NEUROPATHOLOGY: Rotation Directors: Thomas Eskin, M.D., Professor, and Anthony Yachnis, M.D., Associate Professor

1. Description of the Rotation: This rotation represents an introduction to neuropathology and to the methods/approaches to pathologic study of CNS, peripheral nerve and skeletal muscle disease. The rotation is 4 weeks in length and intended for senior level (PGY3 and 4) residents. It revolves around study of current neurosurgical, muscle and nerve biopsies, as well as of post-mortem CNS from autopsies which occur during the rotation. The trainee will be expected to: 1) develop a knowledge base re. The basic core curriculum (v.i.) and 2) achieve a basic level of competence in neuropathologic practice, to 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 the trainee's progress will be made in the context of the six ACGME-defined core competencies:

2. Goals: The achievement of ***CORE COMPETENCIES IN NEUROPATHOLOGY***:

A) PATIENT CARE (individual case-management and patient-focused care):

- The resident 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 “special” 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 poor quality 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’s case history, 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 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: 1) review of the LCR, 2) contact with the patient's attending physician(s) and radiologist(s), and/or 3) chart review in the outpatient clinic or hospital.

B) MEDICAL KNOWLEDGE:

- The resident 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 (v.i.) as a guide.

- The basic foundations of neuropathology knowledge include: 1) knowledge of the etiology (when known) and pathogenesis (when understood) of the various disorders in the Core Curriculum (v.i.), along with their essential clinical and correlative radiological manifestations, 2) 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 for diagnosis, 3) cognizance of neuropathology laboratory operations and management, including: a) understanding of

mechanisms of brain, peripheral nerve, and skeletal muscle, tissue acquisition, transport to the laboratory, and processing, with awareness of pre-analytical factors that can affect interpretation, b) gross, microscopic, histochemical, immunohistochemical, and EM sample analysis, c) post-analytical reporting, informatics, resource utilization, cost control, quality assurance, and quality control factors.

- 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.

C) PRACTICE-BASED LEARNING (systematic self-evaluation and literature evaluation):

- Residents will continuously and methodically assess their own practice of neuropathology by assessing their proficiency in: 1) creating differential diagnosis lists, 2) making specific correct diagnoses, and 3) 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.
- The resident 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 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.
- The resident will be expected to utilize the Departmental "Powerpath" computerized word-processing (for generating preliminary autopsy brain reports) and information systems, and the Shands hospital clinical information system for patients under study.
- Knowledge and experience deficits will be identified through day-to-day contact with 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.

D) INTERPERSONAL AND COMMUNICATION SKILLS:

- The resident, will be expected to perfect his/her ability to effectively communicate (both listening for 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 with laboratory staff.

E) PROFESSIONALISM:

- With faculty oversight and behavior "modeling", the resident will be expected to be present to carry out professional duties at sign-out, frozen section, and post-mortem 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 "gate-keeping" functions (e.g. insistence on evidence of informed consent for tissue donations for research) will be expected.
- As always the resident will be expected to display sensitivity to patients' culture, age, gender, and disabilities, 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 on-going professional development.

F) SYSTEMS-BASED PRACTICE (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 Aspecial@ 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.

The assessment of mastery of the above six competencies will be carried out as part of the resident “s daily evaluation (in conversation with attending during sign-out, etc), but will be formally documented in his/her evaluation prepared by the program director.

4. 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, the resident will review the slides and formulate his/her 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 Shands and the GVAMC. 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 approach to examination of brain and whether it may be necessary to remove or examine related tissues such as 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.

5. Teaching resources: include a comprehensive neuropathology reference library as well as several Neuropathology microscopic slide and Kodachrome/digital image study sets (including WHO CNS Tumors and "Duffey" Neuropathology sets). **Teaching Staff:** Drs. Eskin and Yachnis.

6. Supervision: All final sign-out responsibility remains with the Attending Neuropathologist (see #3 above), although residents are encouraged to "write cases up" as they feel ready (all "write-ups" are ultimately reviewed and signed by an Neuropathology Attending).

7. Evaluation: Residents are given frequent verbal feedback during the rotation and are given a formal written evaluation following each rotation.

Revised: 4-15-2003

Neuropathology core curriculum (4-14-2003):

Basic neuroanatomy of cerebrum, cerebellum, brainstem, spinal cord, cranial and spinal nerve roots, meninges, and relationships of above to cranium and vertebral column.

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, and immunohistochemical criteria for pathological interpretation/diagnosis of the following:

Primary Intracranial/intraspinal tumors
- Glial tumors
  - Astrocytic neoplasms
    - Astrocytoma
    - Juvenile pilocytic astrocytoma
    - Anaplastic astrocytoma
    - Glioblastoma multiforme
  - Oligodendroglioma
  - Ependymoma
    - Myxopapillary ependymoma
  - Mixed gliomas
  - 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
- Rhabdoid and atypical teratoid tumors
- Primary and secondary lymphomas
- Pineal parenchymal tumors
- 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 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 disease
- Amyotrophic lateral sclerosis
- Other neurodegenerative disorders (general familiarity)

Demyelinating diseases
- Multiple sclerosis

Infectious diseases
- Bacterial infections
- Mycoses
- Viral infections
- Neuropathology of AIDS
- Prion-associated diseases
- Other (Parasitoses, Spirochetal infection)

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