The ABC of Anesthesia: An interactive Tutorial

Preoperative Considerations

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Question 1

You will care for the following patient:

- Mrs. Smith is a 60 year old female with PMH of mild sleep apnea, morbid obesity (BMI = 40), end stage renal disease on hemodialysis, smoker, insulin dependent diabetes, postoperative nausea/vomiting (PONV) and hypertension.
- She presents for urgent ophthalmic surgery due to retinal detachment with worsening vision.
- She last ate toast and drank milk (light meal) 4 hours ago.
- Ophthalmologists request general anesthesia for the 2 hour surgery, after which she will be discharged home.

Based on her medical comorbidities, what is her ASA physical status classification?

A. ASA 2E

B. ASA 3E

C. ASA 4E

D. ASA 5E

B: She is an ASA-PS classification of 3E, patient with severe systemic disease requiring emergent surgery

Table 1. ASA Physical Status Classifications and Examples

ASA PS Classification	Definition	Examples
ASA I	A normal healthy patient	Healthy, nonsmoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; one or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA <60 wk, history (>3 mo) of MI, CVA, TIA or CAD/stents
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (<3 mo) MI, CVA, TIA or CAD/stents; ongoing cardiac ischemia or severe valve dysfunction; severe reduction of ejection fraction; sepsis; DIC; ARD; or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

ARD, acid reflux disease; **ASA,** American Society of Anesthesiologists; **BMI,** body mass index; **CAD,** coronary artery disease; **COPD,** chronic obstructive pulmonary disease; **CVA,** cerebral vascular accident; **DIC,** disseminated intravascular coagulation; **DM,** diabetes mellitus, **ESRD,** end-stage renal disease; **HTN,** hypertension; **MI,** myocardial infarction; **PCA,** postconceptual age; **PS,** physical status; **TIA,** transient ischemic attack

Dr. Erin Hurwitz reported at the 2015 ASA meeting on the results of her web-based study

Table 2. Accuracy of ASA Physical Status Designations

Provider	Number	Definition Only (No. Correct/10 Cases)	Examples and Definitions (No. Correct/10 Cases)
All anesthesia providers	779	5.8±1.6	7.7±1.7
All nonanesthesia providers	110	5.4±1.7	7.9±1.7
Anesthesiologists	524	5.9±1.6	7.7±1.7
Residents/fellows	90	5.8±1.8	7.7±1.8
Nurse anesthetists	125	5.4±1.6	7.5±1.8
Anesthesiologist assistants	37	5.4±1.2	7.5±1.9
Nonanesthesiologist physicians	69	5.7±1.5	7.9±1.8
Nurses	35	4.9±1.9	8.0±1.3

Question 2

Based on ASA guidelines, how many hours should she be fasting (NPO) from a light meal prior to receiving general anesthesia?

A. 2 hours
B. 4 hours
C. 6 hours
D. 8 hours

C. Patients undergoing elective surgery should fast for at least 6 hours after a light meal

Fasting and Pharmacologic Recommendations

*A. Fasting Recommendations**

Ingested Material	Minimum Fasting Period†
• Clear liquids‡	2h
• Breast milk	4h
• Infant formula	6h
• Nonhuman milk§	6h
• Light meal**	6h
• Fried foods, fatty foods, or meat	Additional fasting time (*e.g.*, 8 or more hours) may be needed

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Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration*. *Anesthesiology* 2017;126(3):376-393. doi: 10.1097/ALN.0000000000001452.

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Recommendations for Preoperative Assessment

- Perform a review of pertinent medical records, a physical examination, and patient survey or interview as part of the preoperative evaluation.
  - The history, examination, and interview should include assessment of ASA physical status, age, sex, type of surgery, and potential for difficult airway management as well as consideration of gastroesophageal reflux disease,[*12] dysphagia symptoms, other gastrointestinal motility and metabolic disorders (*e.g.*, diabetes mellitus) that may increase the risk of regurgitation and pulmonary aspiration.
- Inform patients of fasting requirements and the reasons for them sufficiently in advance of their procedures.
- Verify patient compliance with fasting requirements at the time of their procedure.
- When these fasting guidelines are not followed, compare the risks and benefits of proceeding, with consideration given to the amount and type of liquids or solids ingested.

Pharmacologic recommendations for patients at higher risk of aspiration or delayed gastric emptying

B. Pharmacologic Recommendations	
Medication Type and Common Examples	Recommendation
Gastrointestinal stimulants:	
• Metoclopramide	May be used/no routine use
Gastric acid secretion blockers:	
• Cimetidine	May be used/no routine use
• Famotidine	May be used/no routine use
• Ranitidine	May be used/no routine use
• Omeprazole	May be used/no routine use
• Lansoprazole	May be used/no routine use
Antacids:	
• Sodium citrate	May be used/no routine use
• Sodium bicarbonate	May be used/no routine use
• Magnesium trisilicate	May be used/no routine use
Antiemetics:	
• Ondansetron	May be used/no routine use
Anticholinergics:	
• Atropine	No use
• Scopolamine	No use
• Glycopyrrolate	No use

Question 3

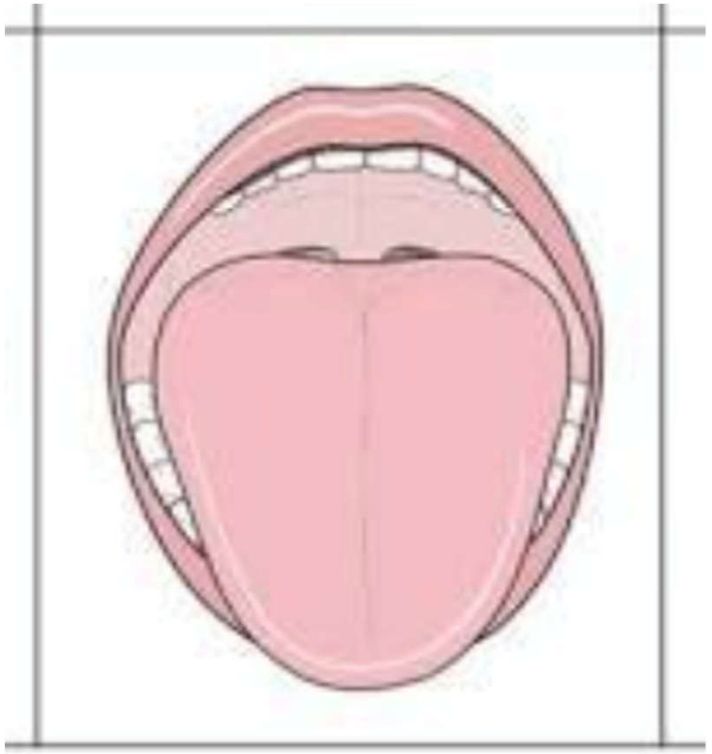
Her airway exam reveals the following:

A. Mallampati 1

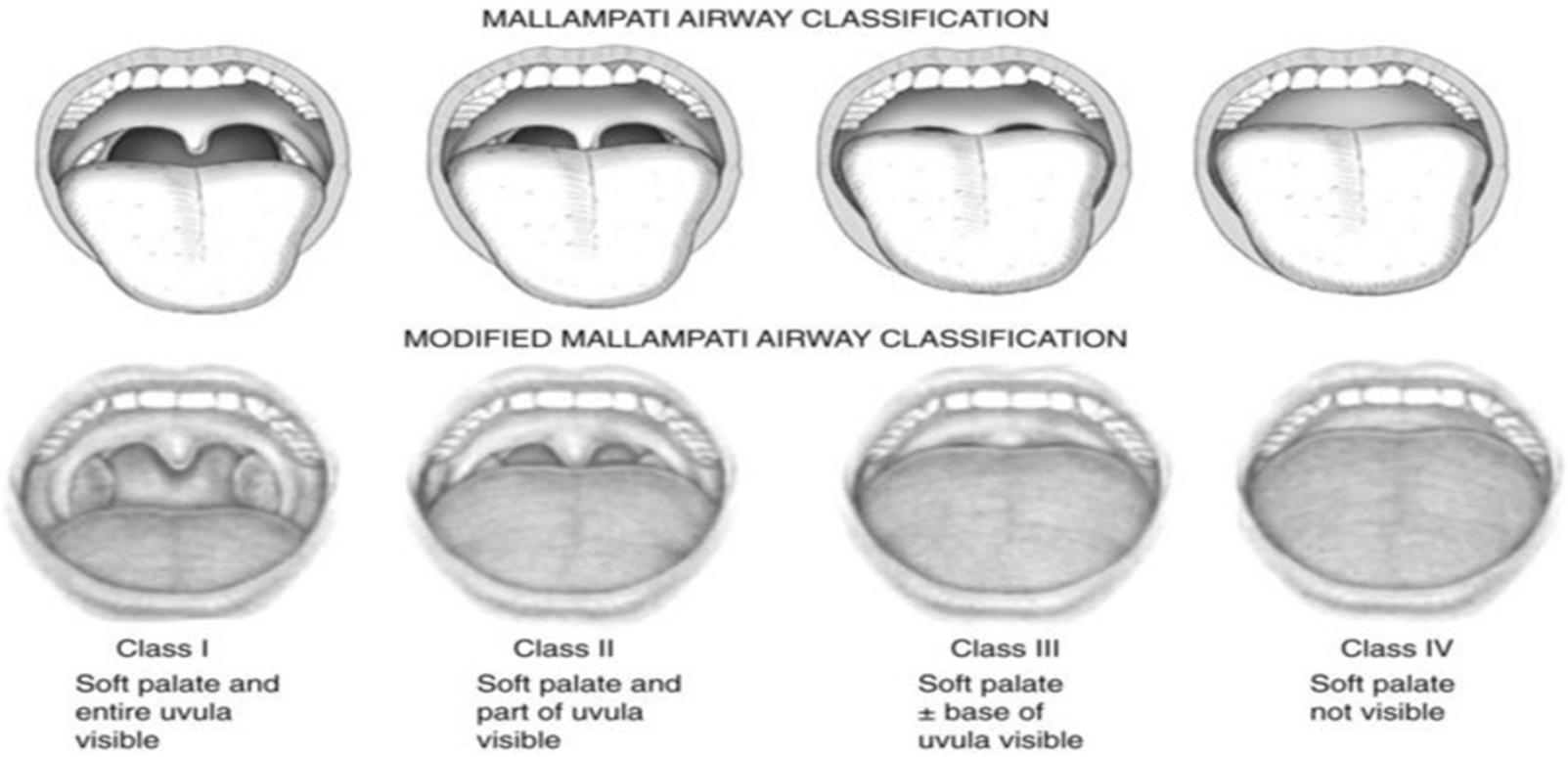
B. Mallampati 2

C. Mallampati 3

D. Mallampati 4



Mallampati score is one component of a comprehensive airway exam



Airway assessment

LEMON Airway assessment method

L	Look externally (Facial trauma, large incisors, beard or moustache, large tongue
E	Evaluate the 3-3-2 rule - Incisor distance: 3 FB - Hyoid-mental distance: 3 FB - Thyroid-to-mouth distance: 2 FB
M	Mallampati Score ≥ 3
O	Obstruction : Presence of any condition like epiglotitis, Peritonsillar abscess, trauma
N	Neck Mobility (Limited neck mobility)

