Core Curriculum in Emergency Radiology

Edited By

Robert A. Novelline, MD

Consultants:

James M. Provenzale, MD, Central Nervous System
James T. Rhea, MD, Face and Neck
Diego B. Nuñez, Jr. MD, Spine
Steven L. Primack, MD, Chest
Stuart Mirvis, MD, Cardiovascular
O. Clark West, MD, Abdomen
Stephen Ledbetter, MD, Obstetrical/Gynecological
Stanford M. Goldman, MD, Male Genitourinary
Fred A. Mann, MD, Upper Extremity
John H. Harris, Jr. MD, DSc, Pelvis and Hip
Eric A. Brandser, MD, Lower Extremity
Carlos J. Sivit, MD, Pediatrics
To define the content structure and study plan for the instruction of Radiology Residents rotating through Emergency Radiology rotations, and for Fellows in Emergency Radiology, during their Emergency Radiology Fellowship year.
II Curriculum and Recommendations for Study

A. Central Nervous System: James M. Provenzale, MD

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
Suggested Readings:

Cerebral Infarction


Carotid and Vertebral Artery Dissection


Provenzale JM. Dissection of the internal carotid and vertebral arteries: Imaging findings. AJR 1995; 165:1099-1104

Intracranial Hemorrhage


Dural Sinus Thrombosis


Provenzale JM, Joseph GJ, Barboriak DP. Dural sinus thrombosis: findings on CT and MR imaging and diagnostic pitfalls. AJR 1998;170:777-783

Reversible Posterior Leukoencephalopathy Syndrome (Hypertensive Encephalopathy)


Brain and Spine Trauma


CNS Infections


B. Face and Neck: James T. Rhea, MD and Diego Nunez, MD, MPH

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. Trauma to the aerodigestive tract
   a. Laryngeal trauma
   b. upper esophageal injuries

4. Infection of the paranasal sinuses
   a. Acute rhinosinusitis
   b. Aggressive fungal sinusitis
   c. Chronic and allergic sinusitis
   d. Complications
      1. cellulitis
      2. orbital subperiostial abscess
      3. osteomyelitis
      4. epidural abscess
      5. subdural empyema
      6. cavernous sinus thrombosis
5. Acute Infection of the suprahyoid neck
   a. retropharyngeal and prevertebral abscess and inflammation (edema)
   b. tonsillitis and tonsilar/peritonsilar abscess
   c. Odontogenic infections
      1. masticator abscess
      2. submandibular abscess
      3. sublingual abscess
   d. Ranula
   e. Parotitis
   f. submandibular sialoadenitis
   g. Ludwig’s angina and cervical necrotizing fascitis.

6. Acute infections of the infrahyoid neck
   a. epiglotitis
   b. croup
   c. lymphadenitis and suppurative adenopathy
   d. jugular thrombophlebitis

7. Ear Infections
   a. External otitis
   b. Cholesteatoma
   c. otomastoiditis
   d. otitis media
   e. apical petrositis.

8. Orbital infection
   a. orbital cellulitis
   b. orbital pseudotumor
   c. optic neuritis

Suggested Readings:

Rhea JT, Rao PM, Novelline RA, Helical CT and three-dimensional CT of facial and orbital injury, Radiologic Clinics of North America 37:489-513, 1999

Novelline RA, Head and neck CD-ROM, RSNA, Chicago, 1996

Lawrason JN, Diagnostic imaging of facial trauma, In: Imaging in trauma and critical care, Mirvis SE, Young JWR, editors, Williams and Wilkins, Baltimore MD, 243-290, 1992

Harris JH, Face, including intraorbital soft tissues; and Castillo M, Acute conditions of the intraorbital soft tissues, In: The Radiology of Emergency Medicine, Harris JH, Harris WH, Novelline RA, editors, Williams and Wilkins, Baltimore MD, 36-119 and 121-126, 1993

Gean AD, Maxillofacial trauma, In: Imaging of head trauma, Gean AD editor, Raven Press, NY NY, 427-495, 1994

Som PM, Curtin HD, Head and neck imaging, Mosby, St. Louis, 1996

C. Spine: Diego Nunez, Jr., MD

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
Concept: 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
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. Osteomyelitis /discitis
6. Epidural abscess
7. Disk herniation

**Suggested Readings:**

Young JWR: Cervical spine trauma. (In) Imaging in Trauma and Critical Care, Mirvis SE & Young JWR (eds); Williams & Wilkins; Baltimore, MD; 1992, pp 291-379.


