Obstetric Anesthesia Management for Delivery in the Severe Pulmonary Hypertensive Patient

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Cardiac Problems in Pregnancy
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Pulmonary Hypertension & Pregnancy Mortality

- Weiss[1] 1978 – 1996
  - **30% – 56% mortality**

- Bedard[2] 1997-2007
  - **17% – 33% mortality**

Outline

Who anesthetically cares for patients with severe PAH

How do anesthesiologists categorize PH

What acutely worsens PAH

How should these patients be anesthetized & monitored

Where should these patients recover

Who cares for these patients during delivery?

Cardiac anesthesiologists

Sub-Sub-specialize your cardiac anesthesiologists

WHO Classification

Group 1 – Pulmonary Arterial Hypertension (PAH)

Group 2 – PH due to left heart disease

Group 3 – PH due to chronic lung disease and/or hypoxemia

Group 4 – Chronic thromboembolic PH

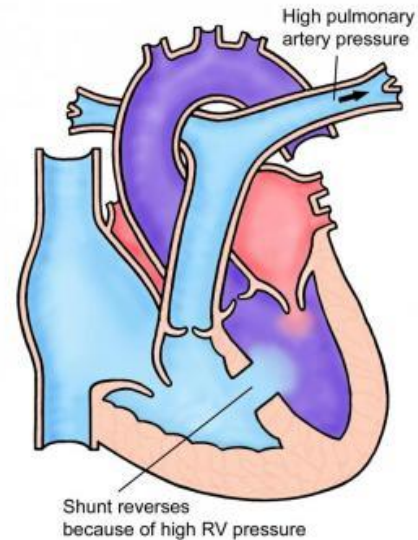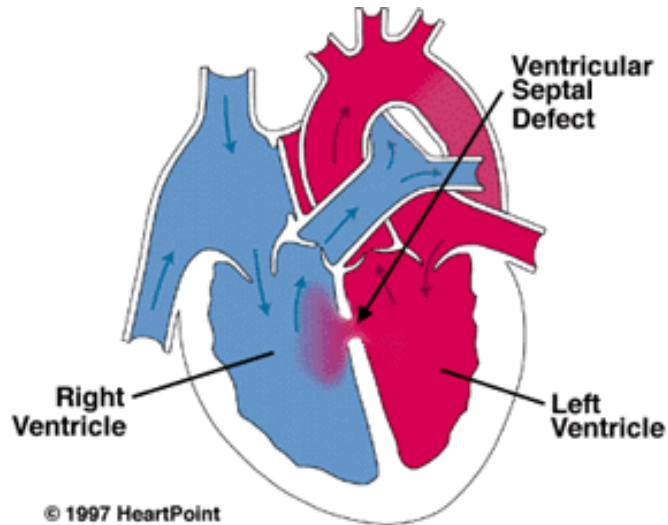Group 5 – PH due to unclear multifactorial mechanisms

Anesthesiologist's classification

- Is this venous congestion (LV failure) or **pulmonary arterial hypertension** (RV failure)?

- Is there actually **RV failure**?

- Do they **shunt**?

