Residency Program

MS in Neurosurgery

Course Curriculum
Phase -A

Department of Neurosurgery
Bangabandhu Sheikh Mujib Medical University
Shahbagh, Dhaka-1000

Introduction

Bangabandhu Sheikh Mujib Medical University (BSMMU), the prestigious Medical University was established in 1998 when the government decided to build the first medical University of the country and transformed the then Institute of post graduate Medicine & research (IPGMR). The IPGM&R was established in the year 1965 and bears a glorious history by producing thousands of specialists in different subjects of Medicine. After the establishment of the University, it expanded the program of the IPGM&R. Now the University has many super specialty departments with modern technology and equipments for better service to the country as well as best place for education. The University Hospital is now recognized as the center of excellence for health care service in the country. The University has its education program for the post graduate students in all specialties in the form of Residency program.

Though MS course in Neurosurgery was started in IPGM&R in the year 1996 but the Residency program in MS was started from 1998 in BSMMU. The department of neurosurgery is situated in the ground and fourth floor of Block C. The faculty of the neurosurgery department includes two Professors, two Associate professors, Five Assistant Professors. The department is equipped with one emergency ward, Male and female wards with a total bed capacity of 100. There are three well equipped operating rooms running simultaneously everyday except the holidays. Operating room facility is available round the clock including holidays for emergency. The Neurosurgery Outpatient department (OPD) is open every day except holidays

Every year the Neurosurgery department accommodate 4 residents for it's MS residency program.

It is noted that there is redundancy in the curriculum. This has arisen because many areas of neurosurgery overlap. The curriculum structure is based on performance. This will hopefully facilitate self-directed resident study. It also will impart some objectivity to periodic resident evaluations. The curriculum is constructed in such a manner that the educational experience is divided into three levels - Junior, Middle, and Senior. The resident should display competency in each level before progressing to the next. Those individuals who do not stay on track will be promptly identified in an objective manner, thereby enabling more timely remedial attention or dismissal. Furthermore, it will force each program to examine its faculty and the structure of the basic and clinical

training to assure an optimal educational experience. The curriculum does not define how information is imparted, only the body of knowledge which must be mastered. It is up to each program to determine whether achievement of the goals will be accomplished through conferences, required readings, scheduled lectures or workshops, etc.

Adequate supervision of the resident performance is critical to assure proper care of the patient and learning of the resident. It is recognized, however, that a great deal of learning also takes place without supervision. Programs should be structured to allow residents to act independently at various tasks commensurate with their skills and the specific medical situation.

Scope of the Course

Being the best center for Neurosurgery, most of the neurosurgical cases are referred to this department. The department of Neurosurgery in BSMMU has a tremendous scope to learn neurosurgery because the department has a well organized neuroemergency ward besides it's routine activities.

Aims of the Course

1. To produce competent Neurosurgeons as per demand of the country.
2. To produce specialists, efficient in teaching and learning process in Neurosurgery
3. To perform research activities in the field of Neurosurgery.

Objectives of the Course

1. To provide adequate facilities for teaching in the basic science, clinical and surgical aspects of neurosurgery
2. To provide background information for understanding the Neurosurgical diseases through an organized academic program.
3. To provide proper training to understand neurosurgical disorders through patient exposure in the wards, outpatient clinic, and emergency ward and in other related surrogate departments.
4. To create a scientific atmosphere by inviting discussion through morning conference journal clubs and by arranging seminars and guest lectures.

5. To provide the means to develop technical proficiency and surgical skills in Neurosurgery through supervised exposure in the operating room.
6. To provide exposure to research activities through thesis program.
7. To encourage a multidisciplinary approach to patient management in various areas.
8. To develop capacity to be clinically eligible scholar, professional, health advocate, manager, collaborator and communicator
9. To provide adequate training to make able in applying knowledge, manage the neurosurgical disorder, conduct research, coordinate and promote collaboration in organizing the department, provide leadership in the development of Neurosurgery.

Pre-requisites for admission

1. Admission is open to government, nongovernment and overseas candidates
2. Candidates for MS Neurosurgery Course must have
   a. MBBS degree or it's equivalent recognized by Bangladesh Medical & Dental Council(BM&DC) and BSMMU
   b. One year of Internship complete
   c. One year service after internship completed.
   d. Registration by BM&DC
3. Other pre-requisites as determined by BSMMU.
4. The Call for admission will be published in four leading Bangla and English national dailies.

Number of Seats

Department of Neurosurgery can accommodate a maximum of 4 candidates each year.

Venue of the Course

Department of Neurosurgery under Faculty of Surgery, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka-1000.

Duration of the Course

Total 05 (Five) academic years.
The course will be divided in to two phases

Phase A	02 years
Phase B	03 Years

Regulations for the Course

A. Title of the Course
Master of Surgery (Neurosurgery)

B. Date of Commencement
January of Each Year.

C. Phase A (Junior Resident)

The duration of Phase A is two years

The Phase A will include basic subjects related to Neurosurgery

The Two years will be divided in to 07 blocks; each block consists of 03 months. Students will be placed for two blocks in

Neurosurgery department and for remaining five blocks in other surrogate departments related to neurosurgery.

D. Phase –B (Senior & Chief Resident)

The duration of Phase B will be 03 years.

Candidates will be promoted to Phase B on completion of Phase A examination.

Phase B will cover the Neurosurgery exclusively.

During the three years period the residents will work in the neurosurgery department as junior residents and gradually promoted to senior resident then to Chief resident on completion of each year. During this phase A resident will also complete a thesis, approved by the department and BSMMU ethics committee.

After completion of residency, the resident will be eligible for final examination and after successful completion of the final examination; he or she will be awarded the degree of MS in Neurosurgery by BSMMU.

Language of the Course

The language of the course will be English

Academic activities of individual student during Phase A

History taking (To use prescribed POMR Sheet)
Case preparation and presentation
Attend morning sessions
Attend Basic Science lectures
Attend lectures of Course Directors hours
Attend lectures provided by the department
Attend ward round
Join Journal clubs
Attend operating room to join in the surgery.
Learn minor procedures and perform them under supervision.
Attend outpatient department with the supervisors.
Attend Neuroemergency operations whenever called.

Attachment plan for Phase A

Phase A

Duration Two years

During the phase A the students will be

1.		Oriented about the neurosurgery department	03 month	Block 1
2.		Neuroemergency	03 months	Block 2
3.		Sent in rotations to surrogate departments		
	a.	Neurology	03 months	Block 3
	b.	Neuroimaging	01 month	
	c.	Cardiology	01 month	Block 4
	d.	Casualty & Emergency	01 month	
	e.	General Surgery	03 month	Block 5
	f.	Orthopedics	01 month	
	g.	Anesthesiology	01 month	Block 6
	h.	ICU	01 month	
	i.	Neuroanatomy	01 month	
	j.	Otolaryngology	01 month	Block 7
	k.	Ophthalmology	01 month	
	l.	Preparation for end of the year examination	03 months	

Phase B

Duration Three Years

12 Blocks in the department of Neurosurgery

General Educational Objectives

For Neurosurgery Residents

Medical expert

- The main focus of a resident in training for Neurosurgery is to develop himself/herself as a medical expert as such he or she must strive at developing a broad knowledge base in Neurosurgery. The resident will progressively acquire in depth knowledge in more and more areas of the specialty during his/her training.

- The resident will also develop and sharpen clinical examination skills including excellent diagnostic and therapeutic judgment.

- The resident will acquire and sharpen his/her procedural and surgical skills in all surgical areas of General Surgery throughout his/her training.

- Throughout his/her training the resident will demonstrate continuous progress in management of medical and surgical emergencies as it relates to Neurosurgery.

- The resident will develop and sharpen his/her consultation skills and consistently be able to analyze and integrate relevant information and be able to formulate proper diagnosis and implement the appropriate therapy. He/she will show ability to communicate the recommendations with colleagues effectively and clearly.

Health advocate

- The resident will show ability in recognizing socio-economic, environmental and psychological factors involved in the health and well being of patients. He/she will demonstrate and develop knowledge and proper utilization of available resources and to strive to act as advocates for patient health when appropriate.

Communicator

- The resident will learn throughout his/her training to communicate effectively with patients and their families. He/she will also demonstrate progress in communicating clearly and effectively in both verbal and written forms with other physicians and other health care professionals.

Collaborator

- The resident will demonstrate a growing understanding of the roles of other physicians from various disciplines as well as other health care professionals in patient care. He/she will develop and improve ability to collaborate with patients, their families and other caregivers in order to provide adequate patient care.

Manager

- The resident will develop and improve knowledge in operating health care facilities both in hospital and private office setting. He/she will continue to develop managerial skills including dealing with employees and other co-workers in various health care settings.

- He/she will demonstrate and improve on leadership skills including the ability to work effectively within the patient care team.

- The resident will demonstrate appropriate resource utilization. He/she will continuously strive to maintain balance between patient care and academic need and other personal activities.

Table of Content

Scholar

- The resident will also demonstrate progress in research skills in various areas including basic science, clinical research as well as quality assurance as it relates to the practice of Neurosurgery
- He/she will also develop and improve teaching and supervisory skills throughout his/her training. This includes patient teaching as well as involvement in student and peer teaching.

- He/she will demonstrate and improve independent learning abilities in order to maintain and advance professional development.

- He/she will develop and improve critical appraisal skills and show the ability to interpret and assess the validity of scientific data.

Health Professional

- The resident will demonstrate the highest standard in clinical care and ethical conduct he/she will show an understanding and adherence to ethical and legal codes of clinical practice in such areas as confidentially and informed consent.
- He/she will demonstrate integrity, honesty and good work ethics.
- He/she will show and improve awareness and sensitivity regarding gender, racial and cultural issues.
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Educational Strategies

1. Problem oriented learning
2. Student centered
3. Patient centered
4. Learning at OPD and at indoor segment

5. Community based
6. Community oriented

Teaching - Learning methods

7. Lecture- given by teachers from department of Neurosurgery
    2. Clinical Attachment - Department of Neurosurgery
    3. Small group teaching
    4. Clinical meeting
    5. Ward round
    6. Self directed learning
    7. Multidisciplinary seminar and symposium

Assessment

A. Principles of assessment

Assessment process will reflect the aim and objectives of the curriculum

There will be provision for external assessors for quality assurance.

The assessment methods will be reliable and valid. A wide range of assessment methods will be adopted which will include:

1. Written

Essay, modified essay and short answer question (SAQs).

2. Practical

Objective practical assessment, such as the objective structured clinical examination (OSCE) or objective structured practical examination (OSPE).

3. Oral

Traditional / Structured Oral Examination (SOE)

Teachers report / structured trainer's report

4. Assessment - individually / as a member in a group.

5.Assessment will be both formative and summative.

6.Assessment will emphasize:

- Recall of knowledge
- Critical thinking and problem solving / analysis/synthesis or evaluation.
- Skill including transferable skill such as communication skill

7. Provision will be made to provide feedback to students (in formative assessment).

8. Students self assessment will be encouraged (Through a checklist).

B. Regulations of assessment

1. Formative assessment will be held at the end of each block placement.

2. Summative assessment will be held for Phase-A & Phase-B in the months of January and July each year.

3. Formative examination will be conducted by Assistant Professor to professor appointed by the department. There will be a provision of Guest examiner from other surrogate department

4. Summative assessment will be conducted by a board of examiners (internal and external) appointed by the University in each paper.

5. There will be 4 (four) examiners for each paper of practical and oral examinations of Phase A , Two examiners will be from Neurosurgery and Two examiner will from Surrogate department.

6. There will be 4 (four) examiners for each paper of practical and oral examinations of Phase-B; Two examiners will be from Neurosurgery and Two examiner will from Surrogate department.

7. There will be 4 (four) examiners for thesis examinations of Phase-B, Two examiners will be from General surgery and Two examiner will from Surrogate department.

8. Student will have to make a protocol for thesis at the beginning of Phase-B (within 09 months), the protocol should be approved by thesis committee at the end Phase-A.

9. Work for thesis will be started at 10^{th} months of Phase-B.

10. The candidate must have to submit 5 (five) copies of thesis on relevant topics selected by the supervising Professor / Associate professor at least three months before Part-B final examination to the thesis committee. Thesis must obtain high standard, be an original one and shall be satisfactory regarding scientific presentation as well as other aspects. Thesis shall be examined separately by the members of the board of examiners appointed by BSMMU, on recommendation of faculty of surgery. Thesis examination board will consist of four members, not below the rank of associate professor (minimum 2 must be external). One of the externals must have PhD/MD/MS/M.Phil or equivalent degree in the respective or allied subjects including basic medical science viz physiology, anatomy, microbiology, biochemistry, pathology, pharmacology etc and have demonstrated the evidence of research capability in the form of published papers .The other three examiners must also have capacity to conduct research studies in the form of published papers. The candidate has to appear in the thesis defense examination as scheduled by BSMMU. The thesis, which has been accepted, will be the property of BSMMU and one copy of each shall be kept in the library of BSMMU, Dean's office and in the National Health Library and Documentation Centre.

11. Candidate whose thesis has been accepted but fails to pass or appear for the final examination may reappear in subsequent examination on payment of usual fees on each occasion. He/she shall not however, again be required to submit a fresh thesis. If a candidate passes in the theoretical, oral and practical of the final examinations but fails in the thesis defense examination, he/she can reappear in the subsequent examination of thesis defense on payment of usual fees

each occasion. The candidate shall however not be required to reappear in the theoretical, oral and practical examinations of the final part.

12. Students should have attended at least 75% of each of the theoretical and practical classes as prescribed in the syllabus duly signed by the Chairman of Neurosurgery Department for appearing Phase-A and Phase-B final examination.

13. Candidate will get maximum consecutive 5 chances to pass Phase-A & Phase-B examination. Otherwise the candidate will be dropped from continuing the course.

14. A candidate will be granted a degree of Master of Surgery in Neurosurgery if he/she passes all the examinations of Phase-B final part with thesis.

C. Assessment Methods

Two types of assessment methods:

A. Formative assessment: assessment and feedback during the course.

B. Summative assessment: will be held at the end of the each part of course.

Phase A

<u>Formative assessment</u> (End block examination)

Bangabandhu Sheikh Mujib Medical University
Residency Training Programme
Faculty of Surgery
End of Block Assessment Report (EBAR)

Resident's Name:---------- RID No---------- Discipline----------

Block Period ---------- Training Dept ----------

Category of assessment	Assessment scale (score / grade)		Score / grade achieved
Written examination	Total marks 50		
Clinical examination	Total marks 100		
Log book assessment	Complete: 80-100% of the activities/task were completed Completed satisfactorily Recoverable: 60-79 % completed satisfactorily Irrecoverable: <60% completed satisfactorily		
Portfolio assessment	Uptodate:80-100%, complete and satisfactoryDeficient: <80% of the desired contents is complete; needs to revise the contents		
Competency rating	Average Rating scale 1 to 10	Clinical competency	
		Communication skill	
		Scholarship	
		Professionalism	

Overall assessment: ----------

Feed Back Summary:----------

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Course Co-ordinator Supervisor

Outstanding	:	Overall excellent performance
Expected	:	Expected progress in all areas of education and training has clear concepts and competent in basic skills
Needs more efforts	:	has clear conception but lacks competency in basic skill; the weakness can be overvome by guided personal effort
Needs to repeat	:	Both conception and basic skill are unsatisfactory

Break up of assessment:

Written examination

Short answer questions (SAQs)

Marks for each question	:	5
Number of questions	:	10
Total marks	:	50
Time	:	90 min
Pass marks	:	60%

Oral examination:

Structured oral examination (board will select 10 questions, each candidate will be asked similar questions; appropriate measure will taken so that question will not leak out among the examinee)

Number of board	:	01
Number of examiner	:	04
Time	:	04+04+04+04 mins
Total marks	:	50
Pass marks	:	60%

OSPE / OSCE

Number of station	:	05
Number of examiner	:	02-03
Time	:	25 min
Marks of each station	:	05
Total marks	:	50
Pass marks	:	60%

Medical record review:

Students will have to produce completed 5 POMR sheet signed by supervisor during each end block examination

Log book assessment :

Students will have to produce completed assigned log book signed by supervisor during each end block examination

Portfolio assessment

Students will have to produce following completed noted signed by supervisor during each end block examination

1. Five operation notes
2. Five postoperative orders
3. Five completed pathological specimen sending reports
4. Five referral notes

Resident's work-based competence assessment:

Clinical competency, communication skill, scholarship, professionalism, collaborator,

health advocacy, Managerial role will be assessed by supervisor everyday

Summative assessment

Phase-A final (after 2 years

A. Written examination: (Marks: 200)

Content Outline

1. Applied Basic Medical Sciences
2. Clinical Methods (Knowledge part)
3. Emergency Presentations

4. Common Symptom-based Presentations
5. Problem Solving Skill (History, Physical Exam.)
6. Planning Investigations and Interpretation of data
7. Clinical Reasoning Skill/Clinical judgment
8. Synthesis of information/Interpretation of Medical Literature
9. System Specific Knowledge
10. Ability to judicious diagnostic tests
11. Management skill and Professional behavior
12. Disease Prevention

Paper I : Basic science (applied) plus other surgical allied subjects (Marks: 100)

Paper II : Principles of surgery (marks: 100)

Question types:

Short assay questions	:	each paper contain 20 questions
Marks	:	5 x 20 = 100 (5 marks for each question)
Time	:	180 min for each paper
Pass marks	:	60%

Examination Organization:

Written Examination will be completed in two consecutive days.

B. Structured Clinical Assessment (SCA)

Number of station	:	12 (interactive station: 2, others station: 10)
Time	:	60 min (5 min for each station)

Marks of each station	:	for interactive station is 10 (2 x 10 = 20) for other station is 8 (10 x 8 =80)
Total marks	:	100
Pass marks	:	60%

Assessment Areas :

3 Communication (1)
4 Management/Medical Ethics (2)
5 Referral Note/Discharge Note/Operation Notes/Procedures Note (1)
6 Data Interpretation (2)
7 Procedure (2)
8 Images (2)
9 Interactive stations (2)

C. Clinical Examination

Short cases

Marks	:	100
Time	:	20 mins Examination + 20 mins Crossing
Number of cases	:	04
Number of Examiner	:	02 for each examinee
Pass marks	:	60%

Long cases (Structured Observed Long Case)

Marks	:	100 (with or without selected investigations reports as per respective curriculum.)
Number of case	:	01
Total time	:	Case taking 30-40 mins + Crossing 20 mins
Number of Examiner	:	02 examiner for per examinee
Pass marks	:	60%

Course Content

NEUROANATOMY

UNIT OBJECTIVE

Demonstrate knowledge of anatomy that is pertinent to the diagnosis of diseases of the nervous system and the practice of neurological surgery.

*** Junior Level = (Junior Resident) Phase A & Year 1 of Phase B**

Middle Level= (Senior Resident)Year 2 Phase B
Senior Level = (Chief resident) Year 3 Phase B
COMPETENCY-BASED KNOWLEDGE OBJECTIVES

Junior Level: (Phase A) & year 1 Phase B

General

1. Review the embryological development of the brain, cerebellum, brain stem, glial elements, spinal cord, conus medullaris, cauda equina, sympathetic and parasympathetic systems and the peripheral nervous system.
2. Discuss the embryologic development of the skull, craniovertebral junction, and spine.
3. Describe and differentiate the different types of neurons.
4. Discuss the microanatomy of the neuron including the:
   a. cell body
   b. dendritic process
   c. axonal process
5. Diagram and describe the microanatomy of the synapse.
6. List the microglial elements and review their microanatomy:
   a. astrocytes
   b. oligodendrocytes
   c. microglia
16. Diagram the cerebral ventricles.
17. Discuss the major arachnoid cisterns.
18. Review the anatomy of the arachnoid villi.
19. Discuss the anatomic correlates pertinent to the production, flow, and reabsorption of cerebrospinal fluid.
   d. ependyma
   e. choroid epithelium
7. Diagram and describe in detail the carotid and vertebral arteries and their branches which provide blood supply to the face, scalp, skull, meninges, brain, brain stem, cerebellum, and rostral spinal cord.
8. Discuss in detail the arterial blood supply to the spinal cord. Include in the discussion the spinal and radicular arteries and the concept of watershed ischemia.
9. Identify and review the venous drainage of the central nervous system.
10. List and identify the bones of the skull.
11. Describe each of the sutures of the skull.
12. Identify each named foramen of the skull and list its contents.
13. Describe the anatomy of the meninges including the:
   a. dura mater
   b. arachnoid mater
   c. pia mater
14. Describe the anatomy of the dura including the falx cerebri and tentorium.
15. Review the layers of the scalp and discuss its innervation.

