NEUROPATHOLOGY ROTATION

Faculty:
- Marie Rivera-Zengotita, MD
- Jesse Lee Kresak, MD
- Anthony Yachnis, MD

1. **Rotation Description:** This rotation represents an experience in neuropathology consultation, including pathologic study of CNS, peripheral nerve and skeletal muscle disease. Neuropathology consultations occur during the four-week resident rotations in neuropathology at University of Florida Health Shands Hospital and during the two-year Neuropathology Fellowship, which revolves around study of current neurosurgical, muscle and nerve biopsies, as well as post-mortem CNS from autopsies that occur during the rotation.

Trainees will be expected to:
- Develop a knowledge base using the basic NP core curriculum (item 7 below); and
- Achieve a basic level of competence in neuropathologic practice, which will include reliable identification and diagnosis of the common neurosurgical entities, as well as master an effective approach for the application of appropriate additional studies for more obscure neurological and neurosurgical disorders when encountered.

Evaluation of trainee progress will be made in the context of the ACGME Neuropathology Milestone Project.

2. **Goals & Objectives:** The achievement of neuropathology milestones:

   A. **PROCEDURE-BASED MILESTONES**
      (individual case-management and patient-focused care)
      - The resident/fellow will assist in the neuropathological assessment and interpretation of gross and microscopic findings:
        - With specific knowledge of the individual patient, up-to-date scientific knowledge (e.g., review of the medical literature, assessment of evidence-based medical practice), and clinical judgment; the resident will:
          1. Determine the appropriate course of further neuropathologic evaluation, (e.g., plan glial, neuronal, axonal, myelin stains, histochemistry (muscle), immunohistochemistry, and electron microscopy), applying an appropriate decision tree, and oversee progress at each decision level with attention to inappropriate testing and the quality of results;
          2. Create a differential diagnosis, or specify a single diagnosis, based upon the interpretation of the gross and microscopic findings in light of the individual patient case history;

Revised: 9/12/2016
3. Recognize the potential effects on this interpretation as a result of pre-analytical factors (e.g., time since death, surgical margins, adequacy of the sample size, ambiguity in site of origin, etc.) and an estimate of the likelihood that such effects might affect the interpretation of the findings in the individual patient; and

4. Counsel and educate the patient’s attending physician(s) and residents concerning proper neuropathologic evaluation and interpretation of results in that specific case.

- Acquiring patient history and physical examination data:
  - When evaluating neuropathologic specimens, the resident/fellow will gather essential and accurate patient information including:
    - Chief complaint and clinical presentation, history of present illness and its management, relevant past medical history (e.g., illnesses, surgeries, immunizations, allergies, medications), family and social history, physical findings and other laboratory and radiological findings. Such information will be obtained through:
      - Review of the LCR;
      - Contact with the patient’s attending physician(s) and radiologist(s); and/or
      - Chart review in the outpatient clinic or hospital.

B. DIAGNOSTIC KNOWLEDGE:

- The resident/fellow will develop an appropriate knowledge-base relevant to neuropathology, as well as consider the relevant fundamental issues pertaining to neurology, neurosurgery and neuroepidemiology, using the Neuropathology Core Curriculum below as a guide.

- The basic foundations of neuropathology knowledge include:
  - Knowledge of the etiology (when known) and pathogenesis (when understood) of the various disorders in the Core Curriculum (Section 7), along with their essential clinical and correlative radiological manifestations; and
  - Understanding the gross, microscopic, ultrastructural, histochemical, and immunohistochemical manifestations of these disorders in tissue, as well as the criteria (with both strengths and limitations of these methods) for their interpretation and diagnosis.

- Problem-solving in neuropathology will be modeled through investigation of the clinical case at hand, in collaboration with the neuropathology attending, using all available resources in a logical, analytical approach.

- Residents/fellows will continuously and methodically assess their own practice of neuropathology by assessing their proficiency in:
  - Creating differential diagnosis lists;
  - Making specific correct diagnoses; and
○ Planning appropriate neuropathologic evaluations. This self-evaluation will include attendance (along with neuropathology Attendings) at clinical-pathological conferences with neurologists, neurosurgeons and neuroradiologists, to assess outcomes of one’s own medical practice.

C. SCHOLARLY ACTIVITY

- The resident/fellow will continuously appraise his/her assimilation of and evaluate the validity of new scientific evidence and advances in the body of neuropathology knowledge (e.g., through literature review and continuing medical education).

- The resident/fellow will learn how to evaluate the published literature through application of knowledge of research study design and statistical analysis. The ability of the trainee to assess the legitimacy of the published literature will then be applied to studies that he/she may (or may not) use to guide their practice during their training.

- Opportunities to participate in research and/or case reports, and/or local or national presentations will be available according to interests of the trainee with appropriate attention to IRB and HIPPA requirements.

