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Basic Rotation Schedule

March 22, 2020

Basic - Key Neuro Topics

The Accreditation Council for Graduate Medical Education (ACGME) requires subspecialty training in Neuroanesthesiology during the anesthesiology residency program. Most academic programs require two months of Neuroanesthesiology, and similarly we have divided the core concepts of Neuroanesthesiology into basic and advanced one-month rotations. The goals of the basic rotation are to provide junior anesthesiology residents with focused exposure to the perioperative management of patients undergoing neurological surgery and to teach them the basic principles of neurophysiology pertinent to this care. After completion of the rotation, the resident should be competent to administer anesthesia for common and relatively straightforward neurosurgical procedures. The following is a collection of key neuro topics that would be appropriate for a CA-1 rotation.

How to Use This Document

“Neuroanesthesia Classroom” links keywords to resources, in the form of problem-based-learning discussions (PBLDs), neuroanesthesia quizzes, and topic specific peer-reviewed articles from the SNACC webpage. The manuscripts were chosen from a library of the most impactful papers in the subspecialty, which have been archived by members of the society. These resources are not exhaustive, but serve as a stepping stone for further discussion and knowledge acquisition. These materials can be used to supplement and facilitate learning, but are not intended to replace a formal curriculum. SNACC strives to be a resource for both educators and learners.

Content Outline: Keywords

Week 1

- ❑ Cerebral physiology:
  - Cerebrospinal Fluid
  - Intracranial Pressure, Cerebral Perfusion Pressure
  - CBF, CMRO2
  - Cerebral ischemia, Cerebral protection
- ❑ CNS anatomy, CNS blood supply, BBB
- ❑ CNS Electrolyte abnormalities
- ❑ Basic OR management of craniotomy

Week 2

- ❑ Craniotomy: concerns and complications
- ❑ Traumatic Brain Injury (TBI)
- ❑ Pituitary Surgery

Week 3

- ❑ Anesthesia for spine surgery
- ❑ Spine complications: spinal shock, autonomic hyperreflexia
- ❑ Analgesia for Spine surgery
- ❑ Blood conservation management
- ❑ Unstable spine airway management
- ❑ Intraoperative neuromonitoring
- ❑ Posterior ischemic optic neuropathy
- ❑ Neurointerventional radiology
- ❑ Anesthesia for MRI

Week 4

- ❑ Craniotomy for DBS placement
- ❑ Epilepsy surgery and intraoperative seizures
- ❑ Anesthetic neurotoxicity
- ❑ TBI patient for non-neurological surgery
- ❑ Coexisting disease and Neuroanesthesia
  - Hepatic disease
  - Cardiac disease
  - Parkinson's disease
  - Pregnancy
  - Brain death
- ❑ Neuroanesthesia during the COVID-19 pandemic

Week 1

During week 1, the trainee will acquire foundational knowledge of cerebral anatomy and physiology. The trainee will:

- Describe the basic anatomy of the brain, including blood supply and cerebrospinal fluid production and flow and physiologic factors that affect it.
- Discuss the effects of anesthetic agents on intracerebral pressure and cerebral blood flow.
- Explain the conceptual and practical aspects of administering anesthesia for a basic craniotomy.

Cerebral physiology: CSF management, Intracranial Pressure and Perfusion Pressure

- CSF Drainage articles (SNACC Bibliography Collection)
- Intracranial Pressure articles (SNACC Bibliography Collection)
- Cerebral Perfusion Pressure articles (SNACC Bibliography Collection)
- Quiz 1: Neuroanesthesia, ICP curve
- Quiz 49: Monitoring the Brain

Cerebral Physiology: influencing CBF, CMRO2

- Quiz 13: Cerebral Blood Flow
- Cerebral Blood Flow articles (SNACC Bibliography Collection)
- Cerebral Metabolism articles (SNACC Bibliography Collection)

Cerebral Physiology: cerebral ischemia and management/protection

- Quiz 30: Glucose and the Brain
- Quiz 12: Hypothermia
- Cerebral Ischemia articles (SNACC Bibliography Collection)
- Neuroprotection articles (SNACC Bibliography Collection)

CNS anatomy: blood supply, blood brain barrier

- Quiz 42: Anatomy and motor neurons
- Blood Brain Barrier articles (SNACC Bibliographic Collection)

CNS-related Electrolyte abnormalities and their management

- Quiz 54: Fluid management

Basic OR management of craniotomy

- Intracranial tumor PBLD
- Quiz 26: Scalp blocks and craniotomy pain

Week 2

During week 2, the trainee will expand foundational knowledge to craniotomy management for traumatic brain injury and pituitary surgery. The trainee will:

- Describe common postoperative complications after craniotomy and management
- Discuss acute and intensive care management of patients with traumatic brain injury including intracranial pressure monitoring
- Explain the intraoperative concerns and anesthetic management of patients undergoing transsphenoidal pituitary surgery for pituitary tumors
- Explain the conceptual and practical aspects of administering anesthesia for a basic craniotomy

