

EMERGENCY RADIOLOGY

Goals and Objectives

Core Curriculum in Emergency Radiology

(edited from curriculum from Robert Novelline, MD.)

1. Demonstrate learning of the knowledge-based objectives - **(Medical Knowledge, Patient Care, Practice-Based Learning, System-Based Practice)**

By the end of the first rotation, PG will be able to:

1. Use the PACS for interpretation of imaging studies
2. Interpret chest, abdomen, spine and extremity radiographs performed for emergent traumatic and non-traumatic indications
3. Understand the imaging algorithm of the Level 1 trauma victim
4. Understand the common mechanisms of injury to the musculoskeletal system
5. Describe common fracture patterns
6. Understand the basics of post-operative orthopedic radiology,
7. Recognize radiographic signs of most life-threatening conditions.

By the end of the second rotation, PG will be able to do the above plus:

8. Protocol and interpret chest, abdomen, and pelvic CT scans performed for traumatic emergencies
 9. Understand the imaging algorithm of chest emergencies such as pulmonary embolism and aortic dissection
 10. Understand the imaging algorithm of abdominal emergencies such as bowel obstruction and urinary calculi
 11. Understand the imaging algorithm of musculoskeletal emergencies such as occult hip fracture and osteomyelitis.
 12. Interpret and understand complex orthopedic radiology problems such as acetabular and pelvic ring fractures
2. Accurately and concisely dictate a radiographic report – **(Patient Care, Interpersonal & Communication Skills)**
 3. Communicate effectively with referring clinicians and supervisory staff – **(Interpersonal & Communication Skills)**
 4. Understand standard patient positioning in chest, abdomen, and bone radiology – **(Medical Knowledge, Practice-Based Learning)**
 5. Obtain pertinent patient information relative to radiologic examinations – **(System-Based Practice)**
 6. Demonstrate learning of the clinical indications for obtaining radiographs and when additional studies, including CT, MR, NM, and interventional studies may be necessary - **(System-Based Practice)**
 7. Demonstrate a responsible work ethic – **(Professionalism)**

II Curriculum and Recommendations for Study

A. Central Nervous System

1. Skull fractures

2. Extra-axial hemorrhages
 - a. subdural hematoma
 - b. epidural hematoma
3. Parenchymal injuries
 - a. cortical contusion
 - b. diffuse axonal injury
 - c. deep gray matter injury
 - d. brainstem injury
4. Subarachnoid hemorrhage
5. Vascular injuries
6. Penetrating injuries
7. Herniation syndromes
8. Cerebral infarction
 - a. arterial infarction
 - b. venous infarction
 - c. diffusion imaging appearance
 - d. perfusion imaging appearance
9. Non-traumatic hemorrhage
 - a. subarachnoid hemorrhage
 - b. parenchymal hemorrhage
10. Central Nervous system infections
 - a. meningitis
 - b. encephalitis
 - c. abscess/cerebritis
 - d. subdural empyema
 - e. spinal epidural abscess
 - f. osteomyelitis/discitis
11. Dural sinus thrombosis
12. Reversible posterior leukoencephalopathy syndrome
13. Pituitary apoplexy
14. Spinal trauma
 - a. spinal cord contusion
 - b. spinal epidural hematoma
 - c. nerve root avulsion.4

B. Face and Neck

1. Facial fractures
 - a. Orbital fractures
 - Blow-out fracture
 - Blow-in fracture
 - Orbital apex fracture
 - b. Zygoma fractures
 - Isolated arch fracture
 - Zygomatic complex fracture
 - c. Nasal fractures
 - d. Naso-orbital-ethmoid fractures

- Posteriorly displaced
- Telescoped
- e. Frontal fractures
- f. Maxillary fractures
 - Dentoalveolar fractures
 - Maxillary sagittal fractures
 - LeFort fractures
- g. Mandible fractures
- 2. Soft tissue injuries of the orbit
 - a. Post bulbar emphysema and hemorrhage
 - b. Extraocular muscle entrapment
 - c. Ocular injuries
 - Rupture
 - Laceration
 - Lens dislocation
 - Vitreous hemorrhage
 - Subchoroidal hemorrhage
- 3. Orbital cellulitis
- 4. Paranasal sinusitis
- 5. Laryngeal trauma
- 6. Parotitis and neck abscesses

C. Spine

Initial assessment issues = "Clearance" in the Emergency Department.

