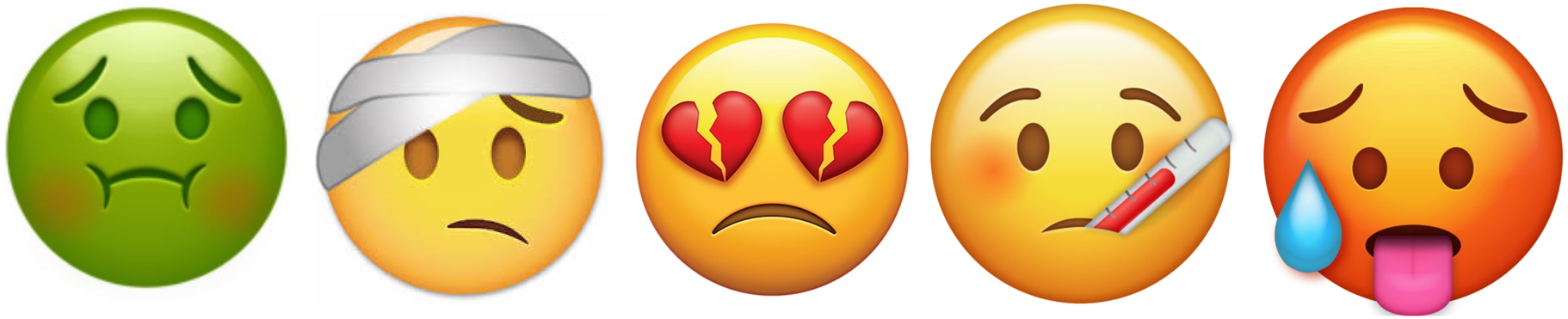

Postoperative Complications

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Overview

1. Identify surgical and patient-related perioperative risk factors

2. Brief timeline of surgical site infections

3. Case studies: Recognize common and not-so-common post-operative complications and know what to do

Surgical risk of complications

1. How healthy is the patient?
    - Acute or chronic medical problems
    - How functional is the patient? (METS)
    - High-risk comorbidities: CAD, OSA, COPD, frail, DM2, immunosuppressed
2. How risky is the operation?
    - Is it emergent or elective?
    - How invasive is the procedure?

Push-up test

METS roughly ~8

N=1104 active adult men in Indiana

40 or more push-ups had decreased cardiovascular risk after 10-year follow-up (IRR 0.04; 95% CI, 0.01-0.36

Yang J, et al. JAMA. 2019; 2(2):e188341

ASA-Physical Status Class	Definition	Examples, Including, but Not Limited to
I	A normal healthy patient	Healthy, nonsmoking, no or minimal alcohol use
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
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 weeks, history (> 3 months) of MI, CVA, TIA, or CAD/stents
IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to) recent (< 3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARDS, or ESRD not undergoing regularly scheduled dialysis
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
VI	A declared brain-dead patient whose organs are being removed for donor purposes	

The addition of "E" denoted emergency surgery: an emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part.

ARDS = acute respiratory distress syndrome; BMI = body mass index; CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; DIC = disseminated intravascular coagulation; DM = diabetes mellitus; ESRD = end-stage renal disease; HTN = hypertension; MI = myocardial infarction; PCA = post conceptual age; TIA = transient ischemic attack.

Adapted from https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system.

Urgent vs Emergent

Retrospective data NSQIP 2013 nationwide data N=173,643 abdominal surgeries

(75% elective, 13 % emergency and 12% urgent = nonelective / nonemergency)

Outcomes: Primary outcome 30-day mortality, Secondary outcomes of 30-day complications, reoperation, readmission.

Rate of mortality worse emergent (3.7%) > urgent (2.3%) > elective (0.4%)

Mullens MG, et al. JAMA Surg. 2017; 152(8);768-774.

Risk category	Risk incidence (%)	Type of surgery
High	>5	Aortic
		Major vascular
		Cardiothoracic
		Emergency
		Long with large blood loss or fluid shifts
Intermediate	1-5	Head, Neck
		Intraperitoneal
		Intrathoracic
		Orthopedic
		Prostate
Low	<1	Ambulatory surgery
		Endoscopy
		Superficial procedure
		Cataract
		Breast

Common complications

- PONV
- Constipation
- Urinary retention
- Pain

“Never event” complications

- Surgery on wrong body part
- Surgery on wrong patient
- Wrong surgery performed
- Unintended retention of a foreign object
- Intraoperative or immediate postoperative postprocedure death on ASA I

50% of post-op complications are avoidable

- SSI
- MACE (MI, stroke, death)
- PE / DVT
- Respiratory arrest (opiate OD, OSA, fluid overload)
- Delirium
- CAUTI
- CLABSI
- Clostridium difficile infection
- PTX