Craniotomy: concerns and complications

- Sitting craniotomy PBLD
- Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Sitting Craniotomy, January 2016)
- Brain Tumor articles (SNACC Bibliography Collection: See D Sharma 2010, CT Wu 2010, AW Gelb 2008, and J Chui 2014)
- Fellows' and Residents' Audio Corner - SNACC (Delayed Emergence After a Craniotomy, April 2019)
- Quizzes:
    - Quiz 31: Reflexes during neurosurgery

Traumatic Brain Injury (TBI)

- Overview, TBI by Martin Smith
- TBI PBLD
- Brain Trauma Foundation Guideline (4th edition, 2016)
- Fellows' and Residents' Audio Corner - SNACC (Traumatic Brain Injury, June 2016)
- Interactive case discussion, Anesthetic management of TBI
- TBI articles (SNACC Bibliography Collection)
- Quizzes
    - Quiz 43: TBI 101
    - Quiz 49: ICP monitoring
    - Quiz 46: Concussive Injury

Pituitary surgery - Secreting tumors/Non-secreting tumors

- Pituitary surgery PBLD
- Pituitary Surgery articles (SNACC Bibliography Collection)
- Quiz 21: Endocrine disorders
- Quiz 27: Pituitary Apoplexy

Week 3

During week 3, the trainee will acquire foundational knowledge of spinal cord anatomy and physiology. The trainee will:

- Describe the basic anatomy of the spinal cord, including blood supply and organization of the motor and sensory tracts within the spinal cord
- Understand principles of intraoperative neuromonitoring for spine surgery including effects of physiologic and anesthetic factors.
- Discuss intraoperative management of patients undergoing spine surgery including airway management, analgesia, blood conservation strategies, and positioning concerns
- Understand presentation and pathophysiology of acute and chronic spinal cord injury and concerns for anesthetic management.
- List concerns for patients undergoing out of operating room procedures including interventional neurosurgery and MRI.

Anesthesia for Spine surgery

- Spine surgery quiz
- Quiz 51: Spine surgery and coexisting disease
- Quiz 15: Spine Injury
- Spine Surgery articles (SNACC Bibliographic Collection)
- Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Spine Surgery, October 2016)

Spinal Shock and Autonomic Hyperreflexia (questions integrated into the above quizzes)

Spine surgery: analgesic and blood conservation management

- Blood Conservation Case Discussion
- Multimodal Analgesia articles (SNACC Bibliography Collection)

Spine surgery: airway management in unstable spine

- Cervical Spine Injury PBLD
- Airway articles (SNACC Bibliography Collection: See E Farag 2016, GA Mashour 2008, and ET Crosby 2007)
- Fellows' and Residents' Audio Corner - SNACC (Intubation of the Patient with Unstable Cervical Spine, February 2017)

Intraoperative neuromonitoring: basics and anesthetic influence

- Neurophysiologic Monitoring - Overview articles (SNACC Bibliography Collection)
- Neurophysiologic Monitoring - Spine Surgery articles (SNACC Bibliography Collection)
- Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Neuromonitoring in Spine Surgery, October 2017)

- Fellows' and Residents' Audio Corner - SNACC (Neuromonitoring for Intracranial Surgery, January 2018)
- Interactive Neuromonitoring Clinical Cases

Posterior ischemic optic neuropathy:

- 2018 Frontiers in Neuroscience article on perioperative visual loss
- Visual Loss Practice advisory 2019
- Postoperative Visual Loss articles (SNACC Bibliography Collection)

Out of OR anesthesia

- Neurointerventional radiology
    - Quiz 14: Cerebral Aneurysms
    - Interventional Neuroradiology articles (SNACC Bibliographic Collection)
    - Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Neuro-interventional procedures, April 2016)
    - SNACC Consensus Statement: Anesthetic Management of Endovascular Treatment of Acute Ischemic Stroke During COVID-19 Pandemic
    - Consensus Guidelines on Acute Stroke During the COVID-19 Pandemic

- Anesthesia for MRI
    - Quiz 44: Anesthesia for MRI
    - 2015 ASA Practice Advisory on Anesthetic Care for MRI
    - Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Intraoperative MRI, December 2016)

Week 4

During week 4, the trainee will expand upon foundational knowledge to include management of patients undergoing specialty procedures and effect of preexisting disease on patients undergoing neurosurgery. The trainee will:

- Discuss intraoperative management of patients undergoing epilepsy surgery and DBS placement.
- Understand the effect of preexisting disease on management of patients undergoing neurosurgical procedures.
- Define criteria for brain death

Craniotomy for DBS placement

- https://www.snacc.org/fellow-resident-audio/ (Anesthesia for Deep Brain Stimulator Placement, July 2017)

Epilepsy surgery and intraoperative seizures

- Quizzes
    - Quiz 57: Vagal Nerve Stimulators
    - Quiz 19: Seizures and Epilepsy
- PBLD: Epilepsy surgery PBLD
- Anesthesia and Epilepsy articles (SNACC Bibliography Collection)
- Fellows' and Residents' Audio Corner - SNACC (Anesthesia for Epilepsy Surgery, December 2019)