- The evaluation of low-risk patients
- The evaluation of high-risk patients (multitrauma)
- The evaluation in patients with neurologic deficits

Concept and Assessment of Instability:

Mechanism of injury
 Radiographic patterns
 Normal variants
 Frequently associated injuries

1. Cranio-cervical / C1-C2
 - a. Occipital condyle fracture
 - b. Atlanto-occipital dislocation / subluxation
 - c. Jefferson burst fracture
 - d. Atlanto-axial rotary fixation
 - e. C1 - posterior arch
 - f. Dens fracture
 - g. Hangman's fracture
2. C3-T1
 - a. Anterior subluxation / whiplash syndromes
 - b. Hyperextension sprain / spinal cord injury without radiographic abnormalities
 - c. Wedge compression, spinous process fractures

- d. Burst compression
- e. Flexion tear drop fracture
- f. Bilateral facet dislocation.8
- g. Unilateral facet dislocation
- h. Articular mass and transverse process fractures
- i. Traumatic isolation of articular pillar / pedicolumnar separation
- j. Corner Avulsion Fracture (extension teardrop)
- k. Laminar fractures
- l. Facet dislocation with fracture
- m. Acute ligamentous injuries
- 3. Thoraco-lumbar spine trauma
 - a. Compression fracture
 - b. Burst Fracture
 - c. Chance fracture
 - d. Complex fracture-dislocation
 - e. Pathological fracture
- 4. Traumatic injuries to intervertebral disks
- 5. Ostoemyelitis /discitis
- 6. Epidural abscess
- 7. Disk herniation

D. Chest

- 1. Chest trauma
 - a. Rib fractures
 - b. Sternal and manubrial fractures
 - c. Hemothorax
 - d. Pneumothorax and pneumomediastinum
 - e. Mediastinal hemorrhage
 - f. Pulmonary contusion, laceration, hematoma
 - g. Tracheobronchial injury
 - h. Esophageal tear
 - i. Diaphragm injury
- 2. Pulmonary embolism
- 3. Acute pulmonary infections
- 4. Aspiration pneumonia
- 5. Airway foreign bodies
- 6. Obstructive airway disease
- 7. ARDS: near-drowning, fat embolism syndrome
- 8. Esophageal rupture

E. Cardiovascular Emergencies

- 1. Myocardium and Pericardium
 - a. Myocardial infarction
 - b. Myocardial laceration
 - c. Myocardial contusion
 - d. Pericardial effusion - tamponade
 - e. Pneumopericardium - tamponade
- 2. Aorta

- a. Aortic trauma
- b. Aortic dissection
- c. Aortic aneurysm
- 3. Pulmonary Edema - various etiologies
- 4. Thrombo-embolic disease
 - a. Deep venous thrombosis
 - b. Pulmonary embolism

F. Abdomen

1. Abdominal Trauma

- a. Hemoperitoneum and intraperitoneal fluid
- b. Hemodynamic status assessment
- c. Retroperitoneal hemorrhage
- d. Gas collections: intraperitoneal and retroperitoneal
- e. Active arterial extravasation on CT
- f. Splenic injuries
- g. Liver injuries
- h. Gallbladder and biliary injuries
- i. Bowel injuries
- j. mesenteric injuries
- k. Pancreatic injuries
- l. Renal injuries
- m. Adrenal injuries
- n. Bladder injuries: intraperitoneal and extraperitoneal
- o. Abdominal wall injuries and diaphragmatic hernias

2. Non-traumatic Abdominal Emergencies

- a. The peritoneal cavity
 - Ascities
 - Peritonitis
 - Abdominal abscess
- b. Liver and biliary tract
 - Jaundice: obstructive and non-obstructive
 - Cholecystitis
- c. Pancreatitis
- d. Urinary tract
 - Urinary stones
 - Infection
 - Pyelonephritis
 - Renal abscess
- e. Adrenal hemorrhage
- f. Gastrointestinal tract
 - Gastrointestinal hemorrhage
 - Bowel obstruction
 - Bowel infarction
 - Bowel infection
 - Appendicitis
 - Diverticulitis

Infectious enteritis and colitis

- g. Epiploic appendagitis.
- h. Inflammatory bowel disease
 - Crohn disease
 - Ulcerative colitis

G. Gynecological /Obstetrical Emergencies

1. Uterine trauma
2. Cervico-vaginal trauma
3. Feto-placental trauma
4. Ovarian cystic disease
5. Ovarian torsion
6. Pelvic inflammatory disease
7. Endometritis
8. Spontaneous abortion
9. Fetal demise
10. Subchorionic hemorrhage
11. Ectopic pregnancy
12. Placenta previa
13. Placental abruption and hemorrhage
14. Biophysical Profile

H. Male Genitourinary Emergencies

1. Urethral and penile trauma
2. Urethral foreign bodies
3. Urethral stones
4. Scrotal and testicular trauma
5. Acute non-traumatic scrotal conditions
 - a. Testicular torsion
 - b. Epididymitis
 - c. Orchitis
 - d. Acute fluid collections (Hydrocele, hematocele, pyocele)
 - e. Epididymoorchitis
 - f. Infarction
 - g. Abscess
 - h. Fournier's Gangrene