D. INTERPERSONAL AND COMMUNICATION SKILLS:

- The resident/fellow will be expected to perfect his/her ability to effectively communicate (both listening for the nature of requested information and generating reports and verbal communications) while assisting the attending neuropathologist in daily exchanges of information with clinical neurologists, neuroradiologists and neurosurgeons, as well as laboratory staff. Opportunities for presentation of neuropathology findings at weekly UF Brain Tumor Board meetings are available according to interests and abilities of the trainee.

E. ACCOUNTABILITY, HONESTY, INTEGRITY, PROFESSIONALISM:

- With faculty oversight and behavior modeling, the resident/fellow will be expected to be present to carry out professional duties at sign-out, frozen section and postmortem brain, eye and spinal cord removals as a priority above all other responsibilities while on the rotation. Respect for the confidentiality of patient information (per HIPAA) and other gatekeeping functions (e.g., insistence on evidence of informed consent for tissue donations for research) will be expected.

- As always, the resident/fellow will be expected to display sensitivity to patient cultural issues that affect care; appreciate cultural diversity in the workplace; and show compassion for the patient’s suffering, both physical and emotional, and respect for others in the health care team.

- The resident will be expected to be committed to personal excellence and ongoing professional development.

F. PROCESS IMPROVEMENT AND PATIENT SAFETY:
• Understanding of common sources of laboratory error in the procurement and processing of brain, peripheral nerve, and skeletal muscle, tissue, transport to the laboratory, with awareness of pre-analytical factors that can affect interpretation:
  o Consistently verifies specimen identity of gross, microscopic, histochemical, immunohistochemical and electron microscopy samples;
  o Identifies systematic problems of pre-and postanalytic reporting and informatics; and
  o Troubleshoots patient safety issues in the promotion of quality-assurance and quality-control factors.

G. REGULATORY, HEALTH CARE TEAMS, LABORATORY RESOURCE UTILIZATION (medical care system-awareness in patient care)

• Understanding interrelationships among pathologists, clinicians, health care organizations and society: The resident will gain an understanding of how the practice of neuropathology and his/her individual actions serve individual neurosurgeons, neurologists, ophthalmologists, etc, with whom they may consult. The resident will learn to appreciate how his/her diagnosis/interpretation affects individual patient outcomes, resource utilization, and patient care costs.

• Individual patient care in the context of the medical care system: In planning or advising neuropathology evaluations, trainees will practice cost-effective health care and resource allocation that does not compromise quality of care. The goal is to arrive at a neuropathologic diagnosis and/or provide data for patient management in the most straight-forward manner feasible within the system, utilizing the fewest number of necessary neuropathologic special studies, (i.e. histochemistry [muscle], immunohistochemistry, and electron microscopy), of lowest cost, that most quickly assists the health care team in management of the patient.

1. Duties and Responsibilities:

A. **Neurosurgical, Muscle and Nerve Biopsies:** Resident rotators are expected to be present at all frozen sections. When the microscopic slides are available on the following day, residents will review the slides and formulate their own diagnoses to the extent possible. At approximately 8:30 a.m. daily, the resident will sign-out these cases with the attending neuropathologist (Pursuant to federal regulation IL-372, residents cannot independently sign-out surgical or biopsy pathology cases.). Residents are also expected to become familiar with muscle biopsy processing. In-house cases and consults are handled in a similar manner.

B. **Autopsies:** Resident rotators will be responsible for neuropathologic review of all autopsies performed during their rotation at UF Health Shands Hospital and the Malcom Randall VA Medical Center. For each case, the chart is reviewed and, in neurological cases, details of all neurologic problems are recorded.
A determination is made (in consultation with the attending neuropathologist) regarding the approach to the examination of brain and whether it may be necessary to remove or examine related tissues, such as the pituitary gland, spinal cord, eyes, peripheral nerve, dorsal root ganglion, autonomic ganglion, cavernous sinus or carotid or vertebral arteries. The fixed brain and any other relevant tissues are grossly examined in one to two weeks at the Brain-Cutting Conference, where clinical histories and general autopsy findings are correlated with fixed brain observations. Tissue blocks are then trimmed for embedding, and when slides are available, the case is signed out with an attending neuropathologist.

2. **Teaching Resources:** These include a comprehensive neuropathology reference library as well as multiple neuropathology microscopic slide sets that are arranged by major classes of disorders for the CNS (tumors, infections, neurodegenerative, etc.).

3. **Supervision:** All final sign-out responsibility remains with the attending neuropathologist; although, residents are encouraged to write-up cases, according to their level of achieved milestones (All write-ups are ultimately reviewed and signed by a neuropathology attending).