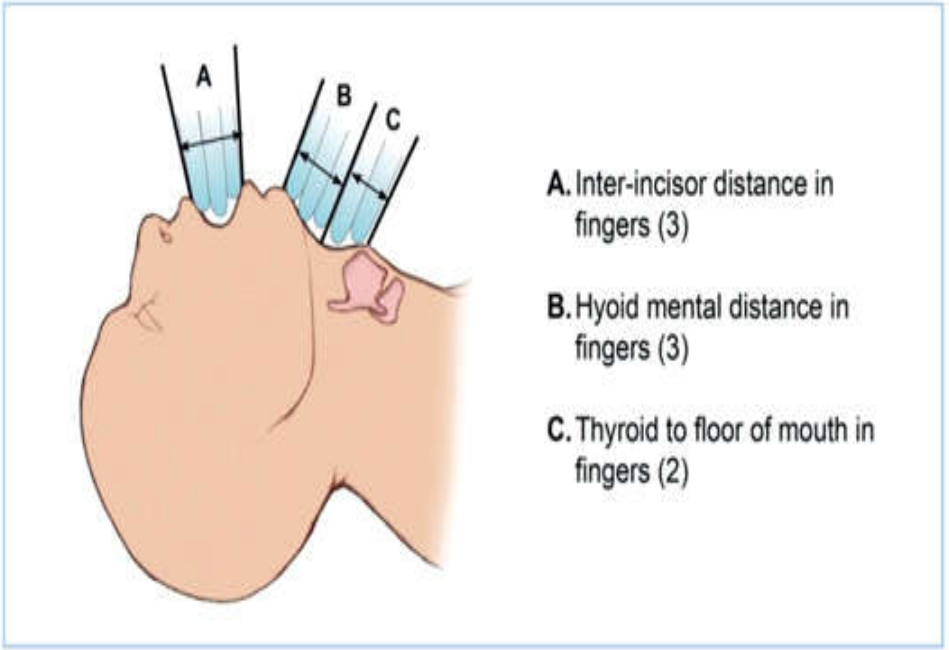
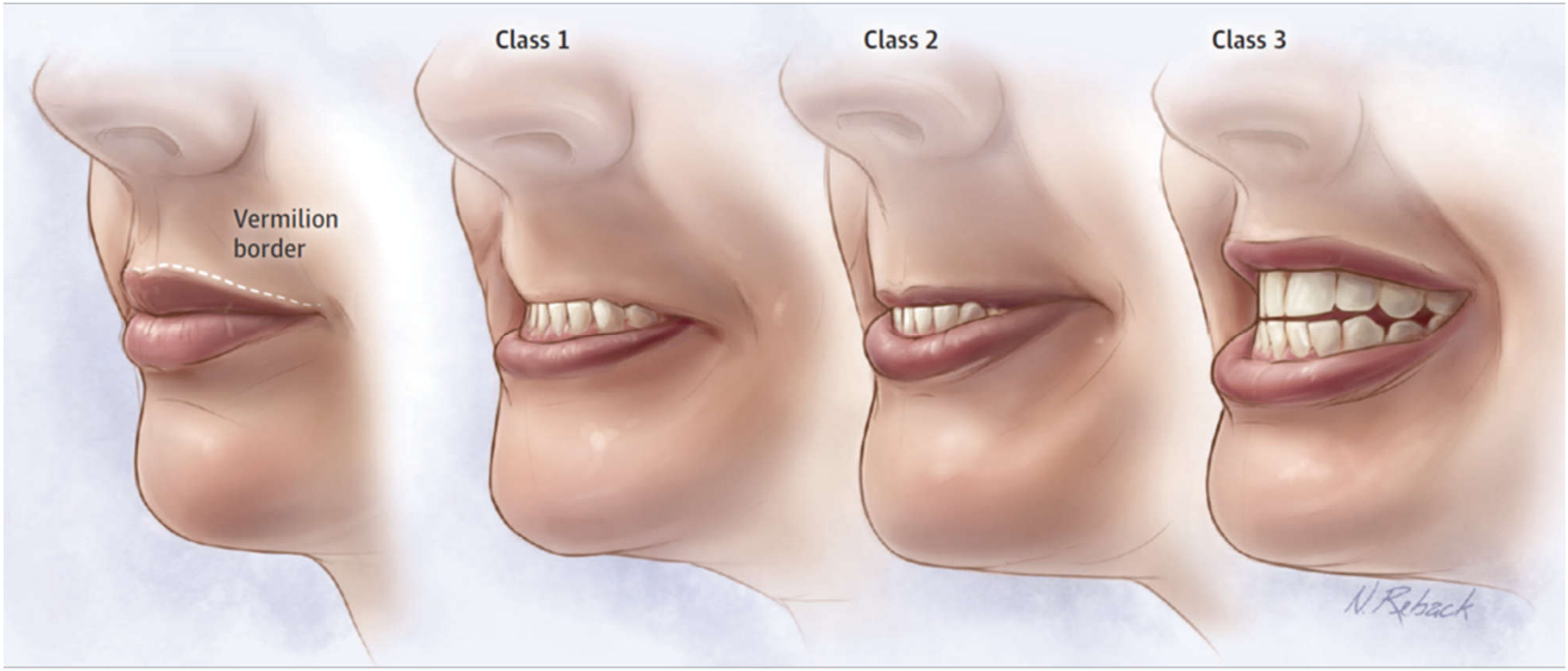


FIGURE 14.6 LEMON airway assessment method. (Murphy MF, Wall RM. The difficult and failed airway. In: *Manual of Emergency Airway Management*. Chicago, IL: Lippincott Williams and Wilkins; 2000:31–39.)

Upper lip bit test (ULBT)



Comparison Of Upper Lip Bite Test And Modified Mallampati Classification In Predicting Difficult Intubation

R Bhat, S Mishra, A Badhe

Citation

R Bhat, S Mishra, A Badhe. *Comparison Of Upper Lip Bite Test And Modified Mallampati Classification In Predicting Difficult Intubation*. The Internet Journal of Anesthesiology. 2006 Volume 13 Number 1.

CONCLUSION

- Upper Lip Bite Test cannot be used as a single bed side test for predicting unanticipated difficult intubation.
- A combination of Upper Lip Bite Test and Modified Mallampati Test in parallel is more sensitive, specific and has a higher discriminative power which is clinically relevant than Modified Mallampati Test or ULBT alone.
- The high negative predictive values of both the tests alone and in parallel and series indicate that they are good predictors of possible easy intubation rather than difficult intubation.

Question 4

All are predictors of difficulty to mask ventilate except:

A. Obese patient
B. Prominent/protruding teeth
C. Sleep apnea
D. Elderly patient

B: Prominent/protruding teeth

Predictors of difficulty to face mask ventilate (OBESE)

1. The **O**bese (body mass index > 26 kg/m2)
2. The **B**earded
3. The **E**lderly (older than 55 y)
4. The **S**norers
5. The **E**dentulous

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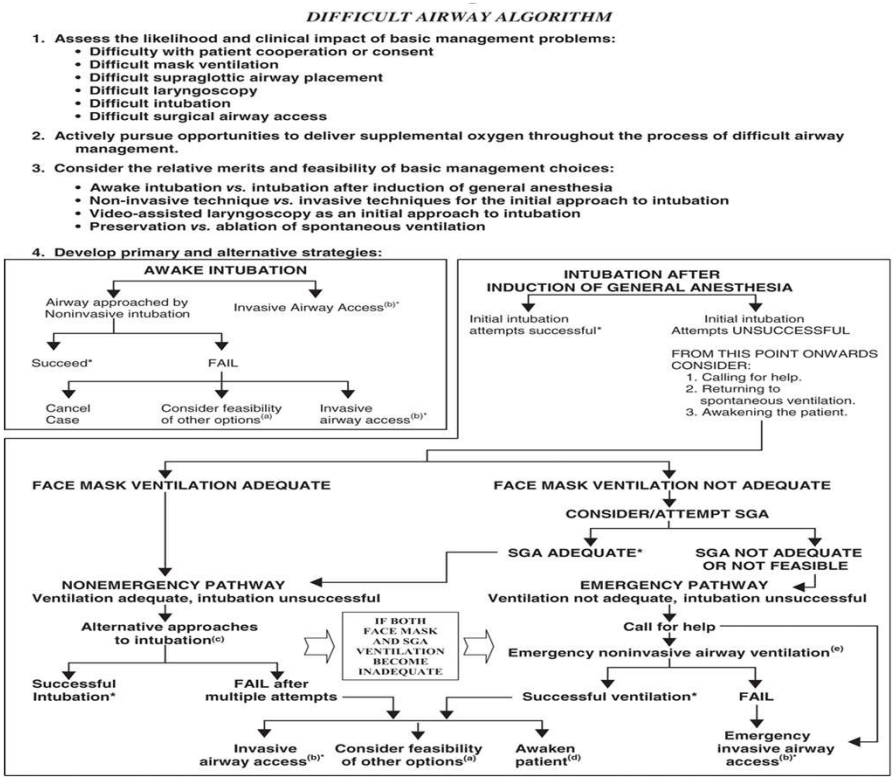
Trusted Evidence: Discovery to Practice

Practice Guidelines for Management of the Difficult Airway: An Updated Report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway

Anesthes. 2013;118(2):251-270. doi:10.1097/ALN.0b013e31827773b2



Question 5

When asked about previous anesthesia issues, Mrs. Smith had a colonscopy. She states she did not “remember anything.” Her anesthesiologist said she was breathing well on her own. This is an example of:

A. General anesthesia
B. Deep sedation
C. Moderate sedation
D. Minimal sedation

A. General anesthesia

Continuum of Depth of Sedation (ASA Definition)				
	Minimal Sedation (Anxiolysis)	**Moderate Sedation/ Analgesia ("Conscious Sedation")**	**Deep Sedation/ Analgesia**	**General Anesthesia**
Responsiveness	Normal response to verbal stimulation	Purposeful[a] response to verbal or tactile stimulation	Purposeful[a] response following repeated or painful stimulation	Unarousable even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

[a]Reflex withdrawal from a painful stimulus is **NOT** considered a purposeful response.

