

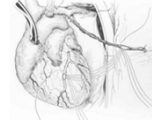
## Pulmonary Issues in Cardiac Patients

*Cheryl Herrmann*  
CARDIAC CLINICAL NURSE SPECIALIST  
APN, CCRN, CCNS-CSC/CMC

1

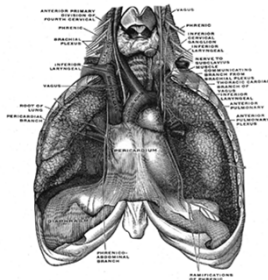
### LIMA/RIMA Complications:

- 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

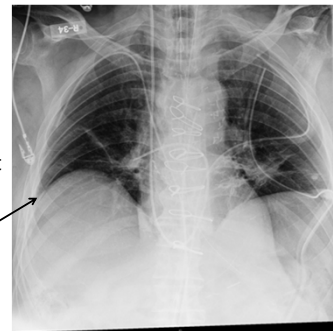
- Cold injury to nerve from cardioplegia solution
- Surgical trauma during takedown of IMA



3

### 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

5

### Phrenic Nerve Injury

#### Unilateral

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

#### Bilateral – rare & serious

- Paradoxical breathing
- Tachypnea
- Nocturnal orthopnea
- CO<sub>2</sub> 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)

6

## 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

7

## Management of Recovery from Anesthesia

8

## Hand Off Communication

- Vital information exchanged between the anesthesia provider and ICU RN

9

## Immediate postop care Objectives

1. Maintenance of cardiac output
2. Maximization of tissue perfusion

10

## Induction Agents Augment the effects of inhalation agents

### Barbiturates

- Depress the CNS
- Cause respiratory depression
- Thiopental sodium
- Methohexital

### Benzodiazepines

- Midazolam (Versed)
  - Watch for resp depression
  - May be used for post op N/V
  - Reversed with Flumazenil (Romazicon)

### Nonbarbiturates

- Etomidate
  - Hypnotic agent – no analgesic effects
  - Agent of choice in pt with CV instability as less likely to cause hypotension.
- Propofol (Diprivan)
  - Sedative
  - Causes less myocardial depression than barbiturates
  - Causes hypotension
  - Causes less post op N/V than Etomidate

11

## Inhalation Agents

- Cause circulatory depression and hypotension as result of vasodilation & ↓ contractility
- Observe for Ventricular ectopy (VT/VF)
- Don't have analgesic properties
- Sevoflurane & Halothane
  - Respiratory depressants
- Enflurane & Isoflurane
  - May cause non-cardiogenic pulm edema
  - Enflurane has residual CNS depressant effects

12

### 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
- Rocuroium
- Vecuronium
- Succinylcholine
- Inadequate reversal may cause return paralysis in the early postop period

13

### Opioids

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

14

### 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
- Prophylactic antiemetics
- Ondansetron(Zofran)
- Promethazine (Phenergan)
- Prochlorperazine (compazine)

15

### 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

16

### 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

17

### Extubate when:

- ABGs within parameters
- Stable Hemodynamics/no bleeding
- Resp. rate < 25-30bpm
- HR < 130bpm
- SaO2 > 95-96%
- Spont TV > 300-600cc
- FIO2 < 70%

18

## 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

19

## 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

20

## Post-extubation

- Administer O<sub>2</sub>
- 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

22

## Complications related 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

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

23

## Malignant Hyperthermia

- Triggered by certain anesthetic agents (succ)
- Muscle rigidity of jaw, tachypnea, tachycardia, ↑ CO<sub>2</sub>, cyanosis, resp and metabolic acidosis, ↑CPK, ↑ K, ↑ temp
- May occur up to 24 hours postop
- Cool, Dantrolene sodium

24

## Arterial Blood Gases

25

## NORMAL ABG VALUES

pH 7.35-7.45  
 pCO<sub>2</sub> 35-45  
 pO<sub>2</sub> 80-90  
 HCO<sub>3</sub> 22-26  
 O<sub>2</sub> % 95-97



## ROMS for pH and pCO<sub>2</sub>

- R = Respiratory
- O = Opposite
- M = Metabolic
- S = Same

27

<b>Respiratory Acidosis</b>	<b>pH ↓</b>	<b>pCO<sub>2</sub> ↑</b>
<b>Respiratory Alkalosis</b>	<b>pH ↑</b>	<b>pCO<sub>2</sub> ↓</b>
<b>Metabolic Acidosis</b>	<b>pH ↓</b>	<b>pCO<sub>2</sub> ↓</b>
<b>Metabolic Alkalosis</b>	<b>pH ↑</b>	<b>pCO<sub>2</sub> ↑</b>

28

## Respiratory Acidosis

↓ pH   ↑ pCO<sub>2</sub>

### Reasons:

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

Cause: Result of Hypoventilation

## Respiratory Alkalosis

↑ pH   ↓ pCO<sub>2</sub>

### Reasons:

Pain, fever, anxiety

PE, high altitudes, Aspirin OD

Head Injuries: trauma, CVA, spinal cord injuries

Hypoxia: While attempting to take in more O<sub>2</sub>, blow off too much CO<sub>2</sub>....

