Neurocritical Care Learning Objectives for Neurology Residents
Updated 12/11/24

Goal: Adult neurology residents will achieve all these objectives by the conclusion of their training.

Learning objectives (by system):

1. **Neurologic**
    a. **Coma and brain death**
        i. **Objective: Teach the elements of the coma exam**
        ii. **Objective: Teach the elements of the brain death exam**
        iii. **Objective: Appraise the available clinical data in making a diagnosis of brain death**

            Methods: Peer teaching, supervised clinical experience, simulation (assessment)

            Details:
            Domains: cognitive, psychomotor; understanding, evaluating
            Rationale: The coma and brain death exams are more focused than the comprehensive neurologic exam—which cannot be performed in many neurocritically ill patients—and require application of brainstem functional anatomy. Brain death is often misunderstood, and misdiagnosis has grave ramifications for the patient and for the medical field in general.
            References: 1, 2, 3, 4, 5

    b. **Neuroimaging**
        i. **Objective: Interpret neuroimaging (both CT and MRI) to recognize common critical pathologies and the compartment(s) affected**
        ii. **Objective: Hypothesize what impending clinicoradiographic progression may be at risk of occurring (e.g. stroke types, herniations, hydrocephalus) based on imaging interpretation**

            Methods: Problem-based learning, team-based learning

            Details:
            Domains: cognitive; remembering, analyzing, creating
            Rationale: Localization of the compartment in which a pathology lies informs the etiology and risk profile. Providing clinical correlation and anticipating what progression could entail helps to inform the clinical team of the early signs/symptoms to monitor, which may help improve outcomes.
            References: 2, 3

    c. **ICP monitoring and management**
        i. **Objective: Identify the different modalities and strengths/weaknesses of ICP monitoring**

ii. **Objective: Interpret abnormal ICP waveforms (e.g. plateau waves)**
iii. **Objective: Recognize the signs/symptoms of elevated ICP in the absence of invasive monitoring (i.e. plateau waves)**

Methods: Reading, problem-based learning

Details:
Domains: cognitive; remembering, analyzing
Rationale: Abnormal waveforms may provide clues to impending decline despite normal quantitative ICP measurements. However, when invasive monitoring is not available, patients may exhibit non-specific signs and symptoms that, in the clinical context, require swift recognition and intervention to prevent morbidity and mortality.
References: 1, 2

iv. **Objective: Select a management strategy for managing elevated ICPs, whether known via invasive monitoring or by clinical signs/symptoms**

Methods: Problem-based learning, simulation (educational)

Details:
Domains: cognitive; applying, analyzing
Rationale: Elevated ICP can result from a variety of neurologic pathologies, and medical management—as well as indication for surgical management such as CSF diversion or decompressive craniectomy—is needed to appropriately manage patients
References: 1, 2, 3, 4, 5

d. EEG

i. **Objective: Give examples of available rapid-response EEG devices (e.g. Ceribell)**
ii. **Objective: Discuss the inherent limitations of these devices**

Methods: Online learning resources, reading

Details:
Domains: cognitive; understanding
Rationale: Use of rapid-response devices is increasing nationwide as availability increases and the benefits are appreciated. However, clinical practice is influenced by the limitations inherent to the modality, as this modality does not remove the need for full-array continuous EEG.
References: 1, 2, 3

iii. **Objective: Explain the indications for continuous EEG**
iv. **Objective: Recommend the duration of continuous EEG monitoring based on the clinical scenario**

v. **Objective: Recognize the ACNS Critical Care EEG terminology**

Methods: Lecture, online learning resources

Details:
Domains: cognitive; remembering, understanding, evaluating
Rationale: Continuous EEG is a ubiquitous diagnostic test in neurocritical care, but its use and application are nuanced. Knowledge of the indications and determination of monitoring duration will optimize its clinical utility. Recognition of ACNS' terminology in formal reports influences the decision-making process for further monitoring and/or treatment.
References: 1, 2, 3, 4

