DIAGNOSTIC NEURORADIOLOGY

ROTATION #1

Typical Day

The morning is spent with Dr. Jim Wood at the VAMC. The afternoon is spent with the Methodist Neuroradiologist as listed on the MRPC work schedule.

In the afternoons your goal is to dictate 5 Brain MR studies and 5 Spine MR studies daily.

STAFF RESPONSIBILITIES

1. Review the Goals and Objectives with the resident at the beginning of the month.
2. Please inform Dr. Somogyi about the performance of the resident. He will give the resident feedback on the Faculty Evaluation at the end of the month.

GOALS

1. **First rotation:** By the end of the first Diagnostic Neuroradiology Rotation, residents are expected to expand and cultivate skills and knowledge learned to achieve the following objectives based on the six general competencies. The resident should exhibit an increasing level of responsibility and independency as he or she progresses throughout the year.

COMPETENCE-BASED OBJECTIVES

Patient Care

1. Learn to obtain informed consent, by explaining the risks and benefits of contrast-enhanced CT/MR to the patient.
2. Learn appropriate techniques for injection of contrast (including use of power injectors).
3. Learn to recognize and treat contrast reactions.

Medical Knowledge

1. Complete the following RSNA/AAPM Physics Modules @ http://www.rsna.org/Education/physics.cfm
    a. Magnetic Resonance
    b. Basic Pricciples of Nuclear Magnetic Resonance
    c. Magnetic Resonance: Image Quality/Bioeffects/Safety
    d. MRI Special Acquisition Methods
    e. MRI Tissue Properties, Contrast agents and Reactions
    f. MRI: Image Characteristics

2. Demonstrate knowledge of the following topics using your favorite comprehensive neuroradiology text as reference:

I) Anatomy:

A. Intracranial

First rotation: Become familiar with the appearance of major intracranial structures as visualized on axial CT and MR scans. Be able to identify all major structures and components of the brain, ventricles and subarachnoid (cisterns) space.

B. Head and Neck

First rotation: Learn the anatomy of the calvarium, skull base and soft tissues of the neck as displayed on plain radiographs.

C. Spine

First rotation: Become familiar with the normal appearance of the spine on plain radiographs and axial CT scans. Be able to assess spinal alignment and be able to identify all osseous components of the spinal canal by completion of first rotation. Learn to identify normal osseous structures, intervertebral discs, support ligaments and the contents of the thecal sac (spinal cord and nerve roots) on CT, MR, and myelography.

D. Vascular

First rotation: Learn to identify the large vessels of the cervical and intracranial regions (carotid, vertebral and basilar arteries, jugular veins and dural venous sinuses) as they appear on routine CT and MR studies of the head and neck.

II) Pathology and Pathophysiology:

Learn the basic pathology and pathophysiology of diseases of the brain, spine, and head and neck.

First rotation: Become familiar with the common traumatic, ischemic and inflammatory conditions of the brain, skull base, neck and spine. Learn the pathophysiology of rapidly evolving processes, in particular cerebral infarction and inflammation.

III) Imaging Technology:

A. CT

First rotation: Become familiar with imaging parameters, including window and level settings, slice thickness, inter-slice gap, and helical imaging parameters, and image reconstruction algorithms (e.g., soft tissue and bone). Learn the typical CT density of commonly occurring processes such as edema, air, calcium, blood and fat.

B. MR

First rotation: Learn the basic physical principles of MR. Be able to identify commonly used pulse sequences and become familiar with standard MR protocols. Learn the intensity of normal tissues on routine pulse sequences. Learn the clinical utility of each routine pulse sequence.

Learn how to combine pulse sequences to produce effective and efficient imaging protocols for common disease processes. Learn the intensity encountered in hemorrhage, fat and calcium.

