

Course Structure for DM Neuroanaesthesia at GIPMER

A. Admission Process

- **Entrance Examination:** The admission process would be through the National eligibility cum entrance test - super speciality courses (NEET- SS) which is the prescribed single entrance examination for entrance into all DM/Mch courses as per the Indian Medical Council guidelines.
- **Eligibility Criteria:** Candidates with recognized PG Medical degree MD/DNB in Anaesthesia. The DNB candidates will be eligible as per MCI amendment dated 31 Oct, 2018.
- **Duration of Course:** Three years as per MCI guidelines.
- **Proposed Intake Capacity for DM Neuroanaesthesia at GIPMER:** Two candidates per year (total of six candidates in three years course duration).

B. Course Curriculum

I. Syllabus

Part 1: General principles of Neuroanaesthesia and Neurocritical Care

1. Organization of Neuroanaesthesia and Critical Care Set up
2. Emergency management and transport of pre hospital patients
3. Principles of consent taking and details of informed consent
4. An awareness of the importance of communication skills and interpersonal relationships
5. Infection control measures and Sterilization procedures
6. Maintenance of asepsis
7. Responsibilities in neurosurgery operation theatre and neurointensive care units
8. Knowledge of various scoring systems, admission and discharge criteria
9. Pre and post-operative care of neurosurgical cases
10. Medical Ethics
11. Biomedical Waste Management
12. Basics of Research methodology and Bio-statistics
13. Internal audit

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14. Training in Communication skills, interpersonal relationships, organizational capabilities, leadership qualities

15. Behaviour and team work

Part 2: Basic sciences

Neuroanatomy:

- a) Gross and applied anatomy of the brain, spinal cord, peripheral and autonomic nervous system
- b) Embryological development of Central and peripheral nervous system

Neurophysiology:

- a) Applied physiology of the brain and spinal cord
- b) The cerebrospinal fluid circulation
- c) Cerebral and spinal circulation and metabolism : Cerebral Perfusion Pressure (CPP), brain elastance , cerebral autoregulation, and metabolic coupling and their measurement methods
- d) Effects of various anaesthetics (inhalational and intravenous agents)
- e) Intracranial pressure (ICP) and its monitoring methods and various herniation syndromes
- f) Determinants of cerebral perfusion pressure
- g) Mechanism of neuronal injury and brain protection
- h) Electrophysiology of CNS, EEG and Evoked Potentials
- i) Mechanism of pain transmission in acute and chronic pain conditions

Respiratory physiology

- a) Physiology of spontaneous respiration and mechanical ventilation
- b) Indications for mechanical ventilation
- c) Modes of ventilation
- d) Weaning from ventilatory support
- e) Complications of mechanical ventilation – recognition and management
- f) Monitoring during ventilatory support

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Cardiovascular physiology:

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- a) Recognition and management of arrhythmias
- b) Management of hemodynamic disturbances – hypotension, hypertension, myocardial ischemia, pulmonary edema and heart failure
- c) Knowledge of commonly employed vasoactive and anti-arrhythmic drugs

Renal physiology:

- a) Fluid and electrolytes physiology and pathophysiology
- b) Prevention, diagnosis and management protocol for acute kidney disease
- c) Basic knowledge of dialysis

Metabolic disorders:

- a) Pathophysiology and management of the Electrolyte disturbances in neurosurgical patients
- b) Acid-base disorders
- c) Understanding of endocrine disorders

Neuropharmacology:

- a) Basic idea of pharmacodynamics and pharmacokinetics of drugs, drug interactions, complications of various drugs used in neurological patients
- b) Sedatives and anaesthetic agents
- c) Analgesics - narcotics and non-narcotic agents
- d) Muscle relaxants
- e) Anticonvulsants , antipsychotics and antidepressants
- f) Vasopressors and inotropes
- g) Drugs for treating brain edema/ raised ICP, Parkinsonism, CNS infections, CNS malignancy, acute and chronic pain
- h) Radiocontrast media used in CNS investigations
- i) Corticosteroids, thrombolytic agents

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Neuropathology:

- a) Applied to brain and spinal cord lesions like tumors, tuberculosis, vascular lesions, infections, ischemic lesions, neuropathies etc.
- b) Common pathology tests relevant to neuroanesthesia

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Neuromicrobiology:

- a) Neuroinfections
- b) Pulmonary infections
- c) Infections related to operating rooms and ICUs
- d) Nosocomial infections

