Training of radiology residents in Neuroradiology Division

Goals, objective and curriculum

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Goals and objectives: On average the radiology residents at the BWH spent a total of 16 weeks in Neuroradiology and head and neck imaging (including core rotations at BWH, as well as off-site rotations in CHB and MEEI). By the end of the last rotation we expect the residents to

1- Be proficient in interpreting CT/MR studies of CNS and head and neck.
2- Be able to perform lumbar punctures independently and myelograms under supervision.
3- Have a working knowledge of protocols and appropriate tests and to be able to respond to consultation needs of other specialists using our services.

Time spent in Neuroradiology Division

Six weeks during R1, four weeks during R2, and four weeks during R3. The fourth year residents may choose to spend additional time in Neuroradiology Division. Additionally, the third-year residents are assigned to Mass Eye and Ear Infirmary for two weeks.

Conferences

Each month two Neuroradiology lectures will be presented following the ABR topic guideline. The lectures will be given by the attending staff from BWH, CHB or MEEI as well as case conferences by the BWH fellows at noontime. We aim to cover the entire field of neuroradiology in an 18 month period.

Additional preparatory conferences are scheduled to help the 1st year resident group to grasp the neuroanatomy and major diseases and to prepare the 2nd year group for call duties. These are usually scheduled between July and September.

While rotating in Neuroradiology Division, the residents are encouraged to participate in divisional conferences and interdisciplinary conferences if the clinical service is appropriately covered. These include Head/Neck (Tues 7:30 AM in L2 main Neuroradiology reading room), Neurology/neuroradiology (Tuesdays 2:30 PM), neurosurgery/neuroradiology (3rd floor BTM Wed 8:00 AM), and Tumor Board conferences (Fridays 3:15 PM, Pathology Cotran conference room).

Testing in neuroradiology

There is an on-line OSCE exam near the end of the first year. The resident will take the test during their last week of rotation in Neuroradiology each year. A report will be sent to the residency program coordinators.

Core competencies:

During their training in radiology, the residents are required to develop six competencies. Residents' progress in these fields are constantly evaluated and monitored by staff radiologists and other members of the team. These six competencies and their specific application in neuroradiology are as follows:

Patient care: The residents are expected to develop skills that will enable them to deliver care that is appropriate, compassionate and effective. In addition to skills acquired, the residents must develop proper attitudes and habits. Staff neuroradiologists monitor residents as they interpret neuroradiology studies (CT and MR examinations of CNS and head and neck) to ensure that interpretations are correct and that they are transmitted in a timely fashion to optimize patient care. Also, staff neuroradiologists monitor these by observing the residents performing procedures (myelography, lumbar punctures, and biopsies/drainages).

Medical knowledge: The residents are expected to be aware of the evolving biological sciences and to be able to appreciate how these will affect patient care. In neuroradiology training, this means learning the basics of the field first and enhancing this knowledge through attending conferences, journal clubs, CME courses, etc. The residents' progress in this competency is monitored by their performance in their in-service exam, and their scholarly activities such as research projects.

Practice –based learning and improvement: The residents are expected to learn and improve as they go through their residency. This also means assimilating new knowledge in improving their patient care. Also it means recognizing one's limitations and knowing when to ask for help. In neuroradiology this means keeping a log of procedures performed (in New Innovation), including complications encountered during these procedures and lessons learned. If residents are not meeting the expected goal (1 to 2 procedures per year), they should contact the Neurorad Liaisons to help coordinate opportunities to observe/perform procedures during neuro rotations/electives. The staff neuroradiologists observe and supervise residents as they perform procedures, and observe residents' improvement in their interpretation of cases.

Communication skills: Delivery of optimal patient care is a collective enterprise. Members of the team delivering care need to communicate effectively. In neuroradiology this means developing working relationships with other members of the team, writing reports that are clear and concise and answer clinical questions. It also means making sure these are delivered in a timely manner. Besides daily observation, the resident's performance will be monitored through ANCR, report signing metrics, etc.

Professionalism: Developing a sense of personal responsibility toward the patients and care team, adherences to high ethical and moral standards, and sensitivity to diversity of patient groups and care delivery system, are necessary for professional development of the physician. The staff neuroradiologists monitor these by observing residents' interactions with the patients and their families and other members of the team.

System-based practice: The healthcare delivery system is very complex. The residents are expected to develop a sense of where they are in this system, what resources are available and how to optimize patient care in this system by using these resources wisely. In radiology, the American College of Radiology has developed "Standards of Care" in multiple fields, including neuroradiology. The residents are advised to consult these guidelines. Staff neuroradiologists observe residents as they consult with other services and guide appropriate radiology care.

Evaluation forms completed by staff neuroradiologists at the end of each monthly rotation address all these areas. These allow the staff to state their opinion and evaluate residents' progress. The attached chart shows how residents at different levels are evaluated in these competencies:

Curriculum:

In order to

a) Establish a framework for learning/ teaching in neuroradiology
b) Set goals for reading, achievements and proficiency

These guidelines are established. The "guidelines" are meant to set "minimum requirements" and, as such, the residents are encouraged to surpass them. Following these guidelines will facilitate gradual advancement in Neuroradiology. However, they are not meant to be rigid. Both trainers and trainees are encouraged to take individual differences (interests, reading habits, speed of progress, etc) into account.