IV) Image interpretation:

A. Intracranial

First rotation: Develop skills in the interpretation of plain films of the skull. Learn to interpret CT scans with a particular emphasis on studies performed on individuals presenting with acute or emergent clinical abnormalities (infarction, spontaneous intracranial hemorrhage, aneurysmal subarachnoid hemorrhage, traumatic brain injury, infection, hydrocephalus, and brain herniation). Learn the CT and MR findings of hyperacute infarction (including findings on diffusion weighted MRI). Learn to identify and characterize focal lesions and diffuse processes and be able to provide a short differential diagnosis for the potential causes of these processes.

B. Head and Neck

First rotation: Learn to identify common acute emergent lesions. Become familiar with the plain film and CT appearance of (a) traumatic (fractures and soft tissue injuries) of the orbit, skull base, face and petrous bones and (b) inflammatory (sinusitis, orbital cellulitis, otitis, mastoiditis, cervical adenitis and abscess) lesions. Learn to identify airway compromise and obstruction. Expand knowledge of the appearance of traumatic lesions on CT. Be able to characterize fractures based on clinical classification systems (e.g., Le Fort fractures). Learn to identify neoplastic masses arising in the orbit, skull base, petrous bone and soft tissues of the neck. Be able to use standard anatomic classification schemes to accurately describe the location of mass lesions.

C. Spine

First rotation: Learn the appearance of traumatic lesions on plain radiographs with an emphasis on findings of spinal instability. Become familiar with the CT and MRI findings of degenerative disease. Be able to identify and differentiate discogenic and arthritic degenerative diseases. Learn to identify and characterize traumatic lesions (e.g., stable vs. unstable, mechanism of injury) using routine and reformatted CT scans.

D. Vascular

First rotation: Learn to recognize the angiographic features of extra- and intracranial atherosclerosis utilizing CTA, MRA and MRV. Learn the indications, limitations, risks and benefits for each technique used for visualization of vascular anatomy and pathology. Learn the angiographic appearance of aneurysms, vascular malformations, occlusive diseases and neoplasms.

First rotation: Become familiar with the appearance of major intracranial structures as visualized on axial CT and MR scans. Be able to identify all

major structures and components of the brain, ventricles and subarachnoid (cisterns) space.

V) Pathology

A. CNS Infections

1. Imaging strategies
2. Pyogenic infections
   - § Meningitis
   - § Cerebritis
   - § Abscess
   - § Subdural and epidural empyema (abscess)
   - § Encephalitis
   - § Herpes (HSV I & II)
   - § Sporadic and epidemic
   - § Chronic – subacute sclerosis panencephalitis (SSPE)
   - § Prior disease – (Creutzfeldt Jakob)
4. Granulomatous infections
   - § Meningeal (basal) – hydrocephalus
   - § Parenchymal – granuloma and abscess
   - § Vasculitis – infarction
   - § Etiology – TB, sarcoid, fungi
3. Infections in the immunocompromised host
   - § Toxoplasmosis
   - § HIV
   - § PML
   - § CMV
   - § Lymphoma
   - § Cryptococcal infection

B. White Matter Disease

1. Multiple sclerosis
2. Acute disseminated encephalomyelitis (ADEM)
3. Small vessel ischemic disease, hypertension, vascular disease
4. Radiation/chemotherapy changes
5. Trauma (axonal injuries)
6. White matter changes in the elderly
7. Osmotic myelinolysis (central pontine myelinolysis)
8. Dysmyelinating disorders
   - § Adrenoleukodystrophy
   - § Krabbe's
   - § Metachromatic leukodystrophy (MLD)
   - § Alexander
   - § Canavan's

C. Trauma

1. Imaging strategies CT/MR/skull films
2. Mechanisms
3. Primary vs. secondary
4. Focal lesions

- Cortical contusions
- Diffuse axonal injury (DAI) -- shearing
- Subarachnoid hemorrhage (SAH)
- Subdural hemorrhage (SDH)
- Epidural hemorrhage (EDH)
- Parenchymal hemorrhage with differentials