Question 6

All of the following increase risk of postoperative nausea and vomiting (PONV) except:

A. Female gender
B. History of PONV
C. Use of volatile agents
D. Smoker

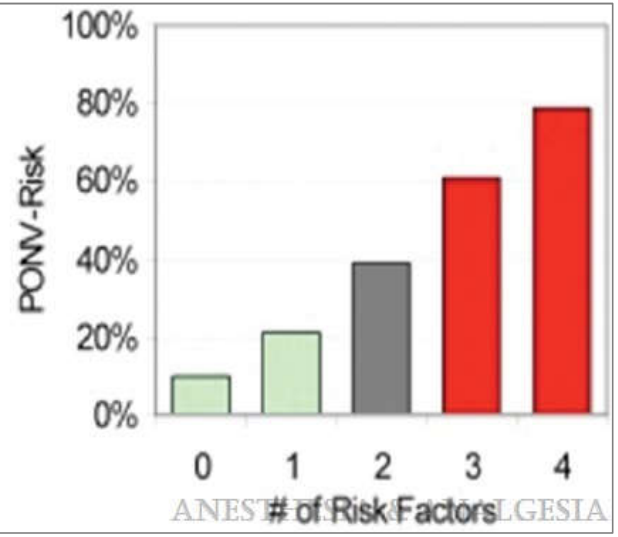
D. Smoker

Evidence	Risk factors
Positive overall	Female sex (B1)
	History of PONV or motion sickness (B1)
	Nonsmoking (B1)
	Younger age (B1)
	General versus regional anesthesia (A1)
	Use of volatile anesthetics and nitrous oxide (A1)
	Postoperative opioids (A1)
	Duration of anesthesia (B1)
	Type of surgery (cholecystectomy, laparoscopic, gynecological) (B1)
Conflicting	ASA physical status (B1)
	Menstrual cycle (B1)
	Level of anesthetist's experience (B1)
	Muscle relaxant antagonists (A2)
Disproven or of limited clinical relevance	BMI (B1)
	Anxiety (B1)
	Nasogastric tube (A1)
	Supplemental oxygen (A1)
	Perioperative fasting (A2)
	Migraine (B1)

PONV = postoperative nausea and vomiting; BMI = body mass index; MS = motion sickness.

Simplified PONV risk score

Risk Factors	Points
Female Gender	1
Non-Smoker	1
History of PONV	1
Postoperative Opioids	1
Sum =	0 ... 4



Risk score for PONV in adults. Simplified risk score from Apfel et al.9 to predict the patient's risk for PONV. When 0, 1, 2, 3, and 4 of the risk factors are present, the corresponding risk for PONV is about 10%, 20%, 40%, 60%, and 80%, respectively. PONV = postoperative nausea and vomiting.

onsensus Guidelines for the Management of Postoperative Nausea and Vomiting

Gan, Tong J.; Diemunsch, Pierre; Habib, Ashraf S.; Kovac, Anthony; Kranke, Peter; Meyer, Tricia A.; Watcha, Mehernoor; Chung, Frances; Angus, Shane; Apfel, Christian C.; Bergese, Sergio D.; Candiotti, Keith A.; Chan, Matthew TV; Davis, Peter J.; Hooper, Vallire D.; Lagoo-Deenadayalan, Sandhya; Myles, Paul; Nezat, Greg; Philip, Beverly K.; Tramèr, Martin R.

Anesthesia & Analgesia118(1):85-113, January 2014.

doi: 10.1213/ANE.0000000000000002

PONV prophylaxis guidelines

Determine the number of risk factors for PONV using the simplified risk score from Apfel.

Risk Factors	Points
Post operative Opioids	1
Non Smoker	1
Female Gender	1
History of PONV/Motion Sickness	1
Risk score = sum	0…4

Base prophylaxis on risk score:

Risk Score	Prevalence PONV	Prophylaxis: No of Anti-emetics	Examples*
0	9%	0-1	± Ondansetron 4 mg
1	20%	1	Ondansetron 4 mg ± Dexamethasone 4mg
2	39%	2	Ondansetron 4 mg +Dexamethasone 4mg ± Propofol infusion
3	60%	3	Ondansetron 4 mg + Dexamethasone 4 mg + Propofol infusion ± Scopolamine patch
4	78%	4	Ondansetron 4 mg + Dexamethasone 4 mg + Propofol infusion + Scopolamine patch

* Combinations should be with drugs that have a different mechanism of action.

Consider strategies to reduce PONV baseline risk such as regional anesthesia instead of general anesthesia, adequate hydration, propofol for induction and maintenance; minimize the use of nitrous oxide and volatile anesthetics.

Please do not order an agent for treatment in PACU that has been used for prophylaxis.

The ABC of Anesthesia: An Interactive Tutorial

Intraoperative Considerations

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October 2019

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Question 7

While performing an angioplasty, a surgeon suspects damage to the right coronary artery in a patient with a right-dominant coronary system. This prompts an immediate conversion to coronary artery bypass grafting. Which of the following leads would provide the most useful information regarding ischemic damage during reperfusion?

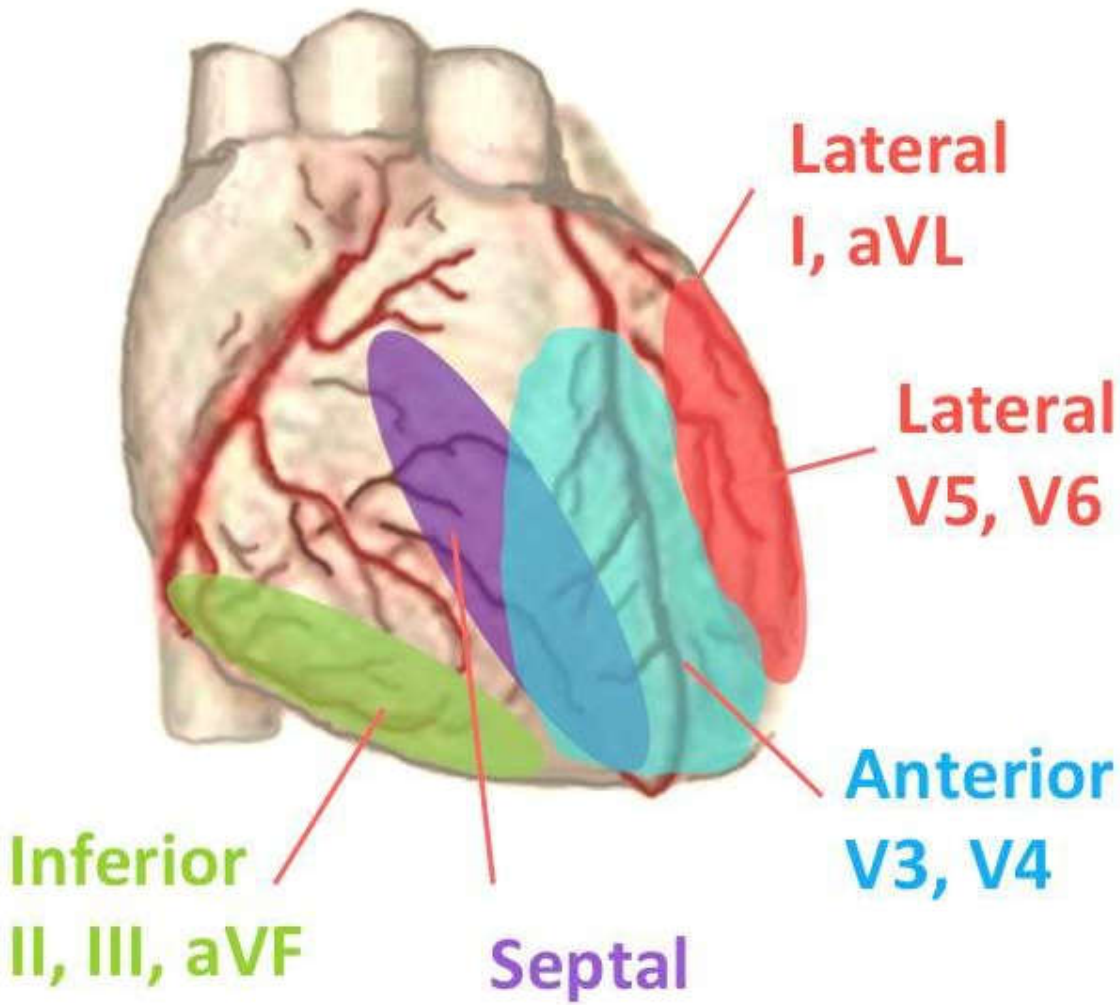
A. Leads V1 – V4
B. Leads II, III, and AvF
C. I, AvF, V5 and V6
D. V5 and V6

