Things that go Bump in the Night- Ortho-OnCall

AAPA-AAOS Musculoskeletal Galaxy

June 10 to June 14, 2023

Austin, Texas

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LEARNING OBJECTIVES

At the end of this lecture attendees will be able to :

- Identify and treat emergent Cauda Equina
- Identify and treat emergent Hematoma
- Identify and treat emergent Acute Compartment Syndrome
- Identify and treat emergent Pelvic Ring Fx
- Identify and treat emergent Infections, Necrotizing fasciitis, Septic Hip vs. Toxic Synovitis
- Identify and treat emergent Open Fractures
- Identify and treat emergent Hip Fx/dislocation, Knee dislocation, Ankle fx/dislocation
- Identify and treat emergent AMS/Stroke
- Identify and treat emergent Chest Pain/MI
- Identify and treat emergent Atrial Fibrillation (Afib)
- Identify and treat emergent Pulmonary Embolism

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ORTHOPAEDIC PROBLEMS

Cauda Equina

Epidural Hematoma

Compartment Syndrome

Pelvic Ring Fx

Septic Hip vs. Toxic Synovitis

Open Fractures

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ORTHO SPINE EMERGENCIES

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CAUDA EQUINA SYNDROME

TRUE SURGICAL EMERGENCY

Cauda Equina syndrome occurs when lumbosacral nerve roots are compressed preventing sensory and motor nerve feedback.

Failures to recognize and act on Cauda Equina syndrome may result in permanent paralysis, loss/impaired bowel & bladder control, & sexual dysfunction.

Causes:

- **Trauma: blunt v. penetrating**
- **Disc herniation**
- **Post op hematoma/swelling- don't forget about anticoagulation**
- **Tumor/Infection**
- **Fracture**
- **Spinal Stenosis – time progression ?**

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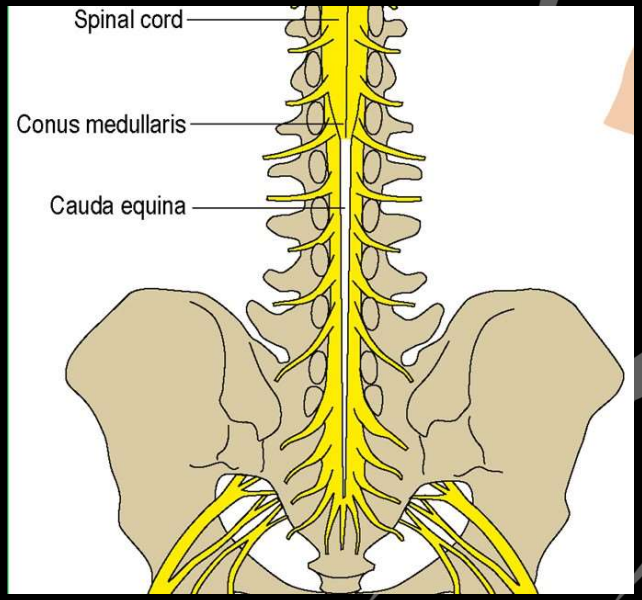
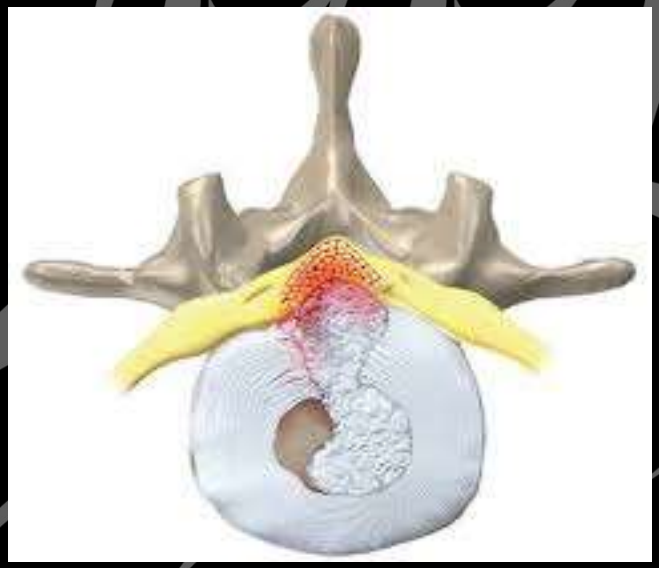
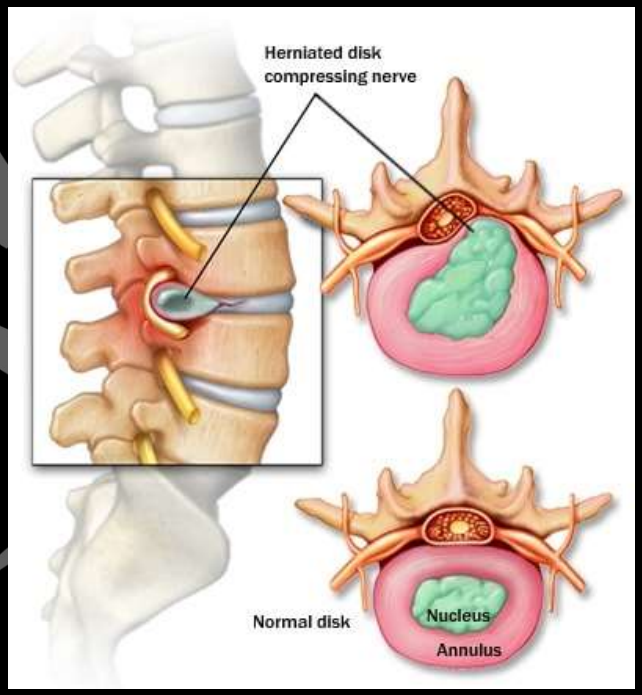
CAUDA EQUINA SYNDROME

Lumbar& Sacral
Spinal Nerves



Central Disc
Herniation





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RED FLAG WARNINGS

- Cauda equina syndrome can cause a variety of symptoms, : severe low back pain
- bladder dysfunction such as urinary retention or incontinence (loss of control)
- bowel incontinence (loss of control)
- muscle weakness or sensory loss in both legs
- loss of motor function in legs (difficulty walking)
- loss or reduction of reflexes
- saddle anesthesia (inability to feel anything in the body areas that would sit on a saddle)
- Poor rectal tone or loss of anal wink
-

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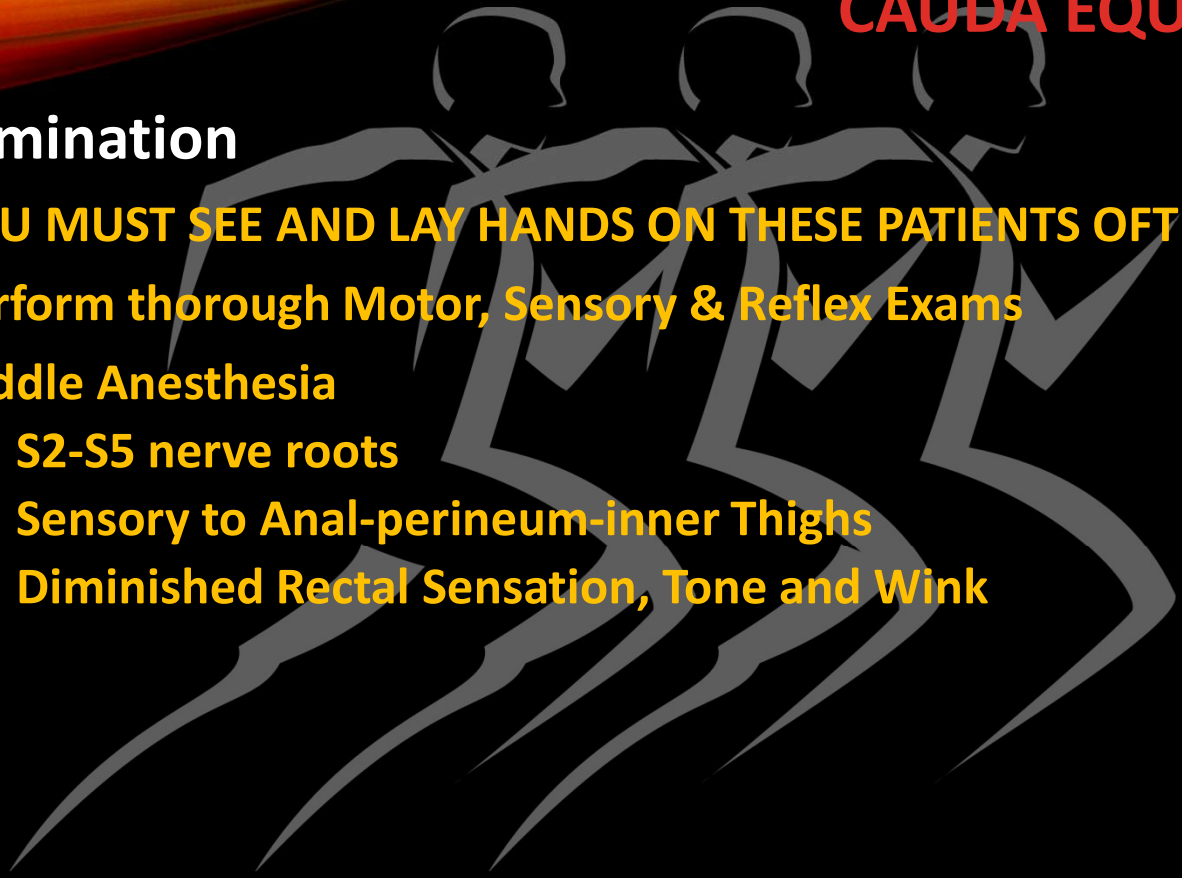
CAUDA EQUINA SYNDROME



Examination

- YOU MUST SEE AND LAY HANDS ON THESE PATIENTS OFTEN
- Perform thorough Motor, Sensory & Reflex Exams
- Saddle Anesthesia
  - S2-S5 nerve roots
  - Sensory to Anal-perineum-inner Thighs
  - Diminished Rectal Sensation, Tone and Wink
-

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CAUDA EQUINA SYNDROME

Diagnostic Studies

- NPO Status & Anticoagulation status
- ***Don't waste time on labs – imaging comes first***
  - Labs: CBC, BMP, CRP, PT/INR
- ***Stat CT Myelogram Or Stat MRI w/ Gadolinium***
- Some cases bypass studies and go directly to OR

Treatment:

- ***Surgical compression of pressure on spinal cord or spinal nerves***

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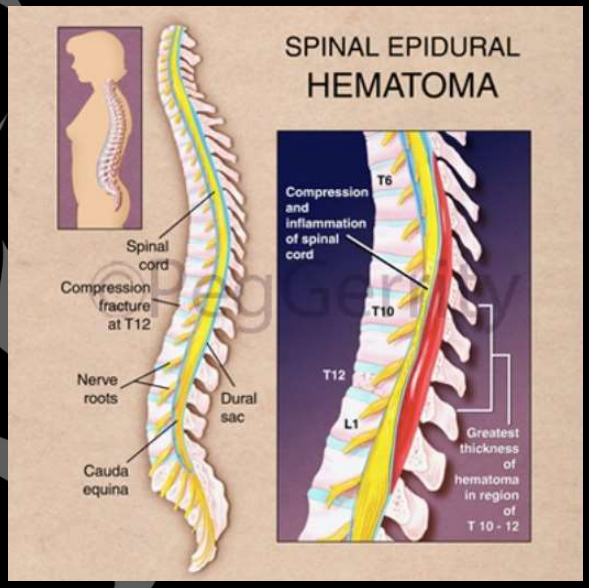
SPINAL EPIDURAL HEMATOMA

