Neuroradiology: Goals and Objectives (ver 7.1)

GENERAL OBJECTIVES:

Residents rotate through the Neuroradiology Service for 4-week rotations during each of their four years of training. It is expected that residents will progressively develop their abilities to perform and interpret imaging studies of the central nervous system (CNS).

The residents will be taught the practical clinical skills necessary to interpret neuroradiologic studies, such as plain radiographs, computed tomography (CT) scans (including CTA/CTP), magnetic resonance (MR) imaging including MR Angio (MRA), perfusion (MRP) and spectroscopy (MRS), as well as ultrasound examinations of: 1) brain and skull; 2) head and neck; and 3) spinal cord and vertebral column.

Residents will be instructed in the performance and interpretation of invasive procedures including myelography/spinal canal puncture, and image-guided biopsies of the spine and neck soft tissues.

The residents will be introduced to the basic science that underlies clinical neuroradiology, including neuroanatomy and neuropathology. They will learn the physical principles of CT, MR, plain radiography, and digital angiography. They will learn the relative value of each modality, enabling them to choose the appropriate study and the appropriate protocol for each patient.

It is expected that residents will participate in the performance of the full range of examinations offered by neuroradiology service according to their level of training:

- The residents will obtain consents (when necessary as per departmental/institutional policy) and if necessary perform or monitor intravenous injections of contrast. The residents will learn the indications and contraindications for contrast media administration and to recognize and treat adverse reactions.
- Residents will protocol and monitor CT and MR exams after they have demonstrated a sufficient level of knowledge and experience to perform these tasks.
- Residents will aid in the performance of invasive procedures including myelograms, lumbar punctures, and other minimally invasive procedures such as image-guided vertebral and neck soft tissue biopsies. They will learn to explain these procedures to patients and their families, obtain pre-procedure consent and write pre- and post-procedure notes and orders.
- The residents will learn to dictate concise and appropriate radiographic reports and to serve as consultants to referring physicians.

Neuroradiology lectures (2/month) are presented to the residents by Neuroradiology Faculty on monthly basis that adhere to a defined syllabus (18-month cycle: 24 topics). The syllabus topics are then supplemented with case conferences and board review sessions as the year progresses (18-month cycle: 12 case conferences).

The residents are expected to attend weekly interdisciplinary conferences, including Wednesday Neuroradiology-ENT clinical conference, taking progressively more active role in preparation and presentation of neuroimaging studies according to their level of training.
ROTATION 1: (Radiology Year 1)

MEDICAL KNOWLEDGE:
- Become familiar with Neuroanatomy (brain/spine/vascular/head & neck).
- Become familiar with emergent findings on MR (stroke, herniation, homograph).
- Become familiar with an image based differential diagnosis for CNS (brain/spine/vascular/head & neck) imaging findings.
- Become familiar with principles of CT/MR Imaging (Physics of image acquisition). Understand MRI sequence design-strengths/weaknesses for achieving an expected diagnosis.

PRACTICE BASED LEARNING AND IMPROVEMENT:
- Review all cases and present findings to the attending. The attending interprets and modifies or corrects preliminary interpretation.
- Review attendings' Resident Evaluation form. Discuss comments when pertinent.
- Learn to access and incorporate Pub Med and Google Searches in interpretive armamentarium.
- Attend weekly Clinical Conferences in Neuroradiology-ENT

SYSTEMS-BASED PRACTICE:
- Attend clinical conferences in Neuroradiology-ENT
- Gain an understanding of the integration of imaging findings with clinical findings in obtaining a focused differential diagnosis.
- Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography.
- Become familiar with ACR practice guidelines, technical standards and appropriateness criteria through discussion with attending Staff and case presentation at Imaging Conference.

PATIENT CARE:
- Develop an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiologic diagnosis (CT, MRI, Angiography, and Myelography) relative to other diagnostic tests for achieving a diagnosis.
- Become familiar with the risks/contraindications of neuroradiologic procedures.
- Become familiar with the contrast agents doses/risks/contraindications used in neuroradiologic imaging.
- Become familiar with the protocol for treatment of contrast reactions.

INTERPERSONAL COMMUNICATION SKILLS:
- Verbalization of observation and interpretation leading to a useful differential diagnosis.
- Organize cases and present a lucid description of patient’s clinical problem as well as past medical history and surgical history prior to image interpretation.
- Dictate cases in an organized, succinct and informative fashion.