- Can we pharmacologically **vasodilate** the pulmonary vascular further?
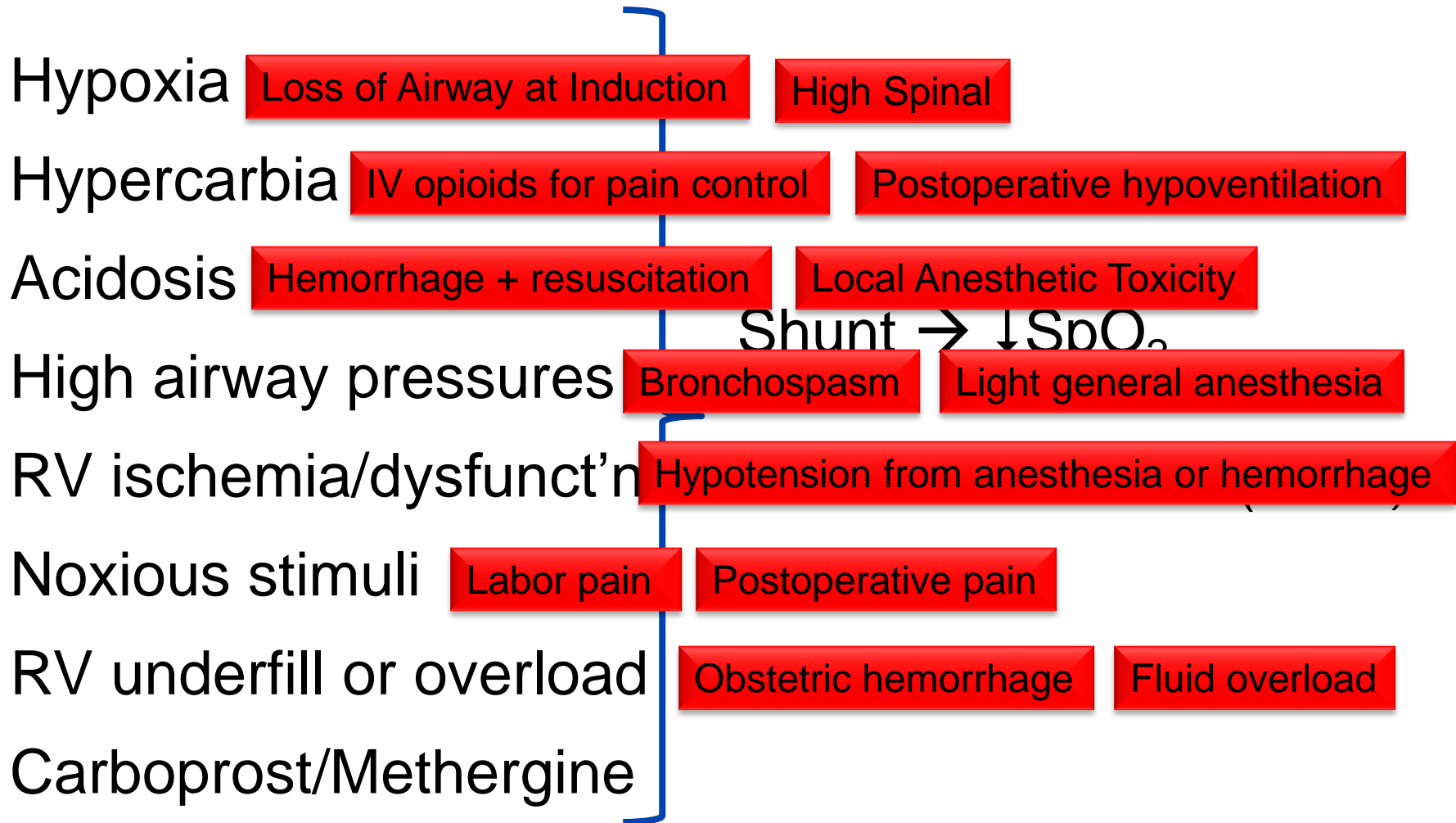
Anesthetic management of shunts

For blood oxygenation:

- Keep systemic blood pressure ↑
- Keep pulmonary pressure ↓

Continuous pulse oximetry + vasoconstrictors = priceless

What acutely worsens pulmonary HTN?