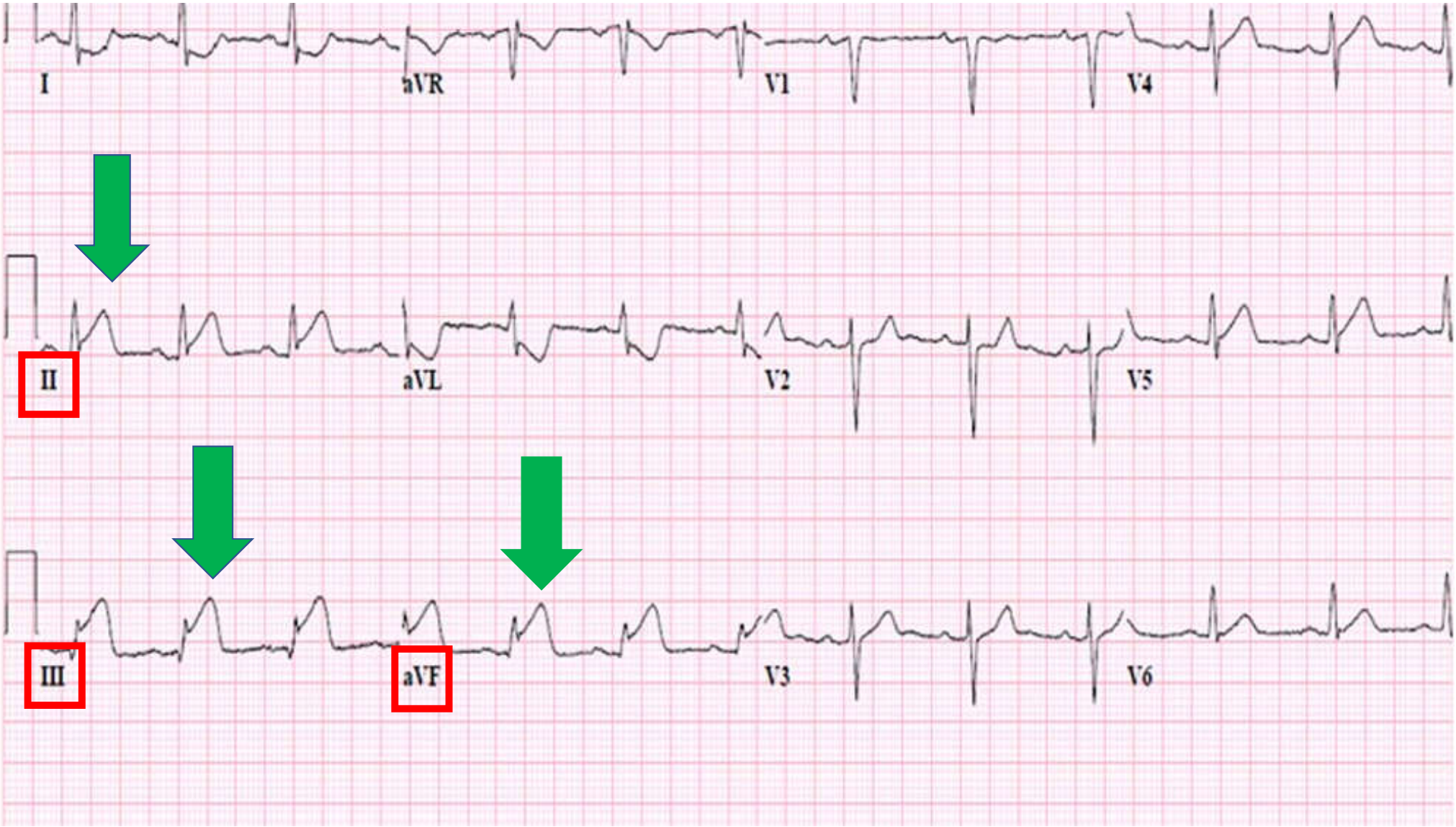
Correct answer: (B) Leads II, III, and AvF.

- **Explanation:** In a majority of the people who have a right-dominant coronary circulation, the inferior part of the heart is supplied by the **right coronary artery** which is in turn supplies the posterior descending artery. The **inferior distribution** is mirrored by leads **II, III and AvF.**

- (A) Leads V1 – V4 would be important if suspected damage was on the **left anterior descending artery**. This artery supplies the anterior portion of the heart.
- (C) Leads I, AvF, V5 and V6 would be useful if suspected damage was on the **left circumflex artery**.

The coronary arteries supply the three main walls of the heart




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

Question 8

After placing a radial arterial line in a patient for close blood pressure monitoring and zeroing the transducer at the level of the heart, the arm drops 50 cm below the level of the heart. Given that the blood pressure reading is 140/80, what is the actual mean arterial pressure of the patient?

A. 50
B. 62.5
C. 100
D. 137.5
E. 150

Correct answer: (C) 100.

- **Explanation:** The patient's **mean arterial pressure** is calculated as approximately **2/3 diastolic pressure plus 1/3 systolic pressure**. Thus, MAP for 140/80 is 100 mmHg.

- When a patient's arterial line transducer is leveled at the level of the heart, more specifically, the aortic root, the effect of the fluid column of the system is negated. Thus, despite the arm below the level of the transducer and the heart, the blood pressure reading of 140/80 is an accurate reading of the blood pressure at the aortic root.

$$mAP = \frac{1}{3} systolic\ pressure + \frac{2}{3} diastolic\ pressure$$

or

$$mAP = diastolic + \frac{1}{3} pulse\ pressure$$

Question 9

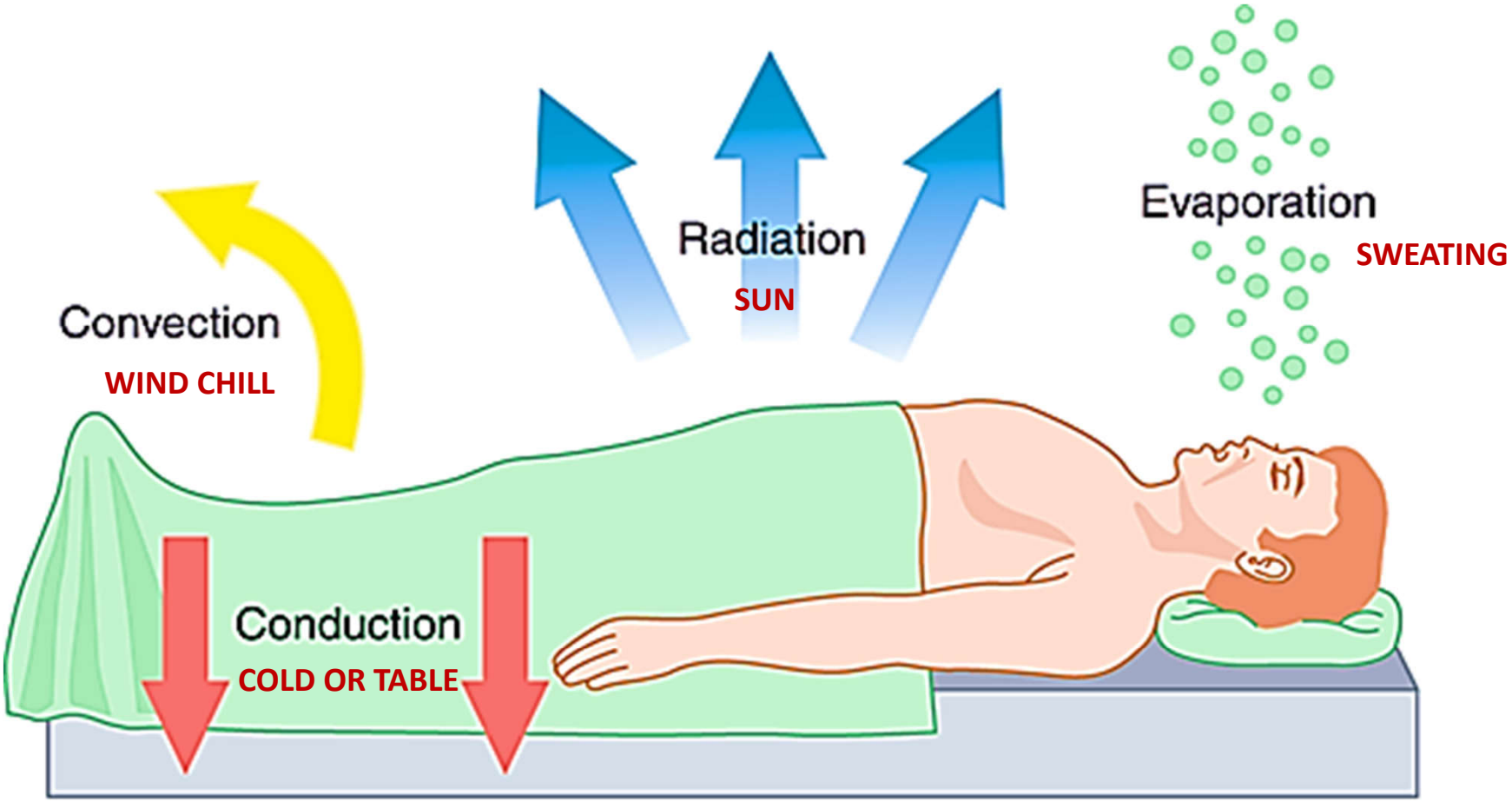
Which of the following is the main mechanism of heat loss for a patient during surgery?

A. Conduction
B. Convection
C. Dilution
D. Evaporation
E. Radiation

Correct answer: (E) Radiation.

- **Explanation:** During anesthesia, the ability of the patient to thermoregulate their temperature is diminished.

- The main mechanism of heat loss in patients is **radiation**, accounting for almost 2/3 of the loss. Defined as **heat loss via photon transfer**.
- **Convective** heat loss is the transfer of heat that occurs with fluid or air turnover such as breeze through an operating room. (wind chill)
- **Conduction** heat loss occurs from physical contact with the patient such as a lying on a cold operating room table.
- **Evaporation** results in heat loss via sweat.



Source: Longnecker DE, Brown DL, Newman MF, Zapol WM: *Anesthesiology, 2nd Edition*: www.accessanesthesiology.com

Question 10

During general endotracheal anesthesia in a patient for partial liver resection you are noticing new ST segment depressions. Which of the following would decrease the time spent in diastole and therefore reduce coronary blood flow?