PROFESSIONALISM:
- Demonstrate respect for all patients.
- Serve as role model for medical students (medicine service) and residents in other specialties.
- Respect patient confidentiality.
- Present oneself as professional in appearance and communication.
- Demonstrate a responsible work ethic with regard to work assignments.
ROTATION 2: (Radiology Year 2)

MEDICAL KNOWLEDGE:

- Neuroanatomy (brain/spine/vascular/head & neck).
- Develop an understanding of the MRI features of neoplastic/inflammatory/ degenerative/metabolic/congenital diseases of the CNS (brain/spine/vascular/head & neck).
- Develop an image based differential diagnosis for CNS (brain/spine/vascular/head & neck) imaging findings.
- Become familiar with interpretation of CTA, CTP and MRP

PRACTICE BASED LEARNING AND IMPROVEMENT:

- Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
- Review attendings' Resident Evaluation form. Discuss comments when pertinent.
- Learn to access and incorporate Pub Med and Google Searches in interpretive armamentarium.
- Attend weekly Clinical Conferences in Neuroradiology-ENT

SYSTEMS-BASED PRACTICE:

- Attend clinical conferences in Neuroradiology-ENT
- Gain an understanding of the integration of imaging findings with clinical findings in obtaining a focused differential diagnosis.
- Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography.
- Demonstrate knowledge of ACR practice guidelines, technical standards and appropriateness criteria through discussion with attending Staff and case presentation at Imaging Conference.

PATIENT CARE:

- Demonstrate and further develop an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiologic diagnosis (CT, MRI, Angiography, and Myelography) relative to other diagnostic tests for achieving a diagnosis.
- Demonstrate knowledge of risks/contraindications of neuroradiologic procedures.
- Demonstrate proper technique and planning in performing myelography and image-guided LP.
- Become familiar with advanced neuroimaging techniques, such as CTA and CTP.
- Image guided access to spinal canal for CSF sampling and myelography

INTERPERSONAL COMMUNICATION SKILLS:

- Consultation with clinicians who come to review imaging studies.
- Verbalization of observation and interpretation leading to a useful differential diagnosis.
- Organize cases and present a lucid description of patient’s clinical problem as well as past medical history and surgical history prior to image interpretation.
- Dictate cases in an organized, succinct and informative fashion.

PROFESSIONALISM:

- Demonstrate respect for all patients.
- Serve as role model for medical students (medicine service), residents in other specialties and co-residents.
- Respect patient confidentiality.
- Present oneself as professional in appearance and communication.
- Demonstrate a responsible work ethic with regard to work assignments.
ROTATION 3: (Radiology Year 3)

MEDICAL KNOWLEDGE:
- Demonstrate knowledge of neuroanatomy (brain/spine/vascular/head & neck).
- Understand the MRI features of neoplastic/inflammatory/ degenerative/metabolic/congenital diseases of the CNS.
- Understand principles of CT/MR Imaging (Physics of image acquisition)
- Understand MRI sequence design-strengths/weaknesses for achieving an expected diagnosis.
- Demonstrate adequate knowledge of CTA and CTP analysis
- Become familiar with analysis of MRS, DTI and MRP

PRACTICE BASED LEARNING AND IMPROVEMENT:
- Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
- Review Attendings' Resident Evaluation form. Discuss comments when pertinent.
- Learn to access and incorporate Pub Med and Google Searches in interpretive armamentarium.
- Attend weekly Clinical Conferences in Neuroradiology-ENT, taking progressively active role in preparation of neuroimaging aspect of the conference.
- Prepare and present a PowerPoint presentation of interesting neuro cases.
- Perform PubMed and Google searches to resolve problematic cases

SYSTEMS-BASED PRACTICE:
- Attend clinical conferences in Neuroradiology-ENT
- Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography.
- Demonstrate knowledge of ACR practice guidelines, technical standards and appropriateness criteria through discussion with Attending Staff and case presentation at Imaging Conference.