Epidural Hematoma

- Brain – between skin and Dura
- Spine – between the dura and vertebral bone
  - Within spinal canal
  - Spinal Cord damage
  - Neurologic injury/deficit

True Ortho Spinal Emergency



https://coreem.net/core/spinal-epidural-hematoma/

Causes:

- Trauma – venous bleeding,
- Spontaneous – anticoagulation, coagulopathies, thrombocytopenia, neoplasm, Vascular malformations
- Iatrogenic –vertebral abnormalities, procedures, resuming/initiating anticoagulation or antiplatelet therapy post procedures

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SPINAL EPIDURAL HEMATOMA

Clinical Presentation

- C/o sudden onset severe neck - back pain
- Sudden onset radicular pain
- Pain /symptoms exacerbated by increased intrathecal pressure (Cough/Sneeze/Valsalva)
- Spinal Tenderness on palpation or movement
- Motor/Sensory changes dependent of size of hematoma a level(s) involved
- Focal weakness – paraplegia or quadriplegia
- Sensory loss – local paresthesia to complete sensory loss involving affected levels

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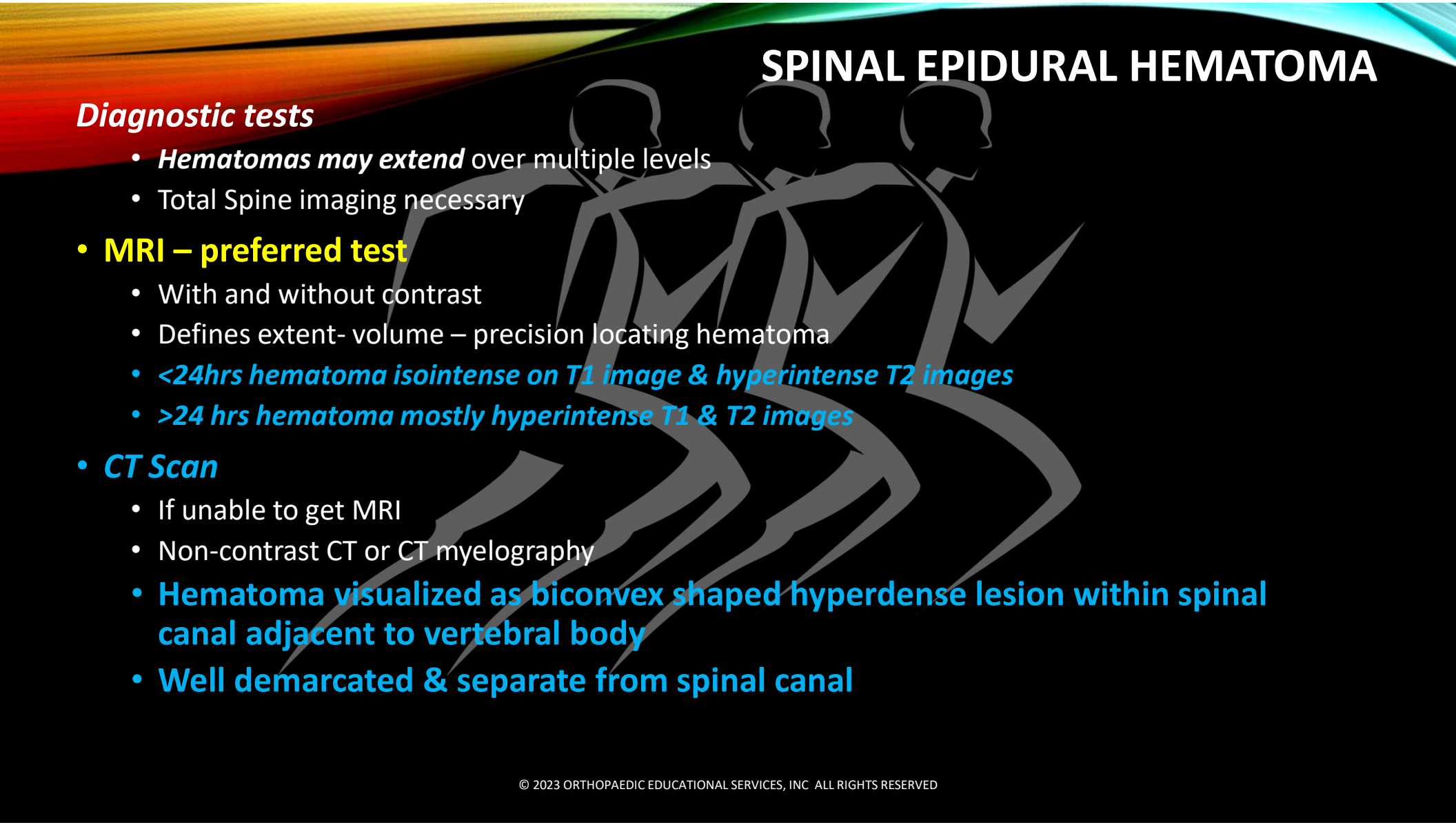
SPINAL EPIDURAL HEMATOMA



Diagnostic tests

- ***Hematomas may extend*** over multiple levels
- Total Spine imaging necessary

- **MRI – preferred test**
  - With and without contrast
  - Defines extent- volume – precision locating hematoma
  - ***<24hrs hematoma isointense on T1 image & hyperintense T2 images***
  - ***>24 hrs hematoma mostly hyperintense T1 & T2 images***
- ***CT Scan***
  - If unable to get MRI
  - Non-contrast CT or CT myelography
  - **Hematoma visualized as biconvex shaped hyperdense lesion within spinal canal adjacent to vertebral body**
  - **Well demarcated & separate from spinal canal**

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SPINAL EPIDURAL HEMATOMA

Treatment

- ***Spinal epidural hematoma is Surgical Emergency***
  - ***Postop neurologic function related to preop exam and time to decompression***
  - ***Delays to decompression can lead to permanent neurologic sequelae***
  - ***Full recovery within 72 hrs is rare***

- ***Pts managed conservatively (non-operatively) 2nd to mild symptoms require***
  - ***Serial exams***
  - ***May receive Dexamethasone***

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OPEN FRACTURES

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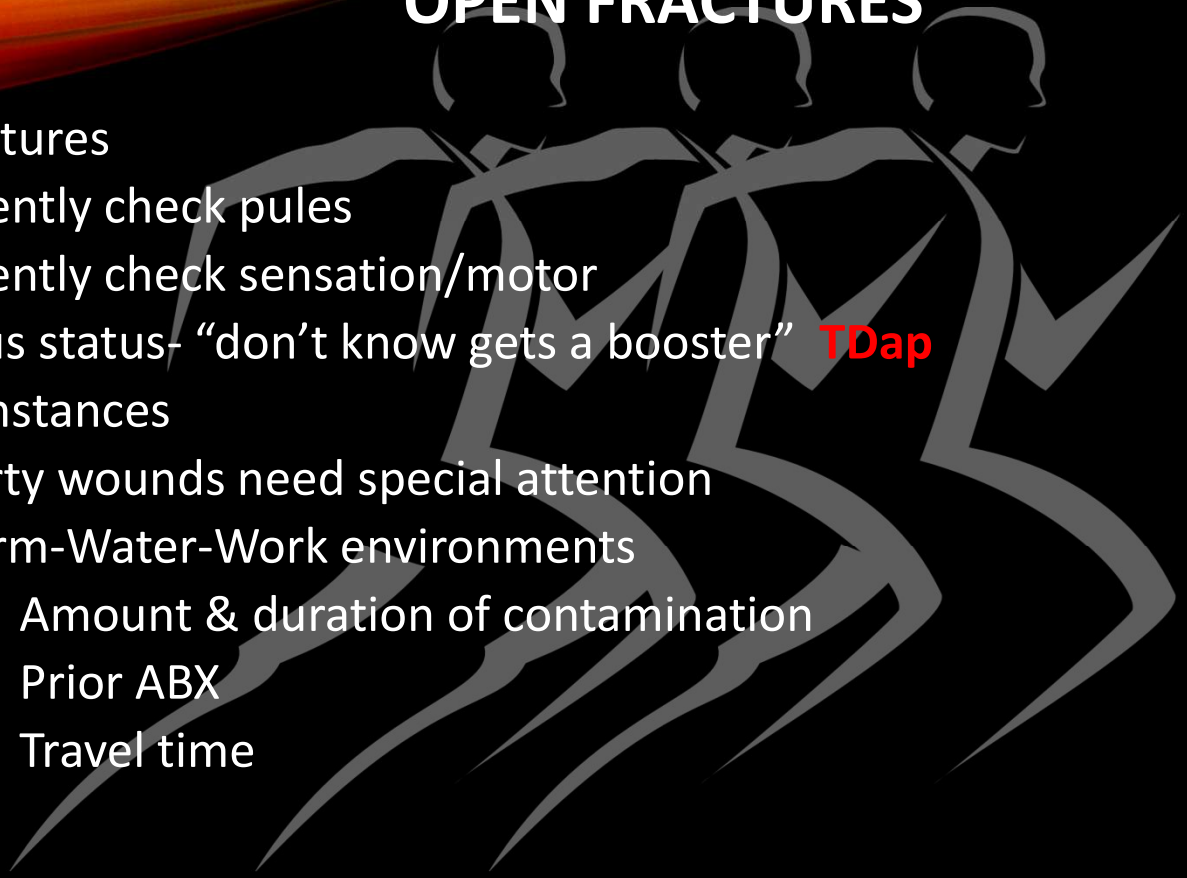
OPEN FRACTURES



- Open Fractures
  - Frequently check pules
  - Frequently check sensation/motor
  - Tetanus status- “don’t know gets a booster” **TDap**
  - Circumstances
    - Dirty wounds need special attention
    - Farm-Water-Work environments
      - Amount & duration of contamination
      - Prior ABX
      - Travel time

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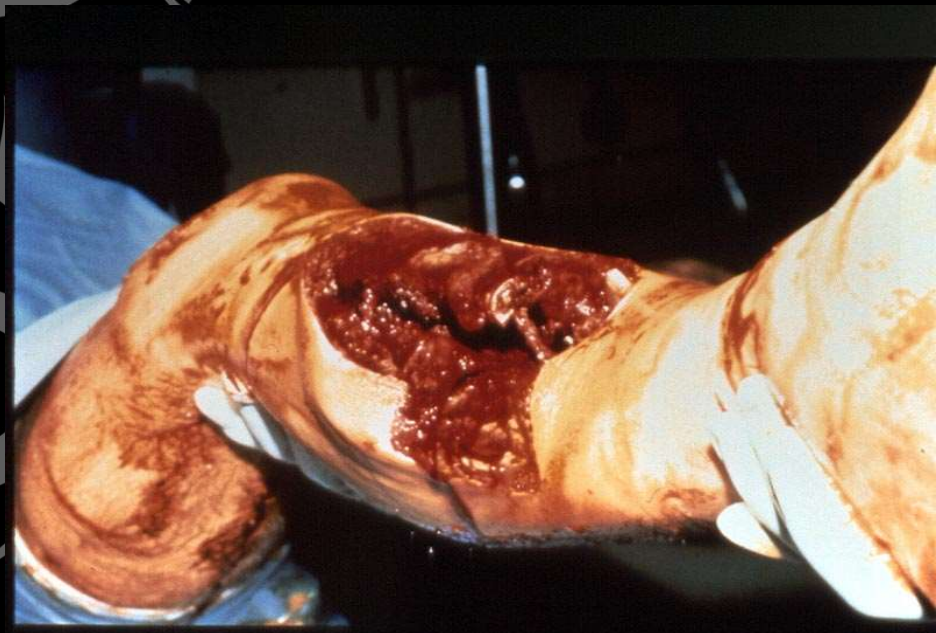
OPEN FRACTURES