Hypoxia Loss of Airway at Induction   High Spinal

Hypercarbia IV opioids for pain control   Postoperative hypoventilation

Acidosis Hemorrhage + resuscitation   Local Anesthetic Toxicity

Shunt → ↓SpO$_2$

High airway pressures Bronchospasm   Light general anesthesia

RV ischemia/dysfunct'n Hypotension from anesthesia or hemorrhage

Noxious stimuli Labor pain   Postoperative pain

RV underfill or overload Obstetric hemorrhage   Fluid overload

Carboprost/Methergine

RV coronary perfusion $\cong$ aortic – RV intramural pressures

PAP $\uparrow$ → RV intramural pressures $\uparrow$

RVSP approaches aortic pressures → RV coronary filling *only* during diastole

RV fails → RVEDP $\uparrow$ → diastolic coronary filling $\downarrow$

Bleed →Hypotension

Hypoxia

Hypercarbia→$\uparrow$ PAP

RV ischemia

RV vol overload →LV CO

Worsening RV function

$\downarrow$ Cardiac output

$\downarrow$ Systemic BP

$\downarrow$ RV perfusion

DEATH

Minai OA, et al. Chest 2013; 144: 329-340
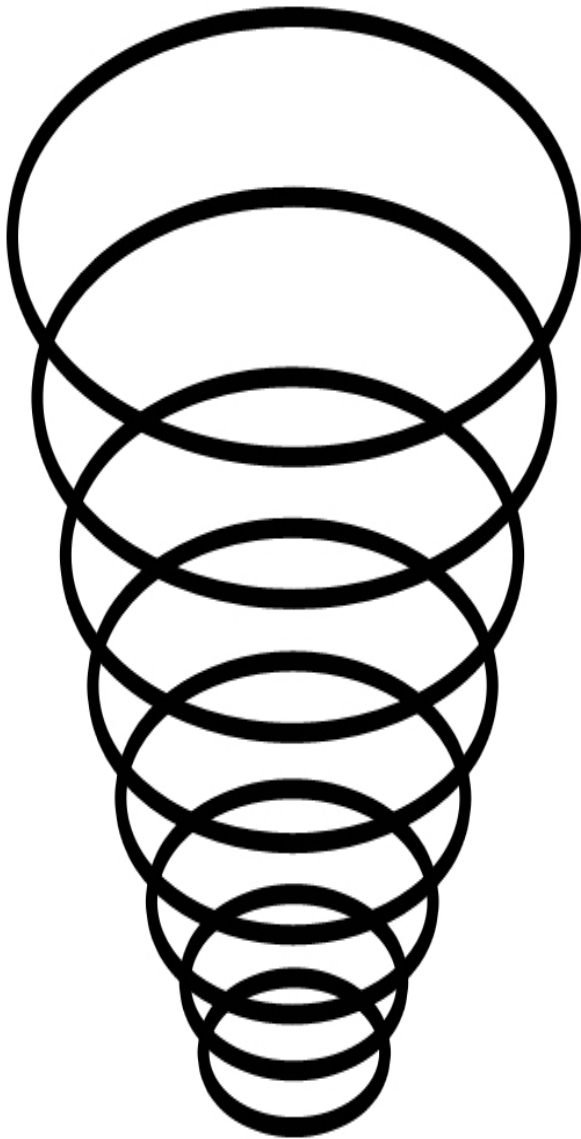
There's no room for anesthetic mistakes

There's no room for obstetric complications

CPR is rarely successful in PAH:
6% survival[1]

1 Hoeper et. al. Am J Respir Crit Care Med 2002; 165: 341.

I) General Physiologic Considerations
- Continue pre-operative PH specific medications
- Optimize fluid balance
  - Avoid low and excessive volume
- Ensure adequate pain control
- Maintain systemic perfusion pressure
  - Avoid systemic vasodilators
  - Maintain sinus rhythm
  - Use pressors if necessary
- Minimize increases in RV afterload
  - Correct hypoxemia and acidosis
  - Pulmonary specific vasodilators may be useful
- Prevent and aggressively treat RV ischemia and failure (see Figure 4)

II) Intubation
- Use opioids, midazolam, or etomidate to minimize sympathetic and cardio-respiratory response
- Rapid sequence intubation to avoid respiratory acidosis
- Be prepared for systemic hypotension post-intubation due to preload dependency

III) Induction
- Opioids, lidocaine permissible
- Muscle relaxants are safe

IV) Maintanence
- Volatile anesthetic agents may be used
- Opioids and muscle relaxants should be used

V) Mechanical Ventilation during Anesthesia
- Use lung protective strategy with low tidal volume (6 mL/kg and plateau pressure <30 cm H_2O)
- Optimize oxygenation by relying on increases in FiO_2 rather than PEEP
- Use PEEP judiciously and avoid compromising pre-load and causing systemic hypotension