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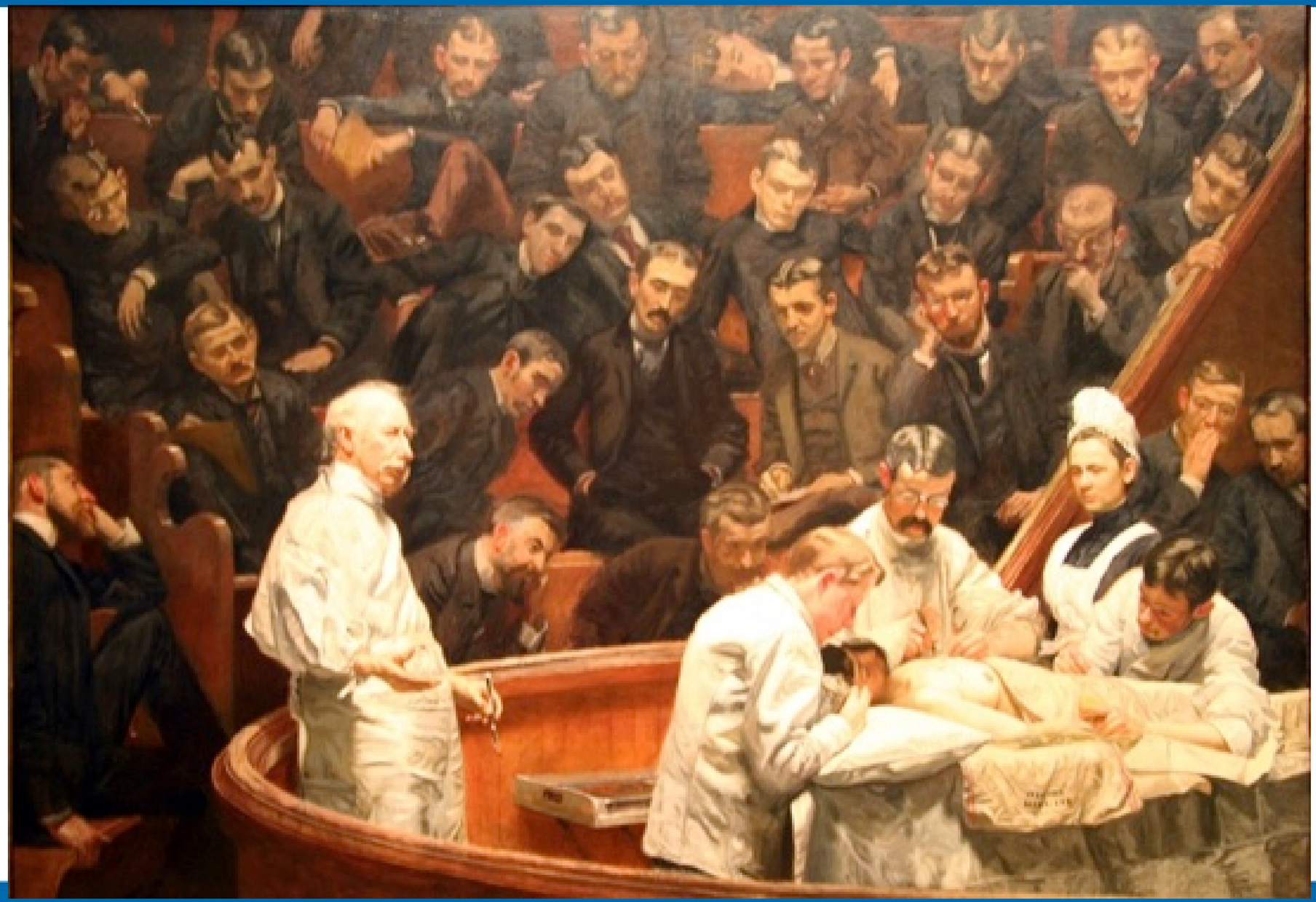
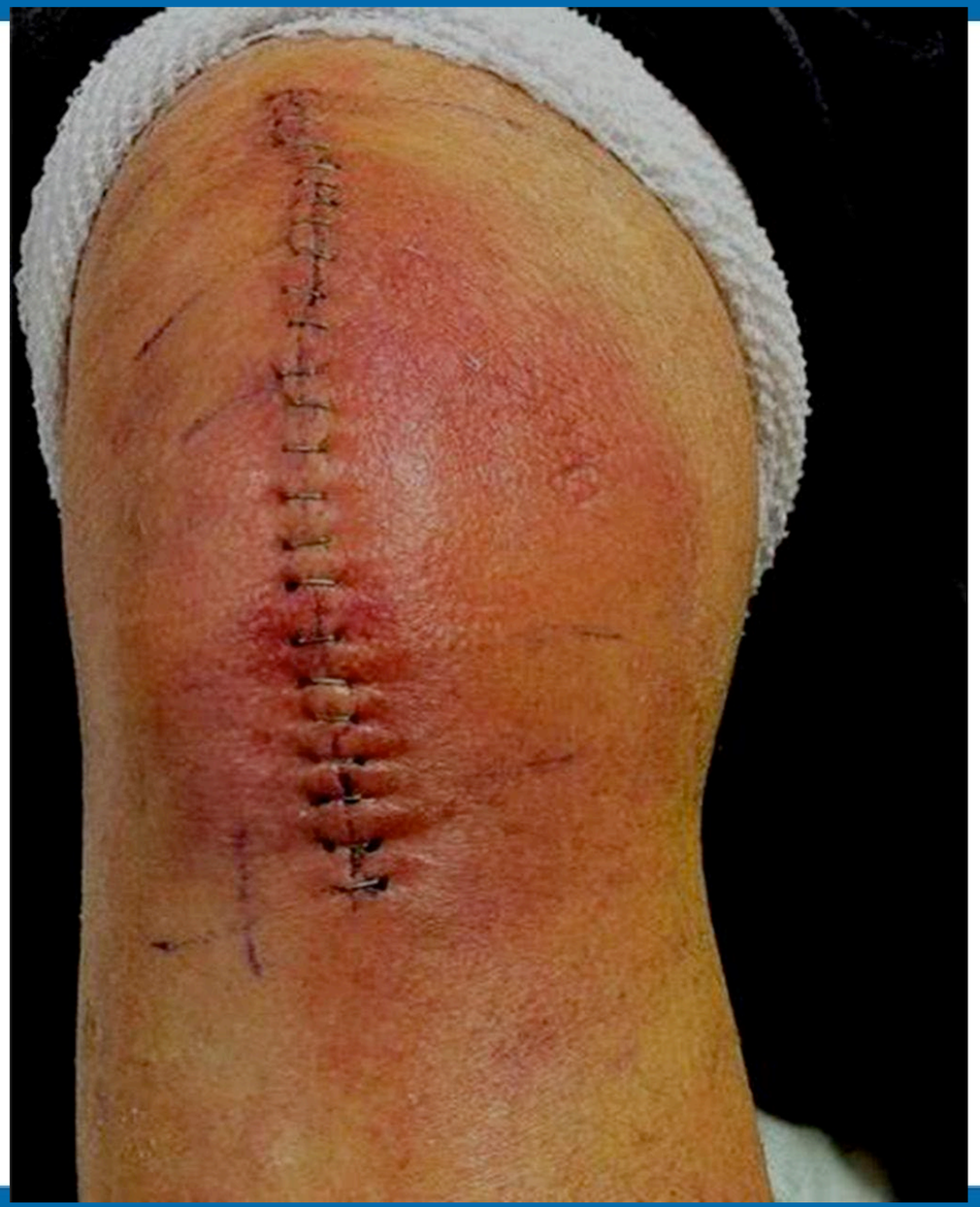


