**Pulmonary Issues in Cardiac Patients**

**LIMA/RIMA Complications:**
- Phrenic nerve devascularization – LIMA
  - Can cause inability or delayed vent weaning
- Spasm (ST segment changes)
  - Diltiazem or Nitroglycerin
- Steal syndrome
- Sternal ischemia
- Brachial plexus injury
  - Limp or paralyzed arm, lack of muscle control in upper extremity
- Pulmonary complications due to pleural dissection
  - Pleural effusion

**Phrenic Nerve Injury Causes**
- Cold injury to nerve from cardioplegia solution
- Surgical trauma during takedown of IMA

**CABG x 4 with Post op CXR**
- Elevated right diaphragm

**Acute Resp Failure R/T phrenic nerve injury**
- Phrenic nerve is responsible for diaphragmatic contraction
- Phrenic nerve injury may be associated with unilateral or bilateral neuropathy or paralysis
- With partial injury of one or both phrenic nerves lower lobe atelectasis may occur – esp on the left side
  - Delay of weaning
  - Decreased ability to clear secretions

**Phrenic Nerve Injury**

**Unilateral**
- Few respiratory symptoms
- Nocturnal orthopnea
- Dyspnea on exertion
- Patients can be extubated without difficulty

**Bilateral – rare & serious**
- Paradoxical breathing
- Tachypnea
- CO2 retention when attempts are made to wean & extubate
- CXR may show elevated hemidiaphragm at end expiration of spontaneous ventilation (won't see if patient is on the vent)
Phrenic Nerve Treatment
- Usually resolves in 3 – 12 months but may take 2 years
- Plication of the diaphragm – attempts to stabilize the diaphragmatic muscle and prevents paradoxical motion with breathing

Management of Recovery from Anesthesia

Hand Off Communication
- Vital information exchanged between the anesthesia provider and ICU RN

Immediate postop care Objectives
1. Maintenance of cardiac output
2. Maximization of tissue perfusion

Induction Agents
Augment the effects of inhalation agents

<table>
<thead>
<tr>
<th>Barbiturates</th>
<th>Nonbarbiturates</th>
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<tbody>
<tr>
<td>• Depress the CNS</td>
<td>• Etomidate</td>
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<tr>
<td>• Cause respiratory depression</td>
<td>- Hypnotic agent – no analgesic effects</td>
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<tr>
<td>• Thiopental sodium</td>
<td>- Agent of choice in pt with CV instability as less likely to cause hypotension.</td>
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<tr>
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<td>• Propofol (Diprivan)</td>
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Benzodiazepines
- Midazolam (Versed)
  - Watch for resp depression
  - May be used for post op N/V
  - Reversed with Flumazenil (Romazicon)

Inhalation Agents
- Cause circulatory depression and hypotension as result of vasodilation & ↓ contractility
- Observe for Ventricular ectopy (VT/VF)
- Don’t have analgesic properties

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<td>• Etomidate</td>
</tr>
<tr>
<td>- Respiratory depressants</td>
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<td>- Agent of choice in pt with CV instability as less likely to cause hypotension.</td>
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<td>• Propofol (Diprivan)</td>
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<td>- Enflurane has residual</td>
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CNS depressant effects
Neuromuscular Blocking Agents (NMBA)
- Adjunct to inhalation agents
- Provide relaxation of skeletal muscles
- Facilitate intubation
- Decrease shivering
- Effects prolonged in pt with severe liver disease
- No amnesic or analgesic effects
- Do not cause LOC

Rocuronium
Vecuronium
Succinylcholine
Inadequate reversal may cause return paralysis in the early postop period

Opioids
- Analgesic or induction agent
- Decrease response and perception to pain
- Monitor for bradycardia
- Post op N/V common SE
- Fentanyl

Post op Nausea/Vomiting (PONV)
- ↑ risk of aspiration
- Disrupts surgical repairs secondary to retching
- ↑ post op bleeding
- Causes electrolyte imbalances/dehydration
- May cause esophageal tears

Post operatively, use antiemetics
- Ondansetron (Zofran)
- Promethazine (Phenergan)
- Prochlorperazine (compazine)

Thermoregulation (hypothermia)
- Alters drug metabolism causing delays in emergence fro anesthesia
- Causes a disruption of the coagulation pathway; ↑ the need for blood transfusions
- Delays wound healing; ↑risk of surgical site infections
- Causes shivering → ↑ myocardial oxygen demand and consumption

Post op Respiratory Management
- Early extubation should be the goal for all patients; within 4 – 12 hr postop
- Extubate if:
  - Adequate muscle strength (able to hold head off bed for 5- 10 sec)
  - Adequate pulmonary function
    - Spont TV > 300 ml
    - NIF at least -20 – 25 cmH20
    - Minute volume no greater than 10L/min
    - Vital capacity 10 – 15 mL/kg
  - Hemodynamic stability & no bleeding
- Extubate when:
  - ABGs within parameters
  - Stable Hemodynamics/no bleeding
  - Resp. rate < 25-30bpm
  - HR < 130bpm
  - SaO2 > 95-96%
  - Spont TV > 300-600cc
  - FIO2 < 70%
### Extubation
- Suction mouth
- Deflate cuff --- ascertain a leak is presence
- Instruct pt to take a deep breath and cough
- Remove tube toward the end of the cough
- Placed low flow oxygen – nasal cannula

### Stir-up Regime
- Used in the immediate postop period if they received an inhalation agent
- Inhalation agents cause respiratory depression and are eliminated by ventilation
- Elevating the HOB and encouraging deep breathing and coughing

