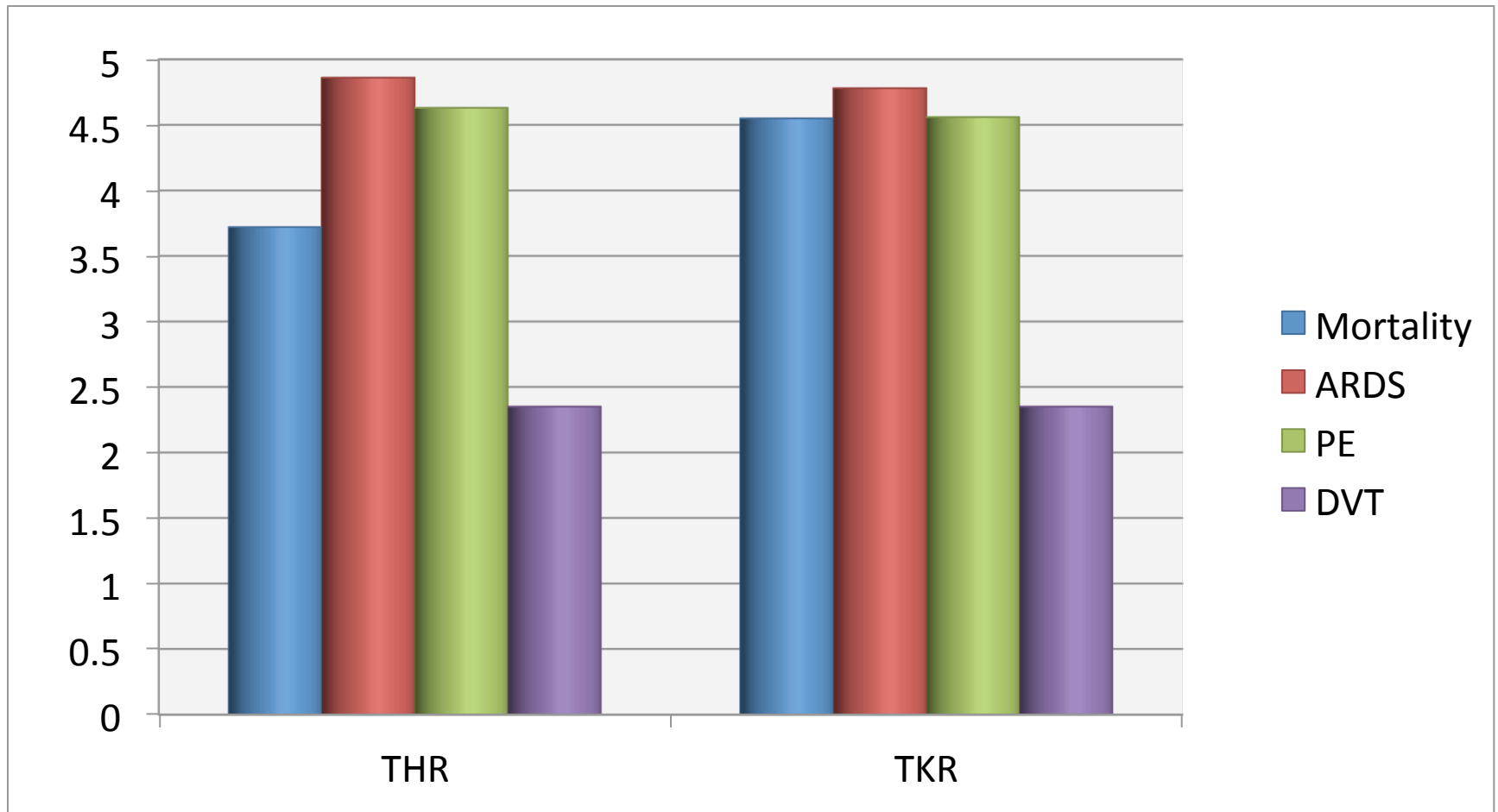
Pulmonary Hypertension Increases Mortality after Major Orthopedic Surgery