20. Identify and describe the gross anatomy of the spine including:
   a. atlas
   b. axis
   c. subaxial cervical vertebrae
   d. thoracic vertebrae
   e. lumbar vertebrae

f. sacrum
g. coccyx
h. intervertebral disc complex
i. supporting ligaments of the spine

21. List the muscles related to the skull and spine.
22. Describe the gross anatomy of the neck.
23. Discuss the anatomical basis for the blood-brain barrier in detail.

Central Nervous System

1. Describe the gross anatomy of the brain, brain stem, cerebellum, cranial nerves, and spinal cord in detail.
2. Describe the anatomy of the cerebral cortex in detail including:
   a. cortical layers
   b. sensory areas
   c. motor areas
   d. prefrontal cortex
   e. fiber tracts
   f. calcarine cortex
3. Describe the anatomy of the olfactory pathways, hippocampal formation and amygdala in detail including:
   a. rhinencephalon
   b. olfactory pathways
6. Describe the anatomy of the diencephalon in detail including:
   a. midbrain-dienencephalon junction
   b. caudal diencephalon
   c. epithalamus
   d. thalamus (including nuclei)
   e. thalamic radiations
   f. internal capsule
   c. anterior commissure
   d. hippocampal formation (including cytoarchitecture)
   e. amygdala
   f. limbic system
4. Describe the anatomy of the corpus striatum in detail including:
   a. striatum
   b. globus pallidus
   c. claustrum
   d. subthalamic region
   e. striatal afferent and efferent connections
   f. pallidal afferent and efferent connections
   g. pallidofugal fiber systems
5. Describe the anatomy of the hypothalmus and pituitary in detail including:
   a. cytoarchitecture of the hypothalmus
   b. afferent and efferent connections of the hypothalmus
   c. supraoptic nuclei and tracts
   d. hypophysial portal system
   e. anatomy of the pituitary stalk
   f. anterior and posterior pituitary
   g. cellular organization of the anterior pituitary
   h. hormonally active cells of the hypothalmus and pituitary
   g. visual pathways
7. Describe the anatomy of the cerebellum in detail including:
   a. cerebellar cortex including organization
   b. deep cerebellar nuclei
   c. cerebellar connections
   d. cerebellar peduncles

8. Describe the anatomy of the mesencephalon in detail including:
   a. superior colliculus
   b. inferior colliculus
   c. pretectal region
   d. posterior commissure
   e. mesencephalic nuclei
   f. oculomotor nerve
   g. tegmentum
   h. mesencephalic reticular formation
   i. substantia nigra
   j. crus cerebri
   k. ascending and descending tracts
9. Describe the anatomy of the pons in detail including:
   a. vestibulocochlear nerve
   b. facial nerve
   c. abducens nerve
   d. trigeminal nerve
   e. ascending and descending tracts
10. Describe the anatomy of the medulla in detail including:
   a. olivary nucleus
   b. medullary reticular formation
   c. cranial nerves of the medulla

Peripheral Nervous System

1. Differentiate between segmental and peripheral innervation.
2. Diagram the anatomy of the spinal nerve root.
3. Diagram and discuss the cervical, brachial, and lumbosacral plexi.
4. Outline the anatomy of the major peripheral nerves of the upper and lower extremity including:
   d. ascending and descending tracts
11. Review the location and connections of each cranial nerve nuclei. Trace the course of each cranial nerve from nucleus to end organ termination.
12. Describe the external topography and landmarks of the fourth ventricle.
13. Describe the anatomy of the spinal cord in detail including:
   a. nuclei and cell groups
   b. cytoacrchitectural lamination (Rexed laminae)
   c. somatic and visceral efferent neurons
   d. posterior horn neurons
   e. descending tracts
   f. ascending tracts
   g. upper and lower motor neurons
   h. somatotopic organization

Autonomic Nervous System

1. Distinguish pre- and postganglionic neurons.
2. Describe the sympathetic nervous system.
3. Describe the parasympathitic nervous system.
4. Review the visceral afferent fibers.
5. Describe the structure of the autonomic ganglia.
6. Discuss the central autonomic pathways.
   a. axillary
   b. suprascapular
   c. median
   d. ulnar
   e. radial
   f. long thoracic
   g. musculocutaneous
   h. lateral femoral cutaneous
   i. femoral

j. obturator
k. sciatic
l. saphenous
m. peroneal
n. tibial

5. Describe the microanatomy of the peripheral nerves in detail.
6. Explain the difference between myelinated and unmyelinated nerves.
7. Review the anatomy of the Schwann cell.
8. List the peripheral afferent receptors and describe the anatomy of each.
9. Segregate peripheral neurons by size and explain the rationale for such a classification scheme.

Muscle

1. Explain the concept of the motor unit.
2. Describe the anatomy of the motor end plate.
3. Describe the microscopic anatomy of striated and smooth muscle.
4. Discuss the subcellular components of muscle.
5. Describe the expected effects of ischemic or destructive lesions of the white matter tracts of the cerebrum.
6. Discuss the expected effect of destructive lesions of specific regions of the cerebral cortex.
7. Review the clinical presentation of strokes in the distribution of the supratentorial cerebral blood vessels.
8. Discuss the relationship of the spinal nerves to the vertebral level of exit.
9. Diagram the structures comprising the boundaries of the spinal neural foramina.
10. Discuss the clinical manifestation of injury for each of the major peripheral nerves.

Middle Level

1. Discuss the clinical presentation in anatomical terms of syndromes of the brain and its coverings including:
   a. epidural hematoma
   b. acute subdural hematoma
   c. chronic subdural hematoma
   d. subgaleal hematoma
   e. injury to innervation of the scalp
2. Discuss the syndromes produced by mass lesions affecting the cranial nerves including:
   a. suprasellar lesions
   b. lesion of jugular foramen
   c. lesion of internal auditory canal
   d. lesions or distortion at the incisura
3. Review the expected effects of stroke or mass lesion at different locations within the brain stem and cerebellum.
4. List the expected effects of destructive lesions in the basal ganglia and cerebellum.

11. Describe the anatomy and presentation of common entrapment syndromes of peripheral nerves including:
    a. thoracic outlet syndrome
    b. carpal tunnel syndrome
    c. ulnar nerve entrapment syndrome at wrist and elbow
    d. anterior interosseous syndrome
    e. posterior interosseous syndrome
    f. meralgia paresthetica
    g. peroneal nerve palsy
    h. tarsal tunnel syndrome
12. Describe the surgical exposure of common peripheral nerve entrapments including:

a. carpal tunnel
b. ulnar nerve at elbow
c. ulnar nerve at wrist
d. lateral femoral cutaneous nerve
e. peroneal nerve

13. Discuss the clinical presentation and neurological deficits associated with common lesions of and injuries to the spinal cord and nerve roots.

COMPETENCY-BASED PERFORMANCE OBJECTIVES

Middle Level:

1. Identify at the time of surgery:
   a. occipital artery
   b. superficial temporal artery
   c. frontalis muscle
   v. each named cerebral artery and vein
   w. components of the brain stem
   x. named structures on the floor of the fourth ventricle
   y. Foramina of Magendie and Luschka
   z. cerebral peduncles
   aa. components of the cerebellum
   bb. cerebellar tonsils
   cc. brachium cerebelli
   dd. vermis
   ee. major supratentorial gyri
   ff. supratentorial lobes
   gg. sylvian fissure
   hh. central sulcus
   d. pterion
   e. inion
   f. asterion
   g. coronal suture
   h. sagittal suture
   i. middle meningeal artery
   j. sagittal sinus
   k. transverse sinus
   l. foramen rotundum
   m. foramen ovale
   n. foramen spinosum
   o. superior orbital fissure
   p. jugular foramen
   q. internal auditory canal
   r. superior sagittal sinus
   s. sigmoid sinus
   t. incisura
   u. each cranial nerve

2. Identify at the time of surgery structures visible in the lateral ventricles including:
   a. Foramen of Monro
   b. fornix
   c. caudate
   d. thalamus
   e. choroidal fissure
   f. named veins
   g. glomus of the choroid plexus
   h. hippocampus

3. Identify the parts of the vertebral column, spinal cord, and nerve roots at the time of surgery including:
   a. spinous process
   b. lamina

c. superior facet
d. inferior facet
e. pedicle
f. pars interarticularis
g. uncovertebral joint
h. neural foramen and nerve root
i. nerve root ganglion
j. disc space
k. vertebral artery
l. dorsal column and lateral column of spinal cord
m. intradural afferent and efferent rootlets

NEUROPHYSIOLOGY

OBJECTIVE

Demonstrate knowledge of physiology that is pertinent to the understanding of neurological disease.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior and Middle Levels:

1. Review the basic biology of the nerves including:
   a. synthesis and movement of proteins in the nerve
   b. membrane potential and membrane properties
   c. ion channels
   d. generation and conduction of an action potential
2. Discuss synaptic transmission including:
   a. types of synaptic transmission
   b. transmitter release
   c. nerve-muscle transmission
   d. chemical messengers
   e. direct gated receptors
   f. second messenger linked receptors
3. Describe the physiology of the sensory systems including:
   a. sensory receptor physiology
   b. anatomy of somatic sensory system
   c. coding of modality specific sensory information
   d. pain and analgesia
   e. cortical integration of sensory perception
   f. visual system
      1. processing of information in the retina
      1. the anatomy of basal ganglia pathways
      2. processing of vision in the central visual pathways
      3. columnar units of visual cortex
      4. processing in the geniculate nucleus
      5. visual perception of motion and form.

   g. auditory system. Within this description review the processing of hearing in the cochlea and the central auditory pathways.
   h. olfaction and taste
4. Discuss the physiology of the motor system including:
   a. mechanisms of muscle contraction
   b. muscle receptors, spinal reflexes
   c. spinal reflexes concerned with position
   d. brain stem reflexes controlling motion
   e. vestibular nuclei control of movement and posture
   f. red nucleus control of movement
   g. cortical control of movement
   h. cerebellar control of movement
      1. regional and cellular organization of the cerebellum
      2. functional divisions of the cerebellum
      3. the role of the cerebellum in planning movement

   i. basal ganglia
      2. neural transmitters in the circuits within the basal ganglia

j. thalamus

5. Describe the attributes of the autonomic nervous system including both the sympathetic and parasympathetic systems.
6. Review the physiological basis of arousal and emotion. Include within this review the:
   a. noradrenergic systems
   b. limbic system. Include within this review the physiologic basis for emotion and memory
   c. sleeping and sleep states
   d. reticular activating system
7. Describe the higher cortical functions including:
   a. anatomy of language
   b. function of association cortex
8. Describe the physiological basis for cerebrospinal fluid production and reabsorption.
9. Review the physiological control of the cerebral vasculature.
10. Discuss, in detail, the physiology of the hypothalamus and pituitary, particularly as related to endocrinology.

NEUROPATHOLOGY

UNIT OBJECTIVES

Demonstrate knowledge of neuropathology that is pertinent to the diagnosis of diseases of the nervous system and practice of neurological surgery.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

General Neuropathology
Middle Level:

1. Describe the techniques available for examination of surgical specimens from central nervous system, peripheral nervous system, skeletal muscle, pineal and pituitary.
2. Review the use of standard chromatic, histochemical and selected immunohistochemical stains employed in the evaluation of surgical specimens from the central nervous system, peripheral nervous system, skeletal muscle, pineal and pituitary.
3. List the techniques available for morphological examination of cerebrospinal fluid and the abnormalities observed in cerebrospinal fluid from patients with meningeal carcinomatosis, meningeal lymphomatosis, pyogenic meningitis and aseptic meningitis.

Central Nervous System
Middle Level:

1. Describe the gross and histopathological features and, when applicable, the genetic basis of the following congenital and perinatal disorders:
   a. encephaloceles and cranial meningoceles
   b. myelomeningoceles and meningoceles
   c. hydromyelia
   d. diastematomyelia and diplomyelia
   e. syringomyelia and syringobulbia
   f. Chiari I malformation
   g. Chiari II malformation
   h. Dandy-Walker malformation
   i. arachnoid cysts
   j. porencephaly
   k. aqueductal stenosis
   l. subependymal germinal matrix hemorrhages
   m. posthemorrhagic hydrocephalus
   n. periventricular leukomalacia (white matter infarcts)
2. Describe the gross and histopathological features and characteristics of the causative agents of the following infectious diseases:
   a. cranial and spinal epidural abscesses

   b. cranial and spinal subdural abscesses

   c. pyogenic bacterial meningitis and ventriculitis

d. brain abscesses
e. tuberculous meningitis and tuberculomas
f. central nervous system sarcoidosis
g. central nervous system cryptococcosis
h. central nervous system mucormycosis
i. central nervous system toxoplasmosis
j. central nervous system cysticercosis
k. Herpes simplex encephalitis
l. central nervous system HIV infections
m. central nervous system cytomegalovirus infection

3. Describe the gross and histopathological features of the following vascular lesions:
a. acute, subacute, and remote infarcts
b. border zone and watershed infarcts
c. manifestations of embolic infarcts including those secondary to atheromatous embolization and embolization from extracoporeal pumps
d. vasculitis including temporal arteritis, primary central nervous system vasculitis, granulomatous angiitis, and Wegener's granulomatosis
e. moyamoya
f. hypertensive intracerebral hemorrhages
g. lobar intracerebral hemorrhages
h. amyloid angiopathy
i. malformations including arteriovenous malformations, cavernous angiomas, venous angioma and capillary telangiectases
j. Vein of Galen "aneurysms"
k. saccular aneurysms
l. infectious ("mycotic") aneurysms
c. ethanol intoxication
d. alcoholic cerebellar degeneration
e. central pontine myelinolysis
m. giant aneurysms
n. traumatic and dissecting aneurysms
o. venous and dural sinus occlusive disease
p. vascular malformations of the spinal cord
q. spinal cord infarcts

4. Describe the gross and histopathological features of the following traumatic lesions:
a. skull fractures
b. entrance and exit gunshot wounds of the skull
c. gunshot wounds of the brain including internal ricochet
d. epidural hematomas
e. acute subdural hematomas
f. chronic subdural hematomas
g. recent and remote cerebral contusions
h. traumatic intraparenchymal hemorrhages
i. diffuse axonal injury
j. traumatic cranial nerve injuries
k. spinal cord injuries
l. cerebral herniation syndromes
m. fat embolization
n. central nervous system trauma in infancy
o. central nervous system radiation injuries
p. manifestations of prior surgical intervention

5. Describe the gross and histopathological features and, when applicable, the metabolic basis for the following intoxications and deficiency states:
a. hypoxic-anoxic encephalopathy
b. carbon monoxide intoxication
f. CNS complications of diagnostic agents including contrast material
g. CNS complications of antimicrobial therapy

h. CNS complications of antineoplastic therapy
i. CNS complications of "street drugs"
j. Wernicke's encephalopathy and thiamine deficiency
k. Subacute combined degeneration and B12 deficiency

6. Describe the gross and histopathological features of the following demyelinating diseases:
a. multiple sclerosis
b. progressive multifocal leukoencephalopathy
c. HIV vacuolar myelopathy
d. postinfectious encephalomyelitis

7. Describe the gross and histopathological features and the metabolic basis for the following leukodystrophies:
a. adrenoleukodystrophy and adrenomyeloneuropathy
b. Krabbe's disease
c. metachromatic leukodystrophy

8. Describe the gross and histopathological features and, when applicable, the genetic basis for the following dementias and degenerations:
a. Alzheimer's disease including familial forms
b. vascular dementia including Binswanger's disease and cerebral autosomal dominant arteriopathy (CADASIL)
c. Pick's disease
d. other fronto-temporal dementias
e. Creutzfeldt-Jacob disease and other prion diseases
f. Parkinson's disease
g. diffuse Lewy body disease
h. Huntington's disease
l. colloid cysts
m. gliomatosis cerebri
n. gangliocytomas and gangliogliomas
o. dysembryoplastic neuroepithelial neoplasms
i. amyotrophic lateral sclerosis
j. paraneoplastic degenerative diseases

9. Describe the gross and histopathological features and, when applicable, the biochemical and genetic basis for the following metabolic diseases:
a. Wilson's disease
b. Tay Sachs disease and other GM-2 gangliosidoses
c. neuronal ceroid-lipofuscinoses
d. hepatic encephalopathy
e. Reye's syndrome

10. Describe the gross and histopathological features and, when applicable, the grading criteria for the following central nervous system neoplasms:
a. diffuse fibrillary astrocytomas
b. gemistocytic astrocytomas
c. anaplastic astrocytomas
d. glioblastoma multiforme including giant cell glioblastoma and gliosarcomas
e. pilocytic astrocytomas including cerebellar, diencephalic, dorsal exophytic pontine, and cerebral pilocytic astrocytomas
f. subependymal giant cell astrocytomas
g. pleomorphic xanthoastrocytoma
h. oligodendrogliomas including anaplastic oligodendrogliomas and mixed oligoastrocytomas
i. ependymomas including myxopapillary ependymomas
j. subependymomas
k. choroid plexus tumors
p. central neurocytomas
q. medulloblastomas
r. atypical teratoid/rhabdoid tumors

s. primitive neuroectodermal tumors and cerebral neuroblastomas
t. olfactory neuroblastoma
u. spinal paragangliomas
v. meningiomas including meningothelial (syncytial) fibrous, transitional, psammomatous, angiomatous, and papillary meningiomas
w. anaplastic and malignant meningiomas
x. meningeal hemangiopericytomas
y. other meningeal mesenchymal tumors
z. meningeal melanomatosis and melanomas
aa. hemangioblastomas
bb. lipomas
cc. primary central nervous system lymphomas
dd. metastatic carcinomas including leptomeningeal carcinomatosis
ee. teratomas
ff. dermoids and epidermoids
gg. schwannomas including acoustic neurinomas or vestibular schwannomas, schwannomas of other cranial nerves, and spinal root schwannomas

11. Describe the gross and histopathological features and the genetic basis for the following tumor syndromes:
a. Neurofibromatosis type 1
b. Neurofibromatosis type 2
c. von Hippel-Lindau syndrome
d. Tuberous sclerosis
b. craniopharyngiomas including adamantinomatous and squamopapillary craniopharyngiomas
c. Rathke pouch (cleft) cysts
d. pituitary involvement by metastatic neoplasms
e. lymphocytic hypophysitis
f. pituitary infarcts including pituitary "apoplexy"
e. Cowden syndrome
f. Turcot syndrome

Peripheral Nervous System

1. Describe the gross and histopathological features and, when applicable the genetic and biochemical basis for the following disorders of peripheral nerves:
a. compressive and traumatic neuropathies
b. Leprosy
c. diabetic and uremic neuropathy
d. Charcot-Marie-Tooth disease
e. Guillain-Barre syndrome
f. sympathetic dystrophy
2. Describe the gross and histopathological features of the following neoplastic and tumorous disorders of peripheral nerves:
a. peripheral schwannoma
b. neurofibromas
c. malignant peripheral nerve sheath tumors
d. spinal root and peripheral nerve root cysts

Pituitary and Pineal

1. Describe the gross and histopathological features of the following pituitary conditions:
a. pituitary adenomas including null cell adenomas, growth hormone secreting adenomas, prolactin secreting adenomas, ACTH secreting adenomas, and oncocytomas
g. pituitary lesions resulting from closed head trauma
h. empty sella syndromes
2. Describe the gross and histopathological features of the following lesions of the pineal:
a. germinomas
b. teratomas and embryonal carcinomas

c. pineoblastomas and pineocytomas
d. metastatic carcinoma

Skull and Spine (including intervertebral discs)

1. Describe the gross and histopathological features of the following disorders of the skull:
   a. dermoids and epidermoids
   b. hemangiomas
   c. osteomas
   d. chordomas
   e. solitary and multifocal eosinophilic granuloma
   f. Paget's disease including secondary osteosarcoma
   g. metastatic carcinomas
   h. plasmacytoma including myeloma
2. Describe the gross and histopathological features of the following disorders of the spine and intervertebral discs:
   a. herniated intervertebral discs
   b. pyrophosphate disease including involvement of ligamentum flavum
   c. tumoral calcinosis
   d. hemangiomas
   e. chordomas
   f. eosinophilic granulomas
   g. metastatic carcinomas including epidural metastases
2. Review the gross, histopathological, and cytopathological features that can be observed in shunt revision specimens.
3. Describe the gross, histopathological, and cytopathological features that can be observed with indwelling pump and intrathecal catheter specimens.
4. Cite the techniques for examination of foreign objects removed from the nervous system and the need for documentation of chain of custody when of potential legal significance.
5. Describe the histopathological features of myotonic dystrophy and central core myopathy and list the potential implications of these diseases with regard to adverse anesthetic reactions including development of malignant hyperthermia.

h. plasmacytoma including myeloma
i. lymphomas
j. primary bone tumors
k. spinal osteomyelitis including tuberculous and fungal spinal osteomyelitis

Eye and Orbit

1. Describe the gross and histopathological features of the following ocular lesions:
   a. retinoblastomas
   b. ocular melanomas
2. Describe the gross and histopathological features of the following orbital lesions:
   a. optic nerve gliomas
   b. optic nerve meningiomas
   c. orbital lymphomas and pseudotumors
   d. orbital metastases

Miscellaneous

1. List the gross and histopathological features found in temporal lobectomy and cerebral hemispherectomy specimens removed during epilepsy surgery.