Part-3: Clinical science

• **Anaesthetic management of various neurosurgical cases**

- a) Perioperative management of neurosurgery for brain tumors, neurovascular lesions, spinal cord pathologies, posterior fossa lesions, skull base lesions, epilepsy, head injury, stroke, pituitary lesions etc.
- b) Anesthesia for Endovascular (neuro-interventional) surgery
- c) Anaesthesia for awake craniotomy, neuroendoscopy, stereotactic surgery, neuronavigation, gamma knife surgery, peripheral nerve repair
- d) Anaesthetic management of pediatric neurosurgery for congenital hydrocephalus, encephaloceles/ meningocele, craniosynostosis and other congenital brain and spinal cord deformities and pediatric brain tumors
- e) Difficult airway management, technique of one-lung anesthesia
- f) Perioperative cerebral protection strategies
- g) Positions used in neuroanaesthesia (supine, prone, sitting, park-bench)
- h) Perioperative basic and advanced monitoring (EEG, evoked potentials, Transcranial Doppler, ICP monitors, Ultrasound, CBF measurement, TEE)
- i) Anesthetic management of patients undergoing neuro-investigations (CT, MRI, DSA): working knowledge of anatomic/ metabolic scanning related to neuroanaesthesia
- j) Use of evolving modalities in neuroanaesthesia: Barbiturate/ diazepam coma, hypothermia, cardio-pulmonary bypass in giant aneurysms, newer brain protective measures, use of immunoglobulins, exchange transfusion, plasmapheresis, use of ozone therapy for spinal pain

• **Emergency neurological conditions and their management techniques**

Management of Traumatic Brain Injury (TBI)

- a) Pre-hospital care of patient with neurological injury
- b) Assessment and resuscitation

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- c) Airway management -conventional laryngoscopic intubation, insertion of LMA, fiberoptic intubation, manual inline stabilisation (MILS), use of videolaryngoscope and surgical airway
- d) Laboratory and radiological investigations
- e) Pathophysiology of head injury
- f) Factors causing secondary injury
- g) ICP - physiology and pathophysiology, and principles of management
- h) Controversies of ICP monitoring in TBI
- i) CPP; its role in TBI management, concept of individualized CPP
- j) ICP-CPP targeted management of TBI
- k) Biochemical markers of brain injury, molecular and cellular mechanisms of injury
- l) Brain Trauma Foundation Guidelines in the management of TBI / spinal cord Injury
- m) Role of hyperventilation in traumatic brain injury
- n) Methods available to measure/estimate ICP/ cerebral perfusion along with advantages and disadvantages of each method
- o) Approaches to management of refractory ICP elevation

Management of spinal cord injury

- a) Resuscitation and care of the affected area
- b) Airway management of C-spine injury
- c) Pathophysiology of spinal cord injury
- d) Conservative management of spine injury

Cerebral vascular accidents

- a) Pathophysiology of stroke and management
- b) Treatment modalities for arterial and venous stroke
- c) Long term care of stroke patient, rehabilitation
- d) Understanding the indications/contraindications/side effects of intrarterial / intravenous thrombolysis in ischemic cerebrovascular accident
- e) Describing the natural history, risk factors and management options for malignant infarcts
- f) Describing the natural history of intracerebral haemorrhage along with the role of early surgical interventional, and medical treatment (i.e. blood pressure & glycemc control, administration of factor VIIa)

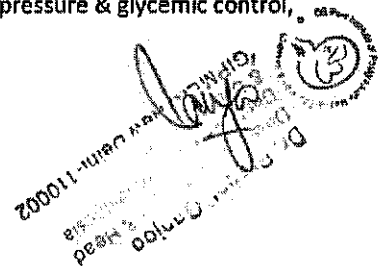
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Subarachnoid hemorrhage