I. Upper Extremity

1. Scapulothoracic dissociation
2. Clavicle fractures and dislocations
 - a. Dislocations
 - Sternoclavicular
 - Acromioclavicular
3. Glenohumeral dislocations
4. Scapular fractures
5. Humerus fractures
 - a. Proximal (head & neck)
 - b. Shaft
 - c. Supracondylar

- extra articular, including epicondyles
 - intra articular, including unicondylar, bicondylar and capitellar
- 6. Elbow dislocations
- 7. Forearm fractures & dislocations
 - a. Fractures
 - Processes
 - coronoid process
 - radial tubercle
 - Distal radius
 - Colles, Smith, Barton types
 - Die-punch fracture radiolunate fossa
 - Defensive injuries to ulna, including classic nightstick
 - b Single bone fracture with associated dislocation non fractured bone
 - Monteggia
 - Galeazzi
 - Essex-Lopresti
 - c. Dislocations
 - Elbow
 - Distal radioulnar joint
- 8. Carpal bone fractures
- 9. Carpal dislocations and malalignments
 - a. Perilunate spectrum
 - b. Carpal instability patterns
- 10. Metacarpal fractures
 - a. Carpometacarpal fracture dislocations, including Fighters' equivalent fractures
 - b. Extra articular fractures of the base, shaft and neck
- 11. Phalangeal fractures
 - a. Dislocations
 - Simple
 - Complex
 - b. Ligament injuries, including those of the extensor mechanism, collateral ligaments
 - Volar plate
 - Mallet type
 - c. Fractures
 - Extra articular
 - Intra articular
 - Amputations

J. Pelvis

- 1. Fractures of isolated bones of the pelvis that do not involve the pelvic ring
 - a. iliac wing (Duvrney)
 - b. sacrum
 - c. coccyx
 - d. avulsion
 - ant. sup. iliac crest apoph. - sartorius m

- ant. inf. iliac crest apoph. - rectus femoris m
- ischial tuberosity - hamstring ms
- lesser troch. apoph. (femur) - iliopsoas
- 2. Pelvic ring disruption. Disruption, ie., fracture or diastasis at two or more sites of the anterior and posterior pelvic arcs..20
 - a. Mechanism of injury
 - lateral compression
 - anteroposterior compression
 - discrete: straddle injury
 - diffuse: open-book pelvic ring disruption
 - vertical shear
 - b. Types of pelvic ring disruption
 - Malgaigne (ipsilateral)
 - bucket - handle (contralateral)
 - open - book
 - other fracture patterns without eponym
 - 3. Insufficiency fractures
 - anterior pelvic arch
 - sacrum
 - 4. Stress fractures
 - 5. Acetabular fractures (Involve only one side of the pelvic ring. Occur concomitantly with PRD in approximately 12%.)
 - a. posterior column (most common) rim
 - b. anterior column
 - c. both columns - above, or through, acetabulum but spare the lunate surface
 - d. transverse ("T")
 - "T" with ant. column extension
 - "T" with post. column extension

K. Hip

- 1. Dislocation
 - a. Posterior or posterosuperior fracture-dislocation.
 - Fracture involves posterior or posterosuperior acetabular rim
 - b. Anterior (obturator)
 - c. Central
- 2. Fractures (usually associated with dislocation).
 - a. Acetabulum:
 - Posterior or posterosuperior acetabular rim
 - Anterior (Involve the acetabular "tear-drop")
 - Central
 - b. Femur:
 - Head of femur- usually associated with hip dislocation
 - Neck of femur
 - subcapital
 - transcervical

basicervical

c. Trochanteric

intertrochanteric

2 - part (proximal/distal fragments)

3 - part (prox./distal + 1 trochanter)

4 - part (prox./distal + each trochanter)

subtrochanteric

isolated fracture, greater trochanter

d. Salter-Harris physeal injuries

4. Avascular necrosis

Stage I - radiograph negative

Stage II - inhomogeneity of femoral head

Stage III - Progressive inhomogeneity; trabecular disruption; "crescent" sign; subcondral cortical disruption.

Stage IV - fragmentation of head

5. Slipped capital femoral epiphysis (SCFE)

L. Lower Extremity

1. Femoral shaft fractures
2. Patella fractures
3. Tibial plateau fractures
4. Tibial spine avulsion fractures
5. Cruciate and other ligamentous injuries of the knee
6. Meniscus tears
7. Knee dislocations
8. Tibial stress fractures
9. Tibial and fibular shaft fractures
10. Tibial plafond fracture (pilon fractures)
11. Ankle mortise injury
12. Calcaneal fractures
13. Achilles tendon and ligamentous injuries of the ankle
14. Talus fractures
15. Talar and subtalar dislocations
16. Tarsal fractures
17. Tarso-metatarsal fracture dislocations (Lisfranc™s fracture)
18. Metatarsal fractures
19. Toe fractures
20. Septic arthritis
21. Muscle injuries
22. Compartment syndrome
23. Diabetic muscle infarction
24. Diabetic foot infections

