

Ortho for the Hospitalist PA

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Disclosures

- Non declaration statement: I have no relevant relationships with ineligible companies to disclose within the past 24 months.



Learning Objectives

At the end of this session, the learner should be able to:

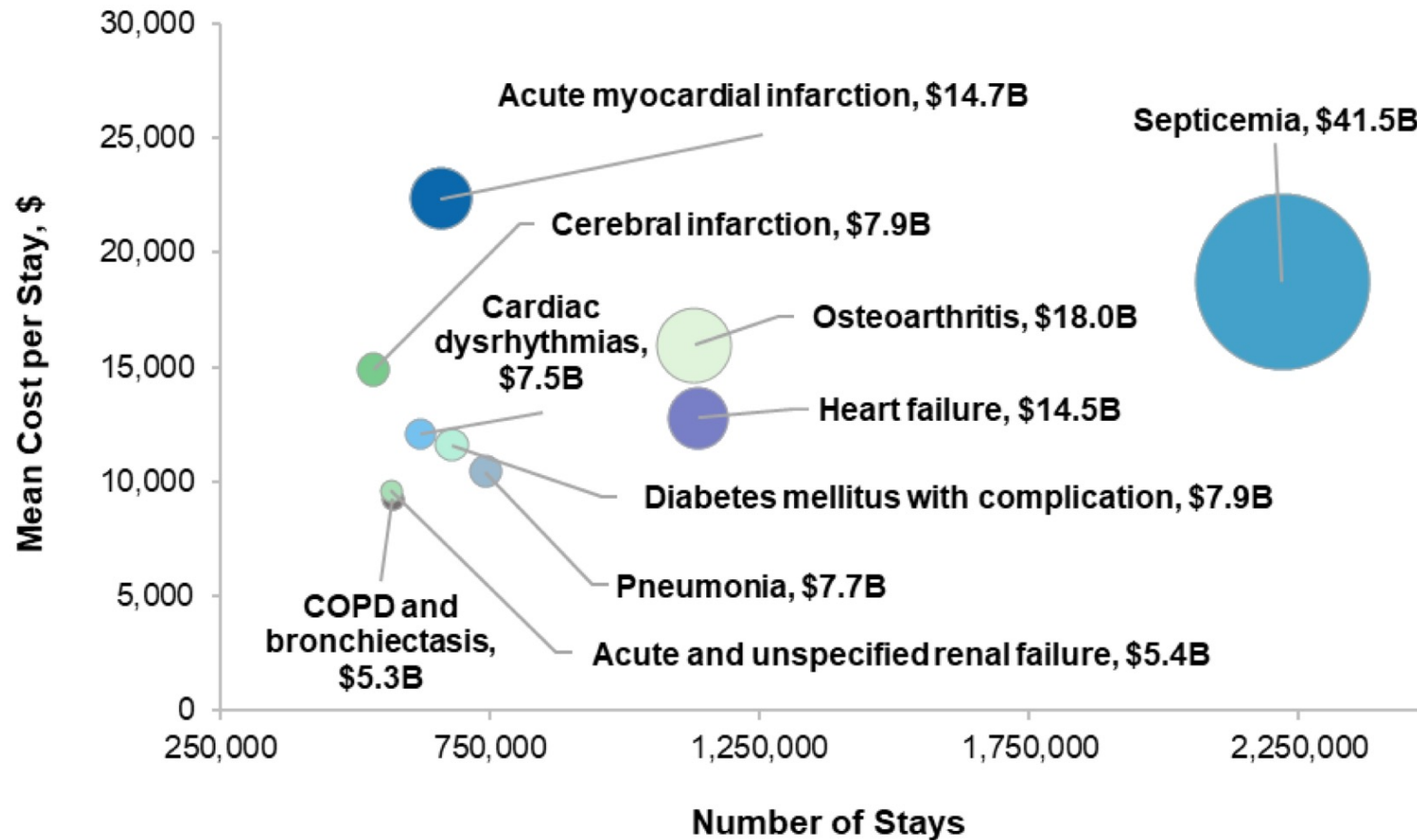
1. Discuss common orthopedic cases seen in the inpatient setting.
2. Describe orthopedic diagnoses that require timely recognition and intervention.
3. Justify treatment recommendations, including appropriate pharmacology, in various orthopedic diagnoses.

What are the most common orthopedic reasons for an inpatient hospital stay?

Top Ortho Reasons for ED/Hospitalization

- **“Back symptoms” and “pain, unspecified”**
 - Top 10 principal reasons for ED visits, 2021¹
- **“Injury, poisoning and certain other consequences of external cause”**
 - Top primary diagnosis by disease category in ED, 2021¹
 - Head, wrist, hand, fingers
- **Osteoarthritis**
 - One of the most common hospitalizations in 2018 (#3)²
 - Second most costly diagnosis - \$18 billion aggregate costs²
- **Skin and subcutaneous infections**
 - #11 most common hospitalization in 2018²
- **Spondylopathies/Spondyloarthropathies**
 - #13 most common hospitalization in 2018²
 - Average stay \$24k vs. \$16k for osteoarthritis

Figure 1. Aggregate cost of nonmaternal, nonneonatal hospital inpatient stays, by mean cost and number of stays, 10 most frequent principal diagnoses, 2018



Abbreviation: B, billion; COPD, chronic obstructive pulmonary disease; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification

Notes: Diagnoses were identified using the Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses. The pneumonia diagnosis group excludes pneumonia caused by tuberculosis.

Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), National Inpatient Sample (NIS), 2018

Top Inpatient Surgeries

- Most Frequent OR Procedures, 2018³
 - Knee arthroplasty #2
 - Hip arthroplasty #4
 - Spine fusion #6
 - Femur fixation #8
 - Vertebral discectomy #10
- Age 0-44 – fixations
- Age 45-75+ - arthroplasties

Back Pain

- **Most common MSK complaint**
- Leading cause of work absenteeism, limited activity⁴
- DDX Broad Categories:
 - Infectious
 - Inflammatory
 - Neoplastic
 - Degenerative
 - Deformative
 - Traumatic
 - Inherited/Metabolic

Back Pain

- **“Red Flag” symptoms:**
 - New onset or progressive motor or sensory loss
 - New or worsening neurologic symptoms focal to lower extremities
 - Progressive/disabling symptoms
 - Bladder or bowel incontinence/urinary retention
 - Saddle anesthesia
 - Hx cancer, trauma, IV drug use, immunosuppression, chronic steroid use, osteoporosis, or recent spinal procedure
 - Unexplained weight loss
 - Fever

Types of Back Pain

Infectious

- Discitis, osteomyelitis, spinal abscess (paraspinal or spinal epidural)
- Think of in immunocompromised, IV drug users
- Back pain + fever = high suspicion for infection
- Limited ROM, overlying erythema

Inflammatory

- Spondyloarthropathies
 - Reactive arthritis, ankylosing spondylitis, RA, Langerhans histiocytosis, psoriatic spondylitis
- Disease flares/progression

Types of Back Pain

Deformative

- Spinal deformities may present similarly to degenerative disc disease (DDD)
- Postural instability, gait imbalance, limited ROM

Degenerative

- Degenerative Disc Disease (DDD) – collapse of intervertebral discs, loss of disc height, neurologic sequelae
- Lumbosacral spine most affected, often causes lower extremity radiculopathies
- Positive SLR test, limited ROM

Types of Back Pain

Traumatic

- Vertebral column fracture, spinal instability, neurologic injury, cauda equina syndrome
- MSK strains, torsional sprains, herniated disc
- Even mild trauma in elderly can produce fracture

Inherited/Metabolic

- Osteogenesis imperfecta, osteomalacia/ricket's, Paget's disease of bone, diabetic neuropathy
- Good family hx, evaluation of bone quality helpful

Types of Back Pain

Neoplastic

- Most common site of any bone metastasis is the vertebral column
 - Think of in any patient with cancer hx (doesn't have to be solid tumor)
- Pain, limited ROM, paresthesia, bowel/bladder incontinence
- Cord compression!

Examining (Low) Back Pain

- **Waddell signs** (psychogenic back pain)⁵:
 - Axial loading
 - Distracted straight leg raise discrepancy
 - Acetabular rotation
 - Overreaction
 - Superficial tenderness
 - Regional weakness
 - Regional sensory disturbance (non-dermatomal pattern)
 - Non-anatomical tenderness

Workup of Back Pain

- **Imaging in:**
 - ANY red flag symptoms/hx
 - Persistent back pain for 6+ weeks
- Minimal benefit to early imaging in non-emergent back pain, unless significant patient anxiety⁴
- Insufficient evidence in the literature to recommend specific imaging sequence

Non-opioid Back Pain Management⁶

- **Physical therapy**
 - Dry-needling? – helps release muscle fascia
- Encourage **activity** – may not improve ACUTE low back pain, but will prevent recurrence
 - Some evidence points to worsening in acute phase with bed rest
- Teach proper **mechanics**
- Massage
- Spinal manipulation
- Acupuncture
- Ice in flare, heat for comfort

Non-opioid Back Pain Management⁶

- **Pharmacologic**
 - NSAIDs – meloxicam
 - Muscle relaxers – Robaxin
 - Epidural steroid injections (ESI) – particularly good for radicular pain; typically used after more conservative measures fail, or in chronic pain
 - TNF inhibitors – herniated disc/radiculopathy
 - Analgesic topicals – diclofenac gel (NSAID)
 - Lidocaine patches
- Herbals?
 - Capsicum based cream
 - Comfrey root extract
- Stem cells and PRP? – have been used but high-quality evidence lacking

Time for some cases...

Case #1

- A 32-year-old female presents to the ED with concern of a skin infection of her hand. Her dog bit her 2 days ago on the dorsal aspect of the hand, overlying the 2nd and 3rd metacarpals, and it was initially red around it. The erythema has now spread, is streaking up into the wrist and she is experiencing pain in the hand.
- **Exam:** There is significant edema and erythema in the R hand including the first 4 digits, a 1 cm laceration, and a small amount of purulent drainage from the wound. Just lateral to the laceration, there is a small area of fluctuance. There is streaking redness on the dorsal and lateral aspect of the wrist. Active flexion/extension of all MCP, PIP, DIP joints intact, though digits 2 and 3 are somewhat limited at the PIP by edema. Full ROM in the wrist. Median, ulnar, radial nerve sensation intact.
- **Vitals:** HR 89 bpm, BP 116/82 mmHg, RR 16 br/min, Temp 100.8F

Case #1

- An x-ray is obtained to rule out foreign body...negative
- CT scan is obtained due to the area of fluctuance...1cm abscess
- CBC reveals leukocytosis with left shift
- Gram stain, aerobic and anaerobic cultures are obtained (pending)

Case #1

Which of the following is an acceptable empiric antibiotic choice to treat the suspected infection?