NEUROPHARMACOLOGY

UNIT OBJECTIVES

Demonstrate knowledge of pharmacology that is pertinent to the treatment of neurological disorders and diseases which affect the nervous system.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Review basic cellular neurotransmission. In the course of this review discuss:
   a. the synapse
   b. membrane potentials
   c. ion pumps
   d. ion channels
   e. transmitter secretion
   f. transmitter identification
2. Define and discuss receptors and receptor pharmacodynamics including:
   a. receptor classification
   b. receptor identification
   c. dose response curves
   d. agonists and antagonists
   e. receptor modulation
3. Discuss the neurotransmitter acetylcholine in detail. Include within the context of the discussion:
   a. cholinergic receptor classification
   b. functional aspects of cholinergic receptors
   c. synthesis, storage, and release of acetylcholine
4. Discuss the catecholamine neurotransmitters (norepinephrine and dopamine) in detail. Include within the context of the discussion:
   a. biosynthesis of catecholamines
   b. storage and release of catecholamines
   c. anatomy of catecholamine receptors
   d. α and β adrenergic receptors
   e. dopaminergic receptors
5. Discuss the neurotransmitter serotonin in detail. Include within the context of the discussion:
   a. anatomy of serotonin receptors
   b. biosynthesis, storage and release of serotonin
   c. sub-types of serotonin receptors
6. Discuss the neurotransmitter glutamate in detail. Include within the context of the discussion:
   a. biosynthesis, storage and release of glutamate
   b. ionotropic glutamate receptors
      1. NMDA receptors and subunits
      2. non-NMDA receptors and subunits
   c. metabotropic glutamate receptors
      1. Group I metabotropic receptors and subunits

2. Group II metabotropic receptors and subunits
3. Group III metabotropic receptors and subunits

d. role in neurological disorders

7. Discuss the neurotransmitters GABA and glycine in detail. Include within the context of the discussion:
   a. synthesis, uptake, and release
   b. physiology and pharmacology
   c. clinically relevent agonists and antagonists of GABA and glycine receptors
8. Discuss the peptide neurotransmitters.
9. Describe the pharmacology of each of the drugs used to treat neurological disorders.

NEUROLOGY

UNIT OBJECTIVES

Demonstrate an understanding of the neurologic examination, diagnostic neurologic testing, neurologic diseases and their treatment.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior and Middle Levels:

1. Discuss electroencephalography (EEG). Recognize normal and abnormal EEG patterns. Identify specific epileptic conditions by EEG findings.
2. Describe the principles of sensory evoked potential testing (SEPs). Discuss how SEPs may be useful diagnostically.
3. List the indications for using intraoperative SEP monitoring and describe in detail how the procedure may be performed.
4. Describe the principles of visual evoked potential testing (VEPs). Discuss how VEPs may be useful diagnostically.
5. Describe the principles of motor evoked potential testing (MEPs). Discuss how MEPs may be useful diagnostically.
6. List the indications for using intraoperative MEP monitoring and describe in detail how the procedure may be performed.
7. Discuss electromyographic (EMG) testing in detail. Describe how the testing is performed and review the diagnostic capabilities of EMG testing. Describe the EMG changes associated with neuromuscular pathology.
8. List the indications for using intraoperative EMG testing and describe in detail how the procedure may be performed.
9. Discuss nerve conduction velocity (NCV) testing in detail. Describe how the testing is performed and review its diagnostic capabilities. List the transmission velocities of the major nerves. Describe NCV changes observed in neuropathy.
10. Define delirium and dementia. List the differential diagnoses for each.
11. Define and discuss coma and altered states of conciousness.
12. Describe the evaluation of a patient with syncope.
13. Describe the etiology and pathogenesis of cerebrovascular disease.
14. Review the clinical presentation and discuss the radiographic evaluation, clinical evaluation, and management of the following:
    a. transient ischemic attacks
    b. cerebral infarction

c. cerebral and cerebellar hemorrhage
e. venous infarction

15. Identify the primary causes of stroke in the pediatric population.
16. Comprehensively discuss the etiology, clinical presentation, diagnostic evaluation, and management of cerebral vasculitis.
17. Differentiate between basal occlusive disease with and without telangiectasia. Review the prognosis and treatment options for each.
18. Describe the acute and chronic effects of ionizing radiation on the central nervous system.
19. Review the diagnosis and management of pseudotumor cerebri.
20. Discuss the diagnosis and management of normal pressure hydrocephalus.
21. Discuss the management of hyperosmolar hyperglycemic nonketotic diabetic coma.
22. Review the neurological manifestations of altitude sickness.
23. List the neurological manifestations of decompression sickness.
24. Describe autism.
25. Review the general topic of chromosomal abnormalities as they may relate to the central nervous system including etiology, inheritance patterns, penetrance, and laboratory diagnosis.
26. List the major syndromes characterized by obesity and hypogonadism including Prader-Willi syndrome
27. Discuss agenesis of the corpus callosum
28. Discuss anencephaly, microencephaly, and megalencephaly.

d. subarachnoid hemorrhage

29. List the major disorders of amino acid and purine metabolism. Discuss the neurological manifestations of each.
30. Review each of the major storage diseases including:
    a. GM_1-Gangliosidoses
    b. GM_2-Gangliosidoses
    c. Fabry disease
    d. Gaucher disease
    e. Niemann-Pick disease
    f. Farber disease
    g. Wolman disease
    h. Refsum disease
    i. Cerebrotendinous Xanthomatosis
    j. Neuronal ceroid lipofuscinoses
31. Review each of the major leukodystrophies including:
    a. Krabbe leukodystrophy
    b. metachromatic leukodystrophy
    c. X-linked leukodystrophies with and without adrenal involvement.
32. Review each of the major mucopolysaccharidoses including:
    a. Hurler syndrome (MPS IH)
    b. Hunter syndrome (MPS II)
    c. Sanfilippo syndrome (MPS III)
    d. Morquio syndrome (MPS IV)
    e. Maroteaux-Lamy syndrome (MPS VI)
33. Review the disorders of carbohydrate metabolism including:
    a. glycogen storage diseases
    b. Lafora disease and other polyglucosan storage diseases.

34. Discuss hyperammonemia as it relates to neurological dysfunction.
35. Discuss adrenoleukodystrophy as it relates to neurological dysfunction including Reye=s syndrome.
36. Review the major syndromes of dysfunctional copper metabolism including:
    a. hepatolenticular degeneration (Wilson disease)
    b. trichopoliodystrophy (Menkes= syndrome)
37. Review the pathogensis, clinical presentation, diagnosis, and treatment of acute intermittent porphyria. List drugs to avoid in patients with porphyria (i.e., sulfa drugs, etc.).
38. Review the pathogensis, clinical presentation, diagnosis, and treatment of abetalipoproteinemia.
39. List the neurological disorders associated with xeroderma pigmentosum.
40. List the major cerebral degenerative disorders of childhood including:
    a. progressive sclerosing poliodystrophy
    b. spongy degeneration
    c. infantile neuraxonal dystrophy
    d. Hallervorden-Spatz disease
    e. Pelizaeus-Merzbacher disease
    f. Alexander disease
    g. Cockayne syndrome
    h. peroxisomal diseases
    i. Leigh disease
41. Review in detail the major neurocutaneous disorders including:
    a. neurofibromatosis, Type 1 and Type 2
    b. encephalotrigeminal angiomatosis
    c. incontinentia pigmenti
    d. tuberous sclerosis
42. Discuss Leber Herditary Optic Atrophy
43. Review the salient features of progressive external ophthalmoplegia.
44. Define peripheral neuropathy, polyneuropathy, mononeuropathy, mononeuropathy multiplex, and neuritis.
45. Review the major inherited neuropathies including:
    a. peroneal muscle atrophy
    b. Dejerine-Sottas disease
    c. Refsum disease
    d. hereditary sensory neuropathy
    e. porphyric neuropathy
46. Discuss the etiology, clinical presentation, diagnosis, treatment, and prognosis of Guillain-Barre syndrome.
47. List the major acquired neuropathies other than Guillain-Barre syndrome including:
    a. chronic demyelinating polyneuritis
    b. acute and chronic idiopathic sensory neuropathy
    c. acute pandysautonomia
    d. tick paralysis
    e. brachial neuropathy (neuralgic amyotrophy)
    f. radiation neuropathy
    g. cold neuropathy
    h. cryoglobin neuropathy
    i. diabetic neuropathy
    j. hypothyroid neuropathy
    k. acromegalic neuropathy
    l. vasculitic neuropathy
    m. uremic neuropathy

n. hepatic neuropathy
o. infectious neuropathies
    i. leprosy
    ii. acquired immunodeficiency virus
    iii. Lyme
    iv. herpes zoster
p. sarcoid neuropathy
q. paraneoplastic neuropathy
r. amyloid neuropathy
s. polyneuropathy associated with plasma cell dyscrasia
t. polyneuropathy associated with dietary deficiencies
u. neuropathy induced by metals
    1. arsenic
    ii. lead
    iii. mercury
    iv. thallium
v. drug-induced neuropathy
w. neuropathy produced by aliphatic chemicals

48. Discuss the major hereditary ataxias including:
    a. Friedreich ataxia
    b. Levy-Roussy syndrome
    c. hereditary cerebellar ataxia
49. Review the major noninherited forms of cerebellar ataxia including:
    a. acute cerebellar ataxia in children
    b. ataxia telangiectasia
    c. Marinesco-Sjögren syndrome
    d. Ramsay-Hunt syndrome
    e. Joseph disease
50. Discuss the pathophysiology, clinical presentation, treatment, and prognosis of Alzheimer=s disease, Pick disease, and diffuse Lewy body disease.
51. Define hemichorea and hemiballismus.
52. Review the pathophysiology, clinical presentation, treatment, and prognosis of Syndenham chorea, Huntington=s disease, and senile chorea.
53. Define myoclonus.
54. Review Tourette=s syndrome.
55. Review the major general and focal dystonic conditions.
56. Define benign essential tremor.
57. Discuss the pathophysiology, clinical presentation, diagnosis, treatments and prognosis of Parkinsonism in detail.
58. Define progressive supranuclear palsy.
59. Review the pathophysiology, clinical presentation, diagnosis, and treatment of tardive dyskinesia.
60. Discuss hereditary spastic paraplegia.
61. List the major generalized and focal forms of spinal muscular atrophy including:
    a. Wernig-Hoffmann disease
    b. Kugelberg-Welander syndrome
    c. benign focal amyotrophy
62. Describe the pathophysiology and neurological manifestations of poliomyelitis.
63. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of amyotrophic lateral sclerosis.

64. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of subacute combined degeneration of the spinal cord.
65. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of juvenile and adult myasthenia gravis.
66. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of botulism.
67. Review the common muscular dystrophies including:
    a. Duchenne muscular dystrophy
    b. fascioscapulohumeral muscular dystrophy
    c. myotonic muscular dystrophy
    d. myotonia congenita
    e. congenital muscular dystrophy
68. Review the major periodic paralysis syndromes including:
    a. familial periodic paralysis
    b. hypokalemic periodic paralysis
    c. hyperkalemic periodic paralysis
    d. paramyotonia congenita
69. Discuss polymyositis.
70. Review the epidemiology, pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of multiple sclerosis.
71. Define Marchiafava-Bignami disease.
72. Review central pontine myelinolysis in detail.
73. Discuss multiple system atrophy.
74. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of migraine headaches.
75. Discuss the diagnosis and management of non-migrainous headache syndromes.
76. Review the pathophysiology, clinical presentation, diagnosis, treatment, and prognosis of the common epileptic disorders in detail.
77. Define status epilepticus and discuss the medical treatment of same.
78. Describe the neurological implications of the common collagen-vascular diseases.
79. Describe the neurological implications of alcoholism.
80. Discuss the neurological aspects of pregnancy.
81. Review malignant hyperthermia.

NEURORADIOLOGY

UNIT OBJECTIVES

Demonstrate an understanding of neuroradiological imaging and interventions as they specifically relate to neurosurgical patients.
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COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Describe the precautions which should be taken when performing radiologic examinations.
2. Identify the normal anatomical structures of the skull on antero-posterior, lateral, Towne, and submental vertex radiographs.
3. List the indications for carotid and cerebral angiography.
4. Review the potential complications to intravenous contrast agents and discuss the management of same.
5. Identify the major arteries and veins of the neck and brain on angiograms.
6. Describe the concepts of computerized tomographic (CT) scanning.
7. Identify the normal anatomical structures of the scalp, skull, dura, brain, and cranial vasculature on CT scans.
8. Describe the concepts of magnetic resonance (MR) scanning. Review the various imaging sequences which may be obtained.
9. Identify the normal anatomical structures of the scalp, skull, dura, brain, and cranial vasculature on MR scans.
10. Recognize common traumatic injuries which may be detected by skull radiographs including:
    a. linear skull fractures
    b. depressed skull fractures
    c. pneumocephalus
    d. foreign bodies
11. Recognize common pathologic conditions which may be detected by skull radiographs including:
    a. neoplasms
    b. fibrous dysplasia
    c. congenital bone diseases
    d. metabolic bone disorders
    e. infections
12. Recognize common traumatic injuries which may be detected by head CT including:
    a. skull fractures
    b. pneumocephalus
    c. intracranial hematomas
        i. epidural
        2. acute subdural
        3. chronic subdural
        4. intraparenchymal
        5. intraventricular
    d. cerebral contusions

e. subarachnoid hemorrhage
f. foreign bodies

13. Recognize common pathologic conditions which may be detected by head CT including:
    a. ischemic infarction
    b. venous infarction
    c. hydrocephalus
    d. cysts
    e. tumors
    f. cerebral edema
    g. infections
    h. congenital abnormalities
    i. infections
14. Recognize common traumatic injuries which may be detected by head MR scans including:
    a. pneumocephalus
    b. intracranial hematomas
        i. epidural
        ii. acute subdural
        iii. chronic subdural
        iv. intraparenchymal
        v. intraventricular
    c. cerebral contusions
    d. diffuse axonal injury
15. Recognize common pathologic conditions which may be detected by head MR scans including:
    a. ischemic infarction
    b. venous infarction
    c. hydrocephalus
    d. cysts
    e. tumors
    f. cerebral edema
    g. vascular occlusions
    h. infections
    i. congenital abnormalities
16. Identify the normal anatomical structures of the craniovertebral junction on plain radiographs.
17. Review the radiographic diagnoses of platybasia and cranial settling.
18. Describe the plain radiographic findings of common traumatic injuries to the craniovertebral junction including:
    a. occipital condyle fractures
    b. atlanto-occipital dislocation
    c. Jefferson fractures
    d. posterior atlas fractures
    e. dens fractures
    f. axis body fractures
    g. hangman=s fracture
    h. atlas and axis facet fractures
    i. atlanto-axial rotatory dislocation
19 Distinguish between orthotropic and dystropic os odontoideum.
20. Describe the common congenital abnormalities of the craniovertebral junction.
21. Recognize common spinal congenital abnormalities on plain radiographs.
22. Recognize common spinal traumatic injuries which may be detected by plain radiographs including:
    a. vertebral body fractures
    b. facet fractures and dislocations
    c. posterior element fractures

d. transverse process fractures
e. vertebral subluxation/dislocation

23. Recognize common spinal degenerative conditions which may be detected by plain radiographs.
24. Discuss the indications for CT and MR scanning of the spine in the setting of trauma.
25. Describe the CT scan appearance of each of the traumatic spinal lesions previously listed.
26. Describe the MR scan appearance of:
:
a. spinal ligament injury
b. traumatic disc herniation
c. spinal cord contusion
d. spinal epidural hematoma

27. Recognize common spinal degenerative conditions which may be detected by MR including:
a. disc degeneration
b. disc herniation
c. degenerative spinal stenosis
d. facet hypertrophy
e. osteophyte formation
f. foraminal stenosis
g. degenerative spondylolisthesis
h. degenerative scoliosis
i. ossification of the posterior longitudinal ligament

28. Identify spinal and spinal cord tumors on CT and MR scans.
29. Discuss the indications for spinal myelography.
30. Review the indications for spinal angiography.
31. Discuss the use of both the radiographic contrast and radionuclide shuntogram in evaluating neurosurgical patients.

Middle Level:

1. Identify the common carotid and vertebral circulation congenital variants on angiograms.
2. Recognize intracranial aneurysms on angiograms.
3. Identify and characterize intracranial vascular malformations on angiograms. Recognize:
a. arteriovenous malformations
b. venous angiomas
c. arteriovenous fistula
d. feeding vessels
e. draining veins
f. associated aneurysms
g. degree of shunting
4. Discuss the angiographic evaluation of carotid and vertebral disease.
5. Review the role of MR angiography and venography in the evaluation of cerebrovascular disease, neoplasms, and trauma.
6. Describe the radiological evaluation of CNS vasculitis.
7. Describe the radiological evaluation of spinal vascular malformations.
8. Discuss the role of myelography in the evaluation of neurosurgical patients.
9. Discuss the radiological evaluation of suspected CNS and spinal infection.
10. Review MR neurography.
11. Describe the appearance of peripheral nerve tumors on MR scans.
12. Review the role of radionuclide scans in the evaluation of patients with suspected cranial and spinal disease.