- a) Various types of cerebral aneurysms
 - b) Describe the common aneurysm locations leading to SAH
 - c) Understand the clinical and radiographic grades of SAH
 - d) Methods used to detect cerebral vasospasm & strategies to treat cerebral vasospasm to prevent secondary ischemic stroke
 - e) Indications for temporary external ventricular drains/permanent shunts
 - f) Non-neurological complications of SAH and their management
 - g) Surgical clipping and coiling of cerebral aneurysm
 - h) Giant intracranial aneurysms and their implications
 - i) Anastomotic procedures in cerebral ischemia
- **Understanding basics of neurological diseases**
 - a) Neurologic examination
 - b) Differential diagnosis and work-up of patients presenting to neuro-critical care; coma scores and Stroke scores
 - c) Pathophysiology, and therapy of coma arising from metabolic, traumatic, infectious, mass lesions, vascular-anoxic or ischemic, drug induced events of patients following cranial and spinal surgery
 - d) Management of airway, ventilation, hemodynamics, fluid and electrolyte balance, raised ICP, brain edema/ ischemia.
 - e) Management of brain/spine injury, spinal cord lesions, neurological and neuromuscular disorders, status epileptics, stroke, subarachnoid hemorrhage.
 - f) Nutritional issues, physiotherapy, rehabilitation, open/ percutaneous tracheostomy.
 - **Understanding and management of specific neurological diseases**
 - a) Status epilepticus, refractory status epilepticus, super refractory status epilepticus, epilepsy and encephalopathies
 - b) Guillian-Barrie syndrome
 - c) Muscle dystrophies with complication
 - d) Systemic illnesses causing neurological manifestations: Neuropathy, myopathy, dys-electrolytemias, renal and hepatic failures, multi organ failure etc.
 - e) Myasthenia gravis
 - f) Stroke (cerebrovascular accidents) and CVT (cortical venous thrombosis)

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g) Neuroinfections

- o Bacterial, viral, fungal meningitis
- o Causative organisms of community-acquired & nosocomial meningitis/ventriculitis/ abscess along with preferred antibiotic agents
- o Describe the pharmacodynamic/ pharmacokinetic principles influencing CNS antibiotic activity

h) Peripheral motor neuron disease

- o Review the natural history/expression of motor neuron disease related to degenerative diseases, infectious agents and inflammatory conditions
- o List the changes that occur in denervated muscles and implications for use of medications with activity at the neuro-muscular junction
- o Understand the presentation of respiratory failure and indications for non-invasive and invasive ventilatory support
- o Indications for and problems associated with plasmapheresis and intravenous immunoglobulin
- o Review the non-neurologic complications and management of motor neuron disease (cardiac denervation, intestinal movement disorders)

• Principles of neurointensive and postoperative care

- a) Management of airway, ventilation
- b) Management of hemodynamics, fluid and electrolyte balance, raised ICP,
- c) Management of brain oedema/ ischemia.
- d) Management of brain/spine injury, spinal cord lesions,
- e) Neurological and neuromuscular disorders,
- f) Status epileptics, stroke, subarachnoid hemorrhage.
- g) Nutritional issues, physiotherapy, rehabilitation, open/ percutaneous tracheostomy.

Brain Death

- a) Criteria, determination and certification of brain death
- b) Differential diagnosis e.g. drug induced, locked-in syndrome, etc
- c) Organ donation: metabolic and hemodynamic management pending organ harvesting

Monitoring in critical care

- a) Neurological monitoring at the bedside
- b) EEG- understanding basic EEG, role of continuous EEG monitoring in ICU

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- c) Monitoring cerebral oxygenation
- d) Monitoring cerebral blood flow
- e) Monitoring biomarkers
- f) Hemodynamic monitoring
- g) Respiratory monitoring
- h) Intracranial pressure monitoring

Nutrition in the neuro-critical care

- a) General principles and indications
- b) Total parenteral nutrition—indications, advantages/ disadvantages
- c) Enteral nutrition: indications, advantages, and side effects
- d) Nutrition in presence of metabolic and systemic diseases

Neuroimaging

- a) Basics of neuroradiology
- b) CT, MRI, TCD (Trans cranial Doppler), USG (Ultrasound)
- c) Interventional neuroradiologic procedures
- d) Identify the basic structures in the central nervous system (ventricles, cisterns, sinuses, major anatomic landmarks)
- e) List the imaging techniques/signs used to identify acute intracranial hemorrhages, mass lesions, arterial and venous lesions, and ischemic penumbras / infarcts
- f) Distinguish imaging characteristics of SAH, epidural hematomas, subdural hematomas, intra - parenchymal hemorrhage and relate to anatomic structure
- g) Understanding the concepts of medical and surgical managements of various emergencies based on imaging and various decision paradigms
- h) Management of complications in neuroradiological procedures

Neuro- rehabilitation

- a) Head injured and spinal cord injured patients
- b) Prevention of acute problems
- c) Attendant training and counseling
- d) Understanding long term goals in neuro- rehabilitation