- A. IV vancomycin
- B. IV clindamycin
- C. IV piperacillin-tazobactam
- D. IV azithromycin

Mammalian Bite Infections⁷

- **Dogs > Cats > Humans**
- Infection occurs in **30-40%** of bites to the hand
 - Within 24-72 hrs.
- Polymicrobial (aerobes and anaerobes)
 - **DOGS:**
 - Pasturella spp., Staph spp., Strep spp., Neisseria spp., Fusobacterium spp.
 - **CATS:**
 - Pasturella multocida (75%), Strep spp., Staph spp., Moraxella spp., Neisseria spp., Fusobacterium spp.
 - **HUMANS:**
 - Eikenella Corrodens, Staph spp., Strep spp., Corynebacterium spp.

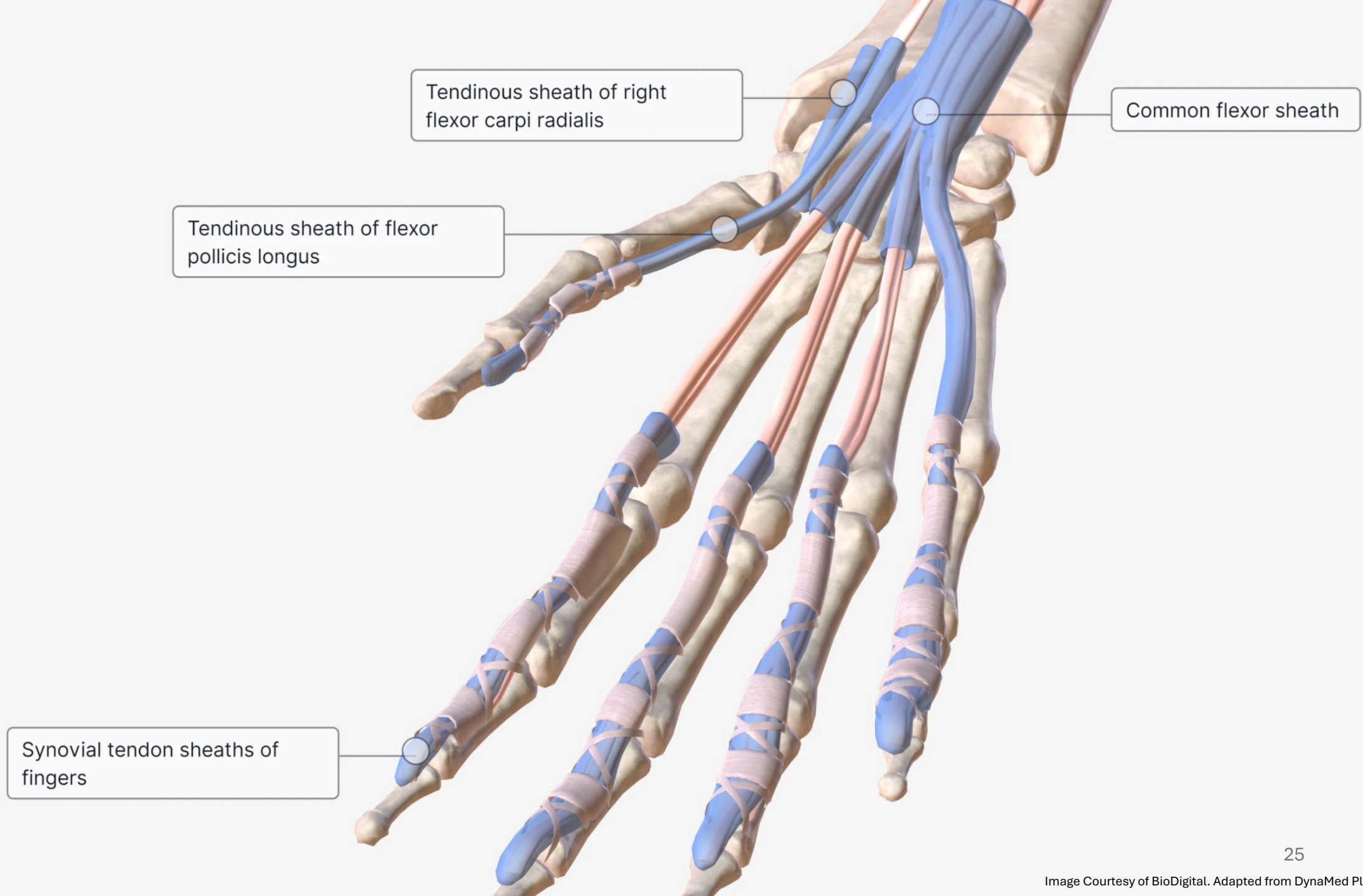
Mammalian Bite Infections

- **Why do they bite?**
 - Two reasons that increase risk: separating fighting animals, attempting to aid injured animal
 - Humans = fights
- **Notable complications:**
 - *Capnocytophaga canimorsus* infection is associated with severe, sometimes fatal sepsis after dog bite (think of if asplenia, hepatic dysfunction)
 - *Pasturella multilocida* may lead to necrotizing soft tissue infections

Mammalian Bite Infections



- **Purulent flexor tenosynovitis (PFT)** – closed space infection of the flexor tendon sheath of the hand
 - **Kanavel signs** – 91-97% sensitivity, 51-69% specificity⁸
 1. Symmetric swelling of the entire digit
 2. **Exquisite tenderness along the course of the tendon sheath**
 3. A digit with semiflexed posture
 4. **Pain with attempted passive extension of the digit**
 - 5. **One study also cited pain < 5 days as an independent predictor**
 - **If #2, #4, and #5 all present – 88% likelihood of PFT**
 - Can progress to necrosis of the tendon and pulleys
 - May require I&D and irrigation OR surgical debridement in addition to antibiotics
 - Even with timely treatment may have residual pain, diminished function, stiffness
 - Delays or inadequate treatment can result in tendon rupture, tissue necrosis, or amputation