4. **Evaluation:** Knowledge and experience will be gained through day-to-day contact with a neuropathology attending; a final neuropathology exam and in-service exams and will be addressed through focused training from faculty and resident self-study. Residents also have a role in facilitating the learning of neurology and neurosurgery residents, as well as student rotators, on neuropathology. Residents are given frequent verbal feedback during the rotation and are given a formal written evaluation following each rotation. The neuropathology fellow is evaluated every six months according to ACGME Neuropathology Milestones recommendations.

5. **THE UNIVERSITY OF FLORIDA NEUROPATHOLOGY CORE CURRICULUM:**

   A. A comprehensive outline of neuropathology containing all major areas of the discipline is used as a practical study guide. The outline includes basic CNS reactions, craniospinal trauma, developmental disorders, CNS infections, toxic-metabolic diseases, cerebrovascular diseases, demyelinating and neurodegenerative disorders, peripheral nerve and skeletal muscle diseases and brain tumors. This is provided to the trainee as a 42-page Microsoft Word document.

   B. An approximately 500-slide PowerPoint presentation contains representative neuropathology images showing gross, microscopic, and, when pertinent, molecular findings that directly correspond to the comprehensive outline described above.

*Revised: 8/12/2016*
A brief summary of core curriculum content follows.

Basic neuropathologic reactions

- Edema, mass effect and herniation
- CNS necrosis, organization and gliosis
- Etiology (when known); pathogenesis (when understood); essential clinical and correlative radiological manifestations; and gross, microscopic, ultrastructural, histochemical, immunohistochemical, and molecular criteria for pathological interpretation/diagnosis of the following:
  - Primary Intracranial/intraspinal tumors
  - Gliial tumors
    - Astrocytic neoplasms
      - Astrocytoma
      - Anaplastic astrocytoma
      - Glioblastoma multiforme
      - Juvenile pilocytic astrocytoma
    - Oligodendroglioma
    - Ependymoma
      - Myxopapillary ependymoma
    - Gliomatosis cerebri
    - Other gliomas (general familiarity)
  - Choroid plexus tumors
  - Neuronal and glioneuronal tumors, hamartomas and related:
    - Lesions
    - Ganglion cell tumors
    - Central neurocytoma
  - Dysembryoplastic neuroepithelial tumor
    - Other glioneuronal tumors, hamartomas and related lesions (general familiarity)
  - Embryonal neuroepithelial tumors
    - Medulloblastoma and other CNS primitive neuroectodermal tumors
  - Atypical teratoid/rhabdoid tumors
  - Primary and secondary lymphomas
  - Pineal parenchymal tumors

Revised: 9/12/2016
• Hemangioblastoma (von Hippel-Lindau disease)
• Meningioma and related tumors
• Nerve sheath tumors
• Chordoma

• Cerebrovascular disorders
  • Stroke
    ▪ Cerebral infarction
    ▪ Hypertensive hemorrhage
  • Intracranial aneurysms
  • Vascular malformations
  • Primary CNS angiitis
  • Cerebral amyloid angiopathy

• Trauma
  • Closed vs open (penetrating) head trauma
    ▪ Contusion/laceration
    ▪ Diffuse traumatic axonal injury
  • Traumatic intracranial hemorrhage
    ▪ Epidural hematoma
    ▪ Subdural hematoma

• Developmental disorders
  • Malformations
    ▪ Neural tube defects (anencephaly, meningomyelocele)
    ▪ Chiari malformations and hydrocephalus
    ▪ Other malformations (general familiarity)
  • Interrupted development
    ▪ Pre-and perinatal brain injury (germinal matrix hemorrhage, hypoxic-ischemic injury, prenatal CNS infections)

• Neurodegenerative disorders
  • Alzheimer disease
  • Non-Alzheimer dementias (general familiarity)
  • Parkinson and related Lewy body diseases
  • Amyotrophic lateral sclerosis
- Other neurodegenerative disorders (general familiarity)

- Demyelinating diseases
  - Multiple sclerosis
  - Neuromyelitis optica
  - Acute disseminated leukoencephalitis

- Infectious diseases
  - Bacterial infections
  - Mycoses
  - Viral infections
  - Neuropathology of AIDS and the immunocompromised host
  - Prion-associated diseases
  - Other (parasitoses, spirochetal infection)

- Neuromuscular disorders
  - Basic handling of peripheral nerve and muscle biopsy tissues
  - Basic reactions (axonal vs demyelinating) in peripheral nerve disorders
  - Neurogenic vs. myopathic disorders and essential features

  - Key features of inflammatory myopathies:
    - Dermatomyositis
    - Polymyositis
    - Inclusion body myopathy

- Toxic-Metabolic Disorders
  - Inborn errors of metabolism (leukodystrophies, hepatic encephalopathies, etc.)
  - CNS toxins