Mortality by PHTN Status and Procedure Type

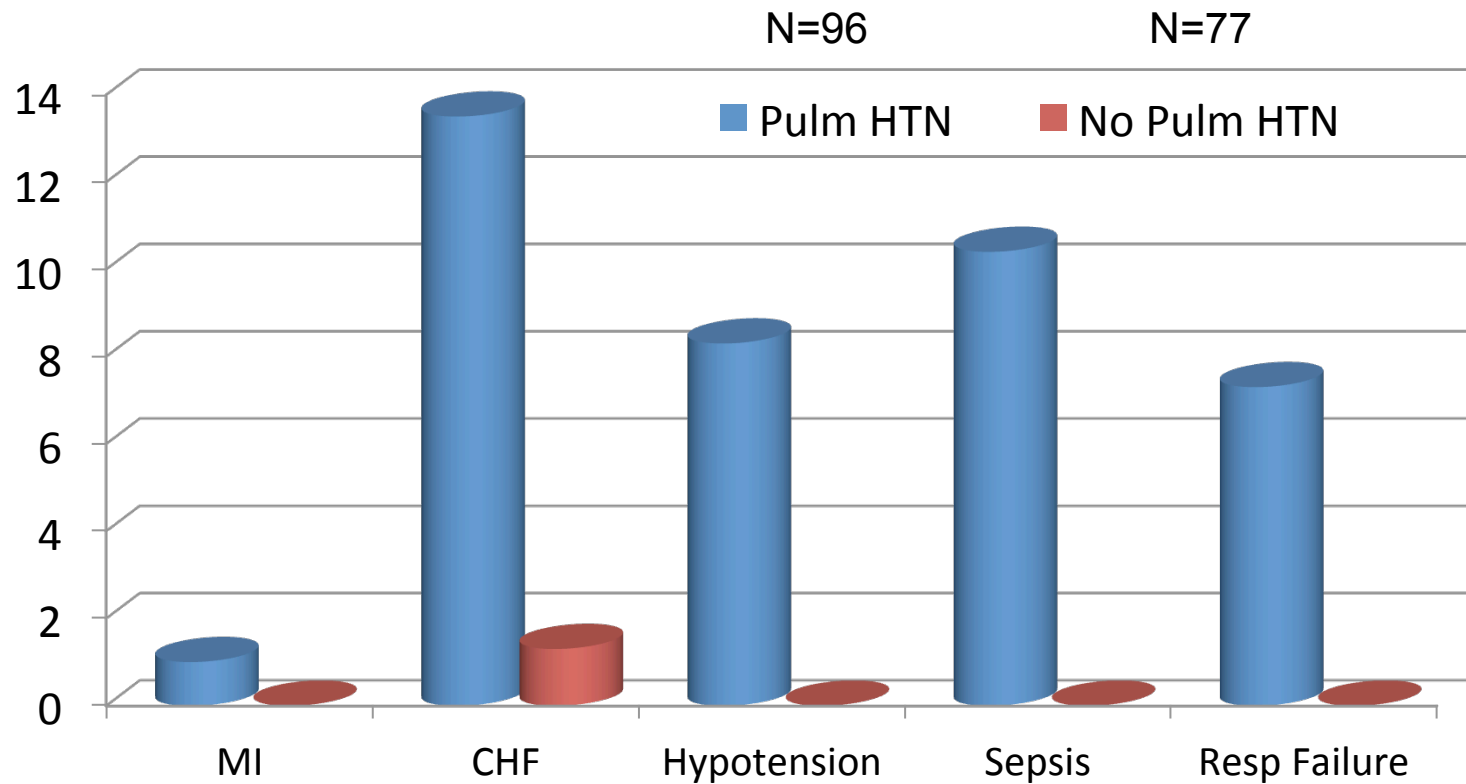


Higher Rates of Multiple Morbidities if Pulmonary Hypertension

Odds Ratio for Outcome if Pulmonary Hypertension



Pulmonary HTN by Right Heart Cath (rather than echo): Increased Morbidity c/w Matched Controls



How About CABG?

- 287 patients with pulmonary hypertension
- 69 with complete f/u data studied
- Pulmonary HTN = Preop echo PA mean pressure \geq 30 mm Hg
- Comorbidities common: 51% smokers, 26% diabetes, 46% hypertension, 61% prior MI
- Mean f/u 34 months

CABG is Generally Safe: AF is Most Common Adverse Event

Event	% Patients
New onset AF	14%
ICU inotrope requirement	13%
AKI	6%
Respiratory failure	3%
Pneumonia	0
30 Day mortality	0
Late mortality (> 30 days post d/c)	6%

Does the Society of Thoracic Surgeons risk score accurately predict operative mortality for patients with pulmonary hypertension?