5. Ages of hemorrhage by CT/MR
6. Intraventricular hemorrhage
7. Diffuse cerebral swelling and edema
8. Herniation syndromes
9. Skull fractures, types, complications
10. Vascular injuries—dissection, pseudoaneurysm, penetrating injuries,lacerations, complications
11. Non-accidental trauma

D. Neoplasms and other masses

1. Tumor classification by histology
   - Glial
   - Astrocytoma
   - Glioblastoma multiforme (GBM)
   - Oligodendroglioma
   - Ependymoma
   - Subependymoma
   - Pleomorphic xanthoastrocytoma (PXA)
   - Neuro-glial
   - Central neurocytoma
   - Ganglioma/ganglioneuroma
   - Primitive neuroectodermal tumor (PNET)
   - Dysembryoplastic neuroectodermal tumor (DNET)
   - Lymphoma
   - Primary or secondary
   - Metastases
   - Meningioma
   - Choroid plexus tumors
   - Other mesenchymal tumors
2. Tumor evaluation by location
   - Intra-axial vs. extra-axial
   - Infra-tentorial masses – pediatric
   - Medulloblastoma
   - Ependymoma
   - Brainstem glioma
   - Cerebellar juvenile pilocytic astrocytoma (JPA)
   - Infra-tentorial masses – adult
   - Hemangioblastoma
   - Metastasis
   - Sellar/parasellar
   - Pituitary adenoma

- Craniopharyngioma
- Rathke's cleft cyst
- Meningioma
- Arachnoid cyst
- Hypothalamic glioma
- Hamartoma
- Germinoma
- Chordoma
- Lymphoma
- Pituitary hypoplasia with ectopic posterior pituitary gland
- Pituitary hemorrhage (apoplexy)
- Pituitary abscess
- Pineal region
- Germ cell tumors (germinoma)
- Pineocytoma and pineoblastoma
- Pineal cyst
- Meningioma
- Glioma
- Cerebellopontine angle tumor
- Vestibular Schwannoma
- Meningioma
- Epidermoid
- Arachnoid cyst
- Metastases
- Schwannomas of other cranial nerves (V-X)
- Aneurysm (AICA)
- Intraventricular tumors
- Choroid plexus papilloma and carcinoma
- Colloid cyst
- Giant cell astrocytoma
- Subependymoma
- Central neurocytoma
- Meningioma
- Glioma
- Metastases
- AVM
- Cysticercosis
- Skull base
- Chordoma
- Chondrosarcoma
- Nasopharyngeal carcinoma
- Myeloma, lymphoma and leukemia
- Metastases
- Schwannoma (lower cranial nerves)
- Glomus tumors
- Meningiomas

- § Fibrous dysplasia

E. Cerebrovascular disease

1. Infarction
   - § Strategies for imaging
   - § CT—signs of hyperacute infarction
   - § MR—value of diffusion weighted images (DWI)
   - § Etiology
   - § Occlusions, large/small vessel
   - § Embolic
   - § Watershed (hypoperfusion)
   - § Hypoxia/anoxia
   - § Dissection
   - § Fibromuscular dysplasia (FMD)
   - § Vasculitis
   - § Venous thrombosis
   - § Vasospasm
   - § Migraine
   - § Hemorrhagic vs. bland
   - § Appearance over time CT/MR, MRA, CTA, angiography
2. Spontaneous hemorrhage
   - § Aneurysm
   - § AVM
   - § Tumor
   - § Hematologic causes
   - § Drugs
   - § Infarct
   - § Congophylic (amyloid) angiopathy
   - § Hypertension
   - § Imaging of hemorrhage over time CT/MR
   - § Serial changes on MR
3. Aneurysms
   - § Types, locations, associated conditions
   - § Incidence by location and of multiple aneurysms
   - § Complication: rupture, mass effect, hydrocephalus, spasm
   - § Imaging, MRI, MRA, CT, catheter angiography and CT angiography
4. Cerebrovascular malformations
   - § Capillary telangiectasia
   - § Cavernous angioma (CA)
   - § Developmental venous anomaly (DVA)
   - § Arteriovenous malformations (AVM)
   - § Classification based on size of components
   - § Vein of Galen malformation
5. Angiography
   - § Film screen, DSA, catheters, injection rates, projections, filming sequences, complications

