

Curriculum

Post-Doctoral Certificate Course In Neuropathology

INTRODUCTION

In India, Neuropathology is emerging as an important field where there is a need for subspecialty training. With many institutes and hospitals (both government and private) having Neurosurgery and Neurology departments, trained neuropathologists are essential in providing accurate laboratory services that help in improving patient care.

Neuropathology is a subspeciality of Pathology focusing on theoretical knowledge and clinical interpretation of various diseases affecting the different components of the nervous system including the brain, spinal cord and peripheral nerve and its extension, the skeletal muscle.

DURATION OF THE COURSE: 12 months

QUALIFICATION: MD/DNB Pathology

METHOD OF SELECTION: Written entrance examination and interview (as per institute regulations for PDCC course)

GOALS OF THE PROGRAMME

1. Training in diagnostic evaluation of samples pertaining to various diseases affecting the nervous system
 - Surgical samples related to neoplastic and non-neoplastic CNS diseases including epilepsy
 - Samples for intra-operative squash/frozen preparation
 - Nerve biopsy
 - Skeletal muscle biopsy
 - Serology samples pertaining to Neuroimmunological diseases
2. Training in the application and interpretation of essential ancillary techniques used in diagnostic neuropathology:
 - Histochemical stains
 - Immunohistochemistry
 - Enzyme histochemistry
 - Fluorescence in-situ hybridization
 - Serological techniques of indirect immunofluorescence, immunoblot and isoelectric focusing
3. Training in the principles and practice of tissue grossing, processing and staining, especially handling nervous tissue, muscle and nerve.
4. To acquire basic knowledge in structural and functional anatomy and histology of brain, spinal cord, peripheral nerve and skeletal muscle.

5. Training in performing clinical autopsies, dissection of whole brain and spinal cord and microscopic evaluation.
6. Exposure to molecular techniques such as Sanger sequencing.
7. Exposure to basic principles of electron microscopy including processing the tissue and interpretation of ultrastructural pathology.
8. Exposure to applied aspects of microbiology, neuroradiology and neurology (EMG, EEG and Nerve conduction studies).
9. Participation in intradepartmental and interdepartmental discussions and teaching sessions.
10. Research activities such as conducting research project/study and publishing the results in scientific journals.

CURRICULUM FOR TRAINING

Sections	Duration	Theory: Practical
Histopathology Surgical samples (neoplastic and non-neoplastic) Squash smears Nerve biopsy Skeletal muscle biopsy Skin biopsy CSF cytology Fluorescence in-situ hybridization Neuroanatomy and histology of brain, spinal cord, peripheral nerve and skeletal muscle.	9 months	30:70
Immunology	1 month	50:50
Posting in other departments (Microbiology, Neuroradiology, Neurology, Biochemistry/Molecular genetics unit, BMT Wing, Statistics course)	4 weeks	50:50
External posting (NIMHANS, Bangalore)	1 month	40:60

Histopathology

1. Neoplastic and non-neoplastic surgical samples:
 - Grossing and processing of tissue.
 - Acquiring skill in assessment of haematoxylin and eosin-stained sections and formulating differential diagnoses.
 - Learn to further evaluate cases using appropriate immunohistochemistry and special stains and Fluorescence in-situ hybridization.
 - Formulating histopathological reports.
 - Theoretical knowledge on the pathogenesis of neoplastic and non-neoplastic diseases and application of molecular techniques.
2. Squash smears:
 - Preparation and staining of squash smears and issuing report.
 - Theoretical knowledge on its usefulness and limitation.

3. Nerve biopsy:
 - Proper grossing technique.
 - Approach to the interpretation of nerve biopsy using haematoxylin and eosin-stained sections and myelin stains.
 - Theoretical knowledge on common neuropathies, how to perform nerve biopsy, its indication, use of semithin, ultrathin sections and teased fibre preparation.
4. Skeletal muscle
 - Proper grossing technique and procedure for various enzyme histochemistry stains.
 - Approach to the interpretation of muscle biopsy using haematoxylin and eosin, enzyme histochemistry, and immunohistochemistry.
 - Theoretical knowledge on various muscle disorders, how to perform muscle biopsy, its indication and its transportation, use of electron microscopy, western blot, respiratory complex assay and genetic analysis
5. Structural and functional anatomy and histology of brain, spinal cord, peripheral nerve and skeletal muscle.

Immunology

- Theoretical knowledge on sample collection and storage for immunological tests.
- Methodology of indirect immunofluorescence, immunoblot and isoelectric focusing.
- Interpretation of test results and clinical correlation.