CASE #1

- 65-yo female
- S/p right TKA POD #7
- Persistent pain and erythema along incision site.
- C/o fatigue, leg pain, fevers
- PMH: Tobacco abuse, diabetes, HTN
- AFVSS
- Her physical exam notable for erythematous painful surgical site draining purulent material with limited ROM of the right knee



Q&A #1: What do you do next?

1. CBC with diff, knee x-ray
2. CBC with diff, arthrocentesis (cell count, diff, crystals, culture)
3. CBC with diff, ESR, CRP
4. CBC with diff, blood cultures X 2, lactic acid, then start vancomycin
5. CBC with diff, blood cultures X 2, lactic acid, then start cephalexin

Q&A #1: What do you do next?

1. CBC with diff, knee x-ray
2. CBC with diff, arthrocentesis (cell count, diff, crystals, culture)
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SSI (deep incisional) – definition

Surgery within 90 days involving deep soft tissues of the incision and at least 1 of the following:

1. Purulent drainage

2. Spontaneous dehiscence or deliberately opened/ aspirated AND organism identified AND fever, localized pain or tenderness

3. Abscess or other evidence of infection involving the deep incision that is detected on gross anatomical, histopathologic, or imaging

https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

Surgical Site Infections

- SSI make up most health-care acquired conditions (31%)
- In 2011, N=722,000 HAI in US acute care hospitals, and 75,000 (~10%) patients died
- HAI estimates 2011 SSI N=157,500; Rate 1.9%
- 75% of SSI-related deaths are directly attributable to the SSI
- Estimated annual cost $3.3 billion

https://www.cdc.gov/nhsn/pdfs/pscmanual/9pscssicurrent.pdf

Surgical Site Infection Prevention

- Shower, No shaving
- Chlorhexidine scrub
- Appropriate antibiotics
- Mech bowel prep with po and IV antibiotics for colorectal
- Blood glucose control
- Avoid hypothermia
- Goal-directed fluids
- Dedicated wound closure tray

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Goodman, et al. 2017 Arthritis Care & Research. 2017;DOI 10.1002/acr.23274
Allegranzi B, et al. WHO recommendations, Lancet 2016
Ljungquvist O, Scott M, Fearon KC. ERAS. JAMA Surgery 2017;152(3):292-8

Surgical Site Infection Prevention

- HbA1C >7% increased SSI 35.3% compared to 0.0% for thoracic and lumbar spinal instrumentation surgery.
- Peri-operative hyperglycemia (>200 mg/dL) even without a diagnosis of diabetes is an independent risk factor for SSI at 30 days (OR 3.2, 95% CI:1.3-7.8).
- Post-operative morning hyperglycemia associated with a 3-fold increased risk of peri-prosthetic infection in lower total joints

Hikata T, et al.. J Orhop Sci. 2014;19(2):223-8.
Mraovic B, et al. J Diabetes Sci Technol. 2011;5(2):412-8.
Richards JE, et al. J Bone Joint Surg. 2012;94(13):1181-6.

CASE #2

- 88-yo frail male had an elective laparoscopic cholecystectomy. He did not have a preoperative assessment.
- General surgery calls you (hospitalist) to consult regarding tachycardia and chest pressure POD#3
- HPI: Chest pressure 8/10 with radiation into jaw. No diaphoresis or nausea. He has had CP with exertion for about 6 months, but reports it's just "old age."
- PMH: Stroke, mild cognitive impairment, HTN, BPH, h/o colon cancer.
- SocHx: 40 pack-year smoker. Lives with wife in ALF and uses a walker at baseline.
- Physical Exam: Thin chronically-ill appearing, HR 95, BP 150/55, 92% RA, Chest: No TTP, Lungs Clear, CV: RRR, no MRG, Abd with lap incisions C/D/I appropriately tender

Q&A #2 – What do you do next?

1. Check troponin
2. Order CT chest angiogram
3. Give aspirin, nitroglycerin, and supply oxygen
4. Call cardiology to activate the catheterization lab and start heparin drip

Q&A #2 – What do you do next?

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Post-op MI

- Screen for active angina.
- N= 1,568 NSQIP 2005-2011 Previous MI & NCS.
- Primary outcome MI/cardiac arrest (5.8%). Angina is an independent predictor for postop MI. OR 2.49 [CI 1.20-5.58].

Pandey A et al. Am J Cardiol 2015.115(8):1080-4.

Post-op MI

- Risk stratify using NSQIP (or possibly Gupta)
- If high risk MACE (>1%), only perform cardiac stress testing for moderate-high risk elective surgery if cardiac symptoms or METS<4
- MDCalc now updating their recommendations (RCRI places everyone at high risk)

Post-op MI

"If 30-day post-op mortality was a disease, it would be the 3rd leading cause of death." – Daniel Sessler, Cleveland Clinic

N=104,401 30-day mortality NCS lasting 60+ min retrospective cohort

Threshold for cardiac injury is intraoperative MAP < 65 mmHg. Injury worse with the longer and deeper hypotension.