A. Increase hemoglobin
B. Increase heart rate
C. Increase blood pressure
D. Increase inspired oxygen concentration
E. Decrease coronary resistance

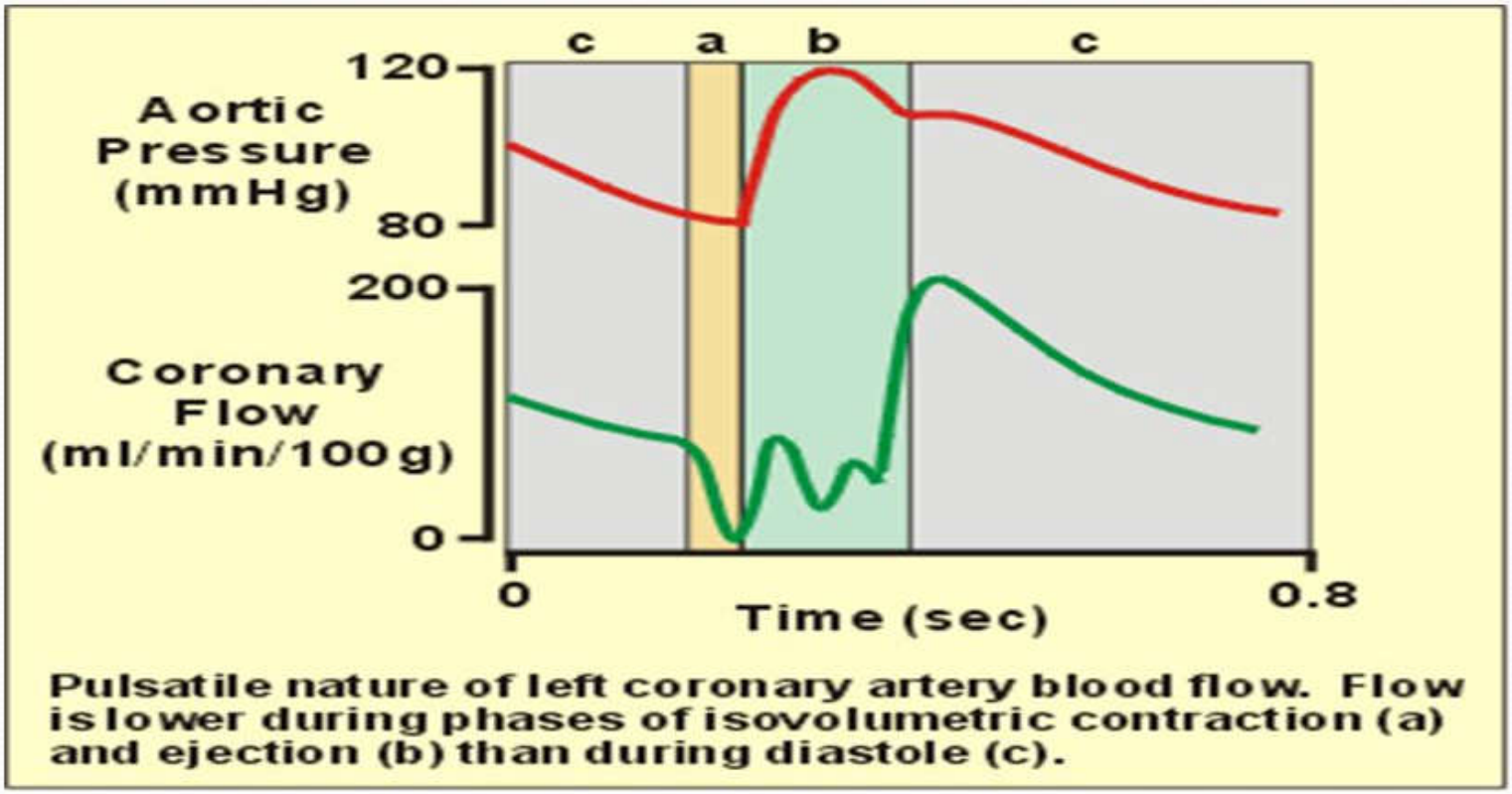
Correct answer: (B) Increase heart rate.

- **Explanation:** Coronary blood flow is determined by:

1. The coronary perfusion pressure = AoDBP - LVEDP
2. Coronary vascular resistance
3. The time spend in diastole.

- **Raising heart rate will therefore decrease the time spent in diastole thereby allowing less time for coronary blood**

Coronary blood flow during Cardiac cycle



Pulsatile nature of left coronary artery blood flow. Flow is lower during phases of isovolumetric contraction (a) and ejection (b) than during diastole (c).

Myocardial Oxygen Supply

Determined by:

Coronary Blood Flow & O_2 Carrying Capacity

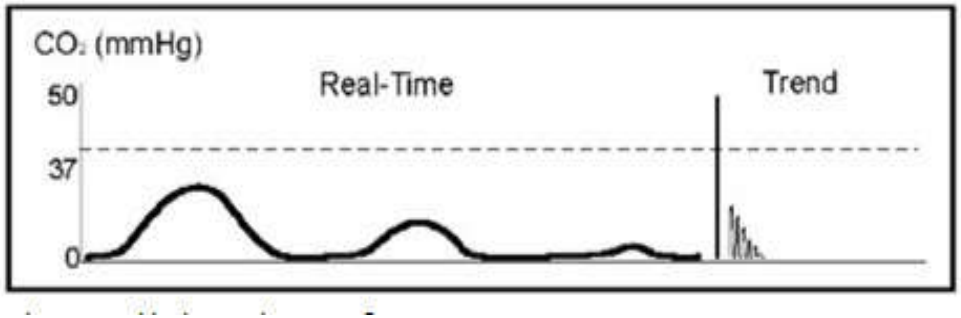
(Flow = Pressure / Resistance)

- Coronary perfusion pressure
- Coronary vascular resistance

- Oxygen saturation of the blood
- Hemoglobin content of the blood

Question 11

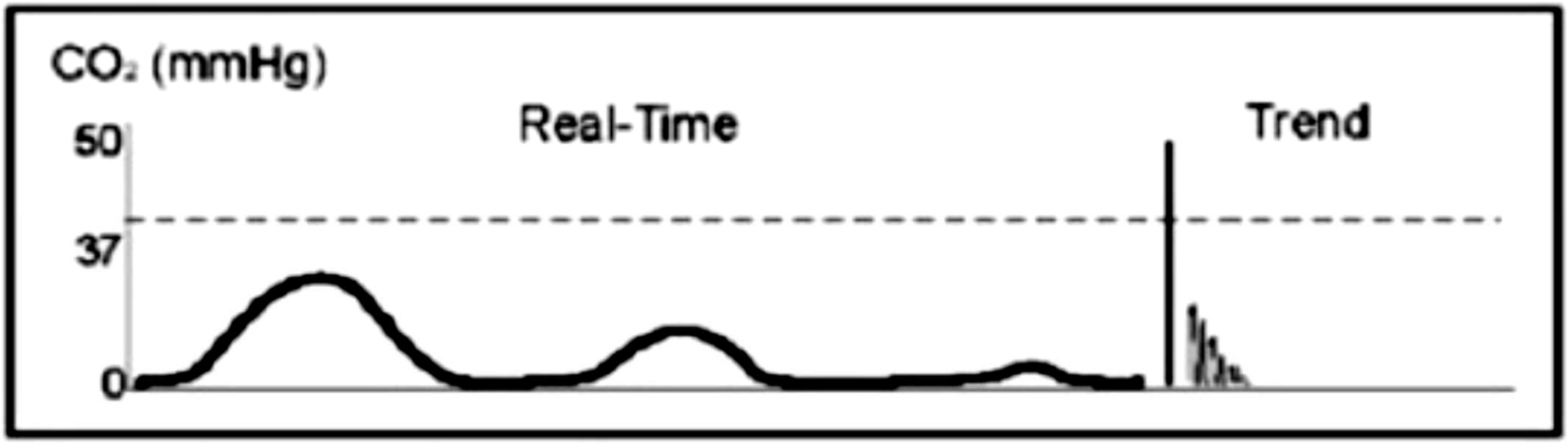
A 22-year-old man presents to the emergency room complaining of right lower quadrant pain. A CT scan reveals appendicitis and he is transferred to the operating room for an emergent appendectomy. After adequate pre-oxygenation, the patient undergoes intravenous induction of anesthesia. A direct laryngoscopy is performed, in which the anesthesiologist performing the procedure indicates visualization of vocal cords and adequate endotracheal tube placement. Following intubation, the end-tidal CO2 tracing is shown in the image below. What is the most likely explanation for this tracing?



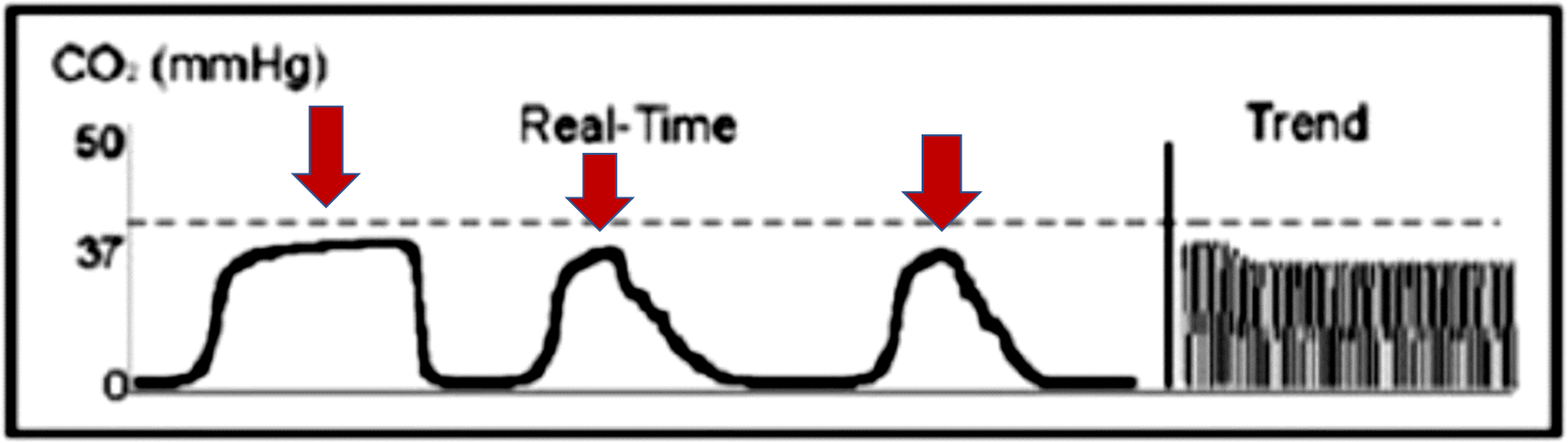
A. Bronchospasm
B. Deflated endotracheal cuff
C. Esophageal Intubation
D. Hypoventilation
E. Faulty ventilator circuit valve

Correct answer: (C) Esophageal intubation.