Temperature regulation

- a) Understand the physiology of temperature regulation in OT and ICU
- b) Management of hypothermia/ hyperthermia in the neuro-intensive care population

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Miscellaneous

- a) Sepsis - Pathophysiology and management
- b) Management of acute and chronic pain, cancer pain.
- c) Pregnancy and neurosurgery
- d) Cyanotic heart disease and neurosurgery
- e) Multiple organ dysfunction syndromes
- f) Reperfusion injury and antioxidants
- g) Shock-types and management
- h) Deep vein thrombosis prophylaxis, management and pulmonary embolism
- i) Coagulopathies and their management
- j) Patient safety and prevention of adverse effects
- k) End of life care issues

Procedures to be done in Neurointensive care unit

- Arterial line placement
- Central venous line placement
- Tracheostomy – surgical and percutaneous dilatational tracheostomy
- Chest drain insertion
- Care of patients with invasive equipment e.g ICP monitor, EVD, deep epilepsy electrodes & grid,
- Patient controlled analgesia pump
- Application of Transcranial Doppler probes
- Ultrasound and its applications
- Bronchoscopy
- Transfer of critical neurosurgical patients to different areas of hospital

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II. Training Program:

Over a span of 3 years, the candidate is expected to acquire a sound knowledge of the theory and practice of clinical neuroanesthesiology. He/she should develop competence in handling of anesthesia and perioperative care during all types of neurosurgeries and interventional neuroradiology procedures and ably manage neurocritical care and acute and chronic neurological pain. The candidate should also

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become a competent teacher of neuroanesthesiology and actively participate in teaching programs and scientific meets. The candidate is expected to be well-versed with research methodologies and should be able to conduct independent clinical/basic science research investigation.

These goals will be achieved through a closely supervised, graduated in-service training program, involving progressive practical training and education within the framework of the department and its related fields.

The candidate will be involved in the teaching activities of postgraduate and undergraduate students and other senior residents and in-house teaching and training activities of nurses and technicians. The candidate will participate in the routine clinical, teaching and research activities of the department and will also undertake any other duties periodically assigned to him/her.

Rotational training

1. Pre-anaesthesia clinic (3 months)
2. Anaesthesia services for Neurosurgical Procedures (16 months)
3. Anaesthesia services for Neurotrauma Procedures (3 months)
4. Anaesthesia services for Neuroradiological Procedures (2 months)
5. Neurosurgical ICU (6 months)
6. Neurology ICU (2 months)
7. Neurology department (1 month)
8. Neurosurgery department (15 days)
9. Radiology (3 weeks)
10. Electroconvulsive therapy (1 week)
11. Clinical Epidemiology and Biostatistics (1 week)
12. Cardiac OT for TEE training (1 week)
13. External posting at other centers (1 month): For learning anaesthesia for advanced neurosurgical techniques and neuromonitoring not available at our institute.

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Timeline for Training Program

FIRST YEAR			
PAC	1 month	Neurology department	1 month
Neurotrauma OT/ICU	1 month	Clinical Epidemiology and Biostatistics	1 week

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Neuroradiology	1 months	Neurosurgery department	1 week
Radiology	2 weeks	Neurosurgery OT	5 months
Neurosurgery ICU	2 months		

SECOND YEAR			
PAC	1 month	Cardiac OT for TEE	1 week
Neurotrauma OT/ICU	1 month	Neurosurgery department	1 week
Neurology ICU	1 month	Neurosurgery ICU	2 months
Neuroradiology	1 month	Neurosurgery OT	5 months
Radiology	15 days		

THIRD YEAR			
PAC	1 month	Neurosurgery ICU	2 month
Neurotrauma OT/ICU	1 month	Neurosurgery OT	6 month
Neurology ICU	1 month	External posting at other centres	1 month

Maintenance of Log Book

Log books serve as a document of the trainee's work. The trainee shall maintain this Log book of the special procedures/ operations performed by him / her during the training period right from the point of entry and its authenticity shall be got regularly assessed by the faculty and certified by the concerned Postgraduate Teacher / Head of the Department. This shall be made available to the Board of Examiners for their perusal at the time of his / her appearing at the final exit Examination. The logbook should record cases anaesthetised (both in the operation theatre and also in the interventional neuroradiological / radiological lab and in the MRI and CT room) seen and presented, procedures performed, seminars, journal club and other (case) presentations. Log book entries must be qualitative and not merely quantitative, focusing on learning points and recent advances in the area and must include short review of recent literature relevant to the entry. It should also contain detailed documentation of a minimum of 5 interesting cases. Log book shall be checked during quarterly assessment as mentioned in the appraisal form.