Masha, et al. Anesthesiology; 2015;123:79-91.

CASE #3

- 45-yo male with a BMI of 44 who does not seek regular medical care underwent elective left total knee replacement
- Post-operatively, the patient is unable to wean off of oxygen in the PACU and is transferred to the surgical floor.
- He received midazolam preoperatively. Post-operatively, he has an adductor canal bupivicaine/fentayl catheter and received 1 mg IV dilaudid X4
- A rapid response is called overhead, and you are a first responder.
- HPI: The patient is difficult to arouse. Denies SOB. The nurse reports he was transferred from the PACU 2 hours prior. You have the nurse pull up his chart and quickly scan:
- PMH: Unremarkable, 20-pack year smoker
- ROS preoperatively: heavy snoring, intermittent HA

CASE #3

- Vitals: T37, P100, BP 170/72, RR 9, SpO2 94% on 4 Liters, 75% on RA
- Gen: Morbidly obese, NAD, difficulty staying awake and intermittently needs sternal rub for stimulation to answer questions
- HEENT: Neck circ 17 in, Mallampati III, MMM, CV: RRR, Ext: Chronic BLE non-pitting edema, incision C/D/I

- Pre-operative labs from last week: CBC normal, CO2 30, Crn 1.10

The Mallampati Score

CLASS I
Complete visualization of the soft palate

CLASS II
Complete visualization of the uvula

CLASS III
Visualization of only the base of the uvula

CLASS IV
Soft palate is not visible at all

Q&A #3: What do you do next?

1. Check a VBG
2. Get a CXR
3. Administer narcan
4. Administer flumazenil
5. Refer to sleep medicine

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Obstructive Sleep Apnea

- N= 904 meta-analysis
- OSA use of CPAP perioperatively reduced risk (12% risk reduction) or postoperative adverse events (NNT 45)

Nagappa et al. Anesth Analg. 2015;120(5):1013-23.

Obstructive Sleep Apnea

- 17% fewer major complications if neuraxial anesthesia used instead of general anesthesia in OSA pts
- Decreased odds ratio for ICU transfer or intubation if multimodal pain control used for pt with OSA underoging elective total joint.

Kaw et al, Br J Anaesth 2012;109(6):897-906.
Memtosoudis et al. Anesth Pain Med 2013;38(4):274-81.
Cozowicz C, et al. Br J Anaesth. 2019;122(1):131.

CASE #4

- 55-yo female POD#0 elective sigmoidectomy using ERAS protocol. She takes apixaban for atrial fibrillation and has chronic back pain, for which she takes MS Contin 30 mg TID
- General surgery calls you (hospitalist) to consult for uncontrolled pain in her legs.
- HPI: POD#0 sigmoidectomy. Apixban was held 48 hours prior to surgery. She describes severe pain in her back with radiation down both legs with pins and needles. +incontinence.
- Physical Exam unremarkable except decreased sensation to light touch and pin prick below L5, knee looks good

Q&A #4: What do you do next?

1. Stat neurosurgery consultation
2. Increase short-acting oxycodone from 5-10 mg to 5-15 mg Q4 PRN severe pain
3. Check CT cervical, thoracic, lumbar, and sacral spine
4. Check CT lumbar and sacral spine
5. Check MRI cervical, thoracic, lumbar, and sacral spine
6. Check MRI lumbar and sacral spine

Q&A #4: What do you do next?

1. Stat neurosurgery consultation
2. Increase short-acting oxycodone from 5-10 mg to 5-15 mg Q4 PRN severe pain
3. Check CT cervical, thoracic, lumbar, and sacral spine
4. Check CT lumbar and sacral spine
5. Check MRI cervical, thoracic, lumbar, and sacral spine
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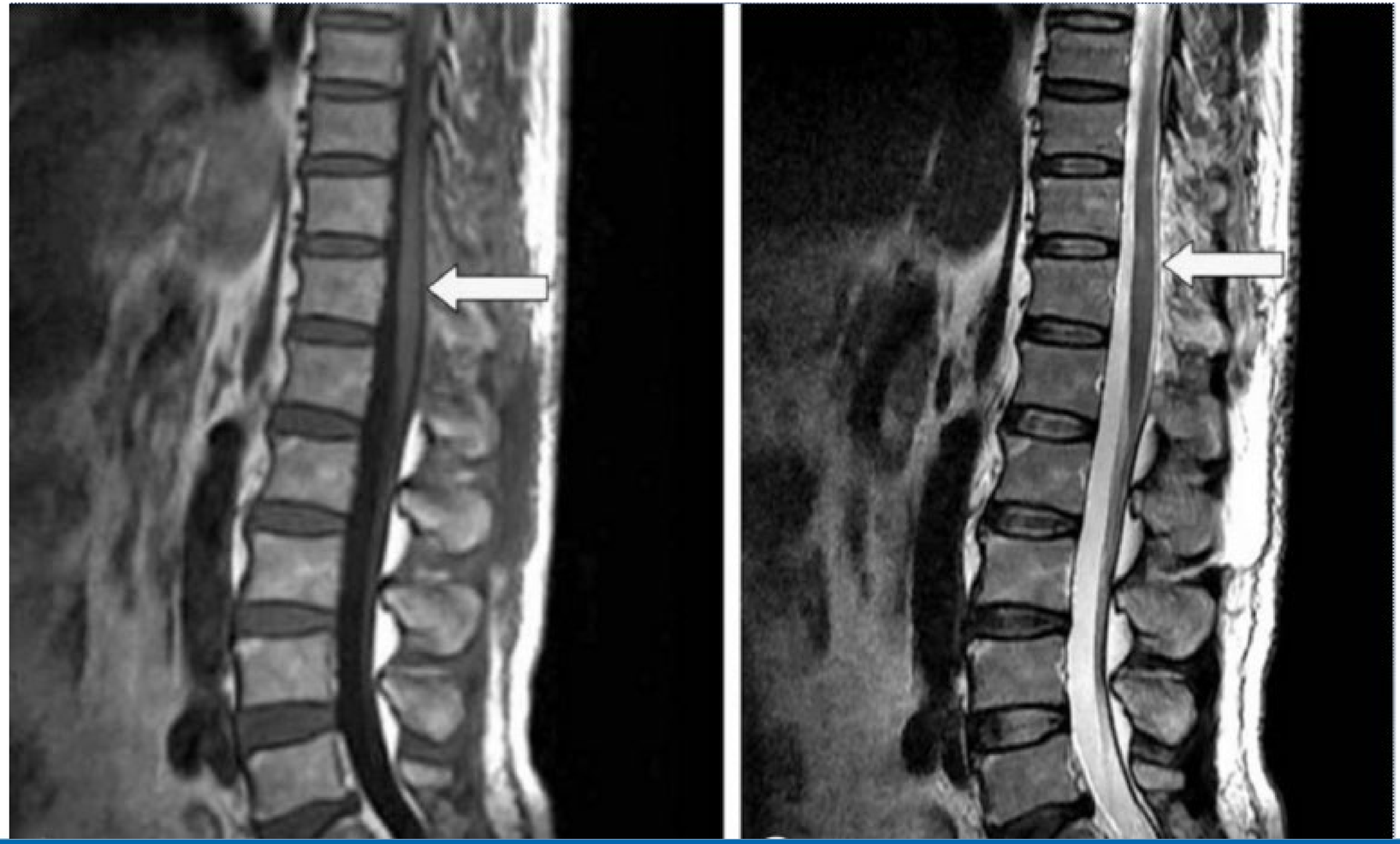
Q&A #4