Mammalian Bite Infections

Workup/Diagnosis

- CBC
- **Gram stain + culture (aerobic + anaerobic)**
- Blood cultures - if systemic symptoms, sepsis
- ESR/CRP?
- Imaging?
 - XRAY - r/o foreign body, fracture
 - CT – if suspicion for abscess or other complication
- Compartment pressures?
- Explore for tissue damage
- **If dog/cat:** ask about vaccination status of animal, rabies in particular
- **If human:** ask about general health of biter, particularly Hep B, C, HIV status

Mammalian Bite Infections

- **Management:**
 - **IRRIGATE!**
 - Debride any devitalized tissue
 - DO NOT close a wound with infection (unless to the face)
 - **Consult ortho hand surgeon** if bite to hand, plastic surgeon for head & neck
 - **IV antibiotics** if hospitalizing
 - 2nd/3rd generation cephalosporin + metronidazole; piperacillin-tazobactam
 - Broaden coverage if abscess, complication
 - 7–14-day course usually adequate, unless involving bone/joint infection
 - Consider tetanus, rabies, Hep B/HIV post-exposure prophylaxis/vaccination

Back to Case #1

- She was taken to the OR on hospital day #2 for abscess drainage and debridement
- Cultures eventually grew *Streptococcus pyogenes*
- She completed 10 days of antibiotics and healed without complication
- Her dog still looks as innocent as ever...



Case #2

- A 62-year-old male is hospitalized for severe pneumonia and required intubation and mechanical ventilation. He is now on hospital day 4 and has been extubated, stabilized, and transferred out of the ICU to the medical-surgical floor.
- He reports to the RN upon transfer that he is feeling much better aside from this throbbing pain in his R forearm. The RN calls you, the PA who has assumed care of the patient. You are busy with a critically ill patient you are transferring to the ICU, and you give the nurse a verbal order for prn acetaminophen.
- Two hours later, the RN calls you back stating that the patient is still in pain and the acetaminophen didn't work. She reports his R forearm is a bit swollen but not too bad and that he had his arterial line removed from the R radial artery earlier today. You are again busy with an admission and order a warm compress and prn ibuprofen for the patient, letting her know to update you.

Case #2

- She calls back a third time, and states the patient is still in pain, and it is becoming more severe. He seems to scream and cringe in pain if she tries to touch the forearm. You decide to go to the bedside and examine the patient. He states his arm feels very tight, and he feels a burning, aching pain. It hurts any time he moves his hand. He is also experiencing numbness and tingling.
- **Exam:** R forearm is swollen and very firm to touch circumferentially. His ROM in the wrist, elbow, and fingers is limited by pain. The patient winces and pulls away with passive flexion and extension of the wrist, noting severe pain. He has diminished two-point discrimination. Radial and brachial pulses are intact. Capillary refill is delay to 4 seconds.

Case #2

- Upon quick chart review, you note that the patient has a history of MI s/p 3-vessel CABG and is on aspirin, metoprolol, and lisinopril. He also has COPD for which he is on an inhaled corticosteroid (ICS). During his hospital stay, he developed a LLE DVT and was placed on heparin and transitioned to rivaroxaban. He is also on day 4/7 of antibiotics, which was transitioned to cefepime for his pneumonia.

Case #2

What is the gold standard in diagnosis for the condition you expect this patient has developed?

- A. Serum creatinine phosphokinase (CPK) level
- B. Compartment pressures
- C. CT scan with IV contrast
- D. Culture and gram stain

Compartment Syndrome

- **Tissue pressure exceeds perfusion pressure** in an enclosed muscle compartment → muscle and nerve ischemia
 - Increased fluid or decreased compartment size
- Can be the result of **many underlying conditions** that hospitalist NPPAs may see, however, most commonly seen in trauma/fractures
 - Burn
 - Seizure
 - Rhabdomyolysis
 - DVT
 - Influenza myositis
 - Drug/alcohol abuse
 - Hemorrhage
 - Envenomation
 - Constrictive dressings
 - Arterial injury
 - IV extravasation

Compartment Syndrome Presentation

- **Pain** out of proportion to injury/pain with passive stretch – first, most sensitive signs of compartment syndrome in an awake patient^{9, 10}
 - Burning, deep and aching
 - Tense edema
 - Severe, progressive
- ***Paresthesia** or numbness – indicative of nerve ischemia, not reliable early on
 - Two-point discrimination or diminished vibrating sense are more reliable early tests
- ***Paralysis** – late finding; recovery rare
 - Motor function deteriorates within 4 hours of ischemia, loss may be irreversible at 8-24 hours¹¹
 - Forearm - hand in intrinsic minus position¹⁰