- Normal anatomy and variants
- Common carotid artery (CCA)
- External carotid artery (ECA) and branches
- Internal carotid artery (ICA)
- Cavernous branches
- Persistent fetal connections
- Circle of Willis
- ACA, MCA, PCA branches
- Vertebro-basilar (VB) arteries
- ECA, ICA, VB collaterals and anastomoses
- Pathologic processes
- Stenosis and occlusion (ASCVD, FMD, Takayasu, emboli)
- Neoplasms
- Fistulas
- AVM
- CA
- DVA (association with CA)
- Aneurysms (berry, atherosclerotic and traumatic)
- Trauma (AV fistulas, transections, dissections)
- Dissection (spontaneous)
- Arteritis
- Spasm
- Venous thrombosis (venous sinuses, cortical veins, deep veins)
- Infants/children
- Occlusions
- Arteritis (Moya, Moya)

F. Congenital CNS lesions

1. Embryology of brain development
2. Disorders of organogenesis
    - Ancephaly
    - Cephaloceles
    - Chiari malformations (I-IV)
    - Corpus callosum anomalies: dysgenesis, lipomas
    - Hydranencephaly
    - Porencephaly
3. Disorders of neuronal migration and sulcation
    - Lissencephaly
    - Cortical dysgenesis: agyria-pachygyria, polymicrogyria
    - Heterotopia
    - Schizencephaly
    - Unilateral megalencephaly
4. Disorders of diverticulation and cleavage
    - Holoprosencephaly (alobar, semilobar, lobar)
    - Septo-optic dysplasia
    - Absent septum pellucidum
5. Posterior fossa cystic disorders

- Dandy-Walker complex
- Mega cisterna magna
- Arachnoid cyst
- Disorders of histogenesis (phakomatoses)
- Neurofibromatosis type I and type II
- Tuberous sclerosis
- Sturge-Weber-Dimitri syndrome
- Von Hippel-Lindau
- Ataxia-telangiectasia; Louis-Bar syndrome
- Rendu-Osler-Weber syndrome
- Basal cell nevus syndrome

Practice-Based Learning and Improvement

1. The resident should demonstrate evidence of independent reading and learning through the use of printed and electronic sources. In particular the resident should utilize Stat Dx, RSNA Physics Modules, & online teaching files.
2. The resident should be competent in using the PACS in the daily accomplishment of the work load and instruct others in its use.

Interpersonal and Communication Skills

1. The resident should be able to communicate effectively results of studies to referring clinicians whenever needed. For emergent studies, reports to referring clinicians should be made in a timely manner. Such communication should be documented in the dictation or preliminary note with the date, time, and name of doctor or nurse.
2. The resident should be able to effectively convey the findings of examinations through accurate dictation of reports. The resident should incorporate feedback from staff concerning the quality of dictated reports.

Professionalism

1. Residents should observe ethical principles when recommending further work-up for cases.
2. Promptness and availability at work are expected of every resident.
3. Residents should dress appropriately at work, wearing a name badge at all times.
4. Patient confidentiality should be observed at all times.
5. CT and MRI technologists and other health workers should be treated with respect and part of the health care team.

Systems-Based Practice

1. Residents should dictate and correct their reports in a timely fashion to avoid delay in patient disposition.
2. Residents should assist in facilitating examinations whenever possible.
3. Resident should recognize the role that radiology plays in the management of patient's illness and make proper recommendations when needed.
4. Suggestions to improve methods and systems utilized in radiology should be made whenever appropriate.