Epidural hematoma

- Spinal epidural hematoma 1 in a million annually.
- Deficits may be focal weakness, paraplegia, paresthesia, or complete loss of sensation below a level.
- Neurosurgical emergency for decompression.

CASE #5

- 65-yo male underwent right shoulder replacement. Orthopedic surgery is discharging the patient today, but when they take off oxygen, his saturations are 82% RA.
- PMH: ILD, HTN
- Orthopedic surgery calls you (hospitalist) to consult
- HPI: POD#1 right TSA. Not requiring narcotics for pain control. Denies SOB other than baseline ILD.
- Physical Exam remarkable for 82% RA sat, thin stature, fine velcro-like crackles bilaterally, and right shoulder in immobilizer

Q&A #5: What do you do next?

1. Outpatient pulmonary function testing
2. Check ABG
3. Obtain CXR
4. Home with oxygen

Q&A #5: What do you do next?

1. Outpatient pulmonary function testing
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3. Obtain CXR
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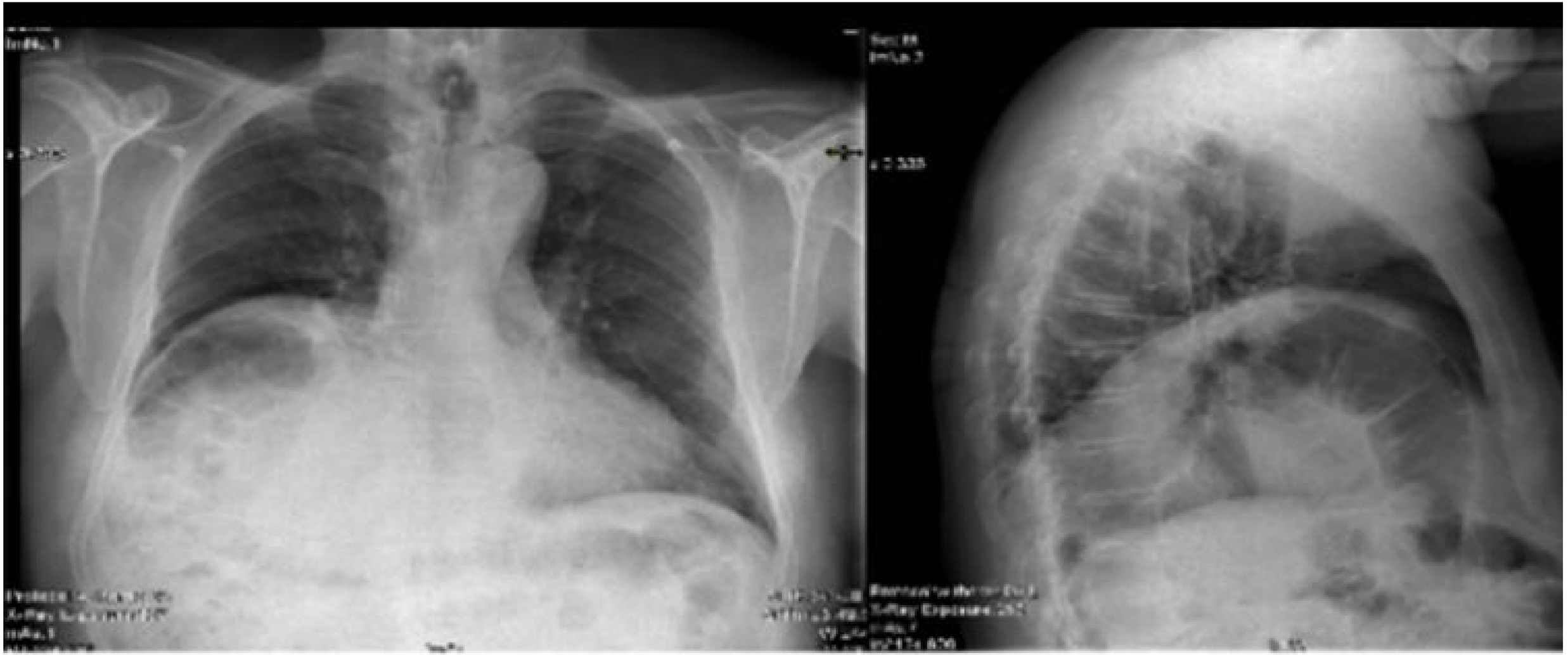
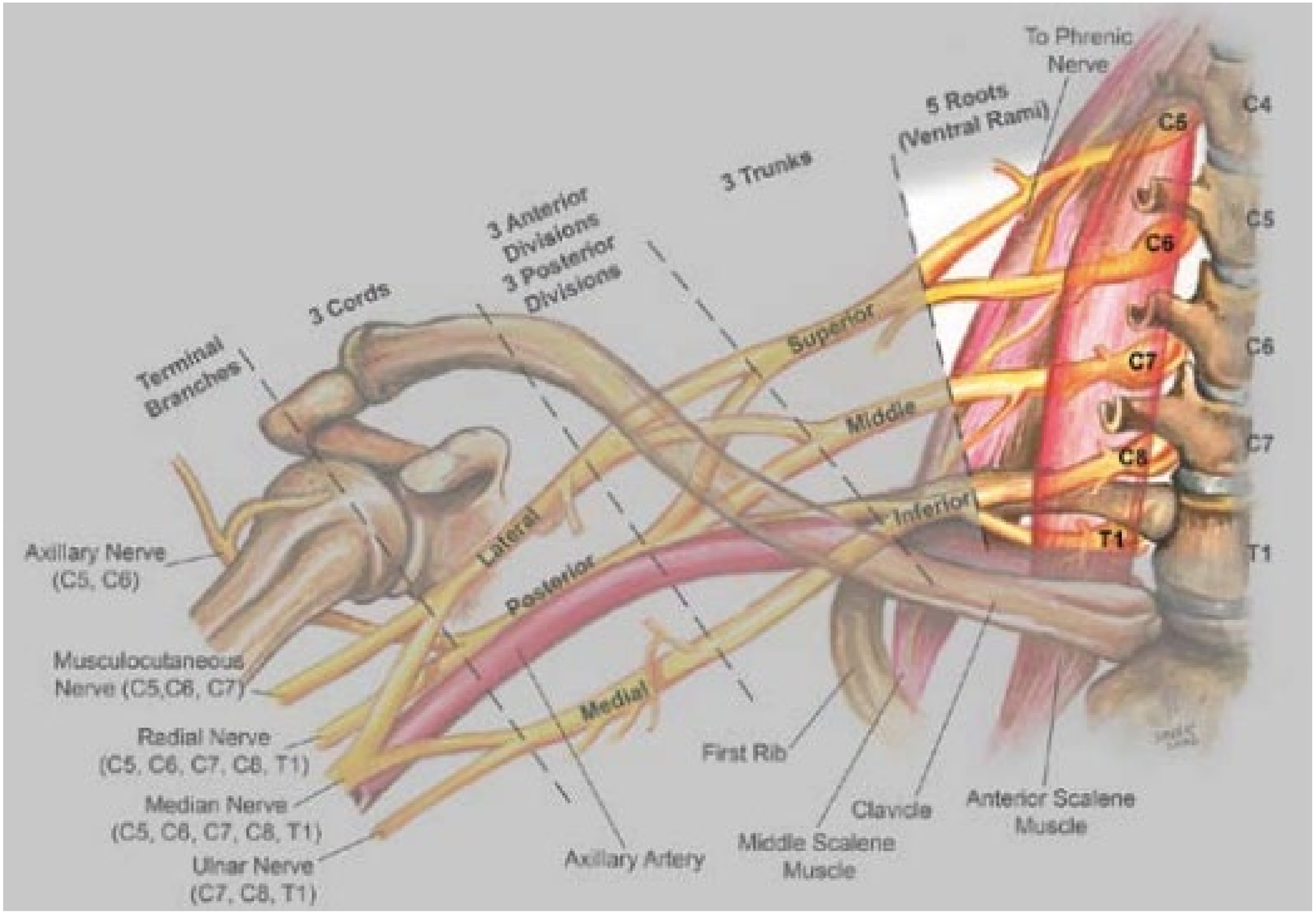
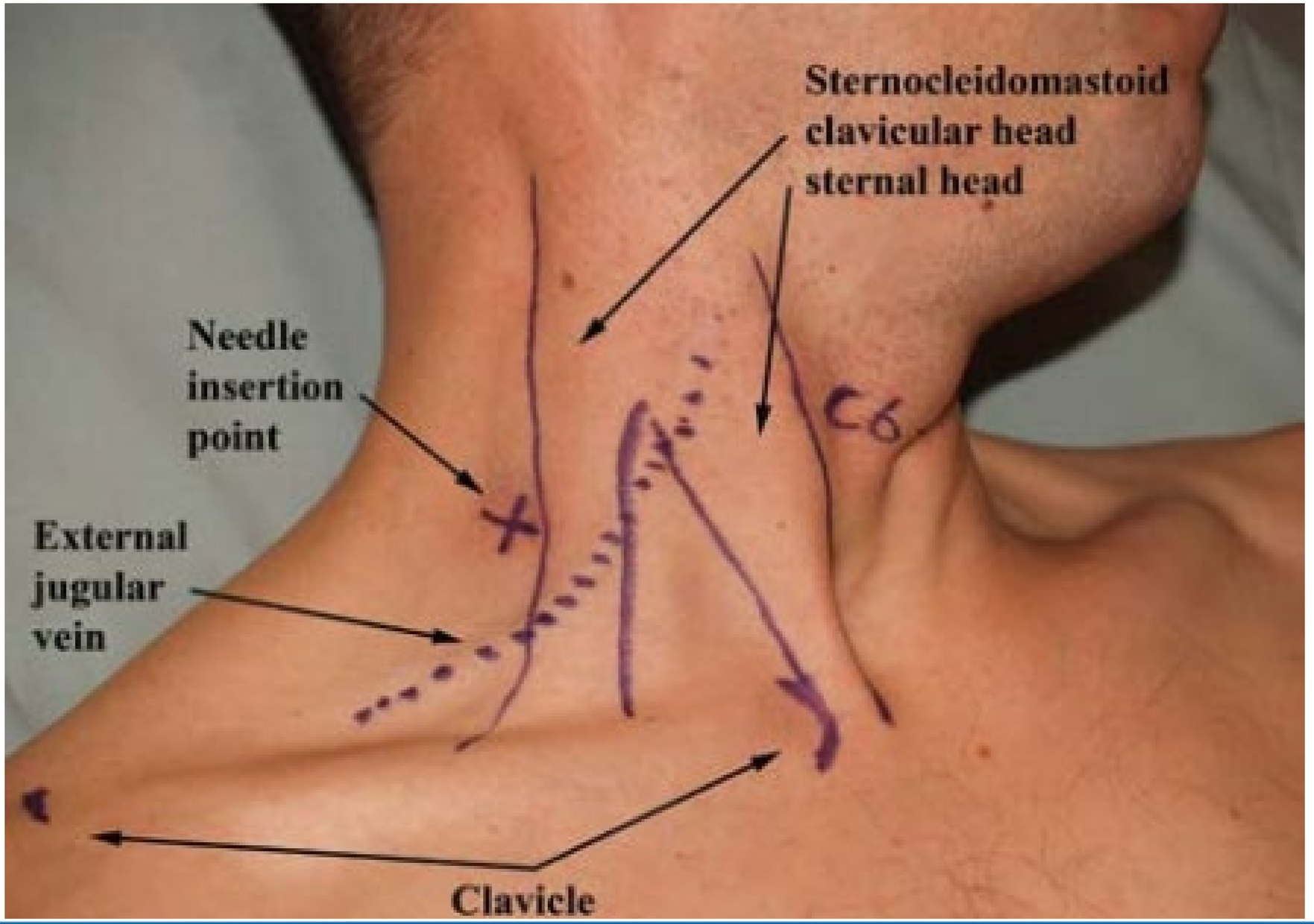