13. Discuss the use of intraoperative radiographs and fluoroscopy.
14. List the indications for CT- and MR-guided biopsies.
15. Describe the concepts of ultrasonography.
16. Review the findings of normal and abnormal neonatal cranial ultrasound
17. Review the findings of normal and abnormal carotid ultrasounds.
18. Discuss the use of transcranial doppler ultrasonography in the management of patients with subarachnoid hemorrhage, trauma, and occlusive vascular disease.

Senior Level:

1. Review the indications for interventional endovascular therapies for:
   a. aneurysms
   b. vasospasm
   c. cranial vascular malformations
   d. spinal vascular malformations
   e. tumor embolization
   f. carotid and vertebral stenosis
   g. carotid and vertebral dissection
2. Describe the indications and techniques of endovascular trial occlusions.
3. Review the role of quantitative cerebral blood flow studies in the management of neurosurgical patients.
4. Describe the concepts of positron emission tomography. Review the indications for obtaining such scans.
5. Describe the concepts of functional MR imaging. Review the indications for obtaining such scans.
6. Describe the concepts of MR spectroscopy. Review the indications for obtaining such evaluations in neurosurgical patients.
7. Discuss the indications and technique of discography. Describe the procedure.
8. Discuss the indications for percutaneous vertebroplasty. Describe the procedure.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Order appropriate radiological evaluations in a timely fashion.
2. Complete radiological requisitions properly.
3. Demonstrate the ability to accurately interpret the radiographic studies of trauma patients.

Middle Level:

1. Demonstrate the ability to accurately interpret carotid and vertebral angiograms.
2. Demonstrate the ability to accurately interpret spinal angiograms.
3. Demonstrate the ability to accurately interpret spinal myelograms and post-myelogram CT scans.
4. Demonstrate the ability to accurately interpret cranial and spinal CT and MR scans of nontraumatic lesions.

Senior Level:

1. Demonstrate the ability to accurately interpret radiological examinations of neurosurgical patients.

2. Demonstrate the ability to use intraoperative ultrasonography.

FLUIDS, ELECTROLYTES, AND NUTRITION

UNIT OBJECTIVES

Demonstrate an understanding of normal and pathologic fluid and electrolyte homeostasis. Demonstrate an ability to maintain normal electrolyte balance. Demonstrate an understanding of the basics of nutritional management in neurosurgical patients.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior and Middle Levels:

1. Discuss the normal distribution of intracellular and extracellular fluid and electrolytes including:
   a. sodium and water distribution and metabolism
   b. clinical assessment of water and sodium balance and the concept of osmolality
   c. normal maintenance requirements
   d. management of pathologic conditions such as diabetes insipidus and the syndrome of inappropriate antidiuretic hormone secretion
   e. cerebral salt wasting
2. Review the potential implications of diuresis and fluid restriction on water and electrolyte balance.
3. Briefly review the potential clinical implications of calcium, phosphorous, and magnesium excesses and deficiencies and the treatment of same.
4. Review the criteria for nutritional assessment including:
   a. history of significant weight loss
   b. hypoalbuminemia
   c. impaired immune response including diminished total lymphocyte count and anergy
   d. physical signs of malnutrition
5. Briefly describe the metabolic responses to starvation and stress.
6. Describe and contrast the indications, contraindications, complications, and benefits of enteral and parenteral nutrition.
7. Analyze the implications of specific nutritional deficiencies as they relate to neurological and neurosurgical diseases.
8. Briefly review swallowing disorders.
9. Describe the common changes of metabolism and nutritional requirements of trauma patients and their evaluation.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior and Middle Levels:

1. Demonstrate an ability to manage the fluid and electrolyte requirements of neonatal, pediatric, and adult neurosurgical patients.
2. Demonstrate the ability to place central venous catheters.
3. Demonstrate the ability to place enteral feeding tubes.

4. Demonstrate an ability to prescribe appropriate parenteral and enteral nutrition.
5. Recognize and treat the complications of parenteral and enteral feeding including:
   a. line sepsis
   b. glucose intolerance
   c. diarrhea
   d. dehydration
6. Recognize swallowing disorders and manage same.

GENERAL CRITICAL CARE

UNIT OBJECTIVES

Demonstrate an ability to triage neurosurgical patients to and from a critical care setting. Demonstrate a knowledge of and the ability to manage neurosurgical patients in the critical care setting.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Define the adult and pediatric patient which would be best served in a critical care setting; include both medical and neurosurgical issues within the context of this discussion.
2. Review general medical issues pertinent to the management of neurosurgical patients in a critical care setting including:
   a. prophylaxis of gastrointestinal hemorrhage
   b. prophylaxis of pulmonary morbidity
   c. prophylaxis, diagnosis, and treatment of venous thrombosis and pulmonary embolism
   d. skin care
   e. eye care
   f. physical therapy to maintain strength and joint range of motion
   g. universal precautions
   h. workup and treatment of sepsis
3. Describe the indications and pharmacokinetics for medications commonly used in the management of critically ill neurosurgical patients including:
   a. vasoactive drugs
   b. ionotropic drugs
   c. bronchodilators
   d. diuretics
   e. antiarrhythmics
   f. antihypertensives
   g. antimicrobials
   h. anticonvulsants
4. Describe the clinical presentation, evaluation, and treatment of infections which commonly occur in critical care neurosurgical patients.
5. Review the indications for intubation including:
   a. loss of patient airway
   b. respiratory insufficiency
   c. inability to protect airway
6. Discuss commonly used pulmonary values including:
   a. measured pulmonary functions
      i. rate
      ii. minute ventilation

iii. spontaneous tidal volume
iv. forced vital capacity (FVC)
v. functional residual capacity (FRC)
vi. maximum ventilatory volume (MVV)

b. ventilator modes and settings
i. pressure versus volume ventilation
ii. continuous positive airway pressure (CPAP)
iii. intermittent positive airway pressure (IPAP)
iv. pressure support
v. assist control
vi. intermittent mandatory ventilation (IMV)
vii. positive end expiratory pressure (PEEP)
viii. rate
ix. tidal volume

7. Review the indications for weaning patients from ventilatory support. Describe the methods by which this is accomplished and the general pulmonary parameters a patient must demonstrate prior to extubation.
8. Discuss the medications used to improve pulmonary function.
9. Briefly review the following cardiac function parameters:
a. preload
b. afterload
c. contractility
10 Review the indications for implementing the following monitoring devices. Briefly describe how the information obtained is utilized to optimize patient management:
a. arterial catheters
b. central venous catheters
c. Swan-Ganz catheters
d. pulse oximetry
e. electrocardiographic monitoring
f. end-tidal CO_2 monitors
11. List the signs of acute myocardial ischemia and briefly discuss the emergent treatment of this condition.
12. Review the impact of renal insufficiency as it pertains to the management of neurosurgical patients.
13. Briefly discuss the diagnosis and management of acute renal insufficiency.
14. Describe the diagnosis and management of an ileus. List the differential diagnosis for an ileus.
15. Review the diagnosis and management principles of the following endocrine disorders:
a. hypo/hyperthyroidism
b. hypo/hyperparathyroidism
c. adrenal cortical excess and deficiency
d. diabetes mellitus
e. diabetes insipidus
16. Review the medical and legal definitions of brain death.
17. Discuss moral and ethical issues pertaining to critically ill neurosurgical patients including:
a. patient or family requests to withhold or withdraw treatment
b. organ donation.
18. Summarize the physiology of hydrogen ion production and excretion.
19. Briefly discuss acute and chronic buffering systems.
20. Discuss metabolic acidosis and alkalosis.
21. Discuss respiratory acidosis and alkalosis.

22. Review the effects of acid-base disturbances on the central nervous system and intracranial pressure.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior and Middle Levels:

1. Obtain ACLS and ATLS certification.
2. Demonstrate the ability to perform an initial evaluation and management of critically ill neurosurgical patients.
3. Perform the following procedures:
   a. orotracheal intubation
   b. nasogastric intubation
   c. bladder intubation
4. Serve on a trauma team.
5. Demonstrate an ability to manage neurosurgical patients in a critical care setting.
6. Diagnose and treat acid-base abnormalities in neurosurgical patients.
7. Demonstrate an understanding of the management of complex acid-base disturbances in the critical care setting.

Senior Level:

1. Oversee and direct the junior and middle level resident management of critically ill neurosurgical patients.

INFECTION

UNIT OBJECTIVES

Demonstrate an understanding of the factors related to the acquisition, diagnosis, and treatment of infections as they pertain to neurosurgical patients. Describe the typical presentation and treatment of common neurosurgical infections. Review the methods used to minimize infectious complications in neurosurgical patients. Demonstrate an understanding of the techniques to minimize the risk of spread of viral infections, including hepatitis and human immunodeficiency virus (HIV).

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior and Middle Levels:

1. List the common organisms responsible for meningitis in an age related fashion.
2. List the common CNS infections and describe the populations which are most at risk for each.
3. List the common opportunistic CNS infections and describe the populations which are most at risk for each.
4. Describe in detail the clinical and pathological symptoms and findings associated with CNS infections.
5. Discuss the radiological evaluation of patients with suspected and known CNS infections.
6. Review the indications for alerting individuals at risk for infections based on exposure to a patient with a known CNS infectious process.
7. Review each major class of antimicrobial drugs.
   a. describe the potential of resistance to each drug
   b. list the potential complications of each agent
   c. review the serological monitoring of each antimicrobial agent including the need for monitoring renal, hepatic, and hemopoietic function
   d. indicate which drugs will traverse the blood-brain barrier and which will not
   e. demonstrate a knowledge of the pharmacokinetics of each antimicrobial agent
   f. describe the potential complications of each antimicrobial drug and explain how to monitor for and detect same
   g. review the rationale for monitoring drug levels and list the therapeutic levels of antimicrobials commonly used to treat neurosurgical infections
8. Discuss the advantages and disadvantages of treatment of CNS infections with corticosteroids.
9. Review the role of anticonvulsant therapy in the management of CNS infections.
10. List the universal precautions for prevention of infection as they pertain to health care workers in general and neurosurgeons in particular.

11. Discuss the role of hand washing as the most important method of preventing infection.
12. Describe the role of the clinical epidemiologist in tracking infectious disease incidence and potential sources of infection within the hospital and community setting.
13. Review the mode of transmission, diagnosis, and treatment of non-CNS infections which may commonly arise in neurosurgical patients such as:
    a. respiratory infections
    b. urinary tract infections
    c. wound infections
14. Review the prevention, diagnosis and management of sepsis.
15. List the common sources of a postoperative fever.
16. Describe the workup for a febrile patient.
17. Discuss the use of prophylactic antibiotics.
18. Review the symptoms, clinical evaluation and management of patients with shunt infections.
19. Discuss prion disease and precautions to be taken when it is suspected.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior and Middle Levels:

1. Demonstrate the ability to use universal precautions.
2. Demonstrate the ability to use sterile technique.
3. Appropriately diagnose and treat non-CNS infections in neurosurgical patients.
4. Appropriately diagnose and treat CNS infections in neurosurgical patients.

PRACTICE MANAGEMENT, LEGAL AND SOCIOECONOMIC ISSUES

UNIT OBJECTIVES

Demonstrate an understanding of the principles of practice management and the business aspects associated with the delivery of health care.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior and Middle Levels:

1. Discuss the ethical and moral factors associated with the practice of neurosurgery.
2. Review the role of the neurosurgical leadership in the community and hospital setting.
3. Explain the neurosurgeon=s responsibilities in terms of health care cost containment.
4. Review the features and relationships of the healthcare system including:
   a. treatment facilities
   b. third party payment systems
      1. Medicare
      2. Medicaid
      3. employer-provided insurance
      4. private insurance
   c. physician practice organizations
   d. medical equipment manufacturers
   e. pharmaceutical companies
5. Recite the rules and regulations of the training hospital(s) as they pertain to the practice of neurosurgery in which the residency is performed.
6. Name the institutional and social service agencies in your community and review their role in the overall management of neurosurgical patients.
7. Demonstrate a knowledge of the rules and regulations of your State Medical Board.
8. Discuss the concept of informed consent.
9. Discuss mandatory reporting laws.
10. Discuss issues pertinent to the topic of the impaired physician.
11. Name and describe the local, regional, and national neurosurgical organizations including their purposes, roles, activities, and interactions.
12. Discuss the importance of tracking morbidity, mortality, and patient outcomes.
13. Review the career options available at the completion of neurosurgical residency in detail including:
    a. private practice
    b. academic practice
    c. subspecialty fellowship
    d. research
    e. administration
    f. military

14. Discuss post-residency fellowship training program availability, application process, and career usefulness.
15. Describe the types and characteristics of surgical practice organizations including:
    a. solo practice
    b. group practice
        1. partnership
        2. professional association
        3. corporation
    c. academic practice
    d. Health Maintenance Organizations (HMO)
        1. Preferred Provider Organizations (PPO)
        2. Individual Practice Associations(IPA)
        3. staff model (Kaiser-Permanente type)
    e. Federal
        1. Department of Veterans Affairs
        2. Military
        3. Public Health Service
16. Discuss hospital payment systems (e.g., DRGs, per diem rates) and describe their incentives and how they affect hospital profitability.
17. Discuss the role and influence of national quality oversight and review organizations for hospitals and health plans (JCAHO, NCQA).
18. Discuss the history, changes, eligibility, funding, and problems associated with the Medicare program.
19. Describe the Medicare program features, such as eligibility, funding, administration, federal-state relationship, benefits, and payment methods.
20. Discuss federal funding of graduate medical education and how current federal budget allocations and proposals for changes in funding affect or will affect neurosurgical training programs.
21. Discuss the significance of the following issues as they relate to the practice of neurosurgery:
    a. legislative/regulatory requirements
        1. Americans with Disabilities Act
        2. Clinical Laboratory Improvement Amendments (CLIA)
    b. Federal/professional regulatory institutions
        1. Health Care Financing Administration (HFCA)
        2. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
        3. Occupational Safety and Health Administration (OSHA)
    c. miscellaneous
        4. affirmative action
        5. equal opportunity
        6. sexual harassment
22. Discuss the common causes of malpractice actions and effective measures to reduce the risk of malpractice complaints.
23. Describe the ways, means, and reasons physicians influence the political process at the national, state, and local level.
24. Discuss the demographics of neurosurgeon distribution, numbers, workload studies, and workforce needs.
25. Outline the requirements for certification by the American Board of Neurological Surgery.
26. Formulate a strategy to evaluate personal and professional considerations in making a career choice.

27. Appraise the importance of family involvement in making career choices, including geographic location.

Senior Level:

1. Review the requirements to obtain certification from The American Board of Neurological Surgery.
2. Discuss the available opportunities to obtain continuing medical education credits.
3. Describe the political, economic, and social factors which impact on the practice of medicine generally and neurosurgery specifically.
4. Demonstrate a working knowledge of the International Classification of Diseases (ICD) and the Current Procedural Terminology (CPT) coding and analysis.
5. Discuss the concept of relative values units (RVUs).
6. Summarize the process of impairment determination as it relates to the neurosurgical patient population.
7. Review the availability, requirements, and application procedures for post-residency fellowship if appropriate.
8. Discuss the following issues as they relate to planned neurosurgical practice:
   a. healthcare delivery systems, including managed care
   b. health care economics
   c. political and legislative processes in healthcare
9. Obtain a demographic profile of potential practice locations to include population and medical demographics.
10. Outline the essential business characteristics of neurosurgical practice including:
    a. content and interpretation of financial reports
    b. income and expense statement
    b. management of human resources
    c. facility design and maintenance
    d. billing and collection processes
11. Discuss the key elements of a provider professional services agreement, such as a PPO or HMO contract, and identify provisions that require particular attention.
12. Describe the typical provisions and considerations in a physician employment contract including what to look for and what to avoid.
13. Describe, compare, and contrast partnership versus corporate practice structures, including the tax and liability advantages and disadvantages of each.
14. Describe the advantages and disadvantages of solo, single specialty group, and multispecialty group practice.
15. Review the financial issues associated with the neurosurgical career options under consideration.
16. Describe the administrative structures and processes required for managing an office practice including
    a. billing and collection for medical services
    b. financial accounting and reporting
    c. scheduling
    d. transcription
    e. medical record management
    f. appointment scheduling
    g. information system
    h. facility selection and maintance
    i. secretarial services
17. Describe the content, interpretation, and utilization of the following financial documents:
    a. balance sheet
    c. accounts payable and receivable

d. collection analysis

18. Discuss the insurance requirements associated with neurosurgical practice including:
    a. personal and professional liability
    b. personal health and disability
    c. casualty, fire, and theft
    d. personal life
19. Discuss the issues of quality assurance as related to neurosurgical practice including:
    a. maintenance of the clinical record
    b. review and documentation of morbidity and mortality
    c. risk management
20. Discuss the theory and organization of CPT coding, along with examples of complex procedural coding.
21. Describe the considerations in Evaluation and Management (E & M) coding, including documentation requirements.
22. Describe the work, practice expense, and malpractice expense components of Medicare=s Resource-based Relative Value Scale (RBRVS) and how they are derived.
23. Explain how Medicare and commercial payer conversion factors are derived and used to create a fee schedule from the RBRVS.
24. Describe commonly used methods of physician risk contracting, such as capitation payment, and explain the considerations in negotiating such a contract.
25. Describe the practice information necessary to safely and profitably manage a neurosurgical risk contract.
26. Review the features, similarities, and differences in various third party payment systems including
    a. Medicare
    b. Medicaid
    c. commercial insurance
    d. worker=s compensation
27. Contrast HMO and PPO health plans
28. Describe the meaning of Amanaged care≅ and its typical components including
    a. contractural discounts
    b. provider risk arrangements
    c. utilization management
    d. provider report cards
    e. practice guidelines
    f. restricted access models
        i. primary gatekeeper
        ii. point of service
        iii. open access
29. List and discuss the ethical issues and conflicts of interest involved in managed care treatment decisions such as:
    a. capitation reimbursement
    b. risk pools
    c. cost saving incentive bonuses
30. Discuss antitrust considerations faced by physicians in payer contract negotiations including the concepts of collective bargaining, price fixing, and group boycott
31. Describe types of retirement plans and funding considerations and limitations.

32. Explain the differences between occurrence and claims-made professional liability insurance and considerations made in selecting insurer and coverage levels.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior and Middle Levels:

1. Demonstrate an ability to interact effectively, professionally, and respectfully with:
   a. patients and their families
   b. fellow residents
   c. allied health care personnel
   d. hospital staff
   e. medical students
   f. faculty physicians
   g. referring physicians
2. Demonstrate the ability to maintain accurate and current medical records.
3. Discuss neurosurgical career options with:
   a. faculty
   b. peers
   c. family
   d. non-faculty neurosurgeons and other mentors
4. Accumulate information about post-residency career options.
5. Create and keep current a resume/curriculum vitae.
6. Record CPT codes for office visits and procedures performed on service.
7. Accurately document H&P and consultations according to the AMA-CPT E&M documentation guidelines.

Senior Level:

1. Demonstrate the ability to properly code neurosurgical activities.
2. Accurately assign and justify medical impairment ratings for neurosurgical patients.
3. Outline a post-residency career track.
4. Apply for post-residency fellowship if appropriate.
5. Obtain information about specific practice, research, or administrative career opportunities as appropriate.
6. Compose a list of questions to ask and things to see when interviewing for a neurosurgical position.
7. Read and interpret a financial report.
8. Design a structure for an office practice including a listing of the generic office processes and how to arrange staffing.
9. Prepare lists of neurosurgical instruments/equipment needed for specific operative procedures.
10. Select a proper practice, research, or administrative opportunity if appropriate.
11. Complete license and registration requirements for your chosen location.
12. Complete applications for hospital staff membership and clinical privileges.
13. Complete resident case data sheet for the American Board of Neurological Surgery and have same signed by Program Chair.