PATIENT CARE:
- Demonstrate an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiologic diagnosis (CT/CTA, MRI/MRA/MRP, Catheter Angiography, and Myelography) relative to other diagnostic tests for achieving a diagnosis.
- Obtain informed consent, explaining to patients the risks/contraindications of neuroradiologic procedures.
- Demonstrate knowledge of contrast agents doses/risks/contraindications used in neuroradiologic imaging.
- Appropriately treat contrast reactions.
- Develop an understanding of advanced neuroimaging techniques such as CTA, CTP, MRP and MRS
- Demonstrate proper technique and planning in performing myelography and image-guided LP.
- Produce an appropriate differential diagnosis based upon imaging findings

INTERPERSONAL COMMUNICATION SKILLS:
- Consultation with clinicians who come to review imaging studies.
- Verbalization of observation and interpretation leading to a useful differential diagnosis.
- Organize cases and present a lucid description of patient’s clinical problem as well as past medical history and surgical history prior to image interpretation.
- Dictate cases in an organized, succinct and informative fashion.

PROFESSIONALISM:
- Demonstrate respect for all patients.
- Serve as role model for junior residents.
- Respect patient confidentiality.
- Present oneself as professional in appearance and communication.
- Demonstrate a responsible work ethic with regard to work assignments.
Rotation 4: (Radiology Year 4)

MEDICAL KNOWLEDGE:
• Demonstrate knowledge of neuroanatomy (brain/spine/vascular/head & neck).
• Understand the MRI features of neoplastic/inflammatory/degenerative/metabolic/congenital diseases of the CNS.
• Understand principles of CT/MR Imaging (Physics of image acquisition)
• Understand MRI sequence design-strengths/weaknesses for achieving an expected diagnosis
• Demonstrate proper analysis of CTA, CTP, MRA, MRP, MRS, and DTI images.

PRACTICE BASED LEARNING AND IMPROVEMENT:
• Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
• Review Attendings’ Resident Evaluation form. Discuss comments when pertinent.
• Learn to access and incorporate Pub Med and Google Searches in interpretive armamentarium.
• Attend weekly Clinical Conferences in Neuroradiology-ENT, progressively taking more active role in preparation and presentation of neuroimaging.
• Prepare and present a PowerPoint presentation of interesting neuroradiology topic.
• Perform PubMed and Google searches to resolve problematic cases

SYSTEMS-BASED PRACTICE:
• Attend clinical conferences in Neuroradiology-ENT
• Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography.
• Demonstrate knowledge of ACR practice guidelines, technical standards and appropriateness criteria through discussion with Attending Staff and case presentation at Imaging Conference

PATIENT CARE:
• Demonstrate an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiologic diagnosis (CT/CTA, MRI/MRA/MRP, Catheter Angiography, and Myelography) relative to other diagnostic tests for achieving a diagnosis.
• Obtain informed consent, explaining to patients the risks/contraindications of neuroradiologic procedures.
• Demonstrate knowledge of contrast agents doses/risks/contraindications used in neuroradiologic imaging.
• Appropriately treat contrast reactions.
• Demonstrate proper technique in processing imaging data utilizing 3D post-processing workstation for analysis of CTA, CTP, MRP and MRS.
• Demonstrate proper technique and planning in performing myelography and image-guided LP.
• Produce an appropriate differential diagnosis based upon imaging findings

INTERPERSONAL COMMUNICATION SKILLS:
• Consultation with clinicians who come to review imaging studies.
• Verbalization of observation and interpretation leading to a useful differential diagnosis.
• Organize cases and present a lucid description of patient’s clinical problem as well as past medical history and surgical history prior to image interpretation.
• Dictate cases in an organized, succinct and informative fashion.

PROFESSIONALISM:
• Demonstrate respect for all patients.
• Serve as role model for junior residents.
• Respect patient confidentiality.
• Present oneself as professional in appearance and communication.
• Demonstrate a responsible work ethic with regard to work assignments.
**DAILY ROUTINE:**

Neuroradiology imaging interpretations: the resident is responsible for determining patient history, assessing the relevance of the imaging exam and its relationship to prior imaging, reviewing the study and coming to an independent assessment of the findings. All cases are then reviewed with the Attending Radiologist. The resident is then responsible for formulating and performing the study dictation, which is subsequently reviewed and corrected by the Attending.

Neuroradiology interventional procedures: the resident is responsible for patient history review and formulation of a procedure plan. Residents are trained in analysis of pertinent patient’s laboratory values, obtaining pre-procedure consent and writing pre- and post-procedure notes and orders. All procedures are performed under the direct guidance and supervision of the Neuroradiology Attending. Residents are trained in the performance of basic and advanced diagnostic and interventional neuroradiologic procedures.