To Phrenic Nerve
5 Roots (Ventral Rami)
3 Trunks
3 Anterior Divisions
3 Posterior Divisions
3 Cords
Terminal Branches
Superior
Middle
Inferior
Lateral
Posterior
Medial
C4
C5
C6
C7
C8
T1
Axillary Nerve (C5, C6)
Musculocutaneous Nerve (C5,C6, C7)
Radial Nerve (C5, C6, C7, C8, T1)
Median Nerve (C5, C6, C7, C8, T1)
Ulnar Nerve (C7, C8, T1)
Axillary Artery
First Rib
Middle Scalene Muscle
Clavicle
Anterior Scalene Muscle


Sternocleidomastoid
clavicular head
sternal head
Needle
insertion
point
External
jugular
vein
C6
Clavicle

CASE #6

- 69-yo male elective uncomplicated laparoscopic cholecystectomy
- General surgery calls you (hospitalist) to consult regarding tachycardia, HTN, and fevers 10-minutes post-operatively in the PACU
- PMH: HTN (HCTZ held preoperatively, metoprolol continued)
- FamHx: Father died during surgery at age 55, unclear cause
- Physical Exam: Vitals significant for T 39.5, BP 170/70, HR 115, and rigidity in all extremities

Q&A #6: What do you do next?

1. Ampicillin-sulbactam
2. Sodium nitroprusside
3. Labetalol
4. Dantrolene
5. Restart HCTZ

Q&A #6: What do you do next?