- Pay attention to wound Size
  - Indication of injury energy
  - High energy leads to more damage
  - High energy think compartment syndrome
    - Hand
    - Forearm
    - Thigh/Gluteal
    - Low Leg
    - Foot
  - High energy think associated Injuries



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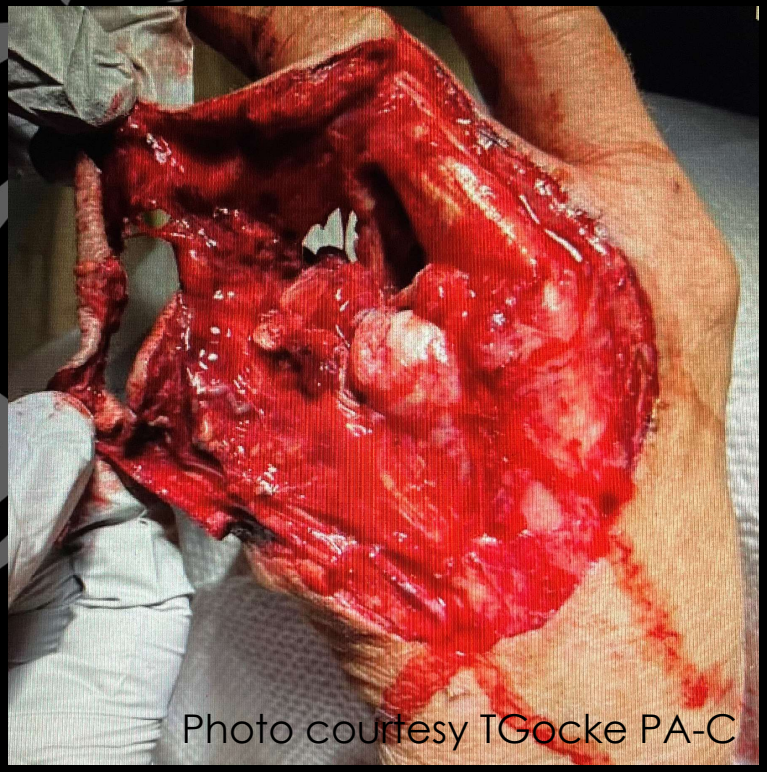
OPEN FRACTURES

- Pay attention to wound Size
  - Indication of injury energy
  - High energy leads to more damage
  - High energy think compartment syndrome
  - High energy think associated Injuries
  - Assess Motor & Sensory
  - Meticulous documentation exam findings



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EXTREMITY OPEN FRACTURES

- Lower Extremity Open Fractures
  - Increased risk infections
  - Compartment Injuries
  - Vascular Injuries

Type	Characteristics
I	Puncture wound <1cm Minimal contamination Minimal soft tissue damage
II	Laceration >1cm but <10cm Moderate soft tissue damage Adequate bone coverage Minimal comminution
IIIA	Laceration > 10cm Extensive soft tissue damage Adequate bone coverage Segmental/severely comminuted fractures or heavily contaminated wounds
III B	As a Gustilo type IIIA injury, but with periosteal stripping and bone exposure
III C	Any open fracture with vascular injury requiring repair

- Upper Extremity Open Fractures
  - Smaller wounds
  - Compartment Injuries
  - Less Likely to get infection

Table 9.1 Classification of compound hand lesions (adapted from Tulipan and Ilyas)[3]

Location		Modifiers	
Type I	Phalanx	A	Primary soft tissue coverage not possible
Type II	Metacarpal	B	Frank contamination
Type III	Carpus	C	Avascularity requiring revascularization

The classification proposed by Tulipan and Ilyas is more reasonable for use in hand traumas, even if some mixed complex injuries involving metacarpal and digits or multiple fingers might be difficult to classify.

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OPEN FRACTURES

Antibiotic Coverage

- Cover for Gram + organisms <2 hours
- Cefazolin most common
  - <50kg: 1g IV q 6-8 hrs
  - 50-100kg: 2g IV q 6-8 hrs
  - >100kg: 3g IV q 6-8 hrs
  - PCN allergy- Clindamycin 900mg IV q 8 hr
  - Continue for 48hrs or 24 hours after wound coverage/closure

- Grade 1 - Cefazolin popular choice
- Grade 2- Cefazolin +/- Aminoglycoside
  - Gentamicin 5mg/kg or Tobramycin 1mg/kg
- Grade 3 Cefazolin +Aminoglycoside
  - Gentamicin 5mg/kg or Tobramycin 1mg/kg
  - High contamination potential
  - Lake/pond/farm
    - Anaerobic organisms- high dose PCN

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ACUTE COMPARTMENT SYNDROME

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ACUTE COMPARTMENT SYNDROME

- Increased pressure in confined anatomic space that can irreversibly damage tissue
  - Tibial Fracture most common
  - Forearm Fx 2nd most common
  - Hand/Foot Crush injuries

- Cause-
  - **Expanding Volume**: traumatic tissue injury in confined space with bleeding/edema
    - Blunt trauma, crush injury , closed fracture
    - Revascularization edema, bleeding disorders
    - Burns
    - Drug overdose
    - Infections
    - Tight splints/cast/bandages

Acute Compartment Syndrome is a CLINICAL diagnosis

Acute Compartment Syndrome = Surgical Emergency

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ACUTE COMPARTMENT SYNDROME

- Arterial line
  - 16 - 18 ga. Needle
    (5-19 mm Hg higher)
  - transducer
  - monitor

Delta pressure: Diastolic BP minus intracompartmental pressure results:

10-<30 mm needs admitted and serial compartment checks

≥ 30mm needs urgent surgical fasciotomy

=Delta pressure < 30mmHg indication for acute fasciotomy

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ACUTE COMPARTMENT SYNDROME

- Treatment:
  - *Recognize possibility of compartment syndrome*
  - *Labs:*
    - *Creatine phosphokinase (CPK) muscle breakdown [ischemia-tissue damage – Rhabdomyolysis*
    - *Rhabdomyolysis – renal function, urine myoglobin, U/A*
  - *Document neuro/vascular status frequently*
  - *Admit patient for monitoring*
  - *Serial Compartment Pressure measurements*

Acute Compartment Syndrome is a CLINICAL diagnosis

Acute Compartment Syndrome = Surgical Emergency

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ACUTE COMPARTMENT SYNDROME

Treatment:

- **Surgery < 6-8 hours optimal time for fasciotomy & to preserve tissue**
- **Surgery > 12-36 hours tissue damage non-reversable, increased risk for infection, limb loss, mortality**
- Fasciotomy:
  - Release compartment(s) pressure(s)
  - iWV vs. Skin grafting needed to close wounds at later date
  - May need 2nd surgery to assess tissues and for debridement of devitalized tissue
- Monitor for signs of infection
- Monitor urine for myoglobinuria - 2nd to muscle tissue ischemia

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ACUTE COMPARTMENT SYNDROME

Muscle compartment contents

Compartment	Contents
Thigh - anterior	Muscles: sartorius, quadriceps (rectus femoris, vastus lateralis, vastus intermedius, vastus medialis) Femoral nerve Saphenous nerve
Thigh - posterior	Muscles: biceps femoris, semitendinosus, semimembranosus Sciatic nerve
Thigh - medial	Muscles: gracilis, adductor longus, adductor brevis, adductor magnus Obturator nerve
Leg - anterior	Muscles: tibialis anterior, extensor hallucis longus, extensor digitorum longus, peroneus tertius Deep peroneal nerve
Leg - lateral	Muscles: fibularis longus, fibularis brevis Superficial peroneal nerve
Leg - deep posterior	Muscles: popliteus, flexor hallucis longus, flexor digitorum longus, tibialis posterior Tibial nerve
Leg - superficial posterior	Muscles: gastrocnemius, soleus, plantaris
Arm - anterior	Muscles: biceps brachii, brachialis, coracobrachialis Ulnar nerve Median nerve
Arm - posterior	Muscles: triceps brachii, anconeus Radial nerve
Forearm - deep and superficial volar	Muscles: superficial (flexor carpi radialis, palmaris longus, flexor carpi ulnaris, pronator teres, flexor digitorum superficialis); deep (flexor digitorum profundus, flexor pollicis longus, pronator quadratus) Ulnar nerve Median nerve
Forearm - dorsal	Muscles: brachioradialis, extensor carpi radialis longus, extensor carpi radialis brevis, extensor carpi ulnaris, extensor digitorum, extensor digiti minimi, abductor pollicis longus, extensor pollicis brevis, extensor pollicis longus, extensor indicis, supinator, anconeus Radial nerve

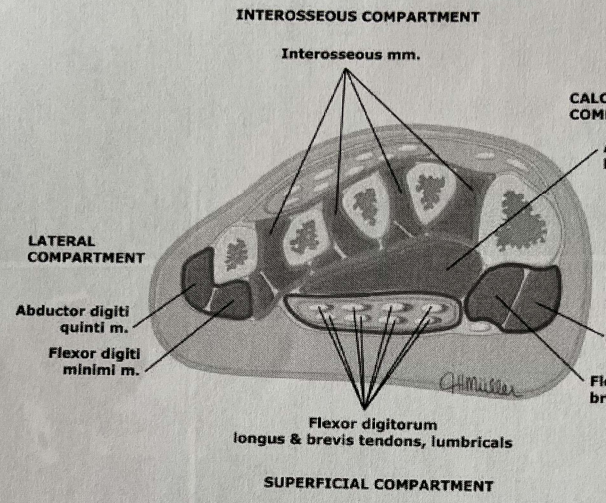
Important compartment syndrome findings:

ain is the most important finding. Any pain with passive stretch is worrisome.

lpate for tender and tense compartments

te findings can include motor deficits involving the muscles of the involved compartment and sensory deficits involving the rves in the involved compartment

Muscle compartments of the foot



Compartments of the foot:

- Interosseous (turqoise) — Interosseus muscles, each in its own compartment.
- Calcaneal (pink) — Flexor digitorum brevis, quadratus plantae and adductor hallucis.
- Lateral (green) — Flexor digiti minimi and abductor digiti quinti.
- Medial (red) — Abductor hallucis and flexor hallucis brevis muscles.
- Superficial (blue) — Flexor digitorum brevis, lumbricals, flexor digitorum longus tendons.