**MECHANISM OF EVALUATION**

- **Daily:**
  a. The resident’s progress will be monitored by the attending radiologists on the service, with an ongoing detailed verbal feedback during clinical case read-outs.
  b. A supplemental case-based review will help assess resident’s strengths and weaknesses

- **Monthly:**
  a. During last week of each rotation a case-based quiz will help to assess resident’s medical knowledge.
  b. The resident will receive a formal evaluation of his/her performance from each attending on the service based on six Core Competencies (as described above).
  c. The deficiencies or substandard performance will be discussed personally and privately with the resident and will be brought to the attention of the Residency Program Director by the attending radiologists.

- **Annually:**
  a. The progress of medical knowledge in neuroradiology will be assessed by the ACR in-service examination, as an objective feedback tool for both, residents and faculty.
1) Technique and Indications:

Understand the Basic Principles Behind and Indications for Use of Methods of Examination

a) Radiography
b) CT
c) MR
d) Ultrasound
e) Angiography
f) Advanced imaging techniques
   i) MRA
   ii) CTA
   iii) CT perfusion
   iv) MR perfusion
   v) Diffusion-weighted imaging
   vi) MR spectroscopy (MRS)
   vii) MR functional imaging
   viii) Diffusion tensor imaging
   ix) Myelography
   x) Cisternography
   xi) PET CT and other nuclear medicine imaging techniques

Be able to appropriately choose study types for a variety of clinical situations, and recognize the strengths and weaknesses of each type of imaging exam.

2) Brain

a) Normal anatomy
   i) Brain parenchyma
   ii) Ventricular system
   iii) Extra-axial spaces
   iv) Pial and dural coverings
   v) Cranial nerves
   vi) Arterial and venous structures
   vii) Skull and surrounding soft tissues
   viii) Intracranial arterial and venous structures on imaging studies
       (1) CTA
       (2) MRA
       (3) Catheter angiography

Understand the function of the anatomic structures and how they are affected by various pathologies.

b) White matter disease (inherited)
   i) Adrenoleukodystrophy
   ii) Metachromatic leukodystrophy
   iii) Alexander disease
   iv) Canavan disease
   v) Krabbe disease
   vi) Pelizaeus- Merzbacher disease
   vii) PKU and other amino acid disorders
c) Neurodegenerative disorders
   i) The aging brain
ii) Alzheimer disease
iii) Other cortical dementias
iv) Parkinson disease
v) Cerebellar degeneration
vi) Amyotrophic lateral sclerosis
vii) Wallerian degeneration
viii) Huntington disease
ix) Fahr disease
x) Wilson disease
xi) Hallervorden-Spatz disease
xii) Leigh disease
xiii) Tay-Sachs disease
xiv) Hurler syndrome
xv) MELAS syndrome
d) Infection/inflammation/demyelinating
i) Viral
ii) Bacterial
iii) Mycobacterial
iv) Fungal
v) Parasitic
vi) Prion infections
vii) Congenital and neonatal infections
   (1) CMV
   (2) Toxoplasmosis
   (3) HSV
   (4) HIV
   (5) Varicella
   (6) Rubella
   (7) Enterovirus
viii) Non-infectious inflammatory processes
   (1) Chemical meningitis
   (2) Limbic encephalitis
   (3) Lymphocytic hypophysitis
   (4) Granulomatous processes
      (a) Sarcoidosis
      (b) Histiocytosis
ix) White matter inflammatory conditions
   (1) Multiple sclerosis
   (2) Viral and post-viral demyelination
e) Congenital/developmental
i) Chiari malformations
ii) Cephaloceles
iii) Corpus callosum anomalies
iv) Holoprosencephalies
v) Septo-optic dysplasia
vi) Sulcation and migrational disorders
vii) Posterior fossa malformations
viii) Cysts
ix) Neurocutaneous syndromes
   (1) NF I and II
   (2) Tuberous sclerosis
   (3) Von Hippel-Lindau
(4) Sturge-Weber
(5) Basal cell nevus syndrome
(6) Klippel-Trenaunay-Weber syndrome
(7) Wyburn-Mason syndrome
(8) Rendu-Osler-Weber syndrome
(9) Ataxia- telangiectasia
(10) Neurocutaneous melanosis

x) Normal patterns of cortical and white matter development, and deviations from normal
   (1) Cortical dysplasias
   (2) Hemimegalencephaly

Recognize and be familiar with the imaging appearance and clinical presentation of mesial temporal sclerosis and other seizure-associated conditions.