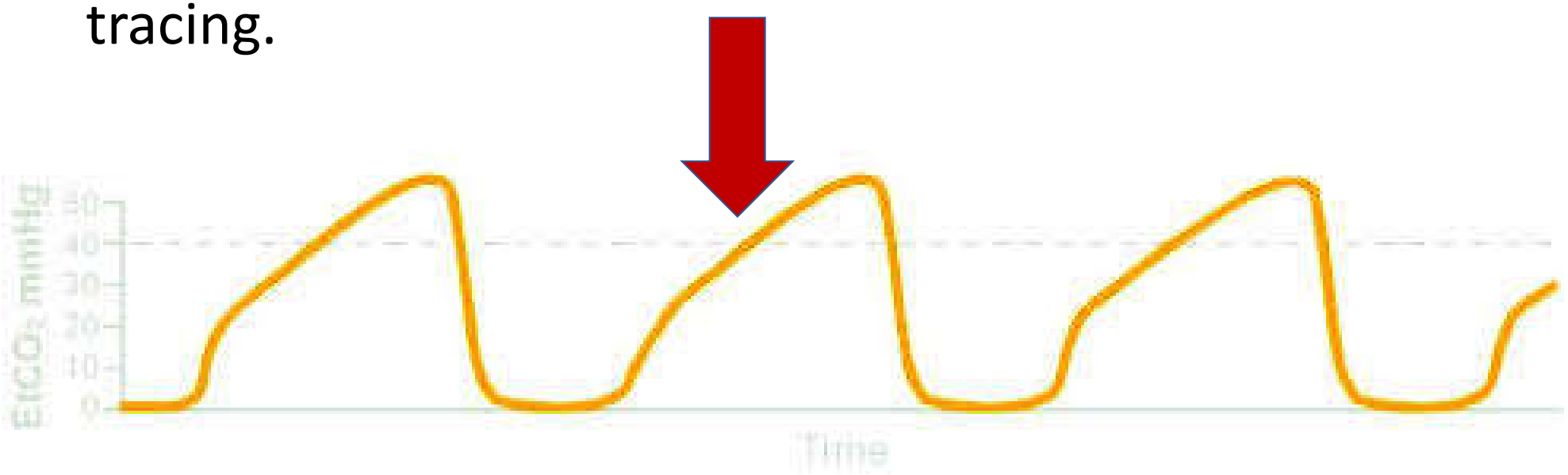
- **Explanation:** With an **esophageal intubation**, little or no ETCO2 is present.



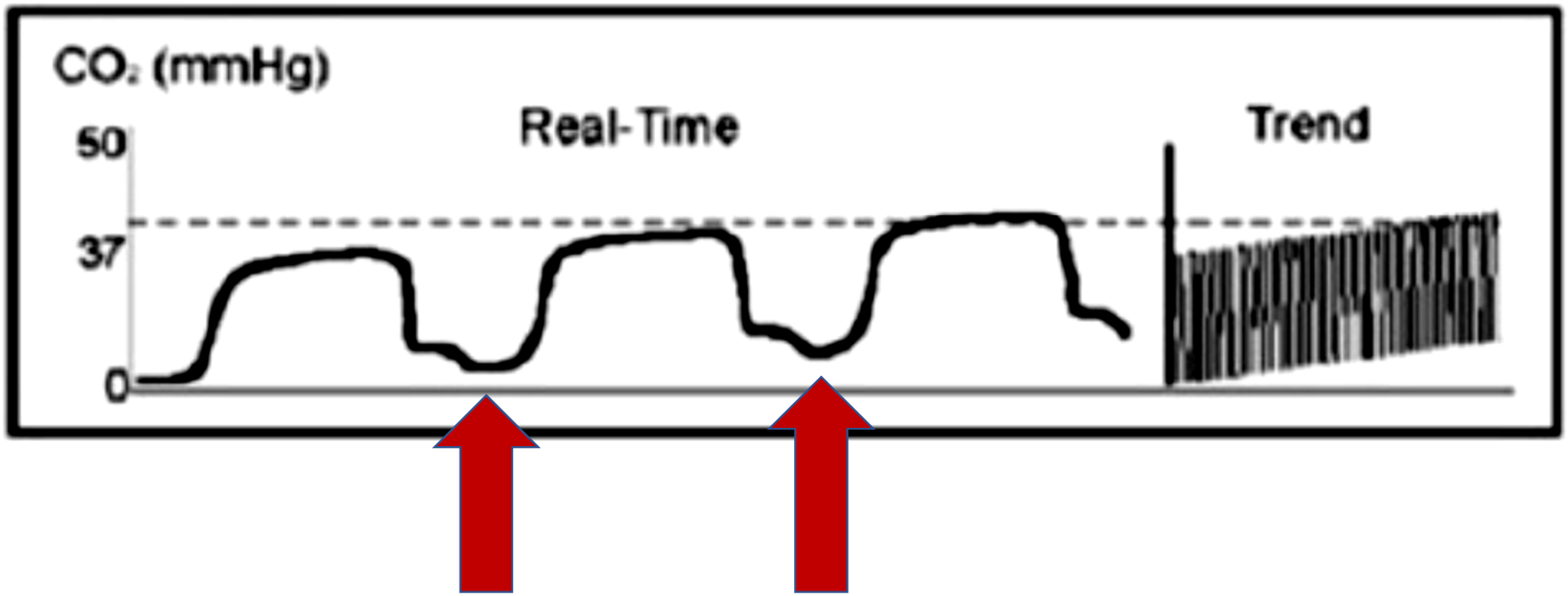
A **deflated endotracheal cuff** would cause the following:



Bronchospasm would result in an increased slope of the expiratory plateau, but an otherwise normal tracing.



The end tidal CO2 of faulty circuit valve:



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Postoperative Considerations

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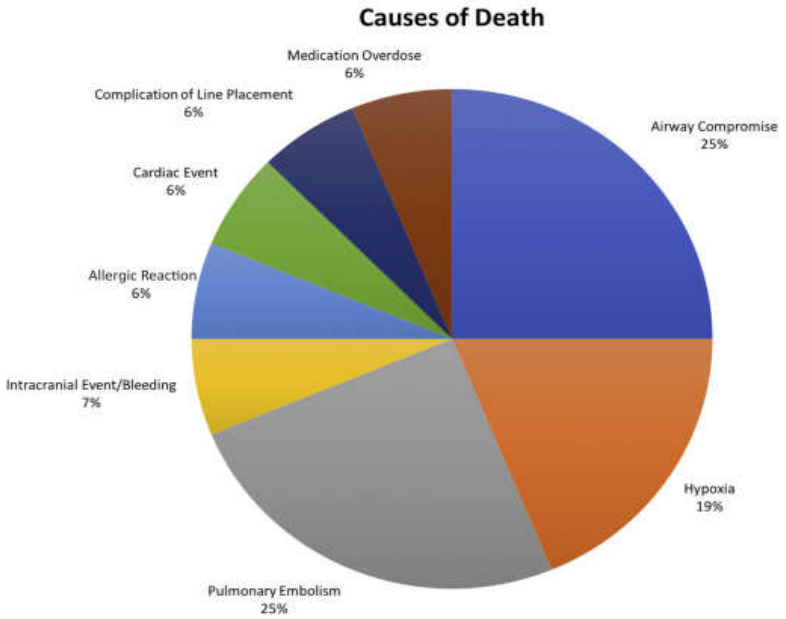

Fig. 1

Causes of death in PACU claims.

Analysis of adverse outcomes in the post-anesthesia care unit based on anesthesia liability data

Daniel B. Kellner, Richard D. Urman, Penny Greenberg and Ethan Y. Brovman

Journal of Clinical Anesthesia, 2018-11-01, Volume 50, Pages 48-56, Copyright © 2018 Elsevier Inc.

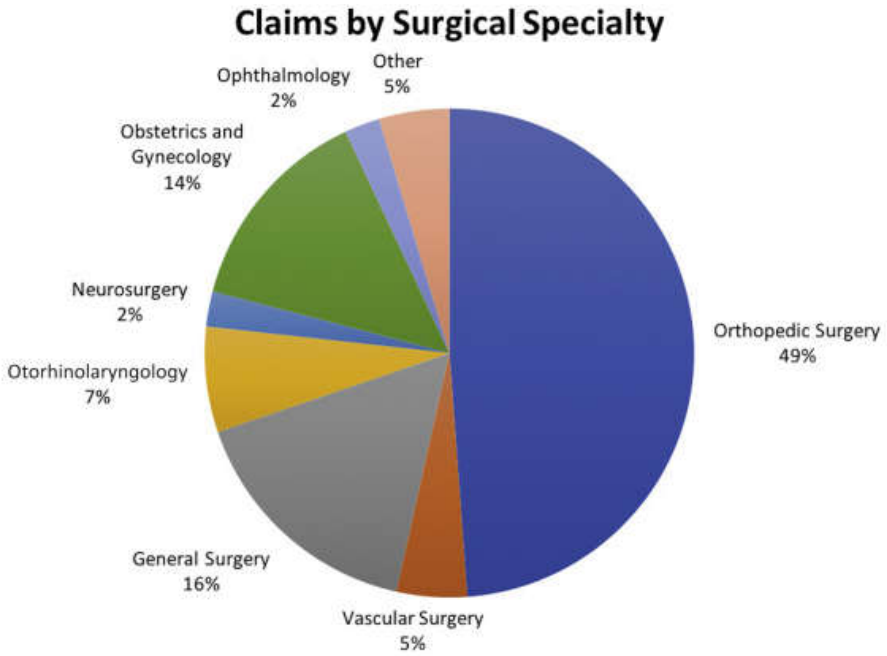

Fig. 2

PACU claims by surgical specialty.