Rogers LF: Fractures of the sacrum. (In) Radiology of Skeletal Trauma (2nd Ed), Rogers LF (ed); Churchill Livingstone, New York; 1992, pp 1019-1023
D.  Chest: Steven L. Primack, MD

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

Suggested Readings:


E. Cardiovascular Emergencies: Stuart Mirvis, MD

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

Suggested Readings:


E. Abdomen: O.Clark West, MD

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
      Ascites
      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

Suggested Readings:


I. Gynecological /Obstetrical Emergencies: Stephen Ledbetter, MD

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

Suggested Readings:


Moore L, Wilson SR. Ultrasonography in obstetric and gynecologic emergencies. Radiol


H. Male Genitourinary Emergencies: Stanford M. Goldman, MD

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. Abcess
   h. Fornier’s Gangrene

Suggested Readings:


I. Upper Extremity: Fred A. Mann, MD

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 capetellar fractures
6. Elbow dislocations
7. Forearm fractures & dislocations
   1. Fractures
      a. Processes
         1. coronoid process
         2. Radial tubercle
      b. Distal radius
         1. Colles, Smith, Barton types
         2. Die-punch fracture radiolunate fossa
      c. Defensive injuries to ulna, including classic nightstick
   2. Single bone fracture with associated dislocation non fractured bone
      a. Monteggia
      b. Galeazzi
      c. Essex-Lopresti
   3. Dislocations
      a. Elbow
      b. 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
      Ligament injuries, including those of the extensor mechanism, collateral ligaments
   b. Fractures
      Extra articular
      Intra articular
      Volar plate
      Mallet type
      Amputations

Suggested Readings:


J. Pelvis and Hip: John H. Harris, Jr. MD, DSc

A. Pelvis
   1. Fractures of isolated bones of the pelvis that do not involve the pelvic ring
      a. iliac wing (Duhrney)
      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.
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

B. Hip
1. Dislocation
   a. Posterior or posterosuperior
      pure
      fracture-dislocation. Fracture involves posterior or posterosuperior acetabular rim
   b. Anterior (obturator)
   c. Central

2. Fractures (usually associated with dislocation).
   a. Posterior or posterosuperior acetabular rim
   b. Anterior (Involve the acetabular "tear-drop")
   c. Central
C. Proximal femur
   1. Slipped capital femoral epiphysis (SCFE)
   2. Salter-Harris physeal injuries
   3. Fractures
      a. Head - usually associated with hip dislocation
      b. Neck
         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
   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

Suggested Readings:

Berquist TH, Coventry MB. The Pelvis and Hip. (In) Imaging of Orthopedic Trauma, 2nd
ed.

246; Proximal femur: 269-272; 285-289.

Pelvis, acetabulum and hips. (In) The Radiology of Emergency Medicine. Harris JH,
Harris WH,(eds); Williams & Wilkins, Baltimore; 2000, pp 725-814.

Young JWR: Fractures of the pelvis. (In) Imaging in Trauma and Critical Care, Mirvis SE
& Young JWR (eds); Williams & Wilkins; Baltimore, MD; 1992, pp 380-420

Daffner RH: Pelvic trauma. (In) Trauma Radiology, McCort JJ & Mindelzun RE (eds);
Churchill Livingstone; New York; 1990, pp 339-380
(In) Radiology of Skeletal Trauma (2nd Ed), Rogers LF (ed); Churchill Livingstone, New York; 1992; Fractures of the acetabulum, pp 1051-1074

K. Lower Extremity: Eric A. Brandser, MD

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
   a. Bucket handle tear
   b. Radial tear
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

Recommended Reading List:


L. Pediatric Emergencies: Carols J. Sivit, MD

1. Brain
   A. Trauma
      1. Cephalohematoma and capput succinadeum
      2. Unintentional blunt and penetrating
      3. 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, moyo-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
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
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

**Suggested Readings:**


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


III. Recommended Textbooks


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