Anesthetic neurotoxicity

- Quiz 40: Anesthetic neurotoxicity
- Anesthetic Neurotoxicity in the Developing Brain (SNACC Bibliography Collection)
- Postoperative Cognitive Dysfunction articles (SNACC Bibliography Collection)

Pre-existing neurological conditions and anesthetic implications

Coexisting Disease and Neuroanesthesia

- Hepatic disease and neuroanesthesia quiz
- Cardiac disease and neuroanesthesia quiz
- Fellows' and Residents' Audio Corner - SNACC (Anesthetic Management in a Patient with Traumatic Brain Injury Coming for Non-Neurologic Surgery, April 2018)
- Parkinson's Disease
    - Parkinson's Quiz 1
    - Parkinson's Quiz 2
    - Parkinson's PBLD

Pregnancy and Neuroanesthesia

- Pregnancy Quiz

- Pregnancy PBLD
- Pregnancy and Neuroanesthesia articles (SNACC Bibliography Collection)

Brain Death

- Brain death quiz
- Brain Death articles (SNACC Bibliography Collection)

Special Practice Guidelines

- Neuroanesthesia during the COVID pandemic

Basic Outline:

1. Neuroanatomy: brain (cortical, subcortical), spine (tracts, reflexes), autonomic nervous system, pituitary gland, blood supply (brain, spine)
2. Cerebral physiology
    1. Cerebral blood flow
        1. Autoregulation
        2. Effects of ventilation, pharmacologic agents, CSF drains, position, disease states (e.g., TBI, stroke, carotid disease)
        3. Monitoring
    2. Cerebral spinal fluid
        1. Production and composition
        2. Flow pathway through the ventricular system
    3. Cerebral metabolism and neuroprotection
        1. $CMRO_2$ (determinants, effects of anesthetic drugs)
        2. Clinical strategies for cerebral protection (e.g., pharmacologic agents, temperature regulation, burst suppression)
        3. Mechanisms of neuronal injury (focal vs. global ischemia)
    4. Intracranial pressure
        1. Monro-Kellie hypothesis (cerebral compensation, herniation)
        2. Signs and symptoms of elevated ICP (including imaging)
        3. ICP monitoring
        4. Basic management of elevated ICP
3. Blood, fluid, and electrolyte management
    1. Blood-brain barrier structure and function
    2. Choice of IV fluids
    3. Transfusion considerations for blood products
    4. Electrolyte abnormalities (e.g., SIADH, cerebral salt wasting, diabetes insipidus)
4. Pharmacology
    1. Effects anesthetic drugs on cerebral function and blood flow (e.g., volatile anesthetics, sedative hypnotics, muscle relaxants, narcotics, vasoactive drugs, antihypertensives, antiepileptic drugs, diuretics)
5. Airway assessment and management
    1. Unstable cervical spine
    2. Elevated ICP
    3. Impaired airway protective reflexes
6. Neurophysiologic monitoring
    1. EEG analysis (e.g., anesthetic depth, seizure activity, burst suppression)
    2. Neurophysiologic intraoperative monitoring: MEPs, SSEPs, EMG, and BAEPs
        1. Indications for use
        2. Anesthetic effects

        3. Physiologic effects (hypotension, hypoxia, hypercarbia, hypothermia, anemia, electrolyte abnormalities)
7. Intraoperative complications
    1. Hemodynamic (e.g., VAE, trigeminocardiac reflex)
    2. Elevated ICP and cerebral edema
    3. Intracerebral hemorrhage (including in endovascular procedures)
    4. Loss of neuromonitoring signals
    5. Positioning risks (e.g., sitting, prone, lateral)
8. Spine pathophysiology and surgical management
    1. Spinal shock and autonomic hyperreflexia (symptoms and management)
    2. Determinants and measurement of spinal cord perfusion
    3. Hemostatic agents and transfusion strategies
9. Surgery for medically refractory epilepsy
    1. Seizure focus resection
    2. Laser ablation
    3. VNS
10. Awake craniotomy for DBS surgery
    1. Indications
    2. Management (including scalp block)
11. Pituitary Surgery
    1. Endocrinopathies
    2. Panhypopituitarism
12. Seizures
    1. Risk factors and need for prophylaxis
    2. Management of seizure activity
13. Post-operative management of neurosurgical patients
    1. Monitoring and neurological exam
    2. Multimodal analgesia
14. Traumatic Brain Injury management
    1. Glasgow Coma Scale
    2. Management guidelines
15. Cerebrovascular disease
    1. Stroke
    2. Cerebral aneurysms and SAH
    3. AVMs
16. Pre-existing neurological conditions and anesthetic implications
    1. Neuromuscular disorders
    2. Movement disorders
17. Pregnancy and Neuroanesthesia
18. Brain Death