f) Cyst and hydrocephalus
   i) Communicating and obstructive hydrocephalus
      ii) Arachnoid cyst
      iii) Colloid cyst
      iv) Rathke cleft cyst
      v) Neuroepithelial cyst
      vi) Disorders of CSF hydrodynamics
         (1) Increased intracranial pressure from hydrocephalus and shunt malfunction
         (2) Intracranial hypotension
         (3) Complications of CSF diversion procedures

g) Tumors and tumorlike conditions
   i) Locations
      (1) Parenchymal
      (2) Meningeal
      (3) Pineal region
      (4) Intraventricular
      (5) Sellar/suprasellar
      (6) Cerebellopontine angle
      (7) Skull base
      (8) Cavernous sinus
      (9) Foramen magnum
   ii) Tumor types
      (1) Low-grade and malignant astrocytomas
      (2) Glioblastoma multiforme
      (3) Gliosarcoma
      (4) Gliomatosis cerebri
      (5) Pleomorphic xanthoastrocytoma
      (6) Pilocytic astrocytoma
      (7) Subependymal giant cell astrocytoma
      (8) Oligodendroglioma
      (9) Ependymoma
      (10) Subependymoma
      (11) Choroid plexus tumors
      (12) Meningioma
      (13) Hemangiopericytoma
      (14) Hemangioblastoma
      (15) Ganglioglioma
      (16) Gangliocytoma
(17) Central neurocytoma
(18) DNET
(19) Lhermitte-Duclos
(20) Germ cell tumors
(21) PNET
(22) Lymphoma
(23) Leukemia
(24) Myeloma
(25) Schwannoma
(26) Neurofibroma
(27) Malignant peripheral nerve sheath tumor
(28) Craniopharyngioma
(29) Pituitary adenoma
(30) Chordoma
(31) Chondrosarcoma
(32) Dermoid
(33) Epidermoid
(34) Lipoma

In the case of primary brain tumors, be familiar with differentiating imaging findings for various tumor grades. Recognize imaging appearance in postoperative and post-treatment changes.

h) Trauma
   i) Subarachnoid hemorrhage
   ii) Epidural and subdural hematoma
   iii) Contusion
   iv) Axonal injury
   v) Diffuse cerebral edema
   vi) Herniation patterns
   vii) Complications and sequelae of head trauma
       1) Ischemia
       2) Infarction
       3) Secondary hemorrhage
       4) Pneumocephalus
       5) CSF leak
       6) Encephalomalacia
   viii) Non-accidental trauma
i) Vascular pathology: Clinical presentation of, complications from, and treatment options for:
   i) Aneurysm
       1) Saccular
       2) Mycotic
       3) Traumatic
       4) Oncotic
       5) Flow-related
       6) Drug-related
       7) Vasculopathic
       8) Fusiform
       9) Dissecting
       10) Pseudoaneurysm
   ii) Vascular malformations
       1) Pial
       2) Dural
(3) Mixed
(4) AV-fistulae
(5) Cavernous angiomas
(6) Capillary telangiectasias
(7) Developmental venous anomalies
(8) Vein of Galen malformations
(9) Venous varix

iii) Stroke
   (1) Arterial
   (2) Venous
   (3) Vasculitic—including specific patterns
   (4) Hypoxic-anoxic encephalopathy
   (5) Vasculitis
   (6) Posterior reversible encephalopathy syndrome
   (7) Vascular occlusive disease

iv) Intracranial hemorrhage
   (1) Age of blood products on CT and MRI
   (2) Patterns of hemorrhage with regard to causative factors
      (a) Trauma
      (b) Neoplasm
      (c) Aneurysm
      (d) Vascular malformation
      (e) Vasculitis
      (f) Non-aneurysmal subarachnoid hemorrhage
      (g) Hypertension
      (h) Hemorrhagic infarct (arterial and venous)
      (i) Amyloid angiopathy