* = late findings

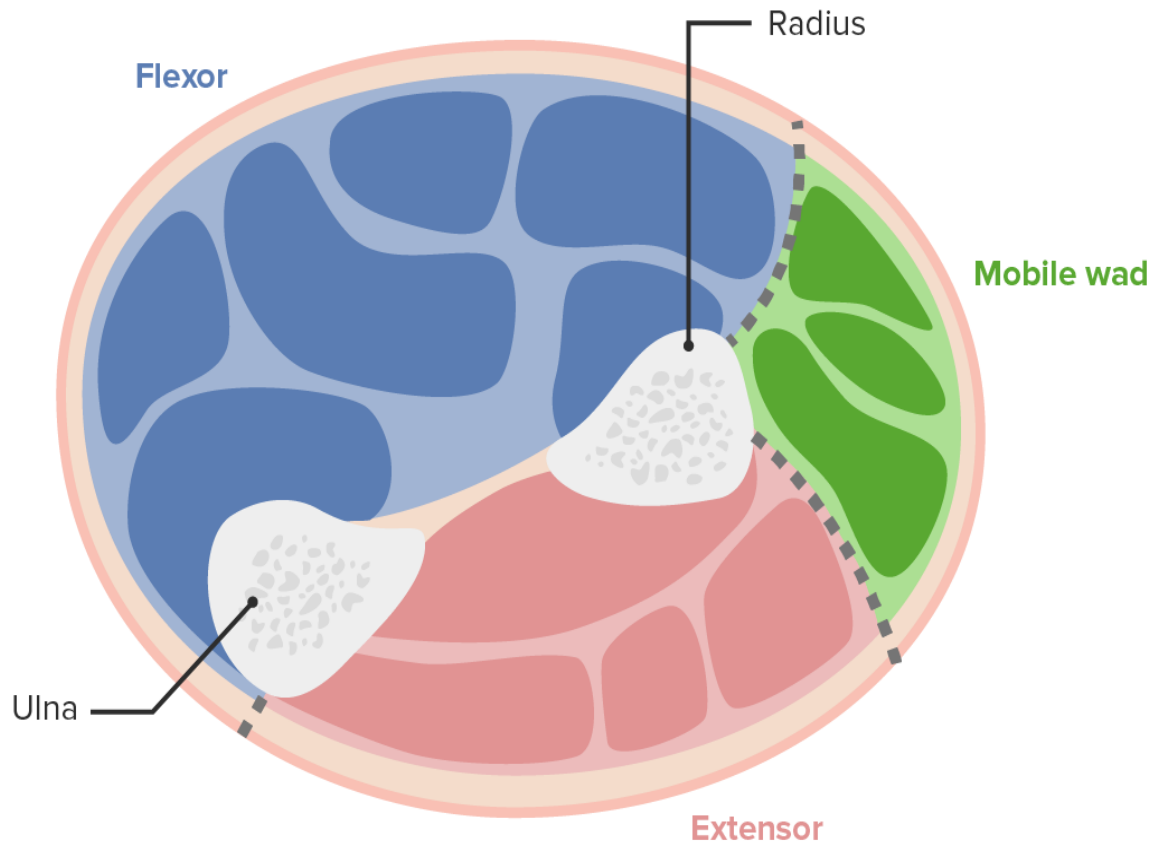
Compartment Syndrome Presentation

- ***Palpable pulses** may also be misleading – venous injury can cause it
 - Pulselessness is a late finding; usually makes amputation inevitable
- ***Pallor** indicates compression of arterial perfusion; late finding
 - May also have skin findings such as blistering in delayed presentation⁹
- **Poikilothermia** – affected extremity may be cooler