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PELVIC RING INJURY

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PELVIC RING INJURIES

- 40% die from unstable pelvic ring injuries and hemodynamic instability is major contributor to that outcome

Pelvic ring injuries are markers of violent injury

  - Hemorrhage
  - CNS-Cardiothoracic-Abdominal & Genitourinary- Extremity trauma

- **In "Open Book" pelvic ring Fx – compression of the pelvis aids on bleeding control**

- Pelvic Radiographs provide assessment of deformity and instability & CT scan provides detailed posterior elements injury assessment

Assessment for Pelvic Ring injury

  - Neurovascular status
  - Asymmetry of pelvis and leg length inequalities
  - Digital Rectal exam and manual Vagina exam- laceration open pelvic fx

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PELVIC RING INJURIES

Standard Imaging

- **Radiographs – AP pelvis, Inlet & Outlet Views (Judet)**
  - Cystogram, Retrograde Urethrogram
  - Vertical displacement best seen on Inlet/Outlet views
- **CT scan – defines injury to posterior Pelvic ring**
  - Sacroiliac joint and Sacral injuries

Pelvic Fx instability is defined as:

- Symphysis diastasis > 2.5cm
- Posterior Pelvis displacement >1cm
- Complete widening of the posterior SI joint
- Neurologic Injury
- Pelvic asymmetry w/ leg length inequality

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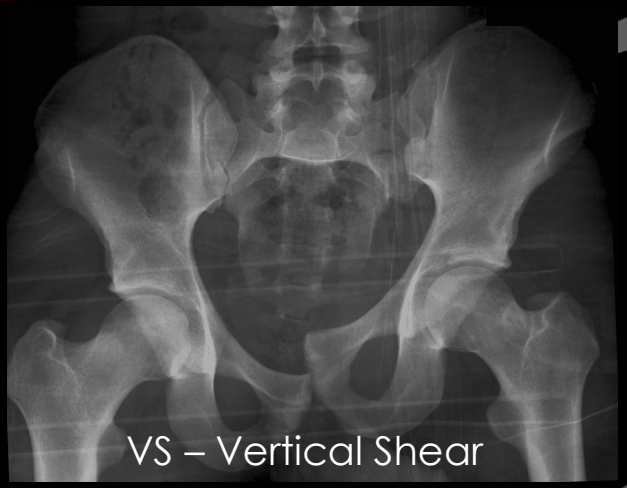
PELVIC RING INJURIES

- Pelvic Fx Classification



VS – Vertical Shear

LC – Lateral Compression

APC- Anteroposterior compression

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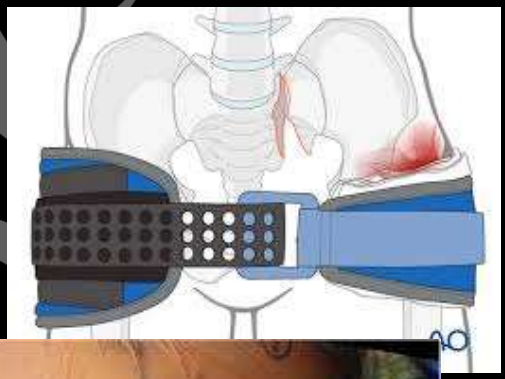
PELVIC RING INJURIES

TREATMENT

- "It takes a village to run a trauma code"
- Fluid Resuscitation – IVF, Albumin Blood (FAST, CT angiogram)
- Pelvic Compression – Sheet-Binder-Ex Fix
  - Binder/Sheet: Foley & "grams"
  - Monitor Urine output , Base Deficits, Hgb & coagulation function
- Radiographs – Pelvic Xray and CT scan
- Hemodynamic stability KEY
- UNSTABLE consider embolization or Ex Lap with packing
- SICU management
- Definitive surgery when pt stable for surgery



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HIP DISLOCATON INJURIES

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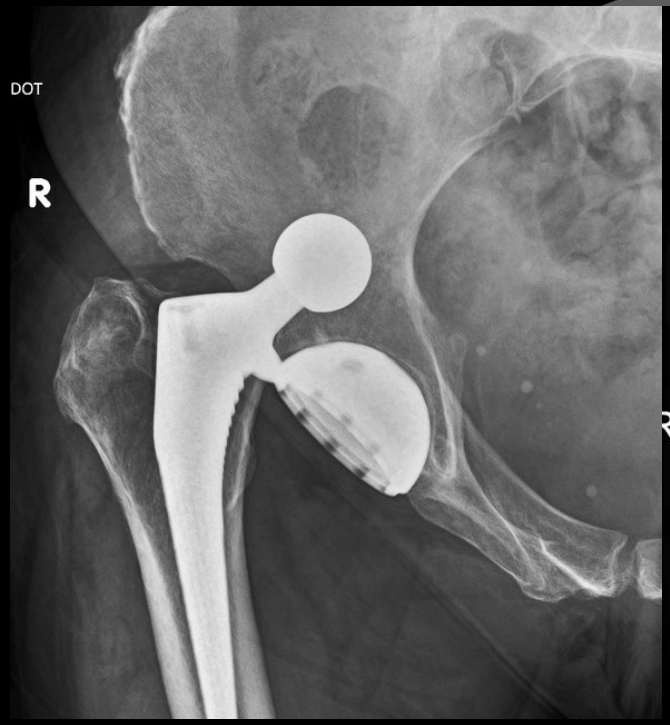
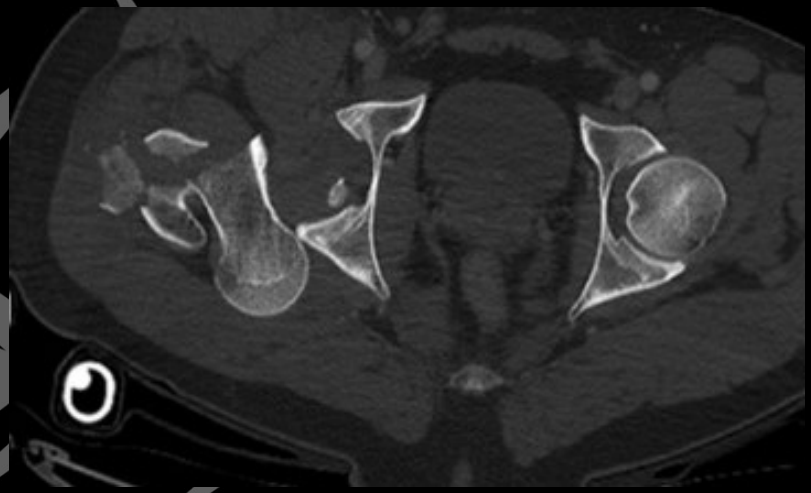
HIP DISLOCATION





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HIP DISLOCATION

- Hip Dislocation
  - **High energy**
  - **Blood supply or Articular Cartlidge injuries**
  - **2 attempts then let someone else try**
- Native or Prosthetic
  - Prosthetic –
    - Easier to reduce but have to focus on components of THA
    - Check the Femoral Head and the Acetabular cup
    - Hip ABD pillow of Hip ABD brace – “Revision THA “
  - Native –
    - Usually associated with **posterior wall acetabulum fx and or femoral head fx**
    - Need good **Xray image of acetabulum or CT scan prior to reduction**
    - Reductions are sometimes difficult due to FB or Soft tissue blocking the Acetabulum
    - Will need Skeletal traction if unable to maintain the reduction
    - Surgical Fixation

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KNEE DISLOCATION

ANKLE FX/DISLOCATION

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KNEE DISLOCATION

Knee dislocation

- High energy Injury – can be limb threatening due to vascular injury
  - Intoxicated and Obese major contributing factors
  - Multiple Ligament injuries ***– SKIN IS NOT a Joint Stabilizer***
  - **Pulses present check Ankle-Brachial Index - > 0.9 good indicator of arterial supply**
  - **Irregular pulse compared to contralateral side consider CT angiogram**
  - Reduction and immobilization – Ex Fix or knee immobilizer
  - MRI Scan for preop ligament injury mapping
  - Timing of surgical intervention

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RADIOGRAPHS- KNEE DISLOCATION

AP view

Cross Table Lateral view

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KNEE DISLOCATION

- Talar Fracture or sub-talar dislocation injury
  - Blood supply tenuous to talus
  - Fx displacement or joint dislocation compromises skin
  - Skin compromise requires urgent reduction

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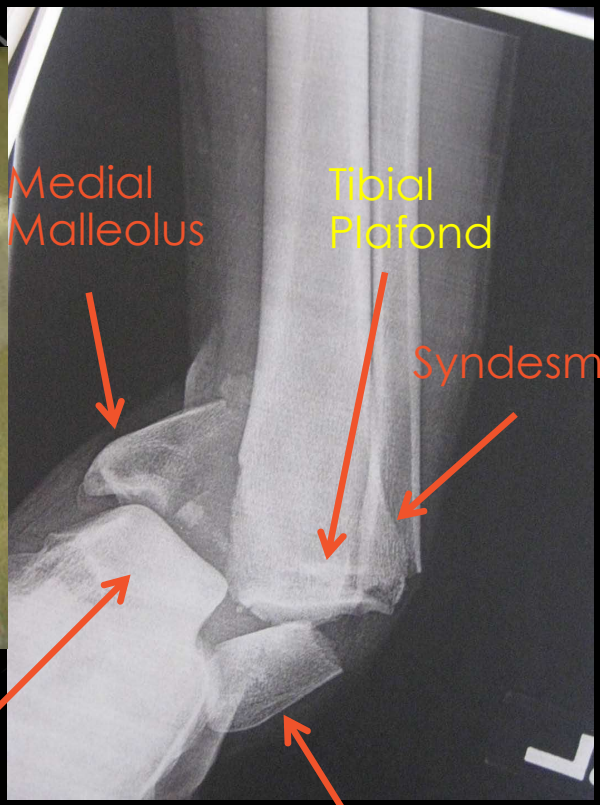
ANKLE FRACTURE-DISLOCATION

- Associated with Bimalleolar or Trimalleolar ankle fractures
- Talus and foot translated completely out of mortise
- Obvious deformity to ankle and foot
- Open vs. Closed
- Play close attention to pre & post reduction neuro and vascular exams



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ANKLE FX/DISLOCATION





REDUCTION AS SOON AS POSSIBLE PROTECTS SKIN

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ANKLE FX/DISLOCATION

- Knee flexion – relaxes effects of Gastroc
  - Water ski traction
  - Reduction
  - Dangle ankle over the edge of the table
- Hold reduction while splint applied and Dries
  - Hold Big Toe and Internal rotation
  - Posterior & Sugar-tong/stirrup splint
- Check Neurovascular frequently
- Post reduction x-ray

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INFECTIONS

TOXIC SYNOVITIS v. SEPTIC ARTHRITIS – PEDS
OPEN FRACTURES – LOWER EXTREMITY
OPEN FRACTURES – UPPER EXTREMITY
INFECTED JOINT
NECROTIZING FASCIITIS

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Septic Arthritis vs. Toxic Synovitis

- **Most frequently occurs in children ages 3-10 years old[3]**
  - Mean age 4.7 years old[3]
  - Agitated or fussy
  - Hip ABD- Flexed & Ext Rotated – enlarges hip joint capsule
  - Males twice as common as Females
  - Similar symptoms with progressive hip and groin pain

- Exact cause is unknown
  - URI, bacterial infection, trauma, allergic reaction

- Clinically manifest as pain in the affected area
  - Toxic Synovitis: self-limited and will resolve within 24 to 48 hours
  - Septic Arthritis: gets worse & associated with other systemic symptoms

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LABORATORY FINDINGS

- CBC, ESR & CRP
- Hip aspiration: Gram stain, Cell count, cultures,

- All children with an irritable hip without a clearly identified source who have an erythrocyte sedimentation rate of more than 20 mm/hr or a temperature of more than 99.5F should be considered for diagnostic hip aspiration[4]

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KOCHER CRITERIA

- **Developed in 1999 by Mininder S. Kocher, M.D., M.P.H., to aid in evaluating a child's presentation that would allow for a more accurate differentiation of these two diseases[3]**

- **Caird and colleagues2006, investigated CRP levels in children for whom joint aspiration was performed[5]**
- **They found that a CRP ≥20 mg/L, as well as the Kocher Criteria being present had a predicted probability of 98%[5]**

