

# Pulmonary Hypertension Perioperative Management

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# Introduction

## *Definition of Pulmonary Hypertension*

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- Increased Mean Pulmonary Arterial Pressure
  - mPAP > 25mmHg at Rest
    - Normal: 14 (11-17) mmHg
  - mPAP > 30 mmHg
    - Dropped from Definition
    - Found in Many Normal Patients

McLaughlin et al., Circulation 2009; 119:2250  
Kovace et al., Eur Respir J 2009; 34:888

# Introduction (cont.)

## *Types of Pulmonary Hypertension*

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- Pulmonary Arterial Hypertension
- With Left-Sided Heart Disease
- With Lung Disease/Hypoxemia
- Due to Chronic Thrombosis/Emboli
- Miscellaneous
  - Sarcoidosis, Histiocytosis X, Lymphangiomatosis, Compression of Pulmonary Vessels (Adenopathy, Tumor, Fibrosing Mediastinitis)

# Pulmonary Arterial Hypertension

## *Etiology*

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- Idiopathic
- Familial
- Associated with Diseases/Conditions
  - Collagen Vascular Disease, Congenital Shunts, Portal Hypertension, HIV, Drugs/Toxins, Miscellany
- Venous or Capillary Disease
- Persistent PAH of the Newborn

# Pulmonary Arterial Hypertension (cont.)

## *Lung Diseases*

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- COPD
- Interstitial Lung Disease
- Sleep-Disordered Breathing/Obstructive Sleep Apnea
- Alveolar Hypoventilation
- Long-Term Exposure to High Altitude
- Developmental Abnormalities

# Natural History

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- Median Life Expectancy
  - 2.8 years
- Prevention
- Screening of High Risk Patients
  - Family History
  - Congenital Heart Disease
  - Connective Tissue Disease
  - Symptoms of PAH

# Pulmonary Hypertension

## *Therapeutic Options*

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- Reversal of Hypoxemia
- Management of Left Heart Failure
- Vasodilators
  - Calcium Channel Blockers
  - Prostacyclin Analogues
  - Endothelin Receptor Antagonists
  - PDE-V Inhibitors

# Pulmonary Hypertension (cont.)

## *Therapeutic Options*

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- Calcium Channel Blockers
  - Nifedipine, Diltiazem, Amlodipine
  - Minimally Effective in Treating PAH
- Prostacyclin Analogues
  - Epoprostenol (Intravenous)
  - Treprostinil (Oral and Intravenous)
  - Iloprost (Inhaled)
- Endothelin Receptor Antagonists
  - Bosentan (Oral)
- PDE-V Inhibitors
  - Sildenafil



# Perioperative Risk

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- Marked Increase in Risk
  - 29% Complication Rate
  - 4/28 Mortality
  - Mild to Moderate Pulmonary Hypertension
- Emergency Procedures, Major Surgery, Long Operative Times Increase Risk

# PAH Perioperative Management

## *Assessing Risk*

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- Contraindication to Liver Transplantation
- Thoracic Surgery
  - Changes in Lung Volume, Intrathoracic Pressure, Oxygenation
  - Acute Changes in PVR and RV Function
- Laparoscopy
  - Decrease Preload, Increased Afterload
- Rapid Intraoperative Blood Loss
- Peripartum
  - Therapy Decreases Mortality (38% to 25%)

Ross Curr Opin Anesthesiol 2010; 23:25  
Pedoto Curr Opin Anesthesiol 2010; 22:44  
Bedard Eur Heart J 2009; 30:256

# Pulmonary Hypertension (cont.)

## *Effect on Outcomes*

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- 145 Patients
  - Retrospective Analysis
  - Non-Cardiac Surgery
  - General Anesthetic
- 42% Short-Term Morbid Events
  - Respiratory Failure (28%)
  - Cardiac Dysrhythmia (12%)
  - Congestive Heart Failure (11%)
- 7% (n=10) Death Within 30 d
  - Respiratory Failure (60%), RV Failure (50%)

# Pulmonary Hypertension (cont.)

## *Effect on Outcomes*

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- Thoracic Surgical Patients
  - 61.5% Morbidity
- Orthopedic Surgical Patients
  - 48% Morbidity
- Gynecologic/Urologic/Plastic/Breast Surgical Patients
  - 16.7% Morbidity

# Pulmonary Hypertension (cont.)

## *Effect on Outcomes*

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- 173 Patients; 96 PAH, 77 Control
- Non-Cardiac Surgery
- PAH Significant Risk for
  - Congestive Heart Failure
  - Sepsis
  - Respiratory Failure

# Pulmonary Hypertension (cont.)

## *Effect on Outcomes*

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- RVSP/SBP Ratio
  - >0.66 Associated with Short-Term Morbidity
- CHF Most Frequent Post-Operative Event
- Patients More Likely to Require Post-Operative ICU Care
- Patients More Likely Readmitted to Hospital Within 30 d

# Pulmonary Hypertension (cont.)

## *Preoperative Assessment*

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- Evaluation of Symptoms
  - Functional Capacity
- ECG, Chest Radiograph, Echocardiogram
- Arterial Blood Gas

# Pulmonary Hypertension (cont.)

## *Preoperative Assessment*

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- Evaluation for RV Dysfunction
  - Right Heart Catheterization
  - Re-Evaluation of Surgery
- Aggressive Intervention
  - COPD Patients
    - Supplemental Oxygen
    - Bronchodilators
    - Antibiotics
    - Steroids
  - Cardiac (LV Dysfunction) Patients
    - Inotropes
    - Vasodilators



# Perioperative Management

## *Anesthetic Technique*

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- Maintain Preload and SVR
  - Maximize Cardiac Function
  - Maximize Right Heart Perfusion
    - Systolic to RV Systolic Gradient
- Prevent Increases in PVR
  - Hypoxia, Hypercarbia, Acidosis, Agitation, Pain, Hypothermia
- Aggressive Treatment of Hypotension
  - Vasoconstrictors
  - Inotropic Support
- Modulation of PVR in RV Failure
  - Inhaled Prostaglandins (Iloprost)

# Perioperative Management (cont.)

## *Anesthetic Monitoring*

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- Intermediate to High Risk Procedures
  - Thoracotomy/Thoracoscopy
  - Prolonged Laparoscopy
  - Open Intra-Abdominal Procedures
- Invasive Monitoring
  - Pulmonary Artery Catheter
  - Transesophageal Echocardiography
- Intensive Therapy
  - Inhaled Iloprost
  - Inhaled Nitric Oxide
  - Intravenous Prostacyclin
  - Inotropic Therapy to Maintain RV Perfusion/Cardiac Function