* = late findings

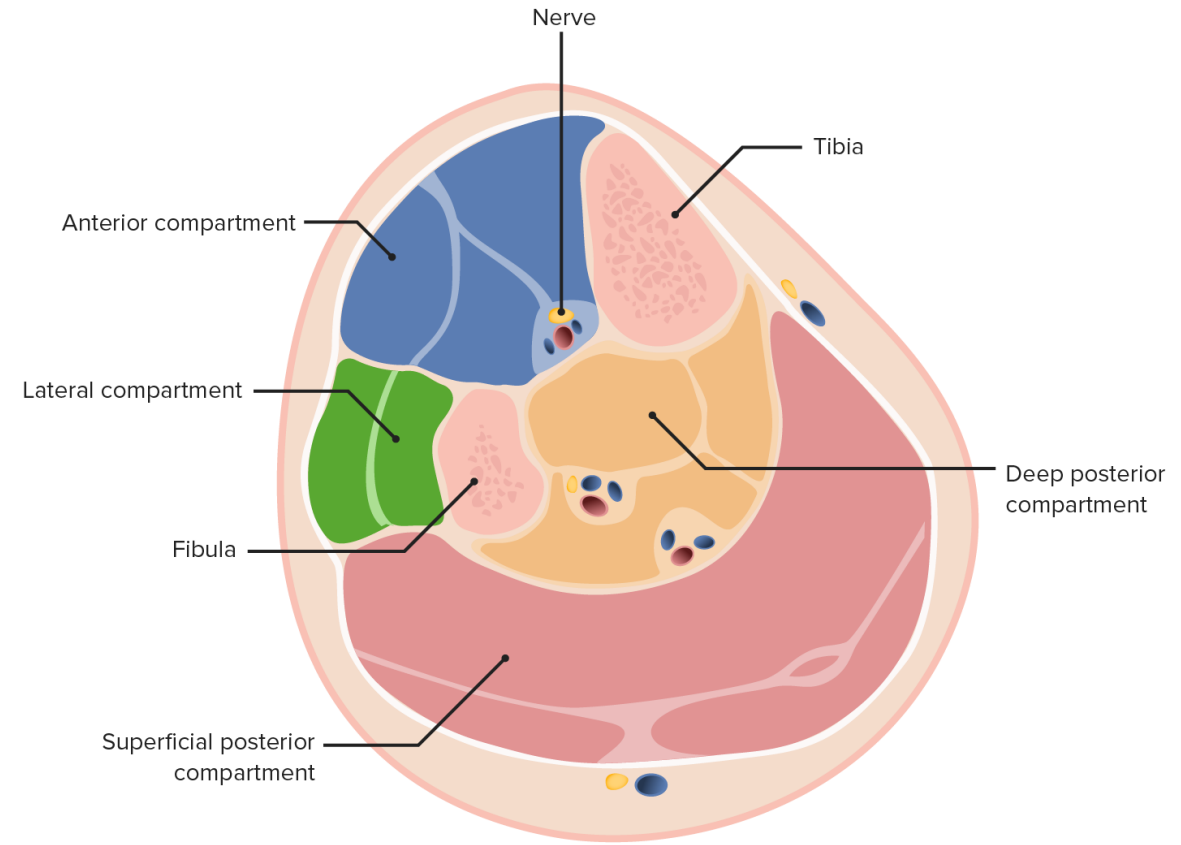
Compartment Syndrome Diagnosis

- Labs often not necessary
 - Creatinine phosphokinase (CPK), UA, urine myoglobin level, renal function to r/o rhabdomyolysis, which may coexist – check electrolytes if so
- **Consult ortho surgeon early if suspected!**
 - Do not wait for symptoms to evolve if unsure
- Compartment pressures are the gold standard in diagnosis, however, primarily a clinical diagnosis
 - **Differential/delta pressure < 30mmHg (diastolic blood pressure – compartment pressure)**
 - Some may accept **absolute pressure of the compartment > 30 mmHg**
 - Measure all compartments in affected area
- Angiography may help identify focal arterial/venous injury and perfusion defect (do not delay care to obtain)¹¹



Forearm Compartments

- Flexor (Volar) x2*
- Extensor (Dorsal)
- Mobile wad



Lower leg compartments

- Anterior*
- Lateral
- Superficial posterior
- Deep posterior

Compartment Syndrome Management

- ABCDE's if trauma patient
- **Remove** any binders, casts, dressings of affected site
- **Elevate** extremity
- **Analgesia**
- **Reverse anticoagulants**, replace factor levels prn
- **Emergent fasciotomy**
 - Wounds left open (wound-vac) for recurrent wound checks, dressing changes, and prn debridement every 24-72 hours
 - Closure within 7-10 days
 - Frequent neurovascular checks
- **Complications include irreversible muscle/nerve damage, paralysis, amputation, Volkmann ischemic contracture, gangrene, complex regional pain syndrome (CRPS)**

Back to Case #2

- Ortho was consulted, and obtained compartment pressures
- Volar compartment was elevated 38 mmHg.
- He was taken to the OR that evening for emergent fasciotomy.
- It was determined that damage to his radial artery and subsequent hemorrhage from his arterial line being pulled was the cause.
- He recovered well with no resulting deficits.

Case #3

- A 62-year-old male presents with a two-week history of worsening back pain. The pain began in his lower back and is now radiating down both legs. He also reports weakness. His past medical history is significant for stage IV lung cancer diagnosed 6 months ago, s/p recent chemo and radiation, HTN, and HLD. He also has chronic back pain from several herniated discs due to his previous career as a construction worker.
- **Exam:** He appears in moderate distress. He has tenderness on palpation of the lumbar spine. He refuses to stand and walk. Strength is 3/5 in bilateral lower extremities, 5/5 in bilateral upper extremities. Sensation to sharp and light touch intact throughout. Two-point discrimination intact. Good anal sphincter tone.

Case #3

What is the next best step in management of this patient?

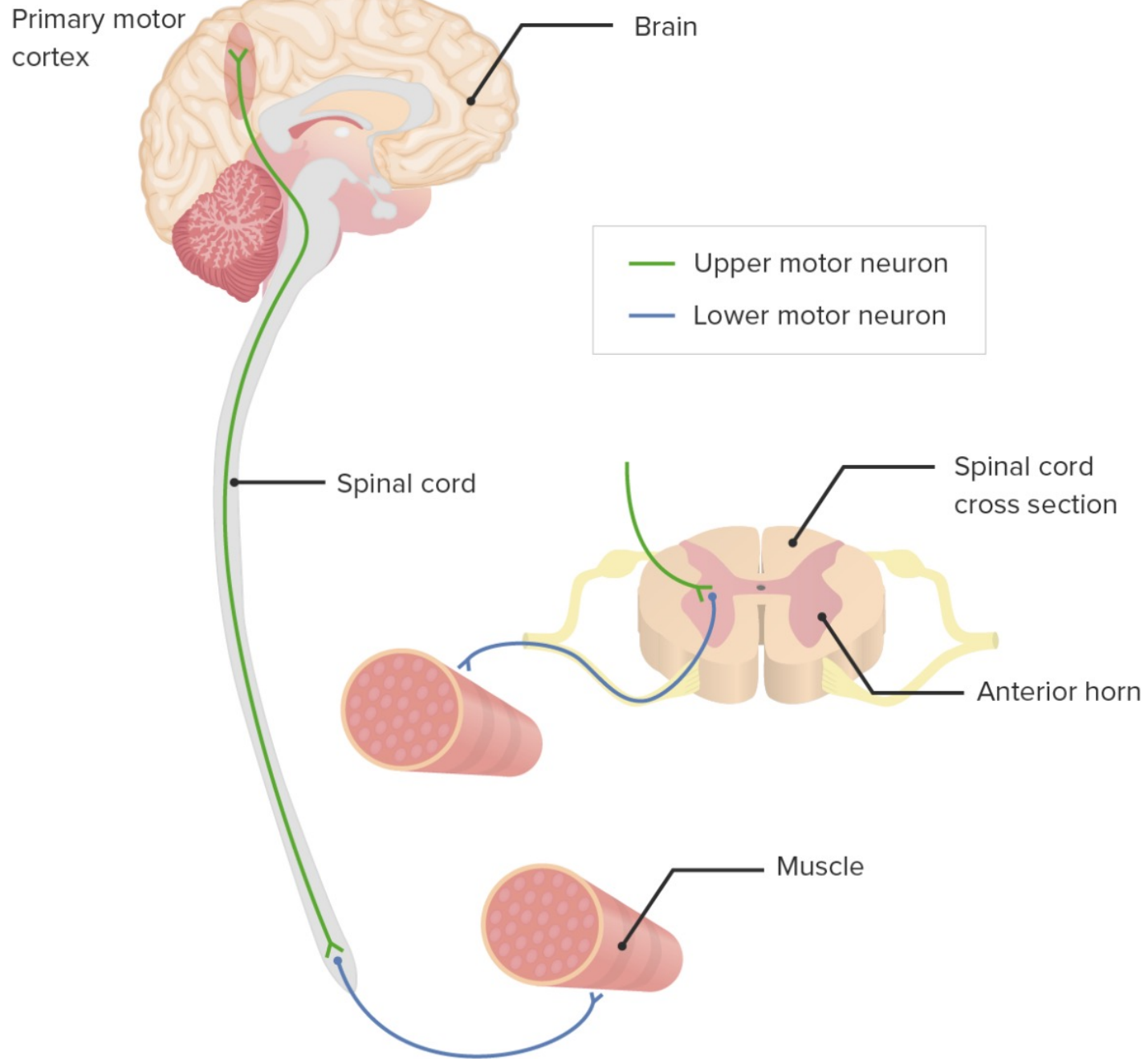
- A. Start IV dexamethasone
- B. Consult oncology
- C. Start IV morphine for pain control
- D. Order stat CT spine