CEREBROVASCULAR SURGERY

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology and presentation of cerebrovascular diseases, including ischemic and hemorrhagic stroke, and other diseases and malformations of intracranial, extracranial, and spinal vasculature. Demonstrate the ability to formulate and implement a diagnostic and treatment plan for cerebrovascular diseases, including medical and surgical management.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Describe the anatomy of the extracranial and intracranial vessels, including the carotid, vertebral, and spinal arteries.
2. Describe the location of key perforating arteries involving the anterior and posterior circulation, their target distribution, and the consequence of occlusion or injury.
3. Review the anatomy of the venous circulation as it pertains to the central nervous system.
4. Identify the classic syndromes of vessel occlusion of the
   a. internal carotid artery
   b. middle cerebral artery
   c. anterior cerebral artery
   d. recurrent artery of Heubner
   e. anterior choroidal artery
   f. vertebral artery
   g. posterior inferior cerebellar artery (PICA)
   h. lower and upper basilar trunk
5. Identify the classic brain stem ischemic syndromes.
6. Explain the concepts of cerebral blood flow, cerebral autoregulation (hemodynamic and metabolic), ischemic thresholds, intracranial pressure, and cerebral perfusion pressure. Describe the impact of intracranial hypertension with and without mass lesion on cerebral blood flow.
7. Recognize the common causes of brain ischemic states including:
   a. cardiac embolism
   b. embolism from proximal vasculature
   c. large vessel occlusion
   d. intracranial conducting vessel occlusion
   e. small vessel disease
8. Associate computed tomography (CT) and magnetic resonance (MR) evidence of ischemic injury with likely anatomic substrate.
9. Describe the epidemiology, physiology, and underlying pathophysiology of ischemic brain injury, including concepts of critical therapeutic window.

10. Recognize the common causes of intracranial and intraspinal hemorrhage including:
    a. aneurysmal disease
    b. vascular malformations
    c. hypertension
    d. vasculopathies
    e. degenerative diseases
    f. hemorrhagic arterial infarction
    g. venous infarction.
11. Relate typical imaging characteristics of central nervous system hemorrhagic lesions to probable causes.
12. Categorize common causes of intracranial hemorrhage, subarachnoid hemorrhage, and ischemic stroke.
13. Explain the principles of fluid and electrolyte resuscitation and maintenance, respiratory physiology, cardiac physiology, and nutritional physiology, as applied to the neurological patient following ischemic or hemorrhagic stroke. Integrate this knowledge with the specific issues of the perioperative period.
14. Recognize the need for laboratory evaluation for systemic illness.
15. List the appropriate diagnostic neuro-imaging studies utilized to evaluate ischemic and hemorrhagic stroke.
16. Recognize the typical clinical course of patients with ischemic and hemorrhagic stroke, including peak risk intervals for edema, vasospasm, re-bleeding, etc.
17. Identify the periods of high vulnerability to systemic complications of cerebrovascular illness, including deep venous thrombosis, pulmonary embolism, bacterial pneumonia, aspiration, congestive heart failure, etc.
18. Explain the principles of augmentation of cerebral blood flow during cerebral vasospasm.
19. Discuss the principles and indications for medical, endovascular, and surgical interventions for ischemic and hemorrhagic stroke.
20. Relate the principles of timing of medical, endovascular, and surgical intervention in these same disease states.
21. Explain the principles, indications for, and complications of barbiturate coma.
22. Recognize the principles and interpretation of normal and common abnormal findings on skull, chest, and abdominal x-rays in the Critical Care Unit.
23. Describe the fundamentals of CT scanning, including the typical appearance of acute, subacute, and chronic blood, calcification, ventricular anatomy, and mass effect.
24. Describe the typical CT appearance of hemorrhagic and ischemic stroke. Provide a detailed explanation for the typical delay between the onset of stroke and appearance of confirmatory CT findings.
25. Explain the fundamentals of MR imaging. Distinguish between normal and abnormal findings within the realm of cerebrovascular disease. Recognize the classic MR appearance of:
    a. arteriovenous malformations
    b. venous angiomas
    c. cavernous malformations
    d. aneurysms
26. List the indications for non-invasive vascular imaging, including ultrasound, magnetic resonance angiography (MRA), and CT angiography. Recite the limitations of non-invasive studies.

27. Describe the practical application of commonly employed non-invasive studies, such as transcranial Doppler, in the setting of cerebral vasospasm.
28. List the indications for catheter angiography. Interpret the findings of angiography in ischemic and hemorrhagic cerebrovascular conditions. Identify the key segments of the internal carotid artery including the upper cervical, petrous, cavernous, and supraclinoid components.
29. Recite the principles of localizing focal intracranial and spinal vascular pathology by the use of traditional topographic measurements and the application of stereotactic guidance.
30. Describe the surgical anatomy and the principles of exposure of the cervical carotid artery.
31. Describe the principles of pterional craniotomy, including scalp and bony anatomy, as well as the anatomy of the sphenoid ridge.
32. Explain the principles of cerebrovascular surgery detailed in the previous objectives to medical students and allied health personnel during conferences.

Middle Level:

1. Recognize controversies regarding the basic neuroscience knowledge concepts mastered during junior residency.
2. Explain the principles of ischemic neuronal protection and salvage.
3. Review the principles of guideline development and outcome assessment related to the basic knowledge objectives achieved during junior residency.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

4. Display an understanding of the principles of hypothesis development and testing, and statistical analysis as applied to clinical research trials, as well as the critique of scientific manuscripts.
5. Recognize areas of controversy related to management protocols in cerebrovascular patients achieved during junior residency.

Senior Level:

1. Demonstrate a sophisticated understanding of current literature related to basic neuroscience knowledge objectives acquired as a junior and middle resident. Define scientific hypotheses in relationship to controversies and evolving knowledge regarding these same objectives and demonstrate the ability to interpret and adapt new knowledge to evolving patient-care paradigms.
2. Demonstrate a mature fundamental knowledge in clinical and teaching conferences, specialty conferences, and in publications and scientific presentations.
3. Understand the guidelines, protocols, and literature controversies regarding the diagnostic imaging modalities available in cerebrovascular disease.

Junior Level:

1. Perform a comprehensive neurological history and clinical examination.
2. Perform a comprehensive systemic evaluation.
3. Adapt comprehensive evaluation to specific pertinent positives and negatives with regard to ischemic and hemorrhagic stroke.
4. Demonstrate an understanding of urgency and the ability to prioritize during emergent aspects of hemorrhagic and ischemic disease states.
5. Demonstrate the ability to manage cardiac and pulmonary complications following cerebrovascular illness and therapy, and review the need for specialty and subspecialty consultations.
6. Apply the principles of perioperative care following common endovascular and surgical procedures directed at cerebrovascular disease.
7. Demonstrate the ability to be vigilant in the clinical detection of subtle neurological change during the acute and subacute phases of illness.
8. Demonstrate the ability to place an arterial catheter , central venous catheter, and pulmonary artery catheter. Perform placement of a ventricular catheter via a burr hole or twist-drill craniostomy.
9. Perform lumbar puncture and cerebrospinal fluid (CSF) reservoir tapping.
10. Define the proper placement of a craniotomy flap in the planned surgical evacuation of hematoma. This should be performed using both topographical as well as stereotactic-assisted navigation techniques.
11. Assist in the opening, exposure, and closure of cervical carotid procedures.
12. Assist during pterional craniotomy for vascular disease.
13. Assist in the performance of intracranial hematoma evacuation.
14. Demonstrate the ability to keep accurate and timely records.

7. Display independence in making decisions regarding the critical care of cerebrovascular patients. Recognize the need for reporting to senior resident and attending staff such decisions.

Middle Level:

1. Perform pterional craniotomy for vascular disease.
2. Demonstrate the ability to make independent management decisions regarding ischemic and hemorrhagic stroke states.
3. Supervise care delivered by PGY1 and junior resident physicians for cerebrovascular patients.
4. Demonstrate efficient prioritization skills for clinical assessment of multiple simultaneous problems in the same or different patients. Display a clear sense of prioritization regarding timing and urgency of medical and surgical intervention for ischemic and hemorrhagic stroke states. Recognize the impact of systemic conditions on prioritization and timing issues.
5. Correctly interpret and respond to changes in patient status related to systemic and neurological parameters.
6. Implement patient-care protocols regarding perioperative management.

8. Demonstrate the ability to obtain appropriate medical and surgical consultation.
9. Display skills in prioritization of diagnostic interventions, including the choice and sequence of studies in the setting of ischemic and hemorrhagic states.
10. Interpret invasive and noninvasive diagnostic imaging studies in relationship to cerebrovascular disease.
11. Formulate preliminary and surgical planning.
12. Perform frameless navigation procedures.
13. Perform routine and complicated twist drill or burr-hole procedures for the drainage of the ventricular system or intracranial hematomas.
14. Perform exposure of the cervical carotid artery for endarterectomy or proximal arterial control.
15. Observe and assist in the performance of plaque removal and arterial closure during carotid endarterectomy.
16. Practice microsurgical techniques in the laboratory setting.
17. Demonstrate a mature understanding of the planning and performance of pterional craniotomy for intracranial vascular pathology. Perform pterional craniotomy with initiation of microsurgical clinical skills. Observe the microsurgical dissection of the Sylvian fissure and basal cisterns for vascular pathology.
18. Perform the surgical approach to vascular structures via a craniotomy other than pterional.
19. Supervise and assist junior residents in burr-hole and twist-drill procedures for ventricular access or intracranial pressure monitoring.
20. Realize an increasingly progressive teaching responsibility to medical students, interns, and junior residents in the various educational objectives of the cerebrovascular curriculum.
21. Supervise the junior residents in the technical performance of cerebrovascular procedures, as well as critical-care catheter procedures commensurate with their level of expertise.
22. Organize clinical and teaching rounds and conferences, as well as the presentation of cases.
23. Prepare topic reviews in lecture and manuscript formats, including literature summaries and reference compilations.

Senior Level:

1. Review fundamental concepts of cerebrovascular disease during conferences and clinical rounds with the house staff and medical student.
2. Demonstrate a mature clinical judgment related to the spectrum of problems encountered in hemorrhagic and ischemic stroke states.
3. Formulate independent plans for patient assessment and management, including prioritization in cerebrovascular disease while maintaining a clear reporting relationship with faculty.
4. Supervise house staff and medical student team in daily patient assessment and care.
5. Identify the indications and controversies of endovascular catheter procedures, perioperative management, and follow-up. Implement and supervise patient care protocols related to these procedures.

6. Display a mature and detailed understanding of indications, principles, and interpretation of the full spectrum of neurodiagnostic armamentarium. Formulate independent management plans based on sophisticated interpretation of diagnostic studies for concise presentation to faculty.
7. Apply evolving technology and new methods to patient protocols and the education of house staff and medical students.
8. Demonstrate a mature understanding of surgical strategies and approaches to common and unusual vascular disease.
9. Apply the principles of intraoperative anesthetic management, proximal and distal control, temporary arterial occlusion, brain protective strategies, and intraoperative localization as applied to vascular disease.
10. Complete the planning, positioning, and execution of pterional craniotomy for common vascular disease.
11. Perform microsurgical dissection of the Sylvian fissure and exposure of the basal cisterns for vascular disease.
12. Perform microsurgical exposure and clipping of intracranial aneurysm.
13. Complete the planning, positioning, and execution of non-pterional craniotomy for intracranial vascular disease.
14. Assist in the microsurgical management of highly complex cerebrovascular disease.
15. Plan and execute the craniotomy for the evacuation of intracranial hematomas.
16. Supervise other house staff in meeting their surgical objectives.
17. Describe the exposure and treatment of intraspinal vascular lesions. Assist in such operations.
18. Oversee all aspects of patient care, identification of appropriate cases for database analysis, morbidity, mortality, conferences, and discussions. Supervise medical students and house staff in every aspect of patient care.
19. Report appropriate patient care issues to responsible faculty members in a timely fashion.
20. Organize and administer teaching conferences.
21. Display mature participation in specialty conferences.
22. Assign responsibilities to junior residents and residents, with the aim of fulfilling their respective educational objectives.

NEUROSURGICAL ONCOLOGY

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology, and presentation of tumor-related diseases of the cranium. Demonstrate the ability to formulate and implement a diagnostic and treatment plan for tumor-related diseases of the cranium that are amenable to surgical intervention.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Summarize the epidemiology, incidence, and risk factors for intracranial neoplasms.
2. Summarize the tenets of tumor biology including genetic factors and biochemical processes associated with invasion. Describe the natural history of intracranial neoplasms.
3. List a differential diagnosis of lesions requiring biopsy and describe their pathophysiology.
4. List the various types of bone tumors involving the calvarium.
5. Describe and differentiate:
   a. astrocytomas, including the accepted World Health Organization (WHO) grading scheme
   b. gliomas other than astrocytomas
   c. metastatic tumors, including location and common origins
   d. infectious, granulomatous, and cystic lesions that may present in a tumor-like manner
6. Define the cell or origin of meningioma, its common intracranial locations, and the expected presentation for each location.
7. Define the embryological origin of arachnoid cysts and their natural history; list the etiologies of other cystic lesions of the brain, including tumoral and infectious.
8. Describe the anatomic location, cell of origin, clinical presentation, age at presentation, and natural history of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma.
9. a. describe the anatomy of the posterior fossa and the relation of the cranial nerves to the brain stem and skull
   b. illustrate the relationship of the facial, vestibular, and cochlear components of the acoustic nerve at the internal auditory meatus
   c. describe the various tumors that may arise in the cerebellopontine angle (CPA)
10. Describe the management of a patient with a brain abscess, including the role of stereotactic drainage or open drainage.

11. Explain the medical workup of a patient with a diagnosed brain abscess.
12. Specify the follow-up and evaluation of the patient with a brain abscess following surgical treatment.
13. Describe the embryological origin of craniopharyngioma. List the common locations of the tumor.
14. Describe the common presentations of pituitary tumors, the cell of origin, and endocrinopathies associated with:
    a. null cell adenomas
    b. somatotrophic adenomas
    c. prolactinomas
    d. corticotrophic secreting adenomas
    e. thyrotrophic-secreting adenoma
15. Define the medical management of the secreting pituitary tumors. Explain the role of surgery in each of the tumors above.
16. Describe the etiology of fibrous dysplasia, its presentation and general management. List the indications for surgery for benign tumors of bone at the base of the skull, and potential adjuvant therapy.
17. List the tumors that may be routinely approached through a transtemporal route.
18. Describe the indications for use of lumbar spinal drainage in skull base surgery, and its implementation. List all complications associated with continuous lumbar spinal drainage.
19. Illustrate the general principles of stereotaxis and the underlying localization techniques used in the presently used frame-based and frameless systems.

Middle Level:

1. Describe appropriate postoperative management with drainage of brain abscess or cyst.
2. Describe the appropriate surgical management and postoperative treatment of bony skull lesions.
3. Describe the role of surgery in arachnoid cysts, infectious cysts, and tumor-related cystic lesions. Describe the adjuvant treatment of parasitic cysts.
4. Explain the rationale and indications for various skull base approaches to the anterior, middle and posterior cranial fossae. Identify the important anatomical landmarks for each approach. Illustrate the general principles used in prophylaxis of CSF leaks employed in skull base surgery.
5. Describe the neurosurgical management for the following tumors involving the anterior cranial fossa:
    a. meningioma
    b. fibrous dysplasia
    c. esthesioneuroblastoma
    d. osteoma of the frontal sinus
    e. chondroma, chordoma
    f. mucocele
    g. bony metastasis.
6. Explain the use of the balloon occlusion test of the carotid artery, its indication for use in skull base tumor surgery, how it is performed, and how the information gained influences surgical management.
7. Explain the surgical advantage of transposing the facial nerve during a transtemporal skull base approach.

8. Describe the transcondylar approach, the relationship of the lower cranial nerves, and the exposure gained over a routine suboccipital craniectomy.
9. Illustrate the transpetrosal approach and the relationship of the transverse and sigmoid sinuses with skull bony landmarks such as the asterion, mastoid and inion.
10. Describe the intradural course of the trochlear nerve, trigeminal nerve through Meckel=s cave and the abducens nerve and Dorello=s canal.
11. Describe the surgical management of the frontal sinus which has been exposed during craniotomy for anterior skull base surgery. Illustrate the development and use of a frontal vascularized pericranial flap and explain its indication. Similarly, illustrate the use of a myocutaneous flap of the temporalis muscle and list the locations for application.
12. Describe the general methods employed for embolization of tumors of the head and neck, and the indications for such procedures.
13. Compare and contrast the methods for stereotactic radiation, including particle beam, gamma ray or linear accelerator, and the indications for each technique

Senior Level:

1. Describe the indications for transcranial orbitotomy and list the lesions which require this approach.
2. Discuss the surgical management and postoperative treatment of astrocytomas, gliomas other than astrocytomas, metastatic brain tumors, infectious
9. Explain the management goal for a patient with craniopharyngioma, and the risks of surgical treatment

granulomas, and cystic lesions presenting in a tumor-like manner. Review the role of radiotherapy, chemotherapy, and other adjunctive treatments of these neoplasms.

3. Describe the role of surgery for intracranial meningioma, and the relation between the surgical option and location of tumor. Discuss adjuvant treatments of meningioma and their efficacy.
4. Discuss the surgical treatment of common intrinsic posterior fossa neoplasms, including cerebellar astrocytoma, medulloblastoma, and ependymoma including the role of ventricular drainage, and surveillance imaging. Present adjuvant treatment options and outcomes for the various posterior fossa intrinsic tumors.
5. Address the surgical goals of treatment, complications of surgical treatment, and adjuvant therapy for posterior fossa meningioma.
6. List and illustrate the various approaches for removal of a vestibular schwannoma, and the rationale and indication for each approach.
7. Describe the role of stereotactic radiosurgery and microsurgery in the management of vestibular schwannoma.
8. List the various approaches to the midline clivus and review the indications for each approach. Outline the surgical and medical management of tumors of the clivus and midline skull base.

and conservative treatment. Describe the various surgical approaches used to resect craniopharyngiomas

and the options for adjuvant treatment, including radiotherapy and chemotherapy (systemic and local).

10. Illustrate the transnasal-transphenoidal approach and its indications. Define the options for treatment of recurrent pituitary tumors of all types (including medical management). Describe the risks of the approach and the management of the complication of CSF leak.
11. Illustrate the various skull base approaches to the anterior, middle and posterior cranial fossae in detail, explaining the key anatomical landmarks and strict indications for the approach. List the complications relevant to each approach and the management of each complication.
12. List a differential diagnosis of orbital tumors, their usual location within the orbit, medical and surgical management of the tumor and the approach used to remove the tumor if indicated.
13. List the various tumors and their location in which an orbitocranial approach may be indicated for their removal.
14. Compare and contrast the exposure offered by the pre- and postauricular infratemporal approach, and the indications for each approach.
15. Illustrate transposition of the facial nerve during a transtemporal skull base approach.
16. Describe the location of meningiomas intracranially which are amenable to preoperative embolization.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Perform a complete history and physical examination on patients with intracranial neoplasms.
2. Review appropriate radiographic studies with a radiologist and formulate a differential diagnosis for patients with intracranial neoplasms.
3. Prepare patients for cranial tumor surgery.
4. Understand the positioning of patients for craniotomy and craniectomy.
5. Assist in the opening and closing of craniotomies and craniectomies for neoplasms.
6. Place lumbar drains.
7. Demonstrate the ability to open and close scalp incisions.
8. Perform ventriculostomies.
9. Demonstrate proper postoperative wound care.