Kocher Criteria	No (0 points)	Yes (1 point)
Non-Weight Bearing	□	□
Temp > 38.5° C (101.3° F)	□	□
ESR > 40 mm/hr	□	□
WBC >12,000 cells/mm^3	□	□

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KOCHER CRITERIA

- Each point is associated with a likelihood of the child having septic arthritis. Based on his paper, the likelihood of a child with 0 of the Kocher Criteria having septic arthritis is 0.2%
- This percentage increases with each additional point up to 99% likelihood at 4 points[3]

Points	Likelihood of Septic Arthritis
0	0.20%
1	3%
2	40%
3	93%
4	99%

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BACTERIAL /SEPTIC ARTHRITIS

Staphylococcus aureus most common organism in septic arthritis and osteomyelitis

Large wt-bearing joints most commonly affected

ABX choice based on Gram stain, underlying conditions and clinical presentation

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BACTERIAL SEPTIC ARTHRITIS

- Predisposing Factors to Joint infection
  - Age: > 80 adults, < 5 kids
  - **Undying medical conditions [HIV, DM, ETOH, Cirrhosis, renal dx, bad choices]**
  - **Immunosuppression: Steroids, Chemotherapy, neoplasm, biologics [DMARDS]**
  - **Total Joint Arthroplasty**
- Common Organisms
  - Staphylococcus species
    - Staph aureus most common [45-65%]
  - Group A/B Streptococcus (Grp B more common elderly)
  - Polymicrobial – Think patient underlying conditions

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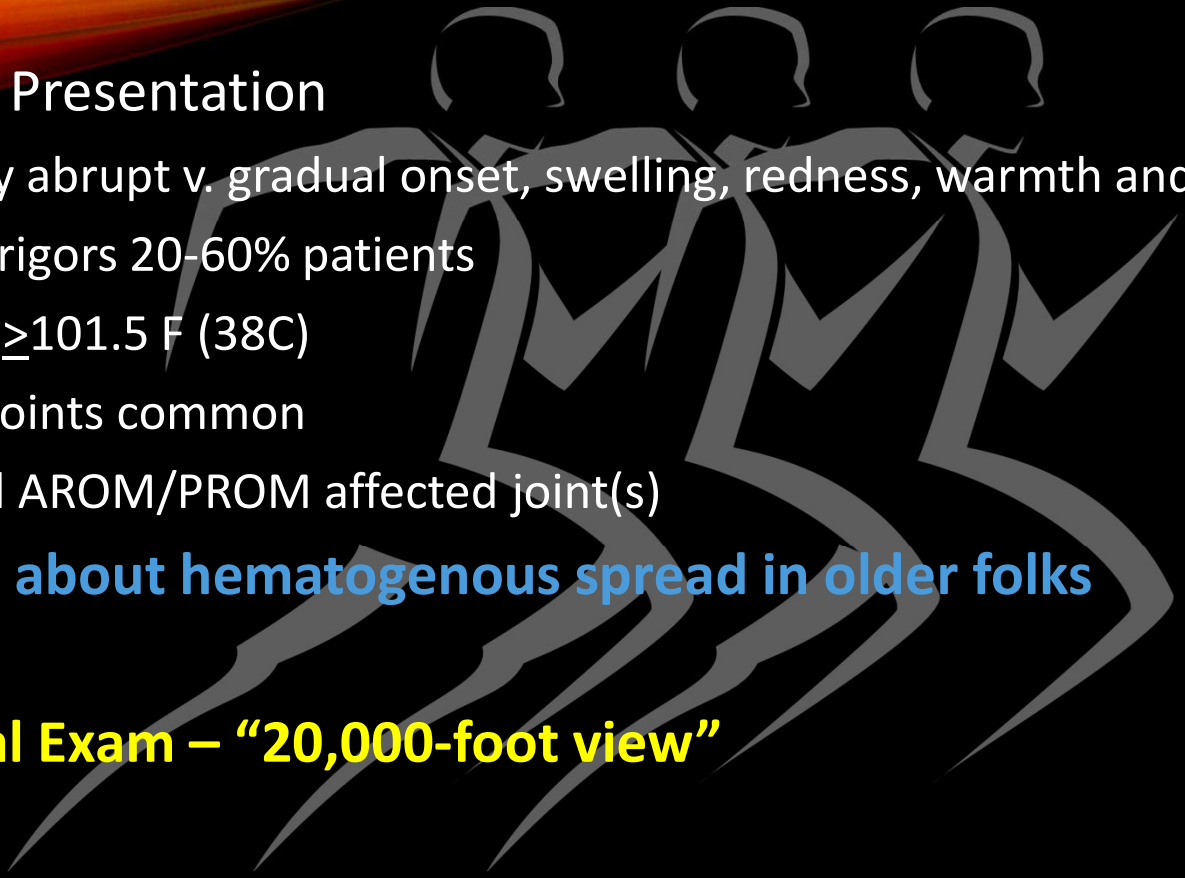
BACTERIAL SEPTIC A



Clinical Presentation

- Usually abrupt v. gradual onset, swelling, redness, warmth and isolated joint
- Chills, rigors 20-60% patients
- Fever: ≥101.5 F (38C)
- Large joints common
- Painful AROM/PROM affected joint(s)
- **Think about hematogenous spread in older folks**

Physical Exam – "20,000-foot view"

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BACTERIAL SEPTIC ARTHRITIS

- Diagnostic modalities
  - Imaging: Radiographs – Ultra-sound – CT/MRI w & w/o contrast
  - Laboratory studies
    - **Blood**: CBC , Glucose, CRP, ESR, [procalcitonin marginally helpful]
      - Blood Cultures, other diagnostic tests
    - **Joint Aspiration**
      - **Gram stain, Cell count, Crystals, & Cultures [aerobes, anaerobes, fungus, AFB]**
      - **Gram stain – 75% gram-positive cocci, 50% gram-negative bacilli**
      - **Polymorphic nucleated (PMN) cells- > 50,000 think infection (total joint > 10,000)**
        - Look at % WBC

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Table 38-5. Nongonococcal Septic Arthritis: Antibiotic Choice for Specific Organisms

ORGANISM	ANTIBIOTIC OF CHOICE	ALTERNATIVES
Staphylococcus aureus	Nafcillin	Cefazolin Vancomycin Clindamycin
Methicillin-resistant *S. aureus* (MRSA)	Vancomycin	Deptomycin Linezolid Clindamycin
Streptococcus pyogenes or *Streptococcus pneumonia*	Penicillin or nafcillin	Cefazolin Vancomycin Clindamycin
Enterococcus	Ampicillin plus gentamicin	Vancomycin plus aminoglycoside
Haemophilus influenzae	Ampicillin	Third-generation cephalosporin Cefuroxime Chloramphenicol
Enterobacteriaceae	Third-generation cephalosporin or levofloxacin	Imipenem Aztreonam Ampicillin Aminoglycoside (not alone)
Pseudomonas	Aminoglycoside plus antipseudomonal penicillin	Aminoglycoside plus ceftazidime, imipenem, or aztreonam

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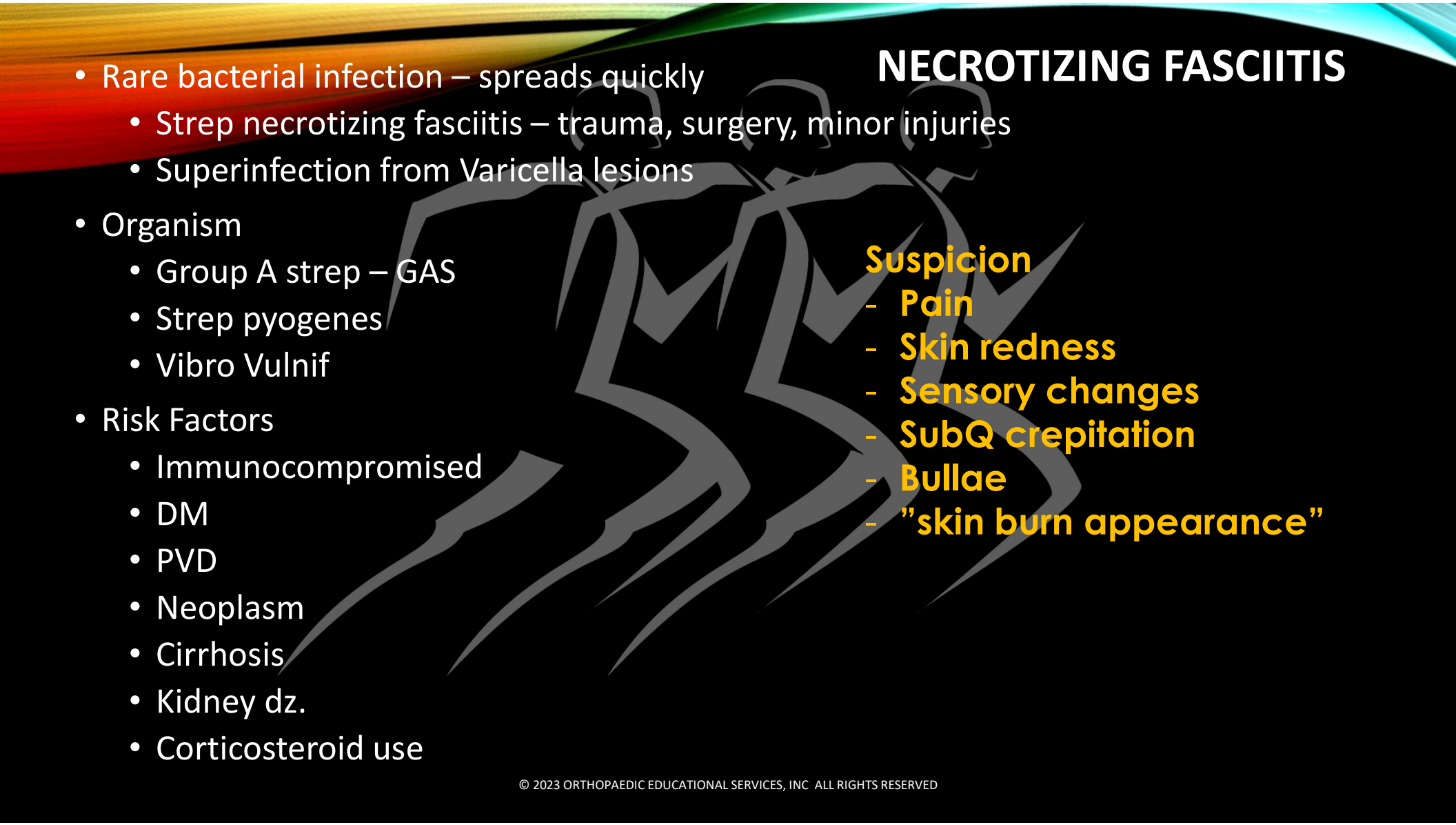
NECROTIZING FASCIITIS

- Rare bacterial infection – spreads quickly
  - Strep necrotizing fasciitis – trauma, surgery, minor injuries
  - Superinfection from Varicella lesions
- Organism
  - Group A strep – GAS
  - Strep pyogenes
  - Vibro Vulnif
- Risk Factors
  - Immunocompromised
  - DM
  - PVD
  - Neoplasm
  - Cirrhosis
  - Kidney dz.
  - Corticosteroid use



Suspicion

- **Pain**
- **Skin redness**
- **Sensory changes**
- **SubQ crepitation**
- **Bullae**
- **"skin burn appearance"**