Malignant Spinal Cord Compression (MSCC)

- **Hematogenous spread** of cancer cells to vertebral bodies → enlargement of **mass compressing** spinal artery, epidural venous plexus, thecal sac and spinal cord → **pain + neuro deficits**
 - **Myeloma** – soft tissue extension from lytic bone lesions (osteoclasts activated, osteoblasts inhibited)
 - **Lymphoma** – sclerotic bone disease with soft tissue growth into epidural space
 - Compression fractures may also play a role as the bone weakens
- Metastatic disease to the spine results most often from: **lung, prostate, breast primaries**¹³
 - It may be the first manifestation of systemic cancer in up to 1/3 of patients
 - Lymphoma, myeloma also very common

Malignant Spinal Cord Compression (MSCC)

- Clinical Presentation:
 - **Back pain** on presentation in 80-95%¹³
 - Constant, aching
 - Worse at night or early morning
 - Exacerbated by coughing, sneezing, Valsalva
 - **Motor deficits** in 35-75% at diagnosis¹³
 - Heaviness, clumsiness, or unable to ambulate
 - Upper motor neuron (UMN) deficits typically symmetric, lower motor neuron (LMN) deficits usually asymmetric and affect distal portion of limb first
 - Rare at presentation: bowel/bladder dysfunction, sensory deficits
 - These present later and are associated with poorer functional outcomes



Malignant Spinal Cord Compression (MSCC)

- Diagnosis:
 - **MRI is gold-standard**
 - Sensitivity of 93%, specificity of 97%¹³
 - MRI of the entire spine recommended
 - CT myelography if MRI contraindicated



Photo courtesy of Medscape: Spinal Cord Neoplasm Workup¹⁴

MSCC Management

- **IV dexamethasone** is mainstay of treatment – don't delay until imaging diagnosis!
 - Dexamethasone downregulates VEGF and prostaglandin production → decreases spinal cord edema; also helps treat neuropathic and inflammatory pain
- **High vs. moderate dosing?**
 - High dosing = 96-100mg bolus dosing x 3 days then taper
 - Moderate dosing = 10-16mg bolus dosing x 3 days then taper
 - Many severe adverse effects may accompany high-dose bolusing – is there clear benefit?



MSCC Management

- **Analgesia**
 - Opioids often needed
 - Some anticonvulsants may aid in neuropathic pain – gabapentin, pregabalin
- **Consult ortho spine** vs. neurosurgery - surgical intervention?
 - Spinal instability (see next slide), neuro deficits, and prognosis all play a role in decision
- Consult radiation oncology - **radiation** therapy

Spinal Instability Neoplastic Score¹³

TABLE 2. Spine Instability Neoplastic Score

Element	Score
Location	
Junctional (occiput-C2, C7-T2, T11-L1, L5-S1)	3
Mobile spine (C3-C6, L2-L4)	2
Semirigid spine (T3-T10)	1
Rigid spine (S2-S5)	0
Pain with recumbency and/or movement of spine	
Yes	3
Occasional, but not mechanical	1
No	0
Bone lesion	
Lytic	2
Mixed (lytic and blastic)	1
Blastic	0
Radiographic spinal alignment	
Subluxation or translation present	4
De novo deformity (kyphosis or scoliosis)	2
Normal alignment	0
Vertebral body collapse	
> 50%	3
< 50%	2
No collapse, with > 50% of body involved	1
None	0
Involvement of posterolateral spinal elements (facet, pedicle, or costovertebral joint fracture or replacement with tumor)	
Bilateral	3
Unilateral	1
None of the above	0
Total score	
Stable	0-6
Indeterminate	7-12
Unstable	13-18

NOTE. From Fisher et al.⁵³

TABLE 2. Spine Instability Neoplastic Score

Epidural Spinal Cord Compression Scale¹³

TABLE 3. The Epidural Spinal Cord Compression Scale

Grade	Description
0	Bone-only disease
1a	Epidural impingement, without deformation of the thecal sac
1b	Deformation of the thecal sac, without spinal cord abutment
1c	Deformation of the thecal sac, with spinal cord abutment, without cord compression
2	Spinal cord compression, with CSF visible around the cord
3	Spinal cord compression, with no CSF visible around the cord

NOTE. From Bilskv et al.⁵⁴

TABLE 3. The Epidural Spinal Cord Compression Scale

Published in: Andrew J. Lawton; Kathleen A. Lee; Andrea L. Cheville; Marco L. Ferrone; Dirk Rades; Tracy A. Balboni; Janet L. Abraham; *Journal of Clinical Oncology* 2019 3761-71.