Middle Level:

1. Independently determine a differential diagnosis based on the patient=s history, physical examination, and radiographic studies.
2. Position patients for craniotomy and craniectomy.
3. Perform the opening and closing of craniotomies and craniectomies.
4. Assist in the resection of intracranial neoplasms.
5. Resect skull lesions.
6. Operatively treat supra- and infratentorial brain abscess.

7. Demonstrate the ability to manage postoperative complications including but not limited to:
   a. brain edema
   b. meningitis
   c. cranial flap infection
   d. postoperative seizures
8. Assess the need for appropriate pre-, intra-, and postoperative monitoring.
9. Obtain proper nonneurosurgical consultation in tumor patients.
10. Identify patients requiring rehabilitation services.
11. Utilize appropriate support agencies and groups for patients with intracranial neoplasms.

Senior Level:

1. Demonstrate the capability to function independently in all phases of management of patients with intracranial neoplasms.
2. Perform resection of supra- and infratentorial intra-axial and extra-axial neoplasms.
3. Perform resection of pituitary lesions.
4. Perform or serve as first assistant for skull base procedures.
5. Oversee the pre- and postoperative management of patients with intracranial neoplasms.
6. Assume teaching responsibilities for junior residents as assigned.
7. Assume responsibility for managing the pyschosocial aspects of intracranial neoplasms.

NEUROTRAUMA AND NEUROSURGICAL CRITICAL CARE

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology, and presentation of traumatic injuries of the brain, spinal cord, and peripheral nervous system, including their supporting structures. Demonstrate the ability to formulate and implement appropriate diagnostic and treatment plans for traumatic injuries to the nervous system, including both surgical and nonsurgical management.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Describe the systematic assessment of polytrauma patients.
2. Rank management priorities in polytrauma patients appropriately.
3. Discuss principles of resuscitation of polytrauma patients including appropriate fluid resuscitation, and explain the anticipated effects of shock and resuscitation on fluid shifts and on electrolyte balance.
4. Name an initial choice for intravenous fluids for a newly admitted Intensive Care Unit (ICU) patients with the following diagnoses and explain changes in that choice based upon specific changes in the patient=s diagnosis, clinical condition, electrolyte and volume status.
   a. head injury
   b. stroke
   c. tumor
   d. infection
   e. hydrocephalic
5. Propose appropriate initial ventilator settings for patients with different types of common neurosurgical conditions and explain changes in that choice based upon specific changes in the patient=s metabolic or pulmonary status.
6. List the mechanisms of action and potential complications of commonly used pressors and hypotensive agents.
7. Discuss indications, pharmacologic mechanism, duration of action, and effect on the neurologic examination for sedative, paralytic, and analgesic agents commonly used in the ICU.
8. Explain the indications, advantages, and risks for various hemodynamic monitoring tools (e.g., pulmonary artery catheters, indwelling arterial lines) used in critically ill patients.
9. Discuss the pathophysiology and management of coagulopathy after head injury.
10. Describe basic principles of nutritional management in neurosurgical critical care.
11. Explain the treatment of posttraumatic seizures.

12. Outline basic principles of ICU management of patients with spinal cord injury.
13. Name the major structures supplied by the major vessels of the brain and spinal cord.
14. Discuss the evaluation, treatment, and prognosis of subarachnoid hemorrhage, both traumatic and spontaneous.
15. Explain the pathophysiology and treatment of cerebral vasospasm.
16. Formulate a diagnostic and treatment plan for patients with cerebral ischemia.
17. Explain the evaluation and management of birth-related intracranial hemorrhage, spinal cord injury, and brachial plexus injury.
18. Describe a systematic approach to the examination of the peripheral nervous system.
19. Describe basic principles of management of peripheral nerve injuries.
20. List principles of rehabilitation of different types of neurosurgical patients.
21. Define brain death and discuss methods of making such a diagnosis.
22. Describe the pathophysiology of electrical injuries to the nervous system and review treatment of same.

Middle Level:

3. Describe the pathophysiology of intracranial hypertension and explain a plan for its management, including arguments for and against various treatments.

Senior Level:

1. Discuss management priorities in polytrauma patients with severe neurological and systemic trauma

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Perform and document pertinent history, physical findings, and radiologic findings in a polytrauma patient.
2. Differentiate central from peripheral nervous system injuries.
3. Insert intravascular monitoring devices for use in the hemodynamic management of critically ill patients, including central venous lines, pulmonary artery catheters, and arterial catheters.
4. Insert intracranial pressure monitoring devices, including ventriculostomy catheters and electronic (fiberoptic or miniaturized strain gauge) devices.
5. Perform twist-drill or burr-hole drainage of subdural fluid collections.
6. Decide appropriately which patients require emergency craniotomy and other procedures.
7. Position patients appropriately for procedures/surgery and begin emergency procedures if more experienced neurosurgeons have not yet arrived.
8. Assist with opening and closure of craniotomies.
9. Perform elective tracheotomies and be able to perform emergency tracheotomies.
10. Be able to intubate patients in both emergency and elective situations.

Middle Level:

1. Perform the following surgical procedures in uncomplicated cases:
   a. craniotomy for subdural and/or epidural hematoma
   b. craniotomy for penetrating head injury
   c. craniotomy for intracerebral hematoma or contusion
   d. craniotomy for depressed skull fracture
   e. decompressive craniectomy
   f. repair/cranialization of frontal sinus fracture
   g. craniotomy/craniectomy for posterior fossa epidural, subdural, or intracerebral hematoma
   h. simple cranioplasty
2. Manage traumatic skull base fractures with CSF leak.
3. Manage infections associated with open CNS injuries.

Senior Level:

1. Perform the above procedures (listed under #1 for AMiddle Level≅) in complicated cases.
2. Reconstruct complex cranial defects, with assistance from other specialties as indicated.
3. Reconstruct traumatic skull base defects, with assistance from other specialties as indicated.
4. Explore and repair peripheral nerve injuries.
5. Supervise and teach junior and middle level residents with cases appropriate for their level.
6. Lead the critical care team in the treatment of patients with neurological injuries, either in isolation or in polytrauma patients.

PAIN MANAGEMENT

UNIT OBJECTIVES

Illustrate an understanding of the anatomical and physiological substrates of pain and pain disorders. Demonstrate an ability to formulate and execute diagnostic and therapeutic plans for management of pain and disorders giving rise to pain.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Describe the anatomy and physiology of nociception within the peripheral and central nervous system.
2. Differentiate the basic categories of pain syndromes:
   a. acute
   b. chronic
   c. nociceptive
   d. neuropathic (including complex regional pain syndromes)
   e. myofascial
   f. cancer-related
   g. postoperative
3. Explain the concept of pain as a biopsychosocial disorder.
4. Discuss the role of rehabilitation in pain management.
5. Describe methods for assessing pain in pediatric patients.
6. Discuss ethical standards in pain management and research.
7. Discuss methods of assessing outcomes of pain treatment and describe common assessment tools.
8. Describe a typical history of a patient with trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain.
9. Diagram the anatomy of the following: trigeminal nerve divisions (ophthalmic, maxillary and mandibular nerves), foramen ovale, Meckel=s cave, trigeminal (gasserian) ganglion, cistern of Meckel=s cave, retrogasserian root, descending tract and nuclei, nervus intermedius, glossopharyngeal nerve.
10. Illustrate the appropriate medical management of patients with trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain.
11. Discuss the potential complications of percutaneous procedures for trigeminal neuralgia.
12. Describe the brain stem anatomy and physiology of the spinothalamic and trigeminothalamic systems.
13. Describe the anatomy of the primary sensory cortex (S1), Rolandic fissure, and the relationship of S1 to the primary motor cortex.
14. Describe the functional anatomy of the following thalamic nuclei: ventral posterolateral (VPL), ventralis caudalis externus (Vce), ventral posteromedial (VPM), and ventralis caudalis internus (Vci). Review the

functional anatomy of the medial thalamic nuclei (e.g., n. parafascicularis).

15. Identify the primary indications for spinal cord stimulation, peripheral nerve stimulation, and intraspinal (epidural, intrathecal) drug infusion therapy.
16. Diagram the spine anatomy pertinent to SCS and intraspinal drug administration, including the spinous process/interspinal ligament/spinous process complex, ligamentum flavum and dorsal epidural space. Review the different degrees of angulation of the spinous processes at various spine levels in the cervical and thoracic area.
17. Diagram the spinal cord anatomy pertinent to spinal ablative procedures for pain management.
18. Recognize complications arising from implantation of pulse generators/receivers and infusion pumps.
19. Describe the anatomy of the major peripheral nerves, brachial plexus, and lumbosacral plexus.
20. Describe the anatomy of the sympathetic nervous system and explain its role in pain.
21. List the common mechanisms of peripheral nerve injury and describe the changes which occur in an injured nerve at both the microscopic and macroscopic level. Explain the theories of pain generation in peripheral nerve injury.
22. Describe the pharmacology of local anesthetic agents (e.g., lidocaine, procaine, tetracaine, bupivacaine) and the use of epinephrine with local anesthetic agents.
23. Discuss the indications for peripheral neural blockade. Explain the principles of blocking procedures including the techniques and expected outcomes. Cite the complications of peripheral neural blockade (including anaphylaxis, neural injury, intravascular or intrathecal administration). List the alternatives to temporary blockade including neurolytic blocks, ablative neurosurgical procedures, augmentative neurosurgical procedures, alternative traditional pain management procedures, and alternative medicine approaches.
24. Review the indications for radiofrequency facet rhizolysis.
25. Discuss the anatomy and biomechanics of the facet complex with emphasis on bone, cartilage, fibrous capsule, synovial fluid, and innervation of this structure.

Middle Level:

1. Name and differentiate the major classes of medications that are used commonly for pain treatment (opioids, non-steroidals and acetaminophen, antidepressants, anticonvulsants).
2. Review the psychosocial issues that may influence a pain disorder and describe the role of behavioral interventions in pain management.
3. Explain the rationale for multidisciplinary management of pain disorders.
4. Contrast impairment and disability.
5. Explain the basis of chemical, balloon compression, and radiofrequency neurolysis in the treatment of trigeminal neuralgia.
6. Relate subcortical and brain stem sites that appear to be involved in the modulation of nociception to targets for deep brain stimulation (DBS) for pain control.

7. Explain how central neurostimulation (cortical, subcortical) is thought to produce analgesia.
8. Explain the role of ablative brain and brain stem procedures, (e.g., cingulotomy, mesencephalic tractotomy, trigeminal tractotomy) in the management of chronic benign pain and cancer pain.
9. Discuss the possible complications of subcortical and brain stem ablative procedures for deafferentation pain.
10. List the primary indications for the following spinal ablative lesions: dorsal root entry zone lesion, open and percutaneous anterolateral cordotomy, myelotomy.
11. Discuss spinal cord stimulation (SCS), including types of stimulation systems and electrodes available, basic techniques of insertion of percutaneous and plate electrodes, the rationale and goals of intraoperative SCS testing (paresthesia coverage of painful area, avoidance of undesirable stimulation), the rationale and techniques for trialing SCS, and advantages and disadvantages of different sites of implantation of SCS pulse generator/receiver.
12. Explain the key aspects of intraspinal drug administration, including the pharmacology of intraspinal drugs, the various types of infusion systems available, the rationale for trialing intraspinal drug infusions, basic techniques for insertion of intrathecal and epidural catheters, and the proper location for infusion pump implantation.
13. Discuss the role of neurectomy and neurolysis for pain control in nerve injury and compare alternative techniques for pain control.
14. Describe the anatomy of the dorsal root ganglion, the bony anatomy of the nerve root foramen and the location of the ganglion within that foramen. Discuss indications for ganglionectomy and describe long-term outcome from ganglionectomy with emphasis on pain recurrence and deafferentation.
15. Describe the indications for peripheral nerve stimulation and contrast to spinal cord stimulation.
16. Describe indications for ablative peripheral neurolysis. Review the pharmacology and histopathologic effects of neurolytic agents (e.g., phenol, glycerine/glycerol, chlorcreosol, absolute alcohol, ammonium chloride/sulfate).
17. Discuss basic principles of ablative neurolytic procedures in terms of technique, expected outcomes, and complications including neural injury, injury to surrounding soft tissue, inadvertent intravascular or intrathecal administration. Describe the alternatives to neurolysis including temporary anesthetic blocks, ablative neurosurgical procedures, augmentative procedures, alternative traditional pain management procedures, and alternative medicine approaches.
18. Describe the principles of radiofrequency lesioning. Include in the discussion the following topics:
    a. probe
    b. thermocouple and thermistor
    c. time
    d. intensity of heat
    e. isotherm fields.
19. Discuss basic principles of radiofrequency facet rhizolysis and list the equipment utilized, technique employed, expected outcomes, and complications (including damage to other nerve root branches,

potential for spinal instability, inadvertent damage to radicular artery, CSF leak, and spinal cord injury).

20. Compare the alternatives to radiofrequency lesioning
    a. local anesthetic facet blocks
    b. epidural injections
    c. neurolytic facet blocks
    d. ablative neurosurgical procedures
    e. augmentative neurosurgical procedures
    f. alternative traditional pain management procedures
    g. alternative medicine approaches
    h. surgical intervention such as instrumentation and fusion

Senior Level:

1. Distinguish the indications for surgical and non-surgical treatment of pain.
2. Construct a management strategy relating to application of percutaneous trigeminal neurolytic procedures, retrogasserian rhizotomy, and microvascular decompression in the care of patients with trigeminal neuralgia.
3. Describe and contrast the approaches to the cerebellopontine angle for microvascular decompression or rhizotomy of the trigeminal and glossopharyngeal nerves.
4. Identify the various target spine levels for spinal cord stimulation according to the pain topography (simple and complex).
5. Identify the various intraspinal structures based on their responses to mechanical and electrical stimulation (dura mater, lateral canal wall, dorsal columns, dorsal roots, ventral roots, motor neurons).
6. Compare the different methods of intraspinal drug administration (epidural, intrathecal, tunneled catheter, implanted infusion system).
7. Describe the techniques for trialing intraspinal drugs.
8. Compare the pharmacodynamics of different drugs delivered intrathecally (e.g., hydrophilic vs. lipophilic).
9. Describe the possible complications of spinal cord stimulation electrode or spinal catheter insertion and their evaluation and treatment:
    a. paralysis
    b. nerve root damage
    c. electrode or catheter migration
    d. electrode or catheter breakage
    e. epidural hematoma
    f. cerebrospinal fluid leak
10. Describe the common drug side effects associated with intraspinal analgesic administration.
11. Describe the correct placement of lesions for DREZ, cordotomy, and myelotomy, including lesion depth and structures affected.
12. Discuss the possible neurological sequellae of spinal ablative procedures with both correct and incorrect lesion placement, with anatomical correlates.
13. Describe the role of DREZ lesioning in the overall management of the patient with deafferentation pain.
14. Describe the techniques for exposure of the major peripheral nerves.

15. Demonstrate knowledge of basic principles of nerve grafting, including regeneration, graft length considerations, and use of allograft donor nerves.
16. Describe the role and outcomes of ganglionectomy in the management of various pain syndromes, contrasting it with augmentative techniques.
17. Discuss in detail the surgical technique of ganglionectomy.
18. Describe percutaneous methods of gangliolysis.
19. Explain the effects of blocking agents at the membrane and synaptic cleft, and the biochemistry and histology of neurotoxicity.
20. Explain the histologic effects of neurolytic agents at the membrane level and display a comprehensive level of understanding with regard to toxicity.
21. Describe the histologic effects of radiofrequency lesioning.
22. Discuss in detail the evaluation and management of a patient selected for radiofrequency lesioning of the facets.
23. Discuss the alternatives to radiofrequency lesioning, with particular emphasis on the potential surgical remedies including decompression, instrumentation, and fusion.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Obtain a pertinent history and perform an appropriate physical examination for a patient with a primary complaint of pain.
2. Formulate and implement treatment plans for simple pain syndromes (e.g., acute postoperative pain, acute low back pain).
3. Evaluate and diagnose a patient with trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain.
4. Assist with radiofrequency, glycerol or balloon compression neurolysis of the trigeminal nerve in patients with trigeminal neuralgia.
5. Assist with surgical exploration of the trigeminal nerve, nervus intermedius, or glossopharyngeal nerve for MVD or rhizotomy.
6. Illustrate appropriate patient selection for spinal ablative or augmentative procedures for pain management.
7. Locate the spinal epidural space and place a percutaneous spinal cord stimulation electrode with supervision.
8. Assist with implantation of a plate electrode for spinal cord stimulation.
9. Insert with supervision a spinal catheter for drug administration.
10. Implant with supervision a spinal cord stimulation system pulse generator/receiver and extension wire.
11. Implant with supervision an intraspinal drug infusion pump.
12. Assist with spinal ablative procedure for pain management (cordotomy, myelotomy, DREZ).
13. For peripheral nerve repair, neurectomy, and neurolysis perform, record, and report complete patient evaluation and assessment, including comprehensive

neuromuscular examination of affected nerve

14. Evaluate electrodiagnostic studies pertaining to peripheral nerve injury.
15. Recognize and treat the potential complications of peripheral nerve repair, neurectomy, and neurolysis including hematoma formation, infection, and local wound problems.
16. Assist in surgical treatment of peripheral nerves.
17. Assist with implantation of a peripheral nerve stimulation system.
18. Perform, record, and report complete patient evaluation and assessment for dorsal root ganglionectomy.
19. Recognize and treat the potential complications of dorsal root ganglionectomy including cerebrospinal fluid leak, infection, and local wound problems.
20. Assist in foraminotomy and exposure of dorsal root ganglion.
21. Assess patients for appropriateness of local anesthetic block(s).
22. Perform simple superficial blocks with supervision and assist in complicated procedures. Following such procedures:
    a. assess outcome of nerve block
    b. recognize and treat complications
    c. record and monitor effects of block over a specified time interval
    d. assess need for repeat blocks
23. Assess patient for appropriateness of ablative neurolysis. Perform simple superficial neurolysis with supervision and assist in complicated procedures. Following ablative neurolysis:
    a. assess outcome of procedure
    b. recognize and treat complications
    c. record and monitor effects of neurolysis over a specified time interval
    d. assess need for repeat procedures

Middle Level:

1. Formulate and implement an appropriate treatment program for complicated pain syndromes (e.g., chronic back pain, Afailed back surgery syndrome≅).
2. Assess the need for multidisciplinary management of pain disorders.
3. Demonstrate appropriate management of psychosocial factors complicating a pain disorder.
4. Employ the Hartel technique to perform radiofrequency, glycerol or balloon compression neurolysis of the trigeminal nerve in patients with trigeminal neuralgia.
5. Implant a plate electrode.
6. Demonstrate appropriate methods for trialing spinal cord stimulation and intraspinal drug administration systems.
7. Implant a peripheral nerve stimulation system.
8. Assess patient for appropriateness of radiofrequency facet blocks. Perform radiofrequency facet blocks with supervision. Following the performance of such procedures:
    a. assess outcome of facet blocks
    b. recognize and treat complications
    c. record and monitor effects of facet blocks over a specified time interval
    d. assess need for repeat facet blocks

9. Diagnose and formulate appropriate treatment plans for sympathetically-maintained pain.
10. Diagnose and formulate an appropriate treatment plan for a patient with occipital neuralgia.