3) Spine

a) Normal anatomy
   i) Bony vertebral anatomy
   ii) Intervertebral discs
   iii) Facet joints
   iv) Ligaments
   v) Spinal cord
   vi) Nerve roots and plexi
   vii) Meninges
   viii) Intradural and extradural spaces
   ix) Surrounding soft tissues

b) Congenital/developmental
   i) Chiari malformations
   ii) Spinal dysraphism (open and occult)
   iii) Tethered cord
   iv) Caudal regression syndrome
   v) Spinal lipomas
   vi) Sacral meningocele
   vii) Sacrococcygeal teratoma
   viii) Split notochord syndromes
   ix) Enterogenous cyst
   x) Scoliosis
   xi) Fusion anomalies
xii) Segmentation anomalies
xiii) NF1
xiv) NFII
xv) Von Hippel-Lindau
c) Degenerative disease
i) Normal aging
ii) Disc degeneration
iii) Disc bulges and herniations (including appropriate descriptive terminology)
iv) Spondylosis
v) Arthrosis
vi) Synovial cyst
vii) Spondylolisthesis
viii) Spondyloysis
ix) Spinal stenosis
x) OPLL
xi) DISH
xii) Scheuermann disease
xiii) Arthritides
xiv) Postoperative spine
d) Infection/inflammatory/demyelinating in specific anatomic sites
i) Arachnoiditis
ii) Diskitis
iii) Osteomyelitis
iv) Epidural infection
v) Subdural infection
vi) Subarachnoid infection
vii) Meningitis
viii) Myelitis
ix) Spinal cord abscess
e) Infection/inflammatory/demyelinating-specific pathologies
i) Bacterial
ii) Mycobacterial
iii) Fungal
iv) Viral
v) Parasitic
vi) Granulomatous
vii) Transverse myelitis
viii) HIV myelopathy
ix) Radiation-induced myelitis
x) ADEM
xi) Multiple sclerosis
f) Trauma
i) Cervical, thoracic, and lumbosacral fracture
ii) Osteoporotic compression fracture
iii) Subluxation
iv) Dislocation
v) Spinal cord injury and its sequelae
vi) Epidural and subdural hematoma
vii) Plexus injuries
g) Vascular
i) Spinal cord ischemia and infarction (arterial & venous)
ii) AVMs
(1) Dural AVF
(2) Glomus malformations
(3) Juvenile type malformations
(4) Intradural extramedullary AVF
(5) Cavernous angiomas

h) Tumors and tumorlike masses: benign and malignant neoplasms of the vertebral column, spinal cord, and nerves
   i) Schwannoma
   ii) Neurofibroma
   iii) Malignant peripheral nerve sheath tumor
   iv) Meningioma
   v) Dermoid
   vi) Epidermoid
   vii) Paraganglioma
   viii) Astrocytoma
   ix) Ependymoma
   x) Hemangioblastoma
   xi) Lymphoma
   xii) Leukemia
   xiii) Myeloma
   xiv) Plasmacytoma
   xv) Chordoma
   xvi) Chondrosarcoma
   xvii) Osteosarcoma
   xviii) Fibrosarcoma
   xix) Ewing sarcoma
   xx) Hemangiomas
   xxi) Osteoblastoma
   xxii) Osteoid osteoma
   xxiii) Osteochondroma
   xxiv) Giant cell tumor
   xxv) Aneurysmal bone cyst
   xxvi) Angiolipoma
   xxvii) Eosinophilic granuloma
   xxviii) Pathologic fractures
   xxix) Metastatic disease

i) Miscellaneous
   i) Arachnoid cyst
   ii) Parameningeal cyst
   iii) Spinal cord herniation

4) Extracranial Head and Neck

a) Normal anatomy—bone and soft tissues
   i) Orbits
   ii) Paranasal sinuses
   iii) Facial bones
   iv) Skull base
   v) Temporal bone, including TMJ
   vi) Nasal cavity
   vii) Oral cavity
   viii) Oropharynx
   ix) Nasopharynx
x) Hypopharynx
xii) Larynx
xii) Neck spaces (suprahyoid and infrahyoid)
xiii) Classification of lymph node level

b) Normal anatomy—vascular: normal extracranial arterial and venous structures on vascular imaging modalities
   i) CTA
   ii) MRA
   iii) US
   iv) Catheter angiography
c) Infectious/inflammatory/ granulomatous
   i) Orbit
      1) Preseptal cellulitis
      2) Orbital cellulitis
      3) Subperiosteal phlegmon and abscess
      4) Extension of fungal sinus disease
      5) Pseudotumor
      6) Thyroid orbitopathy
      7) Sarcoid
      8) Lacrimal adenitis
      9) Wegener granulomatosis
     10) Tolosa-Hunt
     11) Optic neuritis
   