Hypovolemic Shock, Pulmonary Edema, CHF, ARDS, GI Bleed

Cause: Result of Hyperventilation

## Metabolic Acidosis

pH ↓ Cause: Retention of Acid OR Loss Base

HCO<sub>3</sub> ↓ Reasons:

Aspirin Overdose	Starvation
Drug Overdose	Severe Inf with fever
Renal Failure	Diarrhea
Diabetic Ketoacidosis	Pancreatitis
Shock, Sepsis (anaerobic metabolism)	

## Metabolic Alkalosis

pH ↑ Cause: Retention of Base OR Loss of Acid

HCO<sub>3</sub> ↑ Reasons:

- Prolonged Vomiting
- Diuretics, Hypokalemia
- Antacids
- Cushing's Syndrome
- Hypoadosteronism
- Sodium Bicarb administration



33

## Interpret these ABGs:

pH	7.28
PCO <sub>2</sub>	60
pO <sub>2</sub>	83
HCO <sub>3</sub>	28
Base Excess	0.5
O <sub>2</sub> Sat	94
CO <sub>2</sub> Total	30

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

34

## Interpret these ABGs: ANSWER

pH	7.28
PCO <sub>2</sub>	60
pO <sub>2</sub>	83
HCO <sub>3</sub>	28
Base Excess	0.5
O <sub>2</sub> Sat	94
CO <sub>2</sub> Total	30

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

35

## Based on the ABGs, interventions should include

pH	7.28
PCO <sub>2</sub>	60
pO <sub>2</sub>	83
HCO <sub>3</sub>	28
Base Excess	0.5
O <sub>2</sub> Sat	94
CO <sub>2</sub> Total	30

- 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

36

Based on the ABGs, interventions should include ANSWER

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

- 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

37

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

pH	7.51
pCO2	24
pO2	120
Base Deficit	2.4
O2 Sat, Art	99
TCO2	19

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

38

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

pH	7.51
pCO2	24
pO2	120
Base Deficit	2.4
O2 Sat, Art	99
TCO2	19

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

39

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

pH	7.51
pCO2	24
pO2	120
Base Deficit	2.4
O2 Sat, Art	99
TCO2	19

- 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

40

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

pH	7.51
pCO2	24
pO2	120
Base Deficit	2.4
O2 Sat, Art	99
TCO2	19

- 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

41

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

pH	7.17
PCO2	11
pO2	150
HCO3	4.2
Base Deficit	21.7
Lactic Acid	7.17
Sodium	115
Potassium	3.1

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

42

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

pH	7.17
PCO2	11
pO2	150
HCO3,	4.2
Base Deficit	21.7
Lactic Acid	7.17
Sodium	115
Potassium	3.1

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

43

Pt found unresponsive and brought to ED.  
Labs on admission. Based on the ABGs, you  
would anticipate treatment for:

pH	7.17
PCO2	11
pO2	150
HCO3,	4.2
Base Deficit	21.7
Lactic Acid	7.17
Sodium	115
Potassium	3.1

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

44

Pt found unresponsive and brought to ED.  
Labs on admission. Based on the ABGs, you  
would anticipate treatment for:

pH	7.17
PCO2	11
pO2	150
HCO3,	4.2
Base Deficit	21.7
Lactic Acid	7.17
Sodium	115
Potassium	3.1

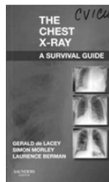
- A. Pulmonary embolus
- B. Pulmonary edema
- C. Cocaine overdose
- D. Diabetic Ketoacidosis

45

## As Easy as Black & White CXR Interpretation

*Cheryl Herrmann*  
CARDIAC CLINICAL NURSE SPECIALIST  
APRN, CCRN, CCNS, CNS/CMAC  
UnityPoint Methodist Peoria, Illinois

46



Power Point Handout available at  
[www.cherylherrmann.com](http://www.cherylherrmann.com)

### References

- Connolly M A. Black, white, and shades of gray: Common Abnormalities in chest radiographs. *AACN Clinical Issues*. 2001;12(2):259-289.
- Lacey G, Morley S, et Berman L. *The Chest X-ray: A Survival Guide*. Philadelphia: Saunders/Elsevier.2008
- Siela D. Chest radiograph evaluation and interpretation. *Advanced Critical Care*. 2008;19(4):444-475.
- Huseby JS, Ledoux D. Radiologic Examination of the Chest. In: Woods SL, Froelicher S, Motzer SA, Bridges, E J, ed. *Cardiac Nursing*, 5th ed. Philadelphia: Lippincott Williams & Wilkens. 2005: 296-306.

47