- Single center, retrospective study of 3343 cardiac surgery patients over 15 years
 - Only included patients with a calculated STS risk score and immediate preoperative mean pulmonary artery pressure invasive measurement
- Outcomes:
 - Primary: 30-day mortality
 - Secondary: length of stay (LOS) & 30-day morbidity (composite of postop stroke, MI, renal failure, prolonged ventilation & pneumonia)

STS Score Less Useful than PA Pressure

RESULTS

- Comorbidities increase with increased pulmonary artery (PA) pressure
- Complications & LOS increase with increased PA pressure
- STS predicted risk of mortality increases with increasing PA pressure
- Mortality increases with increasing PA pressure and more than predicted by STS score

Multivariate Analysis: PA Pressure Correlates with Morbidity and Mortality

Mean PA pressure (mm Hg)	Odds Ratio (95% CI)	
	Mortality	Major Complications
<25	1	1
25-34	1.74 (0.95-3.18)	1.47 (1.16-1.86)
35-44	11.5 (4.97-26.7)	7.19 (4.82-10.7)
>44	38.9 (13.9-109)	9.02 (4.42-18.4)

Other Studies in Cardiac Surgery

- No impact on 30-day mortality for patients undergoing mitral valve repair for MR
 - Ann Thorac Cardiovasc Surg 2015;21:53
- Exercise induced pulmonary HTN (> 60 mm Hg) in asx or mildly symptomatic patients undergoing mitral valve surgery increases MACE rates (39% vs. 12%)
 - Heart 2015;101:391

How to Manage Risk? Morbidity Lower for Surgery in Specialized Centers

- Prospective study
- 114 patients from 7 specialized centers
- Diagnosis confirmed by right heart cath
- 50 % idiopathic pulmonary HTN
- Relative healthy: 54% NYHA Class I or II
- 89% elective surgery
- Most patients on drug therapy for pulm HTN

Univariate Risk Factors for Postop Complications: Only 7 Complications Among 114 Patients

Risk factors

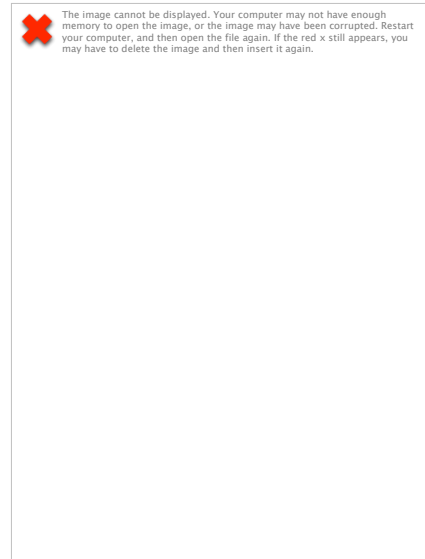
1. 6 minute walk distance
2. Mean right atrial pressure
3. Mixed venous O₂ saturation
4. Vasopressor requirement
5. Emergency surgery

Conclusions:

- Both functional impairment and physiologic variables influence risk
- Complication rate lower in specialized centers for patients on drug therapy for pulm HTN

Anesthesiologist's Considerations: Preop Hemodynamic Goals

- MAP \geq 55 to 60 mmHg
- SBP \geq 80 mmHg
- O₂ sat 92% to 100%
- RAP < 10 mmHg
- MPAP < 35 mmHg
- PVR/SVR ratio < 0.5 (if possible)
- PCWP 8 to 12 mmHg
- Cardiac index \geq 2.2 L/min/m²



Perioperative Strategies to Minimize Pulmonary Vasoconstriction

Avoid pulmonary vasoconstrictors

- Hypoxemia
- PEEP > 15
- Hypercapnia
- Acidosis

Promote pulmonary vasodilatation

- Permissive hypercapnia to pCO₂ 30-35 range
- Alkalosis pH > 7.4

Implications for Practice



- Both primary and secondary pulmonary HTN are major risk factors for death, ARDS, and VTE
- Proceed to surgery only if indication for surgery compelling and no lower risk alternatives
- Unknown if clinically inapparent disease confers same risk : probably not
- Unknown if we should screen for pulmonary HTN before surgery
- Interdisciplinary collaboration is important to improve patient safety in periop period
- Optimally patients at high risk should receive drug Rx and monitoring in specialized centers