   ii) Sinonasal cavity/facial bones
      1) Osteomyelitis
      2) Acute sinusitis
      3) Chronic sinusitis
      4) Complications of sinusitis
      5) Fungal infection
         (a) Immunocompromised and immunocompetent patients
         (b) Allergic fungal sinusitis
      6) Polyps
      7) Polyposis
      8) Mucocele
      9) Retention cyst
     10) Antrochoanal polyp
     11) Sarcoid
     12) Wegener granulomatosis
   
   iii) Skull base and temporal bone
      1) Osteomyelitis
      2) Necrotizing otitis externa
      3) Petrous apicitis
      4) Otitis externa
      5) Otitis media
      6) Mastoiditis
      7) Cholesteatoma
      8) Ramsey-Hunt syndrome
      9) Labyrinthitis
     10) Labyrinthitis ossificans
     11) Bell’s palsy
     12) Otosclerosis
   
   iv) Oral cavity, pharynx, supra- and infrahyoid neck
      1) Odontogenic infections
2) Infections of salivary gland origin
3) Tonsillitis
4) Adenoiditis
5) Cellulitis, phlegmon, and abscess involving neck spaces
6) Sjögren’s disease
7) Non-neoplastic lymphadenopathy
   (a) Viral
   (b) Bacterial
   (c) Mycobacterial
   (d) Granulomatous
8) Thyroiditis (acute and chronic, e.g., Hashimoto)
d) Tumors and tumor-like conditions
   i) Orbit
      (1) Optic nerve sheath meningioma
      (2) Optic glioma
      (3) Lacrimal gland tumors
      (4) Rhabdomyosarcoma
      (5) Retinoblastoma
      (6) Ocular hamartoma
      (7) Uveal melanoma
      (8) Metastases
      (9) Cavernous hemangiomas
      (10) Vasoformative lesions
           (a) Infantile hemangiomas
           (b) Lymphatic/venous malformations
      (11) Lymphoma/leukemia
   ii) Sinonasal cavity and facial bones
      (1) Squamous cell carcinoma
      (2) Undifferentiated carcinoma
      (3) Lymphoma
      (4) Melanoma
      (5) Esthesioneuroblastoma
      (6) Inverted papilloma
      (7) Minor salivary gland neoplasms
      (8) Schwannoma, meningioma
      (9) Juvenile nasal angiofibroma
      (10) Vasoformative lesions
           (a) Infantile hemangiomas
           (b) Lymphatic/venous malformations
           (c) Arteriovenous malformations
      (11) Hemangiopericytoma
      (12) Rhabdomyosarcoma
      (13) Osteoma
      (14) Osteoblastoma
      (15) Giant cell Tumor
      (16) Rhabdomyosarcoma
      (17) Malignant fibrous histiocytoma
      (18) Plasmacytoma
      (19) Paget disease
      (20) Fibrous dysplasia
      (21) Ossifying fibroma and other fibroosseous lesions
      (22) Myxoma
(23) Chondroma
(24) Chondrosarcoma
(25) Osteosarcoma
(26) Ewing sarcoma
(27) Ameloblastoma
(28) Aneurysmal bone cyst
(29) Odontogenic cysts and tumors
(30) Langerhans cell histiocytosis

(31) Metastases

iii) Skull base and temporal bone

1) Hemangiomas
2) Angiofibroma
3) Schwannoma
4) Neurofibroma
5) Teratoma
6) Dermoid
7) Pituitary adenoma
8) Germinoma
9) Lymphoma
10) Nasopharyngeal carcinoma
11) Salivary gland tumors
12) Chloroma
13) Plasmacytoma
14) Metastases
15) Myeloma
16) Chondrosarcoma
17) Chordoma
18) Endolymphatic sac tumor
19) Paraganglioma
20) Adenoma
21) Neuroma
22) Langerhans cell histiocytosis/cosinophilic granuloma
23) Osteoblastoma
24) Giant cell tumor
25) Pigmented villonodular synovitis
26) Rhabdomyosarcoma
27) Paget disease
28) Fibrous dysplasia
29) Osteoma/exostosis
30) Meningioma