VI) Monitoring
- Systemic blood pressure - arterial line preferred to non-invasive monitoring in unstable patients
- Central venous pressure or PA catheter monitoring (see text for details)
- Mixed venous O_2
- Trans-esophageal echocardiography (see text for details)

Minai OA, et al.
Chest 2013; 144: 329-340

Acute Pulmonary Arterial Dilatation Agents

- Phosphodiesterase inhibitors
  - Sildenafil (IV)
  - Milrinone (IV)

- Prostacyclin analogues
  - Epoprostenol (IV)
  - Iloprost (inhaled)

- Nitric oxide (inhaled)

- Endothelin receptor antagonists
 - Tezosentan (IV).....?

Labor Management

- In severe pulmonary hypertension, be *very cautious*

- Early epidural, dosed slowly (anticoagulation?)

- No intravenous opioids

- Air filters on lines

- Monitoring:
  - 5-lead ECG, continuous pulse ox., arterial line
  - ICU/CCU RN

- Any complication of labor will be tolerated *poorly*:
  - Hypotension, vagal response, breakthrough pain, postpartum hemorrhage

- Oxygen throughout labor

Cesarean Management

- Carefully dosed epidural

- Sickest patients → General Anesthesia

- Monitoring:
  - Standard ASA monitors
  - Arterial line
  - Pulmonary artery catheter
    - If titrating pulmonary vasodilating agents
    - Placed in CV surgery suite by cardiac anesthesiologist

PA Catheters and TEE can determine acute treatment
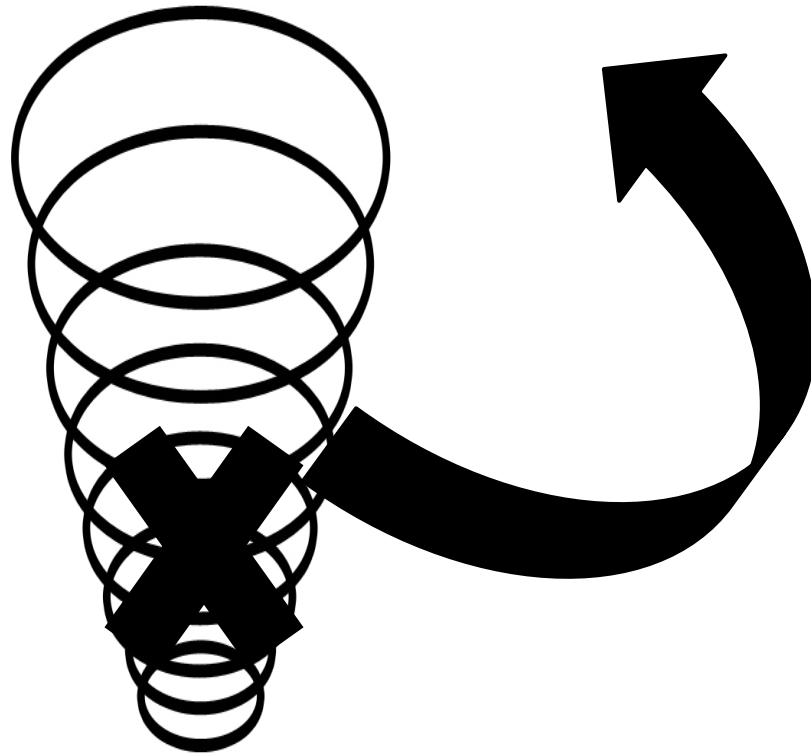
Recovery

Causes of death in systematic review (n=17 deaths)*

6 pulmonary embolism	5 within first 3 days
3 postpartum hemorrhage	8 within first 7 days

78% of deaths occurred in the first month

- Recommendations:
  - ICU or CCU monitoring
  - Maintain PA catheter first 24-72hrs if present
  - DVT/PE prophylaxis
  - Prophylax & monitor closely for postpartum hemorrhage

Thank you!

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