M. Pediatric Emergencies

1. Brain

- a. Trauma
 - Cephalohematoma and capput succinadeum
 - Unintentional blunt and penetrating
 - Intentional (Battered child)
- b. Infection
 - 1. TORCH infections
 - 2. Meningitis, cerebritis, cerebral abscess
 - 3. Mastoiditis
- C. Non-traumatic hemorrhage
 - 1. Neonatal germinal matrix hemorrhage
 - 2. AVM, aneurysm, moya-moya, coagulation disorders
- D. Cerebral ischemia
 - 1. Perinatal brain injury
 - 2. Sickle cell disease
- E. Imaging the child with seizures
- 2. Head & Neck
 - a. Trauma
 - 1. Facial (orbit, zygoma, maxilla, mandible, frontal, nasal)
 - b. Infection
 - 1. Croup
 - 2. Epiglottitis
 - 3. Retropharyngeal abscess
 - 4. Parotitis
 - 5. Orbital cellulitis
- 3. Spine
 - a. Trauma
 - 1. Cervical spine
 - 2. Thoracic spine
 - 3. Lumbar spine
 - b. Infection
 - 1. Osteomyelitis/discitis
 - 2. Epidural abscess
 - c. Miscellaneous
 - 1. Imaging the child with acute back pain
- 4. Chest
 - a. Trauma
 - 1. Pulmonary contusion/laceration
 - 2. Thoracic air leak
 - 3. Mediastinal hemorrhage
 - 4. Esophageal and airways injury
 - 5. Chest wall injury.25
 - b. Infection
 - 1. Pneumonia
 - a. Neonatal pneumonia
 - b. Bacterial pneumonia
 - c. Viral pneumonia

- d. Opportunistic infection
 - 2. Empyema & pleural disease
 - c. Foreign body aspiration
 - d. Neonatal respiratory distress
 - 1. Respiratory distress syndrome
 - 2. Meconium aspiration syndrome
 - 3. Transient tachypnea of the newborn
 - e. Congenital heart disease
 - f. Congestive heart failure and pulmonary edema
5. Abdomen
- a. Trauma
 - 1. Solid viscus injury
 - 2. Hollow viscus injury
 - 3. Peritoneal fluid, hemoperitoneum & active hemorrhage
 - 4. Hypoperfusion complex\
 - b. Non-traumatic hemorrhage
 - 1. Adrenal hemorrhage
 - c. Infection/Inflammation
 - 1. Appendicitis
 - 2. Pancreatitis
 - 3. Cholecystitis
 - 4. Cholangitis
 - 5. Pyelonephritis
 - d. Bowel obstruction
 - 1. Midgut malrotation
 - 2. Bowel atresias
 - 3. Intestinal intussusception
 - 4. Hirschsprungs disease
 - 5. Meconium ileus, meconium plug syndrome & meconium peritonitis
 - e. GI bleeding
 - f. Immunocompromised disorders
 - 1. Neutropenic typhlitis
 - 2. Pseudomembranous colitis
 - g. Obstructive uropathy
 - h. Urolithiasis.26
6. Pelvis
- a. Trauma
 - 1. Bladder and urethral injury
 - b. Infection/Inflammatory
 - 1. PID
 - 2. Ovarian cystic disease & torsion
7. Scrotum
- a. Trauma
 - b. Infection/Inflammatory

1. Neonatal testicular torsion
 2. Testicular torsion in older children
 3. Epididymitis/Orchitis
8. Musculoskeletal
- a. Trauma
 1. Battered child
 2. Growth plate injury
 3. Toddlers fracture
 4. Nursemaids elbow
 5. Elbow injury & normal developmental variants
 6. Biomechanical features of growing long bones
 - b. Infection
 1. Osteomyelitis
 2. Septic arthritis
 3. Pyomyositis
 - c. Miscellaneous
 1. Child with limp
9. Pediatric sedation & monitoring in the emergency setting

III. Recommended Textbooks

Harris JH, Harris WH, The Radiology of Emergency Medicine. Williams & Wilkins, Baltimore, MD, Fourth Edition, 2000.

Harris JH, Mirvis SE. The Radiology of Acute Cervical Spine Trauma. Williams and Wilkins, Baltimore, MD, Third Edition, 1995.

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Mirvis SE, Young JWR. Imaging in Trauma and Acute Care. Williams and Wilkins, Baltimore, MD, 1992.

Novelline RA. Advances in Emergency Radiology, Volumes I and II, Radiological Clinics of North America. WB Saunders, Philadelphia, PA, 1999.
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West OC, Novelline RA, Wilson AJ, Categorical Course Syllabus on Emergency and Trauma Radiology. American Roentgen Ray Society, 2000