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Training in Research Methodology

As per requirement of all existing DM courses, the student will be required to conduct research work and submit his/her thesis to the University 06 months before commencement of his/her final examination for onward transmission to the examiners.

Procedures to be carried independently

The minimum number and type of procedures to be done independently by the candidates is as follows:

• Anesthesia for Neurovascular Surgery	10
• Anesthesia for Posterior Fossa Surgery	10
• Anesthesia for Pediatric Neurosurgery	25
• Anesthesia for Neuroendoscopy	10
• Anesthesia for Neuroradiology	10
• Anesthesia for Spinal Surgery	25 (05 cervical spine cases)
• Anesthesia for Surgeries requiring Neuromonitoring	05
• Transcranial Doppler Monitoring	10
• Fiberoptic Bronchoscopy	05
• Percutaneous Tracheostomy	05

Teaching module

1. Journal Club: The trainee will present a journal article relevant to neuroanaesthesia. A student should present at least two articles along with an interesting relevant case report.
2. Lectures: Attend didactic lectures on basic neurosciences, biostatistics, research methodology, teaching methodology, from external faculty of specialties related to the subject, medical ethics and legal issues related to neuroanaesthesia, neurointensive care practice etc. should be conducted once or twice a week.
3. Subject Seminar: The trainee will present a subject topic allocated after doing a comprehensive preparation and relevant literature search.
4. Clinical Grand Rounds: The trainee will attend the Clinical Grand Rounds monthly in association with the various neuroscience disciplines.
5. Clinical Case Presentation: The trainee will present a clinical case (either from anaesthesia point of view or some neurocritical care case) after performing thorough history and physical

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examination. Trainee will elicit physical and non-physical aspects in history, elicit all physical signs, formulate diagnosis/differential diagnosis and able to plan a comprehensive care plan for the patient.

6. Core Training:

- Daily ICU rounds and on-hands teaching in the OTs This would involve around 1- 2 hours of dedicated teaching, ICU round in the morning, and consultation liaison.
- Monthly Mortality/morbidity review
- Unscheduled and informal discussions will be held as often as possible depending upon the variety and the number of procedures seen.
- Epidemiological and /or clinical research programme will be undertaken on selected topics. the basic methods of research and reporting will be taught.
- The postgraduate students shall be required to participate in the teaching and training program of undergraduate students and interns.
- All the postgraduate trainees are expected to attend regular CMEs, Conferences, Workshops at state and national levels

III. Scheme of examination

Formative assessment (During Training)

The student to be assessed quarterly as per categories listed in postgraduate student appraisal form (Annexure).

Summative Assessment (At the end of the training)

A. Theory examination.

B. Practical, Clinical examination and Viva-voce.

Theory examination and Practical/Clinical, Viva-voce shall be separate heads of passing. Theory examination shall comprise of four papers. Passing percentage shall be cumulatively 50% with minimum of 40% marks in each theory paper. Practical /Clinical examination will consist of at least one long case, three short cases and a viva-voce. Passing percentage shall be 50%. Passing shall be separate for each

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head and failing shall be common, meaning thereby that clearance at theory and failure at practical / clinical shall amount to failure at Summative examination and vice versa.

1. Theory Examination

There shall be 4 theory papers of 3 hours each.

Paper I: Basic Sciences as applied to the subject

Paper II: Clinical Neuroanaesthesia and techniques in anaesthesia

Paper III: Clinical Neuroanaesthesia, interventional neuroradiology, and Neurointensive care

Paper IV: Recent advances in the subject

2. Clinical / Practical and Oral Examination:

(i) Clinical presentation: Students shall examine a minimum one long case and 03 short cases.

(ii) Oral Examination shall aim at assessing the student's knowledge and competence about the subject, investigative procedures, therapeutic techniques and other aspects of the specialty. It would include neuroradiology, neuropathology, general and specific neuro monitoring, neuro equipment, anesthetic agents and other drugs, recent advances and future trends in clinical neuroanesthesiology.

Examiners: As per MCI requirements, there will be 02 External and 02 Internal examiners for the final examination.

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