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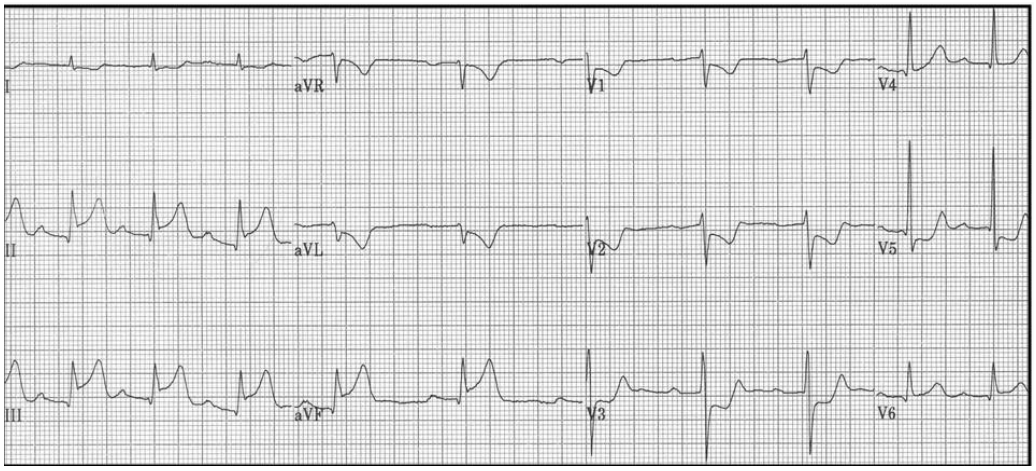
Journal of Clinical Anesthesia, 2018-11-01, Volume 50, Pages 48-56, Copyright © 2018 Elsevier Inc.

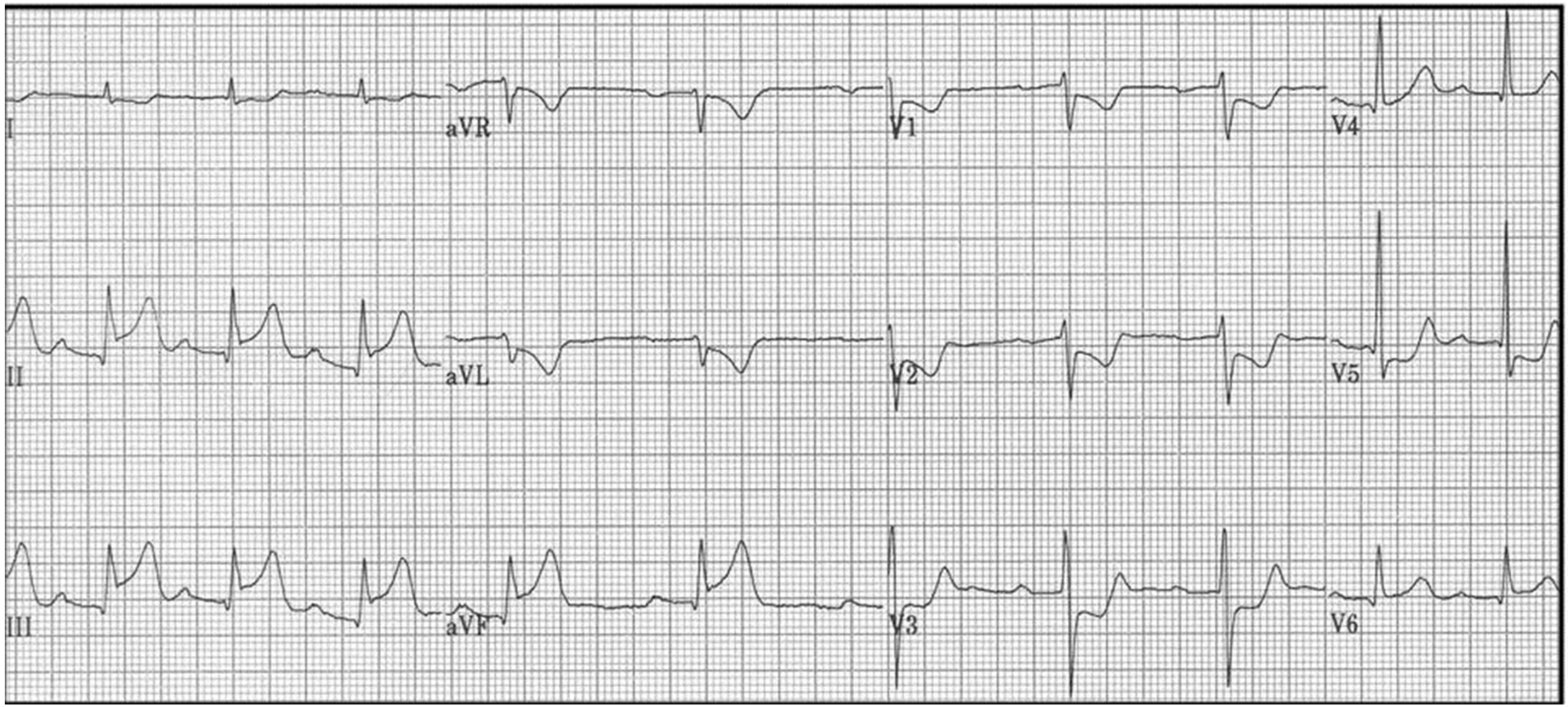
Question 12

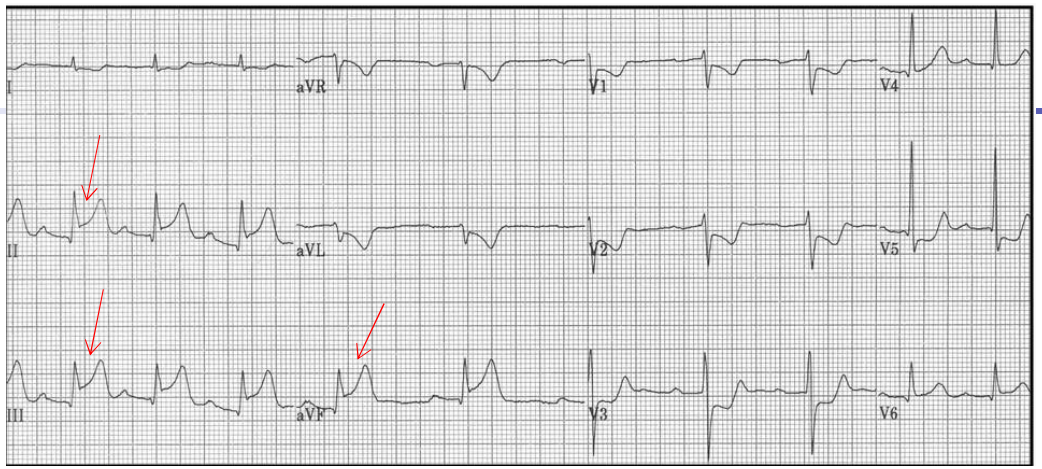
64yo man with history of hypertension and diabetes presents to the PACU after a general anesthestic for a vascular surgery procedure. He complains of chest pain and shortness of breath. You obtained a 12 lead EKG which revealed the following :



Based on this image, his pain and shortness of breath is most likely due to

A: A cardiac event
B: Post operative delirium
C: Respiratory distress
D: Uncontrolled pain from surgery


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6



A: A Cardiac Event

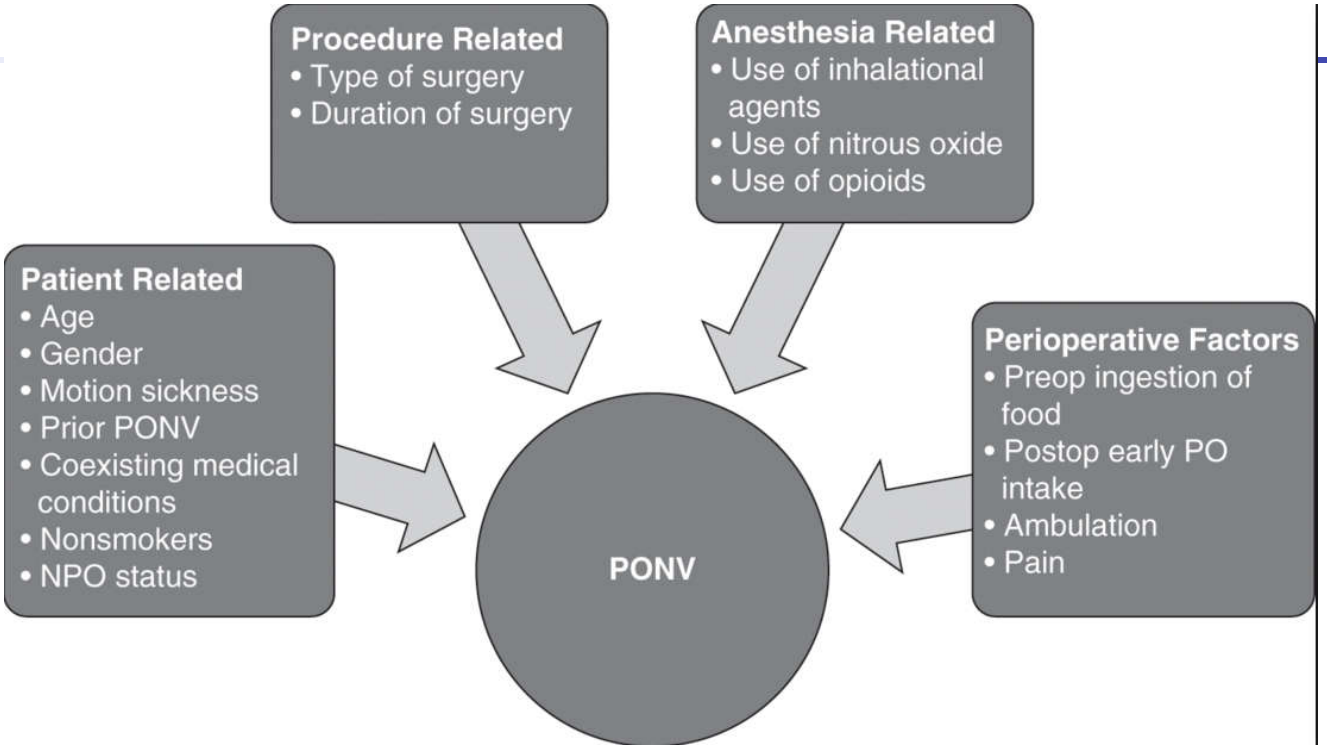
Inferior STEMI: Leads II, III and aVF represent the inferior portion of the heart that is most commonly perfused by the right coronary artery (RCA). Reciprocal ST depressions will be seen in aVL and possibly lead I. Inferior myocardial infarctions are common and represent 40-50% of myocardial infarctions.

Question 13

16-year-old otherwise healthy girl presents to PACU after receiving a general anesthetic for a laparoscopic appendectomy with morphine provided for pain. You get a call that she has persistent vomiting. What are the risk factors that render this patient vulnerable to postoperative nausea and vomiting?