iv) Oral cavity, pharynx, supra, and infrahyoid neck

1) Malignant adenopathy
2) Lymphoma
3) Squamous cell carcinoma
4) Schwannoma
5) Neuroma
6) Neurofibroma
7) Goiter
8) Thyroid neoplasms
9) Parathyroid neoplasms
10) Salivary gland neoplasms
11) Vasoformative lesions
(a) Infantile hemangiomas
(b) Lymphatic/venous malformations
(c) Arteriovenous malformations
(12) Paraganglioma
(13) Lipoma/liposarcoma
e) Cystic lesions of the head and neck
   i) Branchial cleft cysts (Types I-IV)
   ii) Thyroglossal duct cyst
   iii) Ranula
   iv) Dermoid/epidermoid
   v) Thymic cyst
   vi) Cystic hygroma (lymphangioma)
   vii) Laryngopyocele
   viii) Cystic lymph nodes
f) Trauma
   i) Orbital fractures
   ii) Soft tissue injuries of the globe and orbit
   iii) Maxillofacial fracture
   iv) Mandibular fractures
   v) TMJ fracture/dislocation
   vi) Skull base fractures
   vii) Temporal bone fractures (including classification systems)
      1) Longitudinal/transverse
      2) Otic capsule spared/involved
   viii) Laryngeal fractures
g) Vascular
   i) Orbit
      1) Venous varix
      2) Hemangiomas
      3) Lymphangioma
      4) Superior ophthalmic vein thrombosis
      5) Carotid-cavernous fistula
   ii) Sinonasal cavity/facial bones
   iii) Skull base/temporal bone
      1) Dissection
      2) Aneurysm
      3) Pseudoaneurysm
      4) Aberrant internal carotid artery
      5) Persistent stapedial artery
      6) Jugular dehiscence
      7) Jugular diverticulum
      8) High-riding jugular bulb
   iv) Oral cavity, pharynx, supra- and infrahyoid neck
      1) Medial course of internal carotid artery
      2) Dissection
      3) Thrombosis
      4) Occlusion
      5) Pseudoaneurysm
      6) Fibromuscular dysplasia
      7) Aneurysm
h) Congenital
   i) Orbit
      1) Sphenoid wing dysplasia
(2) Septooptic dysplasia
(3) Coloboma
(4) Congenital glaucoma
(5) PHPV
(6) Coats disease
(7) Toxocariasis
(8) Infantile hemangiomas
(9) Lymphatic malformation
(10) Dermoid

ii) Sinonasal cavity/facial bones
   (1) Hypoplasia
   (2) Aplasia
   (3) Down syndrome
   (4) Kartagener syndrome
   (5) Cephaloceles/nasal glioma
   (6) Choanal atresia

iii) Skull base/temporal bone
   (1) Cephaloceles
   (2) Arachnoid cyst
   (3) EAC atresia
   (4) Aberrant facial nerve course
   (5) Congenital cholesteatoma
   (6) Ossicular deformities
   (7) Large vestibular aqueduct syndrome
   (8) Mondini defect
   (9) Michel aplasia

iv) Oral cavity, pharynx, supra- and infrahyoid neck
   i) Branchial cleft cysts (Types I-IV)
   i) Thyroglossal duct cyst
   ii) Lingual thyroid
   iii) Dermoid/epidermoid
   iv) Thymic cyst
   v) Vasoformative lesions
      (1) Infantile hemangiomas
      (2) Lymphatic/venous malformations
      (3) Arteriovenous malformations
NEURORADIOLOGY LECTURE SERIES:

1. Introduction to neuroimaging
2. Head trauma
3. CVA
4. Nontraumatic intracranial hemorrhage
5. Cerebral aneurysms
6. Cerebral vascular malformations
7. Extra-axial tumors
8. Intra-axial tumors
9. Intracranial infections and inflammatory conditions
10. White matter disorders
11. Metabolic brain disorders
12. Degenerative and iatrogenic brain disorders
13. Congenital brain malformations
14. Neurocutaneous syndromes
15. Degenerative spine disease
16. Spinal tumors and tumor-like conditions
17. Spinal vascular disorders
18. Spinal inflammation and infection
19. Spine trauma
20. Spinal congenital anomalies
21. Neck masses
22. Paranasal sinus: anatomy and pathology
23. Temporal bone and TMJ: anatomy and pathology
24. Orbital anatomy and pathology

PRESENTED TWICE PER MONTH WITH EVERY THIRD CONFERENCE BEING A CASE CONFERENCE TO REVIEW AND REINFORCE TOPICS FROM PRIOR LECTURES.
REFERENCES:

NEUROPATHOLOGY

NEURORADIOLOGY