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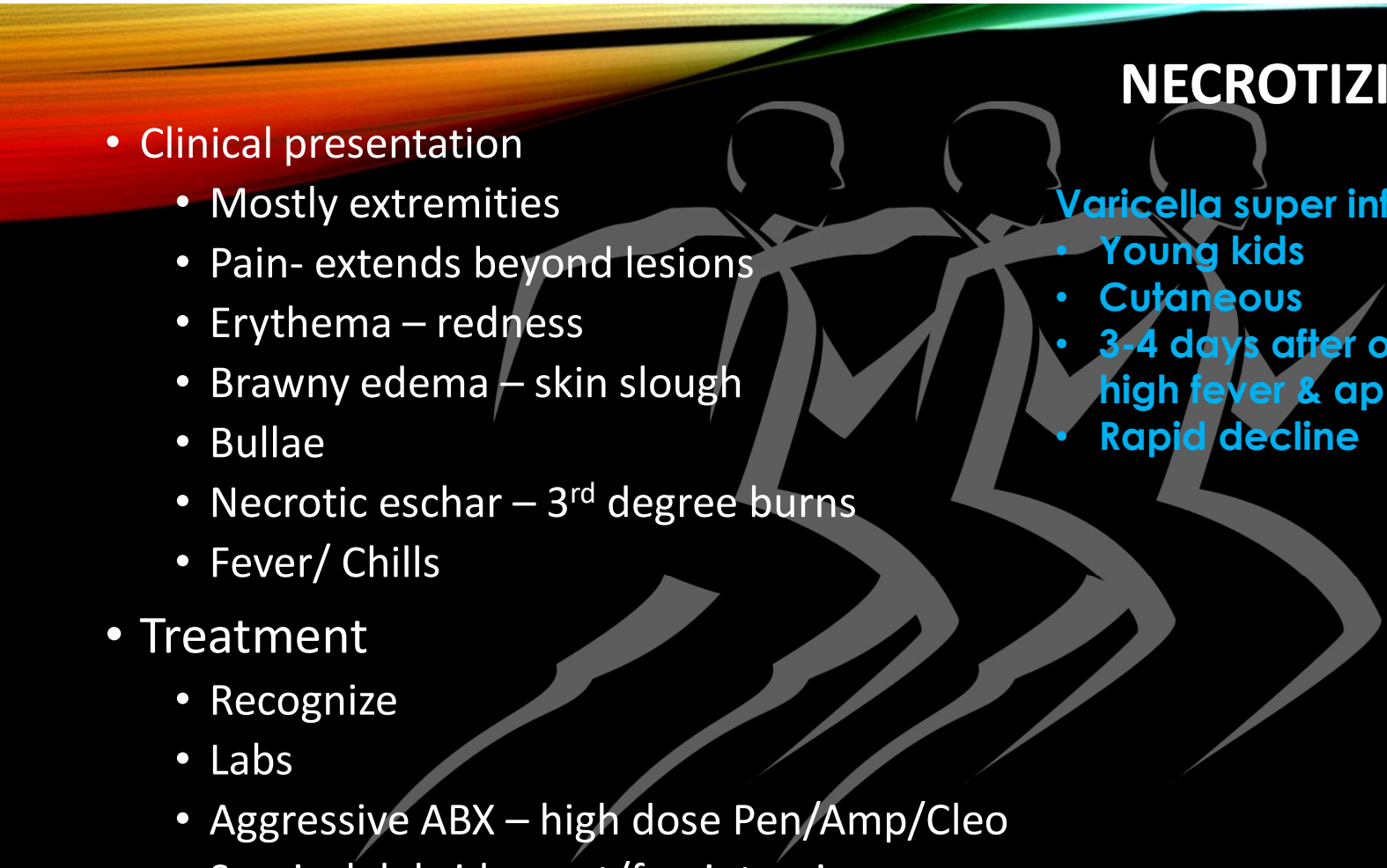
NECROTIZING FASCIITIS

- Clinical presentation
  - Mostly extremities
  - Pain- extends beyond lesions
  - Erythema – redness
  - Brawny edema – skin slough
  - Bullae
  - Necrotic eschar – 3rd degree burns
  - Fever/ Chills
- Treatment
  - Recognize
  - Labs
  - Aggressive ABX – high dose Pen/Amp/Cleo
  - Surgical debridement/fasciotomies
  - **Medical Support**



Varicella super infection

- **Young kids**
- **Cutaneous**
- **3-4 days after onset develop high fever & appears toxic**
- **Rapid decline**

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MEDICAL PROBLEMS

AMS/Stroke

Chest Pain/MI

Atrial Fibrillation (Afib)

Pulmonary Embolism &

Fat Embolism

Hypotension

Hypertension

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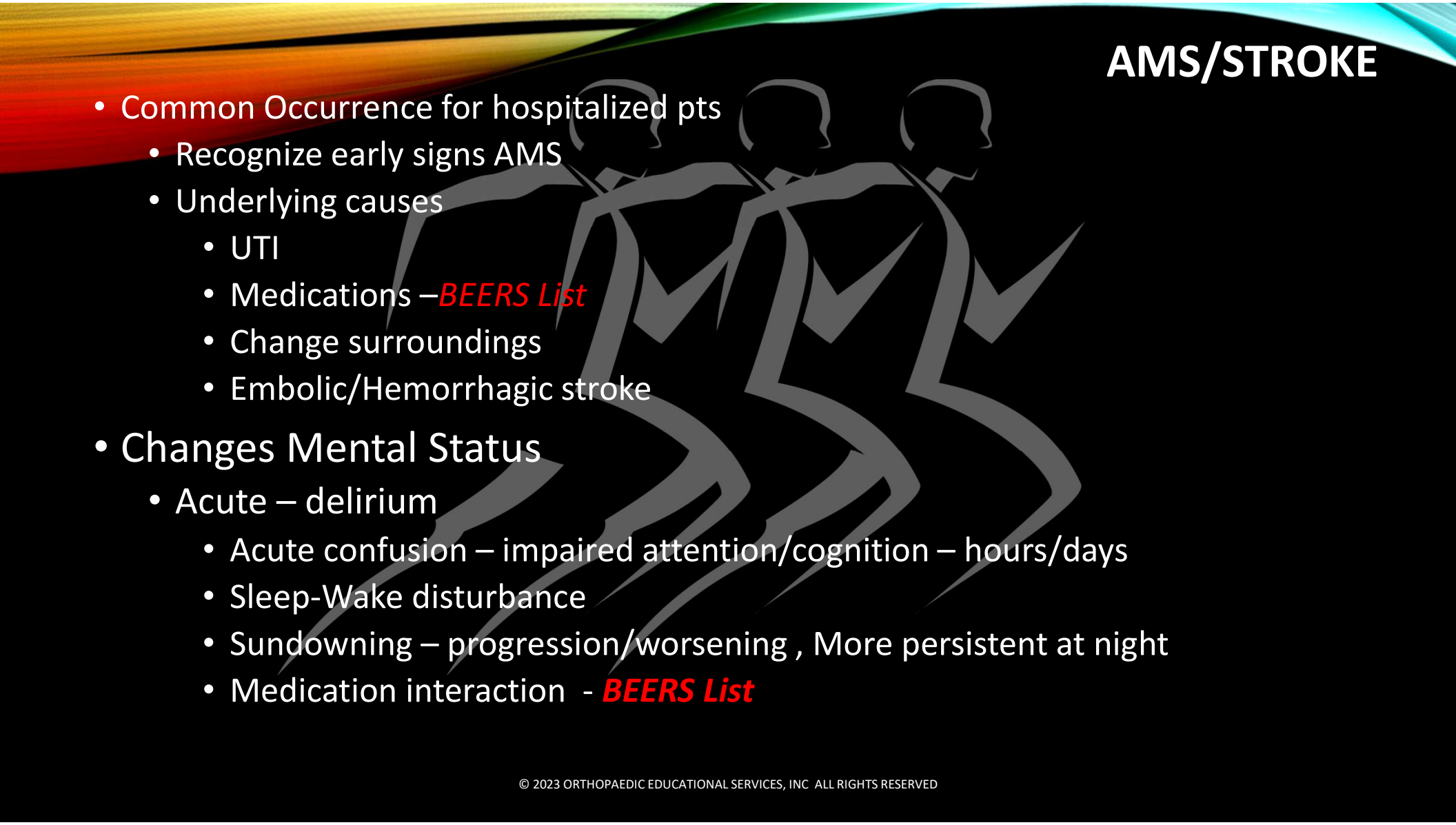
AMS/STROKE



- Common Occurrence for hospitalized pts
  - Recognize early signs AMS
  - Underlying causes
    - UTI
    - Medications –*BEERS List*
    - Change surroundings
    - Embolic/Hemorrhagic stroke
- Changes Mental Status
  - Acute – delirium
    - Acute confusion – impaired attention/cognition – hours/days
    - Sleep-Wake disturbance
    - Sundowning – progression/worsening , More persistent at night
    - Medication interaction - ***BEERS List***

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AMS/STROKE

Common Causes

- Young adults – Toxic ingestions or Trauma
- Older/elderly
  - ***Stroke***
  - ***Infection***
  - ***Drug-Drug interactions***
  - ***Living Environment***
  - ***10-25% Elderly hospitalized will present with Delirium on admission***
- Metabolic
  - **Hypoxia – Hypoglycemia**: adverse effect on CNS contributing to delirium
- Cardiovascular
  - **Malignant arrhythmias**
  - **Hypotension**
    - Adverse effects on Cerebral profusion pressure

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AMS/STROKE

Evaluation

- ABC's, GCS < 8 protect airway
- Hemodynamic support
- Vitals
- EKG
- CXR
- **Labs: CBC, BMP, BNP, Glucose, infection**
- **Mini-Mental Status Exam**
- Neuro exam
  - **Stat Head CT**

TABLE 38-2

Glasgow Coma Scale

BEHAVIOR	RESPONSE	SCORE
Eye opening response	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response	Oriented to time, place, and person	5
	Confused	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score:	*Best response*	15
	Comatose client	8 or less
	Totally unresponsive	3

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AMS/STROKE

TREATMENT

Treatment of symptomatology

- **Naloxone – Glucose - Thiamine**

- **ABCs**
- **Cardiovascular interventions**
  - Pacing
  - Treat arrhythmia
  - Volume replacement
- **Respiratory**
  - Supplemental oxygen
  - Pulmonary toilet
- **Sepsis**
- **Neurological conditions/Trauma**

Acutely delirious treatment

- ***Environmental changes***
  - ***Lighting***
  - ***Sleep Hygiene***
  - ***Activity changes***
  - ***Psychosocial support***
- ***Medication***
  - ***Haloperidol 5-10 mg PO/IM/IV***
  - ***Lorazepam 1-2 mg PO/IM/IV***
    - ***Avoid Benzodiazepines***