Senior Level:

1. Recognize and execute intelligent treatment choices for different pain syndromes including nociceptive, neuropathic, and cancer pain.
2. Demonstrate appropriate use of each of the major classes of medications in common use for treating pain.
3. Demonstrate appropriate selection of patients for surgical treatment of pain disorders.
4. Perform microvascular decompression and rhizotomy of the trigeminal nerve and glossopharyngeal nerves.
5. Assist a junior resident in performing a percutaneous ablative procedure for trigeminal neuralgia.
6. Formulate and implement an appropriate treatment plan for management of pain using spinal ablative and augmentative techniques according to pain etiology, pain topography, and status of spinal column (e.g. previous surgery at implant level, scoliosis, stenosis, etc.).
7. Select and implant an appropriate SCS system, recognizing how to modify electrode insertion technique and location based upon intraoperative responses.
8. Implant a plate electrode in a patient with previous spinal surgery at the same level.
9. Demonstrate proficiency with maintenance and programming of spinal drug administration systems and spinal cord stimulation systems.
10. Recognize and evaluate malfunctions of SCS and intraspinal drug administration systems.
11. Perform surgical revision of SCS and intraspinal drug administration systems.
12. Demonstrate proficiency in identification and lesioning of the dorsal root entry zone, even in cases of nerve root avulsion.
13. Demonstrate proficiency in performing myelotomy and cordotomy.
14. Expose major peripheral nerves and perform closure of extremity incision for peripheral neurectomy/neurolysis.
15. Demonstrate proficiency in neurolysis and nerve grafting techniques.
16. Plan and execute surgical approaches to injuries of the major peripheral nerves.
17. Plan a peripheral nerve reconstruction including exposure, preparation of donor site, and nerve graft.
18. Demonstrate proficiency in technique of ganglion resection.
19. Incorporate ganglionectomy as one part of an integrated approach to the patient with intractable pain.
20. Display appropriate patient selection for local anesthetic blocks.
21. Perform simple superficial blocks with minimal supervision. Relative to these blocks perform the following:
    a. assess outcome of block
    b. recognize and treat complications
    c. maintain detailed records of effects of block and follow-up
    d. assess need for repeat blocks

22. Provide information regarding alternatives for failed nerve block.
23. Perform complicated nerve block procedures with direct supervision. Recognize and treat the complications of these procedures.
24. Display appropriate patient selection for ablative peripheral neurolysis.
25. Perform simple neurolytic procedures with minimal supervision. Relative to these procedures perform the following:
    a. assess outcome of the procedure
    b. recognize and treat complications
    c. maintain detailed records of effects of neurolysis and follow-up
    d. assess need for repeat neurolysis
26. Provide information regarding alternatives for failed neurolysis.
27. Perform complicated neurolytic procedures with direct supervision.
28. Display appropriate patient selection for radiofrequency facet rhizolysis.
29. Perform simple facet blocks with minimal supervision. Relative to these procedures perform the following:
    a. assess outcome of the procedure
    b. recognize and treat complications
    c. maintain detailed records of effects of facet blocks and follow-up
    d. assess need for repeat facet blocks
30. Provide information regarding alternatives for failed facet blocks.
31. Perform complicated facet blocks with direct supervision.
32. Perform sympathectomy.

PEDIATRIC NEUROSURGERY

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology, and presentation of diseases in children which a neurosurgeon may be called upon to diagnose and treat. Demonstrate the ability to formulate and implement a diagnostic and treatment plan for these diseases.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Review the embryology of the central nervous system (CNS) and its supporting structures.
2. List the abnormalities a neurosurgeon may treat which are congenital/developmental in nature and classify them with respect to their embryology defect
3. Describe the incidence, epidemiology and inheritance patterns.
4. State other disorders associated with this set of diseases.
5. Describe the anatomic and pathophysiologic parameters which distinguishe amongst these diseases.
6. Develop a diagnostic treatment plan along with prognostication of outcome with optimal management.
7. List disorders which may be referred for neurosurgical care but do not require surgery.
8. Display current knowledge of the molecular basis for these diseases where known.
9. Describe the expected outcome if treatment is not undertaken.

Hydrocephalus and Other Disorders of CSF Circulation

1. Describe the normal physiology of CSF.
2. Delineate the different etiologies of hydrocephalus and their relative incidence.
3. Explain how to differentiate between CSF collections which require treatment and those which do not.
4. Indicate the various treatment options for the management of hydrocephalus.
5. Distinguish between treatment options for hydrocephalus with normal CSF and contaminated (e.g. infection, blood) CSF.
6. List the complications associated with each treatment option for hydrocephalus and the diagnosis and treatment of same.
7. Differentiate between low-pressure and high-pressure hydrocephalus.

8. Describe the presentation and diagnostic approach to a patient with suspected shunt malfunction.
9. Define how the diagnosis of hydrocephalus is made.
10. List nonsurgical diseases which may be mistaken for hydrocephalus but require treatment different than surgery.
11. Review the causes of cerebral atrophy.

Neoplasia

1. Delineate the differences between pediatric and adult tumors.
2. List the common tumor types occurring in children and their typical location.
3. Describe the changing tumor type and location based upon age.
4. Identify lesions which require biopsy as part of the treatment/diagnostic plan.
5. Describe the typical presentations of tumors.
6. Describe appropriate evaluation for patients suspected of having a tumor.
7. Classify tumor types as to degree of malignancy, role of surgical vs. nonsurgical therapy, and outcomes of optimal treatment.
8. Discuss the possible complications associated with specific tumor types.
9. Describe the pertinent anatomy for surgical treatment of midline or hemispheric cerebellar tumors and hemispheric cerebral tumors.
10. Discuss appropriate preoperative management of patients with tumors.
4. Describe surgical and non-surgical treatment options regarding the alleviation of spasticity in children.
11. Compare the role of biopsy, subtotal resection and total resection in the management of tumors.
12. List possible complications of the treatment options, their diagnostic evaluation and treatment.

Infection

1. Describe the presentations of a shunt infection.
2. List the indications for ventricular lumbar and subarachnoid CSF sampling.
3. List the common organisms seen in shunt infections.
4. Describe treatment plans for shunt infection.
5. List risk factors and risks of shunt infection and the proper diagnostic protocol to establish the presence of a shunt infection.
6. Describe common presentations of intracranial and intraspinal suppuration.
7. List host risk factors which are associated with CNS infections.
8. Describe appropriate diagnostic protocol to establish the presence of CNS infection.
9. Discuss the timeliness and utility of surgical therapy for the treatment of CNS infection both shunt-related and non-shunt-related.

Other

1. Delineate the various types of spasticity and movement disorders seen in children.
2. List seizure types.
3. Describe surgical lesions which may be related to seizures.
5. Discuss the pathophysiology of craniosynostosis.

Cerebrovascular

1. Delineate the possible causes of an atraumatic intracerebral or subarachnoid hemorrhage.
2. Delineate the possible causes of cerebral infarction/ischemia.
3. Discuss the common locations of arteriovenous shunts and their presentation, evaluation, and treatment (includes dural AVM).
4. Discuss the embryology of the cerebral and spinal vasculature and its possible role in vascular anomalies in children.
5. Describe the common locations and types of aneurysms seen in children and how they differ from those seen in adults.
6. List the possible presentations of Vein of Galen aneurysms, their diagnosis and management.
7. List the possible causes of aneurysms in children which are not congenital in nature.
8. Describe the pathophysiology, treatment, and outcome of intraventricular hemorrhage in the neonate.

Trauma

1. List the appropriate diagnostic tests to evaluate a children who has sustained multisystem trauma.
2. Describe the Glasgow Coma Scale and its use.
3. List the salient historical and exam features which lead one to the diagnosis of non-accidental trauma.
4. Discuss the management of the cervical spine in a child who is comatose.
17. Discuss the role of invasive monitoring in all its forms in closed head injury (CHI).
5. Describe the anatomy of the child=s spine which causes the epidemiology of spinal cord injury to differ from adults.
6. Describe the common injuries seen as a result of birth trauma and discuss their diagnosis and management.
7. Describe the use of antibiotics and anticonvulsants in CNS trauma.
8. Review the evaluation and management of a child who has sustained a head injury with loss of consciousness but is now awake.
9. Discuss the management of depressed skull fractures, both open and closed.
10. Describe the diagnosis and management of spinal column injury.
11. Discuss the diagnosis and management of spinal cord injury without radiologic abnormality (SCIWORA).
12. Describe the intracranial pressure (ICP) compliance curve and discuss its utility in the management of head injury.
13. List the parameters needed to decide on letting an athlete who has sustained a CNS injury return to activity.
14. Discuss the concept of Abrain death≅, its diagnosis and role in organ donation.
15. Discuss the importance and interplay between ICP and cerebral perfusion pressure (CPP) in the management of head and spinal cord injury.
16. Define the concept of Asecondary injury≅.

Middle Level:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Enumerate the indications for surgery, surgical options and expected outcomes for each disease entity.
2. Explain the indications for and utility of intraoperative monitoring.
3. Describe appropriate timing of intervention and its rationale.
4. Describe the pathophysiology and presentation of the tethered cord syndrome.

Hydrocephalus and Other Disorders of CSF Circulation

1. Describe normal ICP dynamics and ttheir reelation to eestablishing a differential diagnosis of CSF flow disturbance.
2. Define Aslit ventricle system≅ and how it is diagnosed and treated.
3. Define Abrain compliance≅ and relate how that can affect ventricular size.
4. List indications for and describe technique of accessing a shunt for CSF samples.
5. List disease states which are commonly associated with hydrocephalus.

Neoplasia

3. List all acceptable treatment options for CNS infection with the pros and cons of each plan.

1. Discuss the differential diagnosis and evaluation of tumors located in the following areas:
   a. suprasellar
   b. pineal region
   c. intraventricular
2. Discuss the treatment/diagnostic options for tumors in each location listed in #1 including surgical approaches.
3. Describe the appropriate evaluation and treatment of patients with neoplastic processes associated with:
   a. neurofibromatosis
   b. tuberous sclerosis
   c. von Hippel Lindau
4. Discuss the appropriate use of skull base approaches for specific tumor locations.
5. List tumors which will require adjunctive therapy and describe those therapies and potential complications thereof.
6. Discuss the global management of tumoral hydrocephalus.
7. Cite the long-term outcome and complications for treatment of the common cerebellar and supratentorial hemispheric tumors.

Infection

1. Compare the differing patterns of infection as seen in immune-compromised patients to those with a functioning immune system.
2. Discuss the sequelae of CNS infection, both shunt-related and non-shunt-related.
4. Demonstrate an understanding of the different etiologies for subdural and epidural empyema and brain abscess and differing treatments thereof.

5. Provide a complete differential diagnosis in regard to infectious disease for ring enhancing brain lesions.
6. Discuss the role of osteomyelitis in CNS infection.
7. Differentiate radiographically between infection and tumor of bone.

Other

1. Discuss variance in the surgical management of tumoral vs non-tumoral seizure foci.
2. Discuss surgical options, indications and outcome for non-lesional approaches (e.g., callosotomy).
3. Discuss various surgical options for the management of spasticity.
4. Discuss preoperative evaluation and planning for seizure treatment.
5. Discuss preoperative evaluation and planning for treatment of spasticity and postoperative management.

Cerebrovascular

1. Describe the nomenclature for congenital vascular anomalies and what, if any, role inheritance plays.
2. Describe the pathology, risk factors, diagnosis and treatment of moyamoya in children.
3. List the phakomatoses which have vascular anomalies associated with them and their treatment.

Trauma

1. Discuss the role of apoptosis in brain and spinal cord injury.

Hydrocephalus and Other Disorders of CSF Circulation

1. Discuss the utility of expansion craniotomy in the treatment of hydrocephalus.
2. Compare the utility of epidural, subdural, parenchymal, and intraventricular ICP monitoring.
3. Differentiate between retinal hemorrhages and Terson=s syndrome.
4. Describe the role of electrophysiological monitoring in the management and prognostication of the CNS injured patient.
5. Discuss the evidence for and role of steroid therapy in CNS injury.
6. Discuss the prognosis and management of penetrating injuries to the brain and spine.
7. Discuss the management of CSF leaks after head injury.
8. Describe the diagnosis and treatment of a traumatic leptomeningeal cyst.

Senior Level:

Myelomeningocele and its Variants, Meningocele, Encephalocele, Chiari Malformations, Occult Spinal Dysraphism, Split Cord Anomalies, Segmentation Anomalies, Craniofacial Syndromes and Phakomatosis

1. Differentiate between the use of rigid and non-rigid skeletal fixation in the appropriate surgical setting for this group of disorders.
2. Explain the rationale for surgical treatment of a symptomatic disease.

2. Differentiate between ventriculomegaly, compensated hydrocephalus, and pseudotumor cerebri.

3. Describe the pertinent anatomy of the ventricular system and prepontine cisterns.
4. Describe the role of venous outflow obstruction in hydrocephalus.

Neoplasia

1. Describe the pertinent surgical anatomy for approaches to tumors in the following locations:
   a. suprasellar
   b. pineal region
   c. intraventricular
2. Discuss the role of endoscopic third ventriculostomy in management of tumoral hydrocephalus.
3. Cite the long-term outcome and complications of all treatment options for tumors arising in the following locations:
   a. suprasellar
   b. pineal region
   c. intraventricular
4. Discuss the utility of preoperative embolization and/or chemotherapy in the surgical management of specific tumors.
5. Discuss the role of stereotactic radiosurgery in the management of selected tumors.
6. Describe the presentations of hypothalamic hamartomas and the role of surgery in management.
7. Describe options for CNS monitoring during surgical therapy and their efficacy.
4. List the vascular and endocrine complications seen after head injury.
8. Discuss options for treatment and expected outcomes for recurrent tumors.

Infection

1. Describe in detail the differential diagnosis, evolution and treatment options of an immune-compromised patient with a ring enhancing brain lesion.
2. List the important aspects of the patient=s history which may lead one to entertain the diagnosis of CNS infection both shunt-related and non-shunt-related.
3. List diagnostic tools, other than CSF culture, which are utilized to diagnose a shunt infection.

Cerebrovascular

1. List the locations for traumatic vascular lesions and their risk factors, diagnosis, and treatment.
2. Discuss management options and controversies in the treatment of vascular disease in children.

Trauma

1. Discuss the potential complications and evaluation of comatose patients with skull base fractures.
2. Discuss the utility of lumbar drains and expansion craniectomy and the removal of frontal or temporal lobe in the management of refractory elevated ICP.
3. Describe the approaches to the management of traumatic ICH and its supporting data, both surgical and non-surgical.
5. Discuss the long-term management of a child who has sustained CNS trauma including rehabilitation and neuro-cognitive issues.

6. Discuss the management of peripheral nerve injuries in a child.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Perform complete history, physical examination and assessment on newborns, infants, and children.
2. Interpret results of the physical examination, laboratory and radiological studies to arrive at a differential diagnosis.
3. Perform subdural, intraventricular and lumbar punctures in children.
4. Perform a shunt tap.
5. Perform a twist drill or burr hole for subdural, parenchymal, or ventricular access or as part of a craniotomy.
6. Perform a craniotomy or craniectomy for evacuation of subdural or epidural lesion.
7. Perform a craniectomy as part of skull biopsy.
8. Perform craniotomy for elevation of depressed skull fracture.
9. Place a ventriculoperitoneal, jugular, or pleural shunt.
10. Revise a ventriculoperitoneal, jugular, or pleural shunt.
11. Perform a cranioplasty with artificial material or homologous material.

Senior Level:

1. Perform exposure for suprasellar, pineal and intraventricular lesion (including orbito-frontal, transcallosal and supracerebellar).
12. Perform a laminectomy in a patient with normal spinal anatomy.
13. Position a patient for intracranial or intraspinal surgery.
14. Demonstrate an ability to open and close cranial and spinal wounds to include dural opening and repair.
15. Complete a sagittal synostectomy.

Middle Level:

1. Close an open spinal or cranial neural tube defect.
2. Repair an intracranial encephalocele.
3. Perform the opening for a complex craniofacial repair.
4. Perform the exposure for supratentorial and infratentorial lesions (excluding pineal, suprasellar and intraventricular locations).
5. Perform the exposure for spinal exploration in a patient with abnormal spinal anatomy or reoperation.
6. Evacuate an intraparenchymal hematoma.
7. Accomplish endoscopic third ventriculostomy in uncomplicated settings.
8. Apply and utilize frameless or framed stereotactic modalities for lesion location and shunt placement.
9. Accomplish repair of a Chiari malformation.
10. Accomplish an uncomplicated detethering procedure.
11. Perform a cranial vault expansion.
12. Perform placement of baclofen type pumps.
13. Perform spinal fusion without instrumentation.
14. Apply a vagal nerve stimulator.

2. Remove uncomplicated posterior fossa and supratentorial lesions.

3. Repair complex tethered cords (e.g. lipomyelomeningocele, retethering, and diastematomyelia).
4. Accomplish exposure for intradural spinal neoplasms.
5. Utilize an endoscope to communicate trapped CSF spaces.
6. Remove intracranial vascular malformation less than 3 cm in size and in non-eloquent brain.
7. Perform placement of grids for seizure monitoring.
8. Perform rhizotomy for spasticity.
9. Perform temporal lobectomy in an uncomplicated patient.
10. Perform stereotactic biopsy of supratentorial lesion.
11. Perform spinal fusion utilizing instrumentation.
12. Accomplish endoscopic third ventriculostomy in uncomplicated settings.
13. Assist with complex craniofacial surgery.
14. Assist with a vascular procedure for moyamoya disease.