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MSCC Management

- **Neurogenic bowel/bladder**
 - UMN lesions - retention; LMN lesions – incontinence
 - Bladder incontinence – timed voiding, bladder re-training
 - Bladder retention – intermittent self-catheterization
 - Bowel incontinence – bulking agents
 - Bowel retention – osmotic agents
- **Multidisciplinary approach** – oncologist, radiation oncologist, spine surgeon, palliative care, psychiatry
- **Rehabilitation** should consider patient's goals, care requirements, prognosis



Malignant Spinal Cord Compression (MSCC)

- Prognostic scoring tools exist, but have not been externally validated
 - **Modified Bauer Score**
 - **New England Spinal Metastasis Score**
- **Molecular genetics** and biomarkers may aid



Other Causes of Spinal Cord Compression

- Primary tumor
- Acute demyelination
- Hematoma
- Epidural abscess
- Spinal cord infarction
- Aortic dissection
- Cervical spine stenosis or injury
- Leukemia

Back to Case #3

- The patient was started on IV dexamethasone, 10mg bolus, then 6mg every 6 hrs → taper.
- He underwent a stat MRI of the entire spine which showed tumor invasion of the spine at L3-L5 with cord compression.
- Multidisciplinary discussion took place with the patient present, and goals of care were discussed. It was felt that with his lung CA prognosis and his poor functional status, radiation was his best option.
- He received radiation to the spine on hospital day #2. His symptoms improved significantly. He was able to start PT/OT on day 2 and progressed to walking slowly by day 4.
- He left the hospital on day 5 and went to a SNF.

Take Home Points



Look for red flags in back pain

Not everyone needs imaging

Consider alternative therapies for treatment, even if referrals outside the hospital



Bites to the hand often become infected, complicated

Consult ortho early



Compartment syndrome does not require trauma or injury

Consult ortho early if suspicion so they are ready to go to the OR! Time is tissue



Cancer + new onset back pain = MSCC until proven otherwise; doesn't have to be solid tumor

Urgent spinal imaging

Questions?

References

1. Cairns C, Kang K. National Hospital Ambulatory Medical Care Survey: 2021 emergency department summary tables. Available from: https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHAMCS/doc21-ed-508.pdf
2. McDermott KW (IBM Watson Health), Roemer M (AHRQ). Most Frequent Principal Diagnoses for Inpatient Stays in U.S. Hospitals, 2018. HCUP Statistical Brief #277. July 2021. Agency for Healthcare Research and Quality, Rockville, MD. <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb277-Top-Reasons-Hospital-Stays-2018.pdf>
3. McDermott KW (IBM Watson Health), Liang L (AHRQ). Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals, 2018. HCUP Statistical Brief #281. August 2021. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb281-Operating-Room-Procedures-During-Hospitalization-2018.pdf.
4. Gibbs D, McGahan BG, Ropper AE, Xu DS. Back Pain: Differential Diagnosis and Management. *Neurol Clin*. 2023 Feb;41(1):61-76. doi: 10.1016/j.ncl.2022.07.002. Epub 2022 Oct 29.
5. D'Souza RS, Dowling TJ, Law L. Waddell Sign. Treasure Island (FL): [StatPearls Publishing](#); 2024 Jan-.
6. DynaMed. Acute Low Back Pain. EBSCO Information Services. Accessed August 2, 2024. <https://www.dynamed-com.proxy2.cl.msu.edu/condition/acute-low-back-pain>
7. DynaMed. Mammalian Bite. EBSCO Information Services. Accessed August 2, 2024. <https://www.dynamed-com.proxy2.cl.msu.edu/condition/mammalian-bite>
8. Chapman T, Ilyas AM. Pyogenic Flexor Tenosynovitis: Evaluation and Treatment Strategies. *J Hand Microsurg*. 2019 Dec; 11(3): 121–126. Published online 2019 Nov 2. doi: [10.1055/s-0039-1700370](https://doi.org/10.1055/s-0039-1700370)



References

9. Kistler JM, Ilyas AM, Thoder JJ. Forearm Compartment Syndrome. *Hand Clin.* 2018 Feb;34(1):53-60.doi: 10.1016/j.hcl.2017.09.006.
10. Karadsheh, M. Hand & Forearm Compartment Syndrome. *Orthobullets.com*. Updated July 21, 2024.
11. Pechar J, Lyons MM, Penn Orthopedics. Acute Compartment Syndrome of the Lower Leg: A Review. *J Nurse Pract.* 2016 Apr; 12(4): 265–270. doi: [10.1016/j.nurpra.2015.10.013](https://doi.org/10.1016/j.nurpra.2015.10.013)
12. Compartment Syndrome. *Lecturio*. [Lecturio.com](https://www.lecturio.com). Updated Dec 29, 2023.
13. Lawton AJ, Lee KA, Cheville AL, et al. Assessment and Management of Patients With Metastatic Spinal Cord Compression: A Multidisciplinary Review. *J Clin Oncol.* 2019 Jan 1;37(1):61-71.doi: 10.1200/JCO.2018.78.1211.Epub 2018 Nov 5.
14. Motor Neuron Lesions. *Lecturio.com*. Updated March 29, 2023.
15. Borke J. Spinal Cord Neoplasms Workup. *Emedicine.medscape.com*. Updated May 15, 2023.