A: Opioids provided
B: Gender
C: Age
D: All of the above

Post op nausea and vomiting



All of the above

https://www.cambridge.org/core/books/practical-ambulatory-anesthesia/postoperative-care/52512B333D4985066013C12EB6C04855

Question 14

You are called to the bedside of an infant who received an inguinal hernia repair under a general anesthetic and was extubated deep. His breathing resembles the following

He is tachypneic with saturations 91% on room air. What is your next step in management?

A: Obtain chest xray
B: Speak to anesthesiologist who covered the case
C: Provide supplemental oxygen
D: Intubate

https://www.youtube.com/watch?v=NBA9iigiDgk

Respiratory Distress

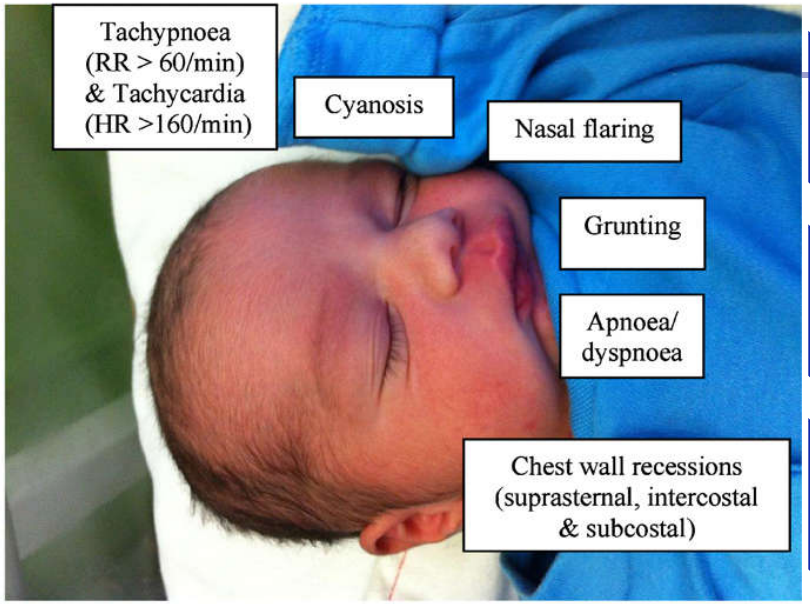


Figure 1. The common signs and symptoms of respiratory distress in term newborn infants.

Published in Paediatric respiratory reviews 2013
Respiratory distress of the term newborn infant.
Martin O. Edwards, Sarah J Kotecha, Sailesh Kotecha

- A • Airway
- B • Breathing
- C • Circulation

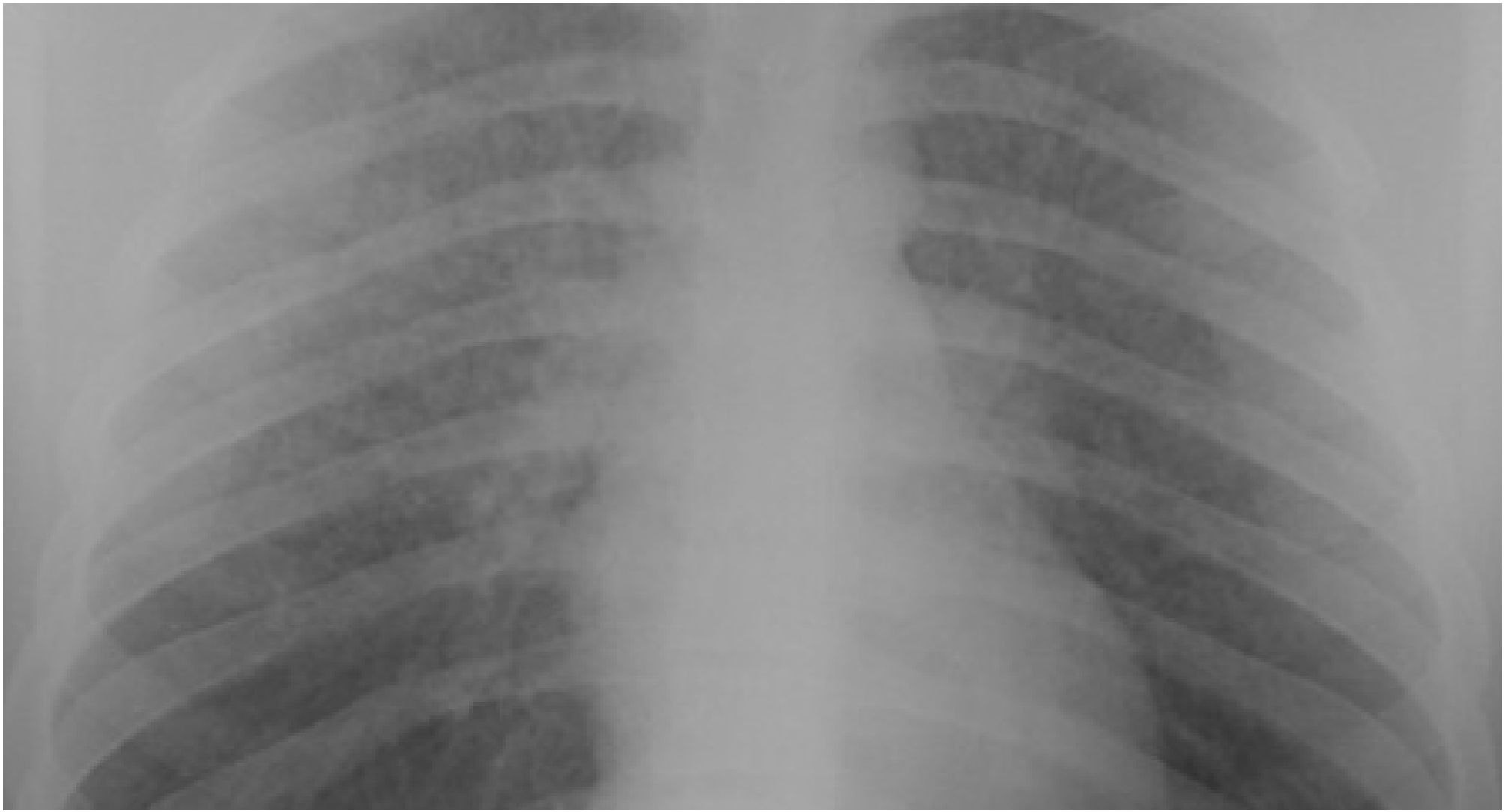
Provide supplementary oxygen

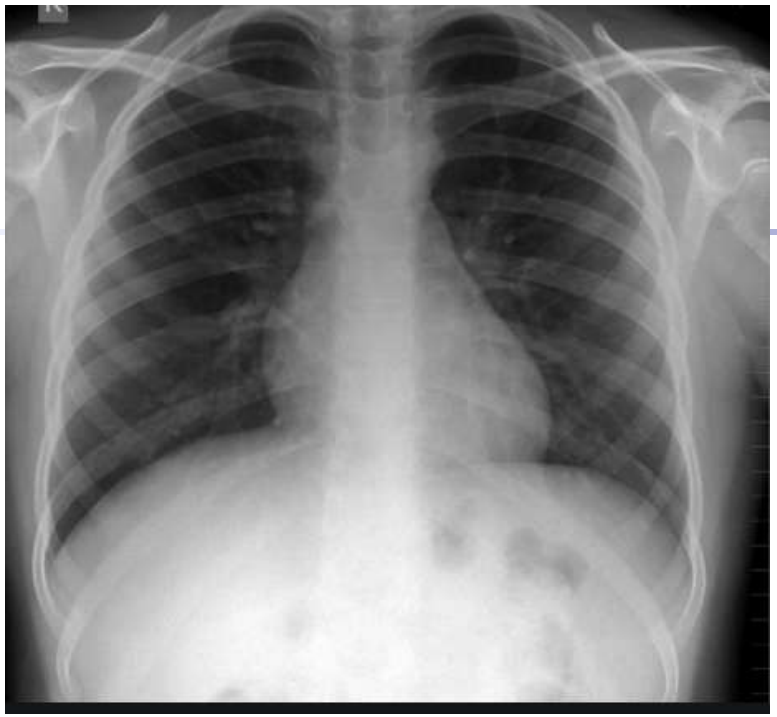
Question 15

A 22 yo otherwise healthy man presents to PACU after general anesthesia for vocal cord lesion removal. His extubation was notable for severe laryngospasm. You are called because he is having difficulty breathing. After reintubation, pink sputum was coming out of the endotracheal tube. A chest xray was acquired which is represented on the next slide.

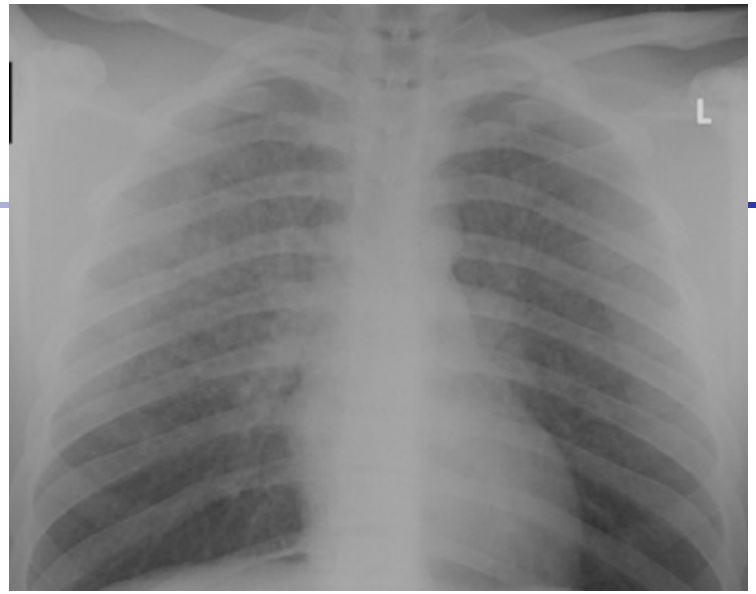
What is the underlying disturbance suggested by the photo?

A: Residual neuromuscular blockade
B: Pulmonary edema
C: Obstructive lung disease
D: Aspiration





normal



Pulmonary edema

Thank you!


The Mallampati Score
CLASS I
CLASS II
CLASS III
CLASS IV
CLASSIC ROCK