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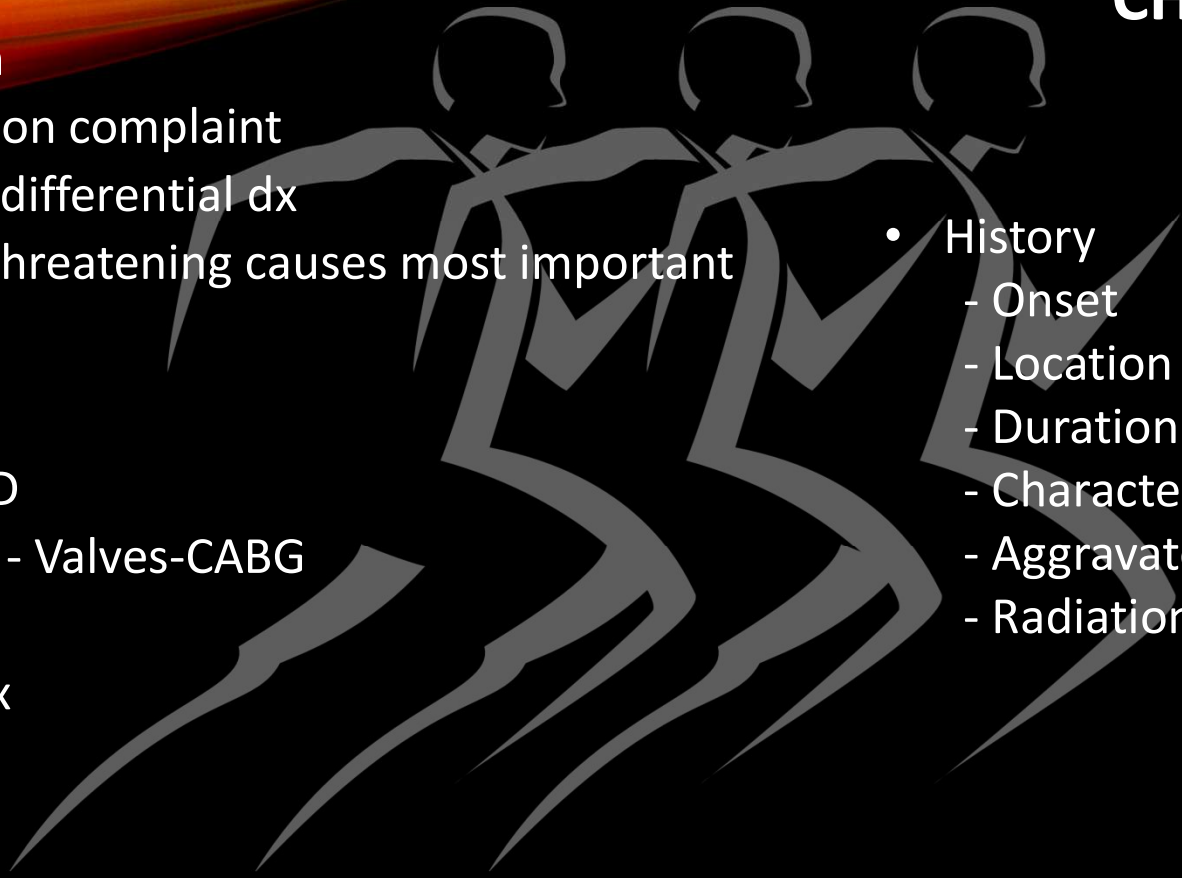
CHEST PAIN/AMI

- Chest Pain
  - Common complaint
  - Broad differential dx
  - Life –Threatening causes most important

- PMHx
  - Hx CAD
  - Stents - Valves-CABG
  - HF
  - AMI hx



- History
  - Onset
  - Location
  - Duration
  - Character
  - Aggravate/Alleviate
  - Radiation

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CHEST PAIN/AMI

- Evaluation
  - Neuro
  - Heart
  - Lung

- Diagnostics
  - Stat EKG
  - Stat labs: CBC, BMP, Serial Troponins
  - Rapid Response
  - Cardiology/Medicine Consults

- *Treatment*
  - *ACLS*
  - ***"MONA"***
    - *Morphine*
    - *Oxygen*
    - *Nitro*
    - *Aspirin*

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ATRIAL FIBRILLATION

What is Atrial Fibrillation

Atrial fibrillation (A-fib) is an irregular and often very rapid heart rhythm (arrhythmia) that can lead to blood clots in the heart.

A-fib increases the risk of stroke, heart failure and other heart-related complications.

Causes Atrial Fibrillation

- HTN/CAD/CHF/Valve dz
- Hyperthyroidism
- Obesity
- Obstructive Sleep Apnea/COPD/Pulmonary edema
- ETOH/Drugs

- **Symptoms**
  - **Asymptomatic**
  - **History of Afib**
  - **Irregular w or w/o rapid HR [RVR]**
  - **Dizziness**
  - **Syncope/near syncope**

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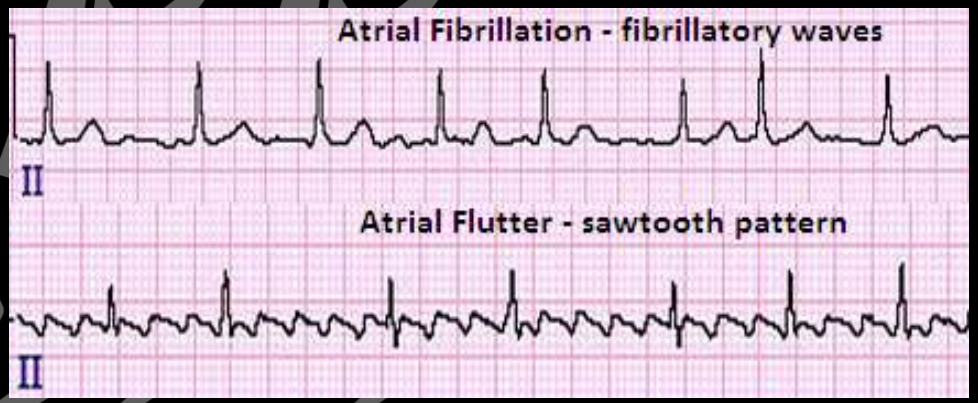
ATRIAL FIBRILLATION

Physical Examination

- Neuro
- Lungs
- Heart- Carotids, peripheral edema

Diagnostic Studies

- **Stat EKG**
- **CBC, BMP, PT/INR, TSH, Free T4**
- **Serial Troponins Q 4 hrs x 3**
- **Telemetry**



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ATRIAL FIBRILLATION

- Treatment
  - Symptomatic - Cardioversion
  - Asymptomatic
    - Fluid resuscitation [hypovolemic]
    - ***Rate Control: Lopressor IV or PO***
      - ***< 120 try vagal maneuvers /PO Metoprolol (Lopressor) 25mg***
      - ***> 120 or fail Vagal or PO Metoprolol : IV 2.5/5mg Slow IV push***

  - **Anticoagulation –**
    - **Direct Oral Anticoagulants (DOAC) - Rivaroxaban (Xarelto), Apixaban (Eliquis)**
    - **Warfarin**
  - Cardiology Consult
  - Transfer to Stepdown or ICU floor
  - Transfer to Medicine Service

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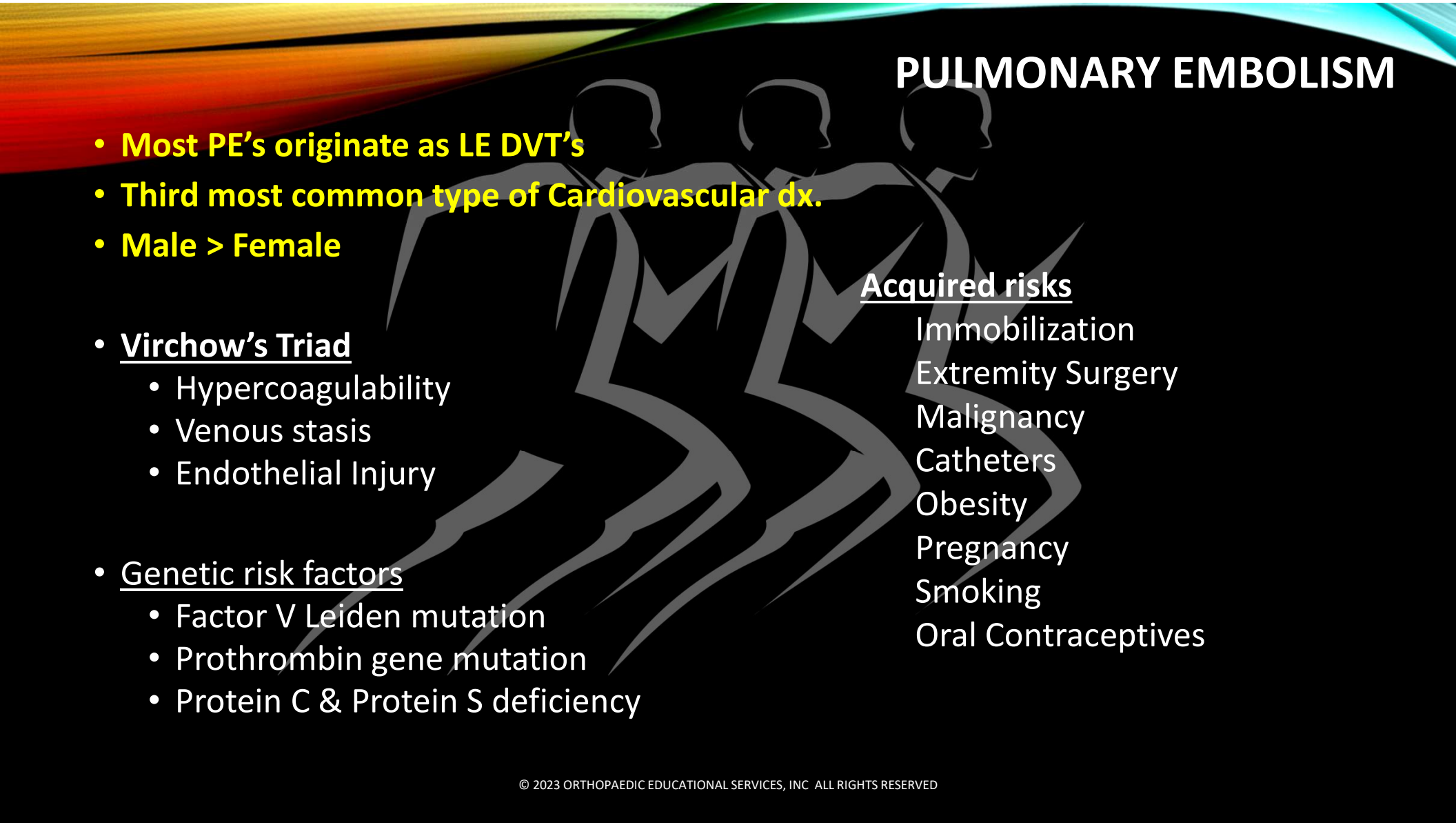
PULMONARY EMBOLISM



- **Most PE's originate as LE DVT's**
- **Third most common type of Cardiovascular dx.**
- **Male > Female**

- **Virchow's Triad**
  - Hypercoagulability
  - Venous stasis
  - Endothelial Injury

- Genetic risk factors
  - Factor V Leiden mutation
  - Prothrombin gene mutation
  - Protein C & Protein S deficiency

Acquired risks

Immobilization
Extremity Surgery
Malignancy
Catheters
Obesity
Pregnancy
Smoking
Oral Contraceptives

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PULMONARY EMBOLISM

Pathophysiology

- PE are multiple, small & lower lobes & both lungs involved
- Large embolus blocks Pulmonary artery (Saddle embolus) – Devastating outcomes
- Smaller emboli block peripheral arteries
- Increased Pulmonary vascular resistance
- Right Ventricular (RV) enlargement
- Vasospasm stimulates respiratory drive causing hypocapnia and respiratory Alkalosis
- RV failure to acute pressure overload is primary cause of death failure