### Post-extubation
- Administer O₂
- Monitor patient
  - Bilateral breath sounds
  - Stridor or ↑ respiratory effort
  - Strength of voice and cough
- Keep HOB ↑
- Pain control
- Incentive spirometry
- Early ambulation

### Complications related to extubation
- **Laryngospasm**
  - Partial or complete blockage of airflow into or out of the lungs from spasms of vocal cord
  - Rocking respirations
  - Wheezing
  - Stridor
  - Dyspnea
  - Use of accessory muscles
  - Encourage to cough
  - May require reintubation or Positive pressure breathing
  - Lidocaine may be helpful

- **Noncardiogenic pulmonary edema**
  - May be triggered by laryngospasm
  - Rapid onset
  - Agitation
  - Tachypnea
  - Tachycardia
  - ↓ oxygen saturation
  - Pink, frothy sputum
  - Crackles
  - Maintain airway
  - Diuretic
  - May require PEEP

- **Hypoxia**
  - Treat underlying cause
  - Ensure adequate reversal of opioids and NMBAs prior to extubation

- **Bronchospasm**
  - Constriction of bronchial smooth muscles after extubation
  - Resolves quickly after airway irritants are eliminated
  - Wheezing
  - Dyspnea
  - Tachypnea
  - Treat with bronchodilator and humidified oxygen

- **Hypoventilation and Hypoxia**
  - May occur up to 24 hours postop
  - Cool, Dantrolene sodium

- **Malignant Hyperthermia**
  - Triggered by certain anesthetic agents (succ)
  - Muscle rigidity of jaw, tachypnea, tachycardia, ↑ CO₂, cyanosis, resp and metabolic acidosis, ↑CPK, ↑ K, ↑ temp
  - May occur up to 24 hours postop
  - Cool, Dantrolene sodium
Arterial Blood Gases

NORMAL ABG VALUES

<table>
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<tr>
<th>pH</th>
<th>pCO₂</th>
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<tr>
<td>7.35-7.45</td>
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</tr>
<tr>
<td>88-90</td>
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<tr>
<td>95-97</td>
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ROMS for pH and pCO₂
- R = Respiratory
- O = Opposite
- M = Metabolic
- S = Same

Respiratory Acidosis

↓ pH  ↑ pCO₂

Cause: Result of Hypoventilation
- Sedation: Anesthesia, pain meds
- COPD, Pulm Edema, Pneumonia
- Head Injuries: trauma, CVA, spinal cord injuries
- Neurological Diseases: MS or ALS, Guillain Barre'
- Chest trauma: flail chest or fx ribs

Respiratory Alkalosis

↑ pH  ↓ pCO₂

Cause: Result of Hyperventilation
- Pain, fever, anxiety
- PE, high altitudes, Aspirin OD
- Head Injuries: trauma, CVA, spinal cord injuries
- Hypoxia: While attempting to take in more O₂, blow off too much CO₂...
- Hypovolemic Shock, Pulmonary Edema, CHF, ARDS, GI Bleed
Metabolic Acidosis

Cause: Retention of Acid OR Loss of Base

Reasons:
- Aspirin Overdose
- Drug Overdose
- Renal Failure
- Diabetic Ketoacidosis
- Shock, Sepsis
  (anaerobic metabolism)

Metabolic Alkalosis

Cause: Retention of Base OR Loss of Acid

Reasons:
- Prolonged Vomiting
- Diuretics, Hypokalemia
- Antacids
- Cushing’s Syndrome
- Hypoaldosteronism
- Sodium Bicarb administration

Interpret these ABGs:

- pH 7.28
- PCO2 60
- pO2 83
- HCO3 28
- Base Excess 0.5
- O2 Sat 94
- CO2 Total 30

A. Respiratory Acidosis  
B. Respiratory Alkalosis  
C. Metabolic Acidosis  
D. Metabolic Alkalosis  
E. Normal

Based on the ABGs, interventions should include

- A. Patient is hypoxic, increase oxygen
- B. Stimulate patient or possibly BIPAP or increase TV or rate on ventilator (if ventilated)
- C. Patient may be in DKA, check blood glucose
- D. Patient is hyperventilating, encourage to take slow deep breaths
- E. Check nasogastric tube for large output
Based on the ABGs, interventions should include

A. Patient is hypoxic, increase oxygen
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60 kg patient on vent after opioid overdose. AC 16, TV 450, PEEP 5. Interpret these ABGs

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B. Respiratory Alkalosis
C. Metabolic Acidosis
D. Metabolic Alkalosis
E. Normal

60 kg patient on vent after opioid overdose. AC 16, TV 450, PEEP 5. Interpret these ABGs (same patient)

A. Respiratory Acidosis
B. Respiratory Alkalosis
C. Metabolic Acidosis
D. Metabolic Alkalosis
E. Normal

60 kg patient on vent after opioid overdose. AC 16, TV 450, PEEP 5. Interventions for these ABGs (same patient)

A. Extubate
B. Increase TV to 550
C. Patient may be in DKA, check blood glucose
D. Decrease TV or rate and switch to SIMV
E. Check Nasogastric tube for large output

Pt found unresponsive and brought to ED. Labs on admission. Interpret these ABGs

A. Respiratory Acidosis
B. Respiratory Alkalosis
C. Metabolic Acidosis
D. Metabolic Alkalosis
E. Normal
Pt found unresponsive and brought to ED.
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**ANSWER**

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A. Pulmonary embolus  
B. Pulmonary edema  
C. Cocaine overdose  
D. Diabetic Ketoacidosis

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Power Point Handout available at www.cherylherrmann.com

**References**