First year residents

First year residents spend a total of 6 weeks in Neuroradiology Division: During their first year the residents are expected to learn neuroanatomy and imaging of neurological emergencies with CT. At the end they will be introduced to MR imaging.

Week 1:

Anatomy of brain:

Brain surface anatomy including gray matter/white matter interfaces, deep gray matter nuclei and brain stem anatomy.
Cisternal spaces.
Cross sectional imaging of vascular territories.

Anatomy of spine:

Osseous elements, discs, joints and ligaments.
Multiplanar anatomy as depicted by CT reformations.
Biomechanical features of each spinal segment.

Contrast agents in Neuroradiology: Indications, basic pharmacology, safety, reactions, treatment of reactions, etc

Goal of diagnostic volume at end of 1st week: 6-10 CT exams AM, 6-10 CT exams PM

Week 2:

Non-Traumatic intracranial hemorrhage: SAH, IVH and lobar hemorrhages. Understand appearance of hemorrhage on CT

Traumatic intracranial lesions: EDH, SDH, contusions, shearing injuries. Shifts and herniation syndromes

Cerebral ischemia and infarction: CT signs of early ischemia. Evolution of ischemic changes on CT. Mass effect. Hemorrhagic transformation. Encephalomalacia.

Goal of diagnostic volume at end of 1st week: 8-10 CT exams AM, 8-10 CT exams PM

Week 3:
Sino-nasal anatomy and essentials of facial fractures. Frequent normal variants and anatomy of ostiomeatal units.
Common fracture patterns (Nasal, mandibular, NOE, ZMC and LeFort)
Cervical/spine trauma: Normal plain films anatomy and CT patterns of fractures and ligamentous injuries. Mechanisms of injury

Goal of diagnostic volume at end of 1st week: 10 CT exams AM, 10 CT exams PM

Recognition of skull base, calvarium and temporal bone fractures

Week 4:
Head and Neck CTA. Scanning parameters and reformations. MIP images
MR: types of pulse sequences: Value of specific sequences: DWI, GE/SWI, Flair/T2 and pre and post contrast T1 with enhancement pattern recognition.
Indications of advanced imaging in emergent conditions: Identification of cord compression, assessment of brain infarct and recognition of MR stages of intracranial hemorrhage

Goal of diagnostic volume at end of 1st week: 8-10 CT exams, 2 MRI AM, 8-10 CT, 2 MRI exams PM

LP and Myelography: first year residents are encouraged to observe LP and myelography procedures during the neuro rotation. Please discuss with Attending/NR fellow on procedure service for scheduled or add-on cases early in the week to plan for procedure participation.

READ: Section 11: Neuroradiology in Brent and Helms Diagnostic Radiology
The Requisites in Neuroradiology

Second Year Residents

Second year residents spend four (4) weeks in Neuroradiology. By the end of this period, they are expected to be able to handle most neuroradiological CT and MR studies. They should be able to cover all MR emergencies

Week 1 Review of normal anatomy, including the neck. Review of stroke imaging, intracranial hemorrhage, Intra-axial vs extra axial masses and post contrast enhancement patterns.

Week 2 Congenital brain and spine conditions.

Scope of degenerative of the spine. Learn appropriate nomenclature
Disk space infection, degenerative diseases

Week 3 Inflammatory brain conditions, including meningitis, abscess, HSE, etc
Demyelinating diseases
Hydrocephalus

Week 4 LP and Myelography: technique, complications, informed consent, clinical responsibilities. Please discuss with Attending/NR fellow on procedure service for scheduled or add-on cases early in the week to set up studies.

Diagnosis of disk herniations, cord compression and spinal stenosis

Goal of diagnostic volume during 2nd rotation: 7-10 CT exams, 6 MRI AM, 7-10 CT, 6 MRI exams PM

Read: The Requisites

. **Third –year residents**

Third year residents spend four weeks in Neuroradiology Division. By the end of this year they are expected to have finished their reading in neuroradiology and be able to handle all neuroradiology CT and MR studies. They are expected to be able to perform myelography/ LP under supervision. Although they are not expected to perform cerebral or spinal angiography, they are required to know the anatomy of vasculature and be able to identify simple angiographic findings such as aneurysms and vascular malformations.

Week 1 Angiography, safety, complications
Normal anatomy of cerebral arteries and veins
Aneurysms and vascular malformations
Carotid/ vertebral artery diseases

Week 2 Brain tumors, Spinal cord tumors

Week 3 Common ENT tumors and inflammations

Week 4 Degenerative brain diseases,

The residents spend an additional Two (2) weeks at Massachusetts Eye and Ear Infirmary.

Goal of diagnostic volume during 3rd rotation: 5 CT exams, 8 MRI AM, 5 CT, 8 MRI exams PM

Read: Finish The Requisites. Read ACR syllabi in brain and spine

Fourth- year residents

Radiology residents can choose neuroradiology as an elective. During the 4th year, the emphasis is on advanced imaging.

Goal of diagnostic volume during 4th rotation: 5 CT, 10-12 MRI AM, 5 CT, 10-12 MRI exams PM

READ: Review the Requisites. Review ACR syllabi in ENT, Brain and Spine imaging