Posting in other departments (Microbiology, Neuroradiology, Neurology, Biochemistry/Molecular genetics unit, BMT Wing, Statistics Course): The student is expected to observe and learn:

- Department of Microbiology: learn correct method and processing of samples for culture and molecular techniques in infectious disease diagnosis.
- Department of Neuroradiology: basics of MRI and CT, neuroanatomy in imaging, imaging features of common neurological diseases.
- Department of Neurology: basics of neurophysiological techniques- NCS, EMG and EEG.
- Department of Biochemistry/Molecular genetics unit: DNA/RNA extraction, PCR, Sanger sequencing, Next-generation sequencing.
- BMT Wing: SROP
- Statistics Course

External posting (NIMHANS, Bangalore): The student is expected to observe and learn:

- Observe ancillary techniques used in the diagnosis of skeletal muscle pathologies such as western blot and respiratory chain analysis.
- Electron microscopy: learn the basics of sample collection, processing and interpretation including semithin sections.

- Observe clinical autopsies.
- Diagnostic nerve and skeletal muscle biopsies to further add on to the training already received at SCTIMST, Trivandrum to encompass a wider spectrum of pathologies.

DUTIES AND RESPONSIBILITIES

The student is expected to follow the typical work schedule:

Duties	Frequency
Grossing of samples received in the department including surgical samples, nerve biopsy and skeletal muscle biopsy	Daily
Participation in the reporting of diagnostic histopathological samples	Daily
Reporting of squash smear/ frozen section	Daily
Handling of fresh skeletal muscle biopsy, freezing and further processing	As and when samples are received
Immunology samples pertaining to neurological diseases Sample processing and interpretation	1 month
Attending interdepartmental teaching sessions <ul style="list-style-type: none"> • Radiology department • Neuropathology teaching session (Neurosurgery and Neurology dept) • Epilepsy 	Friday Saturday Once a month
Journal club	4 per year
Seminar	4 per year
IEC approved Project (Preference to prospective study is highly desirable)	1 project (with manuscript submitted at the end of course)
Presentation in a conference (state/national/international)	1

During the course of 1 year, the minimum requirement that should be met pertaining to sample handling and reporting are as follows:

	Minimum number of cases
Epilepsy specimen grossing	20
Squash smears prepared	30
Muscle biopsy freezing and enzyme histochemistry performed	2
Frozen/squash samples reported	50
Histopathology cases reported (supervised)	400

Muscle biopsy reported (supervised), including external posting	20
Nerve biopsy reported (supervised) including external posting	20
Immunology samples reported (supervised)	
Autoimmune encephalitis panel	10
Anti-AQP4-MOG IIFT	10
Anti-IgLON5 IIFT	4
CSF OCB	10
Myositis immunoblot	5
Paraneoplastic immunoblot	5
Ganglioside ELISA	4
Fluorescence in-situ hybridization: technique and reporting (supervised)	2

ASSESSMENT OF OUTPUT

1. Logbook: Logbook of activities recording the following:

- Number of biopsies reported pertaining to neoplastic brain samples, non-neoplastic samples, nerve biopsy, skeletal muscle biopsy
- Number of neuroimmunology cases reported- immunofluorescence, immunoblot and CSF oligoclonal band
- number of squash smears prepared and interpreted
- Discussion in interdepartmental meetings
- Journal club and slide seminars presented
- 4 interesting cases (anonymized) with clinical and pathological details (2 neoplastic and 2 non-neoplastic)
- Summary of activities during external posting in NIMHANS, Bangalore

2. One completed Institutional Ethics Committee-approved research project/study with manuscript submitted to indexed, peer-reviewed scientific journal.

TEXTBOOKS & JOURNALS FOR READING AND REFERENCE

1. WHO Classification of Tumours Editorial Board. World Health Organization Classification of Tumours of the Central Nervous System. 5th ed. Lyon: International Agency for Research on Cancer; 2021.
2. Burger PC, Scheithauer BW. Tumors of the Central Nervous System (AFIP Atlas of Tumor Pathology, Series 4. Fascicle 7) American Registry of Pathology, Washington DC , 2007.
3. Love S, Perry A, Ironside J, Budka H (editors). Greenfield's Neuropathology 9th ed.
4. Dubowitz V, Sewry CA, Oldfors A (editors). Muscle Biopsy: a practical approach a practical approach 5th ed. 2020.

5. Goebel HH, Sewry CA, Weller RO. Muscle Disease: Pathology and Genetics, 2nd ed. 2013.
6. Bilbao JM, Schmidt RE. Biopsy Diagnosis of Peripheral Neuropathy 2nd ed. 2015.

Journals

1. Neuropathology
2. Clinical Neuropathology
3. Acta Neuropathologica
4. Brain Pathology
5. Neurology India
6. Annals of Indian Academy of Neurology

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