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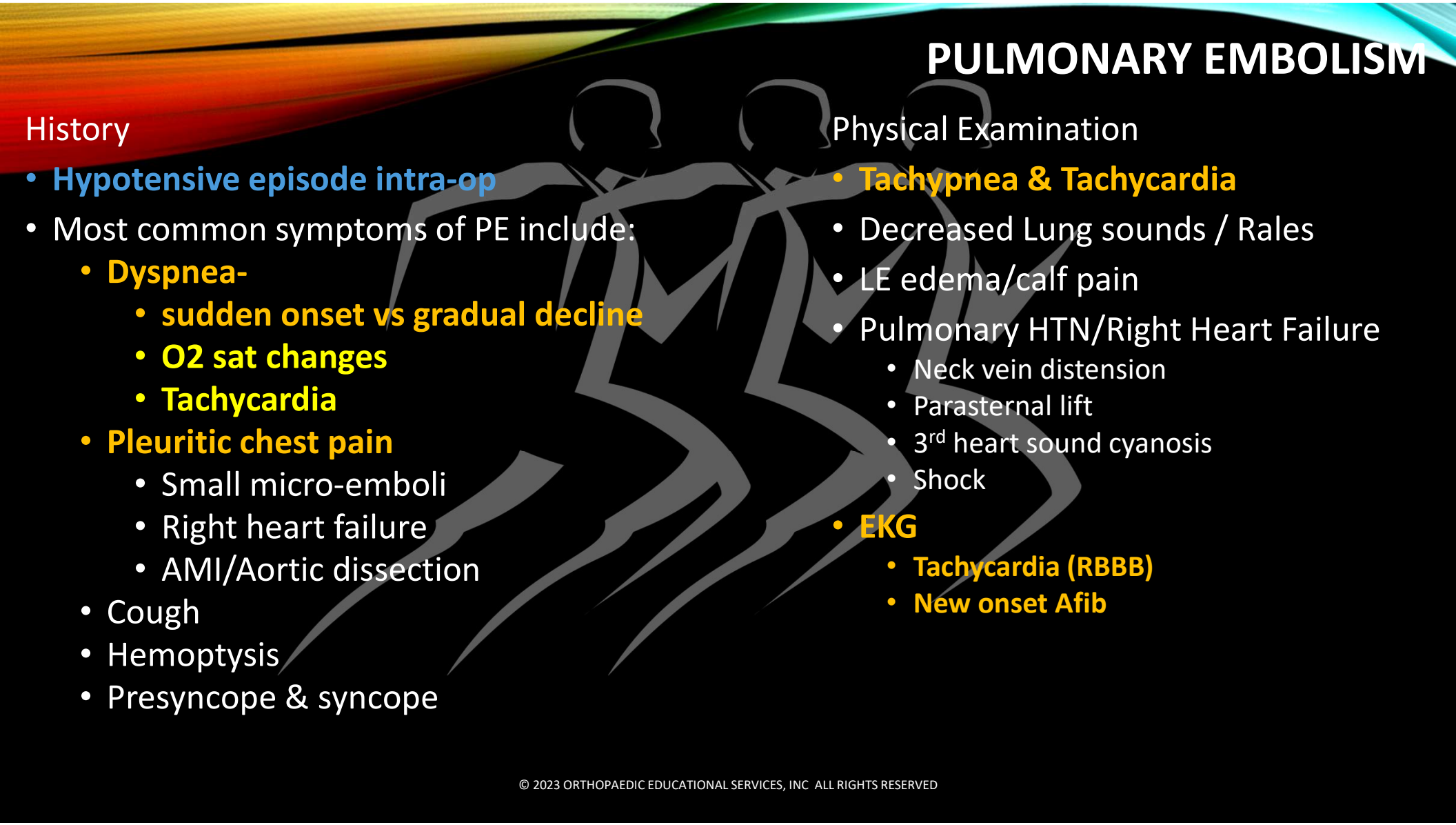
PULMONARY EMBOLISM



History

- **Hypotensive episode intra-op**
- Most common symptoms of PE include:
  - **Dyspnea-**
    - **sudden onset vs gradual decline**
    - **O2 sat changes**
    - **Tachycardia**
  - **Pleuritic chest pain**
    - Small micro-emboli
    - Right heart failure
    - AMI/Aortic dissection
  - Cough
  - Hemoptysis
  - Presyncope & syncope

Physical Examination

- **Tachypnea & Tachycardia**
- Decreased Lung sounds / Rales
- LE edema/calf pain
- Pulmonary HTN/Right Heart Failure
  - Neck vein distension
  - Parasternal lift
  - 3rd heart sound cyanosis
  - Shock
- **EKG**
  - **Tachycardia (RBBB)**
  - **New onset Afib**

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PULMONARY EMBOLISM

LABS:

- CBC
- ABG/VBG: respiratory alkalosis & hypocapnia
- Brain Natriuretic Peptide (BNP): Elevated w/ RV stretch/overload
- Troponin
- D-Dimer: high negative predictive value
- EKG: Tachycardia & non-specific ST-T wave changes (RBBB rate late sign)
  - New onset Afib (RVR)
- CXR – Rule out Pneumothorax, tamponade, infiltrate, fluid
- ***Chest CT angiography – PE protocol***
  - ***Prospective Investigation on Pulmonary Embolism Dx (PIOPED) II***
    - ***Sensitivity 83%, specificity 96% PE diagnosis***
  - ***Contrast Allergy or Renal impairment (eGFR <30) – decisions***
  - ***Alternative study V-Q scan***

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PULMONARY EMBOLISM

Wells Criteria predictive of PE

- Clinical Symptoms of DVT – 3
- Other Dx less likely than PE – 3
- Heart rate > 100 – 1.5
- Immobilization ≥ 3 days or surgery in last 4 wks – 1.5
- Hx DVT/PE – 1.5
- Hemoptysis – 1
- Malignancy - 1

Wells Criteria Score

- **High >6**
- **Moderate 2-6**
- **Low < 2**

Modified Wells Criteria Score

- ***PE likely - > 4***
- ***PE unlikely - <4***

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PULMONARY EMBOLISM

Treatment

- Stable vs. Unstable
- Supportive measures
- O2 supplementation
- Anticoagulation
  - LMWH and Fondaparinux (Arixtra)
    - Less chance major bleeding, HIT
  - Unfractionated Heparin (UFH)
    - Hemodynamic unstable
    - Need for Reperfusion therapy,
    - Renal Impairment

Stable Hemodynamic

- Supportive care
- Imaging studies
  - Low probability – 24 hrs
  - Moderate – 4 hrs
- Treatment: 3-6 months
  - Unprovoked longer Tx
  - LMWH/Fondaparinux
  - Oral Agents – Apixaban/Rivaroxaban/Warfarin

Unstable Hemodynamic

- Supportive Care/Telemetry/LABS/EKG
- Stat Imaging
- Reperfusion Therapy
- UFH/LMWH/DOAC/Warfarin

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TAKE HOME POINTS

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TAKE HOME POINTS

- **Surgical Emergency = Spinal infection/Hematoma/Cauda Equina syndrome**
- **Surgical Emergency = Acute Compartment Syndrome**
- **Compartment syndrome not exclusive to the Lower leg.**
- **Pain & Suspicion are the ONLY DX signs in Compartment syndrome**
- **Chest Pain – AMS – AFIB = gets a workup**
- Pulmonary Embolism – Spiral CHEST CT w/ Angiography
  - Don't forget about Fat Embolism
- **Pelvis Ring Fx = Binder goes around the Trochanters**
- **Septic Arthritis vs Toxic Synovitis – Kocher Criteria is the Key to more accurate Dx**

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REFERENCES

- Wenz JF, Orthopaedic Surgery Resident Survival Guide, Johns Hopkins University, June 2007, accessed March 24, 2023
- Vyas V, Goyal A. Acute Pulmonary Embolism. [Updated 2022 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560551/ accessed March 25, 2023
- Sharma S, Hashmi MF, Bhattacharya PT. Hypotension. [Updated 2023 Feb 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499961/ accessed March 25, 2023
- Patti L, Gupta M. Change In Mental Status. [Updated 2022 Aug 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441973/, accessed March 25, 2023
- Adeyinka A, Pierre L. Fat Embolism. [Updated 2022 Oct 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499885/, accessed March 25, 2023
- Johnson K, Ghassemzadeh S. Chest Pain. [Updated 2022 Dec 14]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470557/, accessed March 25, 2023

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REFERENCES

- Schmidt AK, Anglen J, Nana JD, Varecka TF, Adult Trauma: Getting Through the Night, JBJS 2010;9(2):490-505
- Damage Control Orthopaedics: Evolving Concepts in the Treatment pf patients Who Have Sustained Orthopaedic Trauma, JBJS,2005;87(2):434-449
- Coe, Marcus P. MD, MS; Osborn, Colonel Patrick M. MD; Schmidt, Andrew H. MD. AAOS Clinical Practice Guideline: Management of Acute Compartment Syndrome. Journal of the American Academy of Orthopaedic Surgeons 29(1):p e1-e4, January 1, 2021. | DOI: 10.5435/JAAOS-D-19-00326
- Al-Mutair, Abdulaziz BHSc, MBChB, FRCSC; Bednar, Drew A. MD, FRCSC. Spinal Epidural Hematoma. American Academy of Orthopaedic Surgeon 18(8):p 494-502, August 2010.
- Chien C, Abrukin L, Spinal Epidural Hematoma CORE EM, https://coreem.net/core/spinal-epidural-hematoma/, Nov 2016, accessed April 10, 2023
- Gocke TV, Metacarpal Fractures: A review of Fractures Characteristics and Treatment Options, JBJS-JOPA 2023;11(1):e22-00018.
- Gocke TV , Tibia Fractures-Part 1, Orthopaedic Educational Services, Inc., https://orthoedu.com, March 2022, accessed March 12, 2023
- Colston, J., & Atkins, B. (2018). Bone and joint infection. *Clinical Medicine*, *18*(2), 150-154 https://doi.org/10.7861/clinmedicine.18-2-150

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REFERENCES

- Gocke TV, Metacarpal Fractures: A review of Fracture Characteristics and Treatment Options, JBJS JOPA 2023;11(1):e22.00018
- Gocke TV, Hand and Finger Infections, Orthopaedic Educational Services, Inc., www.orthoedu.com, accessed May 9, 2023

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REFERENCES

1. Nouri A, Walmsley D, Pruszczynski B, Synder M. Transient synovitis of the hip: a comprehensive review. J Pediatr Orthop B. 2014 Jan;23(1):32-6.
2. Long B, Koyfman A, Gottlieb M. Evaluation and Management of Septic Arthritis and its Mimics in the Emergency Department. *West J Emerg Med*. 2019;20(2):331–341.
3. Kocher MS, Zurakowski D, Kasser JR. Differentiating between septic arthritis and transient synovitis of the hip in children: an evidence-based clinical prediction algorithm. J Bone Joint Surg Am. (1999)81 (12): 1662–70
4. Del Beccaro MA, Champoux AN, Bockers T, Mendelman PM. Septic arthritis versus transient synovitis of the hip: the value of screening laboratory tests. Ann Emerg Med. 1992 Dec;21(12):1418-22
5. Caird MS, Flynn JM, Leung YL, Millman JE, D'Italia JG, Dormans JP. Factorsdistinguishing septic arthritis from transient synovitis of the hip in children. A prospective study. J Bone Joint Surg Am. 2006 Jun;88(6):1251-7.

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