SURGERY OF THE PERIPHERAL NERVOUS SYSTEM

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology, and presentation of peripheral nerve diseases. Demonstrate the ability to formulate and implement a diagnostic and treatment plan for diseases of the peripheral nerves that are amenable to surgical intervention.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Define the peripheral nervous system versus the central nervous system.
2. Discuss the major structural elements of a peripheral nerve:
   a. epineurium
   b. perineurium
   c. endoneurium
   d. axon
   e. fascicle
   f. Schwann cell
   g. connective tissue
   h. motor end plate
   i. sensory receptor
3. Discuss the blood supply of the peripheral nerves.
4. Discuss the blood-nerve barrier.
5. Define axonal transport and differentiate fast from slow.
6. Describe an action potential including the flow of ions.
7. Describe the various nerve fibers in terms of size.
8. Discuss the significance of fiber size in terms of function (eg. c-fiber - nociceptive).
9. Discuss the various forms of action potential propagation.
10. Discuss the pathophysiological response to various injuries by a nerve:
    a. compression
    b. ischemia
    c. metabolic
    d. concussive
    e. stretch
11. Define and discuss apoptosis.
12. Define Wallerian degeneration.
13. Discuss nerve regeneration:
    a. sprouting
    b. nerve growth factors
    c. rate of growth
    d. remyelination
14. Define neuroma:
    a. axonal tangle
    b. mechano-sensitivity
    c. neuroma-in-continuity

15. Define and discuss the pathophysiology and clinical significance of the Tinel=s sign.
16. Describe the symptoms and signs of typical nerve injuries:
    a. entrapment syndromes
    b. stretch injuries
    c. laceration injuries
    d. concussive injuries
    e. injection injuries
17. Distinguish upper versus lower motor neuron symptoms and signs in nerve injury:
    a. anatomical definition
    b. degree of atrophy
    c. distribution of weakness
    d. reflex changes
    e. potential for recovery
18. Describe the classification of nerve injury:
    a. Seddon classification
    b. Sunderland classification
19. List the major peripheral nerves of body. Describe the motor and sensory innervation of each.
20. Draw the major components of the brachial plexus.
21. Describe the rating scales for motor power.
22. Describe the various sensory modalities and how to examine each.
23. Describe the symptoms and signs of common nerve entrapments:
    a. carpal tunnel
    b. ulnar entrapment at the elbow
    c. lateral femoral cutaneous nerve
    d. peroneal at fibular head
24. Define EMG and NCV.
25. Describe the changes in EMG and NCV in nerve entrapment.
26. Describe the nonoperative and operative treatment of entrapment syndromes.
27. Define:
    a. coaptation
    b. neurorrhaphy
    c. neurotization
    d. nerve transfer

Middle Level:

1. Define the autonomic nervous system
    a. differentiate sympathetic and parasympathetic
    b. discuss anatomic distribution
    c. identify the various neurotransmitters
    d. discuss Horner=s syndrome
2. Compare and contrast a peripheral nerve to a cranial nerve:
    a. histology
    b. response to injury
    c. root entry zone
3. Describe nerve regeneration in terms of:
    a. specificity
    b. pruning of sprouts
    c. end to side sprouting
4. Draw the complete brachial plexus
5. Discuss the lumbar plexus
6. Discuss stretch injury, missile injury and avulsion injury:
    a. definition

b. typical etiology
c. physical findings
d. electrical findings
e. nonoperative management
f. indications for surgery
g. intraoperative findings
h. potential for recovery

7. Describe the anatomical location of the common entrapment sites. List the various bands and arcades that produce entrapment.
8. Provide a differential diagnosis for common entrapment syndromes:
   a. differentiate radiculopathies from entrapments
   b. discuss repetitive strain disorder
9. Discuss uncommon entrapment neuropathies
   a. Guyon=s canal
   b. suprascapular entrapment
   c. radial tunnel/PIN
   d. median nerve in forearm/AIN
   e. tarsal tunnel (anterior and posterior)
   f. pyriformis syndrome
10. Explain the use of EMG/NCV in the management of peripheral nerve disorders:
    a. physiology
    b. typical findings in neuropathy
    c. typical findings in nerve injury
    d. typical findings in nerve regeneration
11. Discuss the common metabolic/inherited neuropathies.
12. Discuss burn and electrical injury effects on nerves.
13. Classify peripheral nerve tumors.
14. Discuss the pathophysiology of NF1 and NF2.
15. Discuss the timing of peripheral nerve surgery:
    a. laceration injury
    b. blunt injury
    c. missile injury
    d. iatrogenic injury
    e. surgical injury
    f. injection injury
16. Discuss outcome priorities in brachial plexus surgery:
    a. motor versus sensory
    b. functional outcome- elbow flexion, shoulder abduction, etc.
17. Discuss tension at the nerve repair site.
18. Discuss nerve repair techniques:
    a. direct coaptation
    b. nerve graft
    c. nerve transfer
    d. donor (graft) nerves
    e. epineurial repair
    f. fascicular repair
19. Describe intra-operative nerve evaluation:
    a. visual
    b. palpation
    c. internal neurolysis
    d. nerve conduction
    e. biopsy

Senior Level:

1. Discuss with the aid of diagrams the anatomy of the peripheral nervous system:
   a. common sites of entrapments

b. the brachial and lumbar plexus
c. innervation of the bladder

2. Discuss the use of nerve grafting:
   a. types of fixation (suture/glue)
   b. types of grafts (nerve, vein, artificial)
   c. end to side
3. Discuss entrapment syndromes:
   a. thoracic outlet
   b. double crush syndrome
   c. repetitive strain
4. Discuss ulnar nerve decompression:
   a. in situ decompression
   b. transposition (subcutaneous/intramuscular/ submuscular)
   c. medial epicondylectomy
5. Differentiate brachial plexus injury from brachial plexitis.
6. Formulate a management plan for:
   a. birth brachial plexus injury
   b. acute nerve injury (stretch/compression/laceration/ injection)
   c. chronic nerve injury
   d. failed nerve decompression
   e. painful nerve/neuroma
7. Describe the management of nerve tumors:
   a. imaging techniques
   MR neurography
   b. indications for surgery in NF1
   c. operative and adjuvant treatment for malignant peripheral nerve sheath tumors
   d. use of monitoring during tumor surgery
   b. brachial plexus surgery
   e. fascicular dissection
8. Describe adjuvant therapies in nerve injury:
   a. muscle and tendon transfers
   b. prosthesis
   c. joint fusion

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Obtain a history and perform a motor and sensory examination of the peripheral nervous system.
2. Based on history and physical anatomically localize the lesion.
3. Obtain appropriate ancillary tests:
   a. EMG/NCV
   b. metabolic screens
   c. imaging studies
4. Formulate a differential diagnosis for common entrapments.
5. Position and prep for common entrapment releases.
6. Perform a diagnostic nerve and muscle biopsy.
7. Obtain sural nerve for grafting.

Middle Level:

1. Perform pre- and postoperative care of the patient with a peripheral nerve injury.
2. Evaluate a child with birth palsy.
3. Position a patient for nerve surgery:
   a. all entrapment sites
4. Perform a neurolysis/decompression.

5. Expose the brachial plexus.
6. Manage the pain associated with nerve injury:
   a. use of medications
   b. use of rehabilitation
   c. use of stimulation

Senior Level:

1. Perform a consultation concerning a nerve injury.
2. Discuss the risks versus benefits of a surgical repair of a given nerve injury.
3. Determine the parameters confirming anticipated nerve regeneration:
   a. anticipated advancing Tinel=s sign
   b. order of muscle re-innervation
4. Perform a nerve decompression:
   a. carpal tunnel
   b. ulnar nerve at elbow
   c. peroneal nerve
5. Perform a nerve repair:
   a. neurolysis
   b. internal neurolysis
   c. intraoperative nerve conductions
   d. neuroma excision
   e. placement and suture of nerve graft
6. Excise a nerve sheath tumor.
7. Expose a brachial plexus injury:
   a. determine possible repairs including nerve transfers
   b. expose the spinal accessory nerve
   c. expose the intercostal nerves

SPINAL SURGERY

UNIT OBJECTIVES

Demonstrate an understanding of the anatomy, physiology, pathophysiology, and presentation of disorders of the spine, its connecting ligaments, the spinal cord, the cauda equina, and the spinal roots. Demonstrate the ability to formulate and implement a diagnostic and treatment plan for diseases of the spine, its connecting ligaments, the spinal cord, the cauda equina, and the spinal roots that are amenable to surgical intervention.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Review the anatomy of the craniocervical junction, cervical, thoracic, and lumbar spine, sacrum, and pelvis.
2. Interpret plain and dynamic radiographs, bone scans, myelograms, computerized tomographic (CT) scans, and magnetic resonance (MR) scans of patients with spinal disorders.
3. Review the signs, symptoms, and pathophysiology of common syndromes of degenerative spinal disorders: radiculopathy, myelopathy, instability, and neurogenic claudication.
4. Identify the common syndromes of spinal cord injury, including complete transverse injury, anterior cord injury, Brown-Sequard injury, central cord injury, cruciate paralysis, syringomyelia, conus syndrome, and sacral sparing. Describe the pathophysiology of spinal cord injury.
5. Describe the cauda equina syndrome.
6. Recite the differential diagnosis of cervical, thoracic, and lumbar pain.
7. Discuss the indications for cervical, thoracic, and lumbar discectomy.
8. Identify non-surgical spinal cord syndromes including amyotrophic lateral sclerosis, demyelinating conditions, and combined systems disease.
9. Review the initial management of spine and spinal cord injured patients including immobilization, traction, reduction, appropriate radiographic studies, and medical management.
10. Classify fractures, dislocations, and ligament injuries of the craniocervical region, subaxial cervical spine, thoracic, thoracolumbar junction, lumbar, and sacral spine. Describe the mechanism of injury and classify the injuries as stable or unstable. Review the indications for surgical management.
11. Discuss briefly the concept of grading schemes for spinal cord injury and myelopathy.

Middle Level:

1. Review the biomechanics of the craniocervical junction, cervical spine, and thoracolumbar and lumbar spine.
2. Review the biomechanics of common internal spinal fixators.
3. Review the definition of spinal instability based upon the principles of Punjabi and White and other authors.
4. Recognize the radiographic signs of degenerative neoplastic, traumatic, and congenital spinal instability.
5. Review the indications for, and uses, and relative effectiveness of common spinal orthoses. Discuss the degree of segmental and regional immobilization these orthoses provide.
6. Review the indications for, and physiology of, intraoperative spinal cord monitoring. Describe the technical aspects of intraoperative spinal cord monitoring.
7. Compare and contrast indications for anterior and posterior approaches to the cervical spine for the treatment of herniated cervical discs, spondylosis, and instability.
8. Discuss the role of corpectomy in the management of cervical disorders.
9. Compare and contrast the indications for anterior cervical discectomy with and without anterior interbody fusion.
10. Discuss the indications and techniques for anterior and posterior cervical spinal internal fixators.
11. Explain the biology of bone healing and options for bone grafting in spinal surgery.
12. Review the diagnosis and management of primary spinal tumors, spinal cord tumors, and spinal metastatic disease including indications for dorsal decompression, ventral decompression, and radiotherapy.
13. Discuss the management principles for gunshot and other penetrating wounds to the spine.
14. Review the signs, symptoms, and management options in the treatment of the adult tethered cord syndrome and syringomyelia.
15. Review management principles for spontaneous and postoperative spinal infections.
16. Review the management principles for intraoperative and postoperative cerebrospinal fluid leaks.
17. Discuss the surgical management of intradural congenital, neoplastic, and vascular lesions.

Senior Level:

1. Describe indications for the use of angiography and endovascular procedures in the management of spinal disorders.
2. Discuss the management of cervical degenerative disease secondary to rheumatoid arthritis. Describe factors which make it different from the management of non-rheumatoid disease.
3. Compare and contrast the treatment options for cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament, including multilevel anterior cervical corpectomy and fusion, laminectomy, laminectomy and fusion, laminoplasty, and nonoperative therapies.

4. Discuss the indications for posterior cervical spinal internal fixators.
5. Compare and contrast the transthoracic, transpedicular, costotransverse, and lateral extracavitary approaches to a herniated thoracic disc, thoracic tumor, or thoracic spinal injury.
6. Discuss the indications for lumbar fusion for congenital disorders, iatrogenic disease, and degenerative disease, ranking indications from least to most controversial.
7. Compare and contrast the indications for anterior or posterior lumbar interbody fusion and intertransverse fusion for lumbar disease.
8. Discuss internal fixation options for posterior lumbar interbody fusion and intertransverse fusion.
9. Summarize the most common types of spinal tumors in the following categories:
   a. intradural/intramedullary
   b. intradural/extramedullary
   c. extradural/extramedullary.
10. Discuss nonoperative and operative treatment options for fractures and dislocations affecting the atlas and axis.
11. Compare and contrast the indications for nonoperative treatment, anterior approaches, and posterior operative approaches for the treatment of fractures and dislocations of the subaxial cervical spine.
12. Describe the indications for anterior, posterior, and posterolateral procedures in the management of thoracolumbar tumor, trauma, or infection.
13. Compare and contrast the indications for anterior and posterior spinal fixators in the management of thoracolumbar tumor, trauma, or infection.
14. Discuss reconstruction options for vertebral body defects after corpectomy for tumor, trauma, or infection.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Junior Level:

1. Perform a complete history and physical examination on patients with spinal disorders.
2. Interpret plain x-rays, dynamic x-rays, myelograms, CT scans and MR scans of patients with spinal disorders.
3. Prepare patients for spinal surgery, including proper positioning, protection to pressure points, and placement of indicated arterial and central venous catheters, indwelling urinary catheters and anti-embolism devices.
4. Perform lumbar punctures and placement of lumbar drains.
5. Demonstrate the ability to place and manage cranial traction devices for reduction and immobilization of the unstable cervical spine.
6. Demonstrate the ability to place and manage a halo vest, including indications for placement and criteria for removal.
7. Demonstrate the ability to properly place the Mayfield head holder and other headrests.
8. Demonstrate the ability to harvest autologous bone graft from the calvarium, rib, fibula, and anterior or posterior iliac crest.

9. Perform dorsal exposure of the spinous processes, laminae, and facets of the cervical, thoracic, and lumbar spine.
10. Demonstrate the ability to close dorsal, ventral, and lateral spinal incisions.
11. Demonstrate proper postoperative wound care.
12. Demonstrate appropriate postoperative management of patients who have undergone spinal procedures.
13. Demonstrate the ability to perform, with supervision, a lumbar decompressive laminectomy for spinal stenosis.
14. Demonstrate the ability to excise, with supervision, a herniated lumbar disc.
15. Demonstrate the appropriate use of the operating microscope.

Middle Level:

1. Demonstrate the ability to prepare structural allografts for use in spinal surgery.
2. Determine the need for postoperative inpatient or outpatient rehabilitation in patients with spinal disorders.
3. Demonstrate the ability to perform a ventral exposure of the cervical spine followed by anterior cervical discectomy.
4. Demonstrate the ability to perform an anterior cervical interbody arthrodesis.
5. Demonstrate the ability to place anterior cervical instrumentation.
6. Demonstrate the ability to perform posterior cervical decompressive laminectomy.
7. Demonstrate the ability to perform posterior cervical foraminotomy with or without discectomy.
8. Demonstrate the ability to perform medial and lateral approaches to a far lateral lumbar disc herniation.
9. Demonstrate appropriate surgical technique in the management of recurrent lumbar disc herniations and recurrent lumbar stenosis.
10. Demonstrate the ability to perform posterior lumbar arthrodesis with or without the use of interbody instrumentation.
11. Demonstrate exposure of the cervical lateral masses, thoracic and lumbar transverse processes, and the sacral ala.
12. Demonstrate the ability to perform posterior/intertransverse arthrodesis in the cervical, thoracic and lumbar regions.
13. Demonstrate the ability to perform a laminectomy with or without transpedicular decompression for tumor, infection, or trauma.
14. Demonstrate techniques for spinous process arthrodesis of the subaxial cervical spine for fracture or dislocation.
15. Demonstrate the ability to manage postoperative complications of spinal surgery including:
    a. hematoma
    b. infection
    c. spinal fluid leak
    d. new neurologic deficit
16. Demonstrate the ability to perform a tethered cord release.

Senior Level:

1. Demonstrate the ability to function independently in all phases of management of patients with spinal disorders.

2. Demonstrate the ability to perform occipital-cervical arthrodesis.
3. Demonstrate the ability to properly place sublaminar wires, lateral mass screws, lower cervical/upper thoracic pedicle screws, C2 pars interarticularis screws, and C1-2 transarticular screws for the management of cervical spine disorders.
4. Demonstrate the ability to perform, with assistance if necessary, transoral odontoidectomy.
5. Demonstrate common techniques for performing C1-2 arthrodesis.
6. Demonstrate the ability to perform anterior cervical corpectomy followed by arthrodesis.
7. Demonstrate the ability to perform, with assistance if necessary, transthoracic, thoracoabdominal, retroperitoneal, and transabdominal approaches to the thoracic and lumbar spine.
8. Demonstrate the ability to perform costotransverse and lateral extracavitary approaches to the thoracolumbar spine.
9. Demonstrate the ability to excise a herniated thoracic disc by use of the above-mentioned approaches.
10. Demonstrate the ability to perform vertebral corpectomy of the thoracolumbar spine for tumor, infection, or trauma, utilizing the above-mentioned approaches.
11. Demonstrate the ability to perform anterior arthrodesis of the thoracolumbar spine.
12. Demonstrate the proper placement of transpedicular screws in the thoracic and lumbar spine.
13. Demonstrate the proper placement of laminar, transverse process, and pedicle hooks in the thoracic and lumbar spine.
14. Demonstrate the ability to resect intradural spinal neoplasms.
15. Demonstrate the ability to perform methylmethacrylate vertebroplasty.
16. Demonstrate techniques of open reduction of fractures and dislocations of the cervical, thoracic, and lumbar spine.
17. Demonstrate the ability to surgically manage arachnoid cysts and spinal cord syrinx.
18. Demonstrate the ability to perform intradural procedures for congenital, neoplastic, and vascular lesions.

STEREOTACTIC AND FUNCTIONAL NEUROSURGERY

UNIT OBJECTIVES

Define neurosurgical stereotactic procedures and recognize their proper application. Describe the appropriate anatomy, physiology, and presentation of patients that are candidates for stereotactic procedures.

COMPETENCY-BASED KNOWLEDGE OBJECTIVES:

Junior Level:

1. Discuss the considerations of stereotactic frame placement in regard to target localization and purpose of procedure (biopsy, craniotomy, functional, radiosurgery).
2. Describe the direct and indirect basal ganglion-thalamocortical motor pathways.
3. Define and distinguish each of the following entities:
   a. tremor
   b. rigidity
   c. dystonia
   d. chorea
   e. athetosis .
4. Describe the pathophysiology of Parkinson=s disease and cerebellar tremor.
5. Explain the primary symptoms treated by ventro-lateral (VL) thalamotomy pallidotomy.
6. Discuss the advantages and disadvantages of stereotactic biopsy compared to open biopsy procedures.
7. Discuss the differential diagnosis of a newly discovered ring-enhancing intracranial mass.
8. Discuss the differential diagnosis of a newly discovered non-enhancing intracranial mass.
9. Define different seizure types (partial, partial-complex, generalized, etc).
10. Define medically intractable epilepsy.
11. Describe the anatomy of the mesial temporal lobe.
12. Define brachytherapy.
13. Define conventional care for patients with high-grade gliomas.
14. Review the limitations of conventional care for patients with high-grade gliomas.
15. Describe the anatomy of the trigeminal nuclei, root, ganglion and divisions.
16. Define typical trigeminal neuralgia, atypical trigeminal neuralgia, and trigeminal neuropathy.
17. Explain the potential causes for trigeminal neuralgia.
18. Define stereotactic radiosurgery.
19. Explain the differences between radiosurgery and radiation therapy.
20. List the potential indications for radiosurgery.
21. List the reported complications of radiosurgery.

22. Compare advantages and disadvantages of frame-based or frameless stereotactic craniotomies to non-stereotactic craniotomies.

Middle Level

1. Describe factors guiding the choice of neuroimaging (CT, MRI, angiography) for stereotactic procedures.
2. Explain the rationale for various MRI sequences used for tumor localization and functional procedures.
3. Discuss the benefits and limitations of frame-based stereotactic procedures.
4. Discuss patient selection for VL thalamotomy and pallidotomy.
5. Discuss the advantages and disadvantages of ablative procedures.
6. List the potential complications of VL thalamotomy and pallidotomy and bilateral thalamotomies or pallidotomies.
7. Discuss technical considerations to minimize the potential for an intracranial hemorrhage after a stereotactic biopsy.
8. Discuss technical considerations to minimize the potential for a non-diagnostic stereotactic biopsy.
9. Describe the appropriate trajectories to biopsy a lesion in the pineal region, midbrain, pons, and medulla.
10. Compare the advantages and disadvantages of radiosurgery and surgical resection for tumors and vascular malformations.

Senior Level:

1. Identify the microelectrode recordings of the thalamus and globus pallidus.
2. Identify the primary indications for medial thalamotomy and cingulotomy.
3. Describe the evaluation of a patient with medically intractable epilepsy.
4. Discuss the indications for placement of depth electrodes.
5. Describe the surgical treatment of epilepsy in detail.
6. Discuss the theoretical advantages of brachytherapy over external beam radiation therapy.
7. Describe the most common complications of brachytherapy and their treatment.
8. Explain the effect of patient selection on the reported results of brachytherapy for high-grade gliomas.
9. Describe the methods used to localize and percutaneously penetrate the foramen ovale.
10. List the potential advantages and disadvantages for the following trigeminal rhizotomy procedures:
    a. glycerol
    b. radiofrequency
    c. balloon compression
11. Discuss the dose-volume relationships for radiation-related complications after radiosurgery.
12. Discuss potential sources of inaccuracy for stereotactic procedures.
13. Discuss advantages and disadvantages of deep brain stimulation compared to ablative techniques.

COMPETENCY-BASED PERFORMANCE OBJECTIVES:

Middle Level:

1. Perform simple radiosurgery dose-planning.

Senior Level

11. Perform complex radiosurgery dose-planning.
12. Perform stereotactic craniotomies