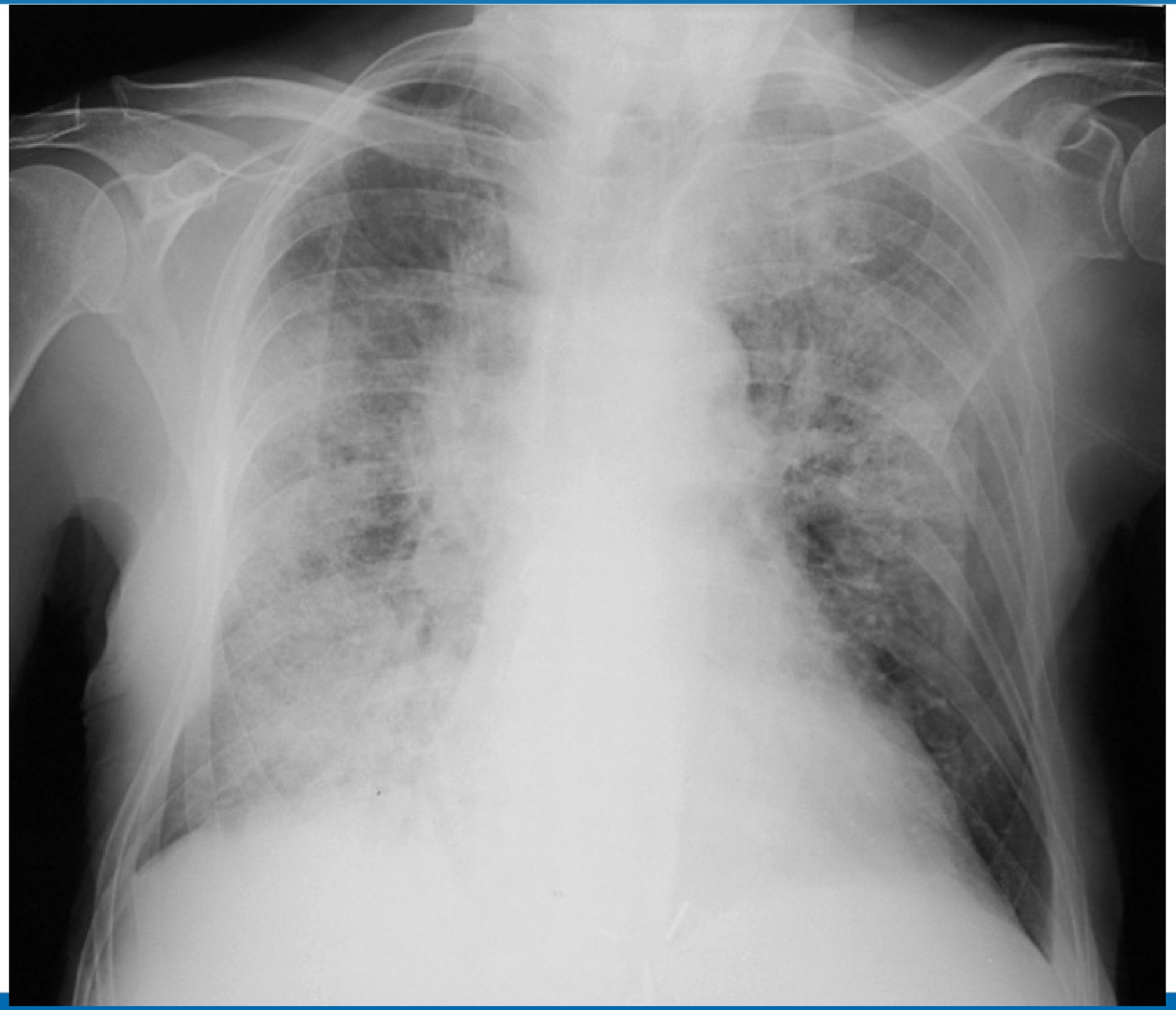
1. Ampicillin-sulbactam
2. Sodium nitroprusside
3. Labetalol
4. Dantrolene
5. Restart HCTZ

Malignant hyperthermia

- Life threatening inherited skeletal disorder of increased intracellular calcium
- Hypermetabolic state precipitated by volatile anesthestics (inhalational anesthestics used during general anesthesia) and depolarizing muscle relaxants like succinylcholine.

CASE #7

- 75-yr-old male POD#0 s/p appendectomy
- General surgery consults you (hospitalist) for post-operative hypoxia.
- HPI: POD#0 lap appy with significant blood loss. Received 1 unit blood intraoperatively. Has been receiving 75 ml/hr NS IV and another transfusion is in process. Still NPO due to nausea.
- PMHx: HTN, OA, No h/o CHF
- Physical exam Spo2 70% RA, 92% 6 liters. HR 120,BP 80/40, RR 40, Appears in respiratory distress, Dry mucus membrane, tachycardic to 110, crackles throughout all lung fields. Abdomen without guarding. Incision looks good.
- What do you do next?



Q&A #7: What do you do next?

1. Lasix 20 mg IV X 1, transfer to the ICU, trial of NIPPV
2. Stop transfusion, transfer to the ICU, hemodynamic support with IVF/ vasopressors
3. Transfer to the ICU, start solumedrol 60 mg IV Q8
4. Stop transfusion, transfer to the ICU, intubate, supportive care

Q&A #7: What do you do next?

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Transfusion-related acute lung injury

- TRALI 1 in 5000 transfused blood
- Mechanisms of TRALI are a two-hit mechanism 1. neutrophil sequestration and priming, then 2. neutrophil activation causing inflammatory (non-hydrostatic) pulmonary edema
- Mortality 50%.

CASE #8

- 69-yr-old female POD#0 s/p elective lithotripsy under general anesthesia
- General surgery consults you (hospitalist) for post-operative hypoxia in the PACU
- HPI: POD#0. No home supplemental O2. Intraop: IV toradol, midazolam, fentanyl.
- PMHx: HTN, Mild COPD
- Physical exam T37.9, HR 110, BP 185/60, RR 35, SpO2 88% 4 liters
- Face is flushed. Bilateral wheezing, mild abdominal pain.
- Labs reviewed and insignificant

Q&A #8: What do you do next?

1. Albuterol nebulizer
2. Methylprednisolone
3. Dantrolene
4. Epinephrine
5. Furosemide

Q&A #8: What do you do next?

1. Albuterol nebulizer
2. Methylprednisolone
3. Dantrolene
4. Epinephrine
5. Furosemide

Anaphylaxis

- Death from anaphylaxis median 5 minutes for iatrogenic causes
- Clinical diagnosis and unpredictable; Patient does not have to be hypotensive
- Non-steroidals one of the most common causes of drug-induced anaphylaxis. Majority patients with 1 NSAID anaphylaxis reaction can tolerate structurally unrelated NSAID.

Pumphrey, RS. Clinx Exp Allergy. 2000;30(8):1144.
Lieberman Et al. Ann Alergy Asthma Immunol. 2015;115(5):341.

Anaphylaxis

- Criteria fulfilled when 1 of the 3 criteria fulfilled:

1. Acute illness with skin involvement and 1 of the following: respiratory compromise, reduced BP or associated end-organ dysfunction

2. Two of more of the following after exposure to a likely antigen: A. Skin mucosal tissue involvemtn, B. Respiratory compromise, 3. Reduced blood pressure, 4. Persistent GI symptoms

3. Reduced blood pressure after KNOWN allergen

Do not miss post-op complications

- SSI
- Post-op MI
- Respiratory complications (worse in OSA)
- Epidural hematoma (neuraxial anesthesia lower total joints)
- Hemidiaphragm paralysis (interscalene block)
- Malignant hyperthermia (general anesthesia)
- TRALI (blood transfusion)
- Anaphylaxis

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