e. **Common neurologic emergencies**
   i. **Objective: Describe the pathophysiology of ischemic stroke**
   ii. **Objective: Summarize the diagnostic and therapeutic management of ischemic stroke**
   iii. **Objective: Describe the pathophysiology of IPH**
   iv. **Objective: Summarize the diagnostic and therapeutic management of IPH**
   v. **Objective: Describe the pathophysiology of SAH**
   vi. **Objective: Summarize the diagnostic and therapeutic management of SAH**
   vii. **Objective: Describe the pathophysiology of SDH**
   viii. **Objective: Summarize the diagnostic and therapeutic management of SDH**
   ix. **Objective: Describe the pathophysiology of EDH**
   x. **Objective: Summarize the diagnostic and therapeutic management of EDH**
   xi. **Objective: Describe the pathophysiology of IVH**
   xii. **Objective: Summarize the diagnostic and therapeutic management of IVH**
   xiii. **Objective: Describe the pathophysiology of status epilepticus**
   xiv. **Objective: Summarize the diagnostic and therapeutic management of status epilepticus**
   xv. **Objective: Describe the pathophysiology of neuromuscular respiratory failure**
   xvi. **Objective: Summarize the diagnostic and therapeutic management of neuromuscular respiratory failure**
   xvii. **Objective: Describe the pathophysiology of TBI**
   xviii. **Objective: Summarize the diagnostic and therapeutic management of TBI**
   xix. **Objective: Describe the pathophysiology of tSCI**
   xx. **Objective: Summarize the diagnostic and therapeutic management of tSCI**

Methods: Lecture, online learning resources, simulation (educational)

Details:
Domains: cognitive; understanding
Rationale: These are the most common neurologic emergencies that neurologists will either primarily manage or on which they'll be consulted. Selection and prioritization of diagnostic and therapeutic options follow from an understanding of the applicable pathophysiology, and may reduce the chances of leaving out any key task. Discussion of the characteristics (e.g. sensitivity, specificity) inherent to the diagnostic tests allows for more informed, accurate diagnosis and management beyond the first level.
References: 1, 2, 3, 4, 5

f. **Neuroprognostication**
   i. **Objective: Integrate clinical, radiographic, and electrophysiologic data while adhering to the latest guidelines and evidence base to provide post-cardiac arrest neuroprognostication**
   ii. **Objective: Integrate clinical, radiographic, and electrophysiologic data while adhering to the latest guidelines and evidence base to provide post-TBI neuroprognostication**

Methods: Lecture, problem-based learning, team-based learning

Details:
Domains: cognitive; analyzing
Rationale: Cardiac arrest and TBI are the two most common conditions for which neurologists may be called upon to provide neuroprognostication. Much uncertainty can be present, but it is the neurologist's responsibility to try to utilize multimodal testing where indicated to prognosticate as best possible. There is a relatively mature yet constantly evolving literature for this topic in these conditions, with recent NCS guidelines published after extensive literature reviews. The general trend has been an increase in understanding that several various markers used to predict poor outcomes, such as myoclonus or the presence of DAI, are not reliable and may lead to falsely pessimistic assessments.
References: 1, 2, 5

2. **Respiratory**
   a. **Airway protection**
      i. **Objective: Indicate whether a patient's airway protection capacities are impaired**
      ii. **Objective: List common signs suggestive of such impaired airway protection**

Methods: Supervised clinical experience, peer teaching

Details:
Domains: cognitive; understanding
Rationale: Neurologically ill patients frequently lose their ability to protect their airway as a result of their underlying pathology. Recognition of this is crucial to ensure care is escalated appropriately early before complications develop or accrue.
References: 1, 2

b. **Neuromuscular respiratory failure**
   i. **Objective: Interpret clinical and radiographic data to support or refute a diagnosis of neuromuscular respiratory failure**

      Methods: Problem-based learning

      Details:
      Domains: cognitive; analyzing
      Rationale: Respiratory failure is a common indication for ICU admission in patients with and without neurologic disease. Neurologists may be consulted upon to determine whether this is due to an underlying neurologic disease that is known, or one that is to be newly diagnosed. Accurate determination influences the diagnostic and therapeutic options.
      References: 1, 2, 4

3. **Cardiac**
   a. **Heart failure**
      i. **Objective: Recognize clinical signs and symptoms suggestive of decompensated heart failure**

         Methods: Peer teaching, supervised clinical experience

         Details:
         Domains: cognitive; remembering
         Rationale: Neurology patients often have relevant comorbid cardiac disease. Conventional management of several acute neurological illnesses often entails liberal fluid administration, which may exacerbate heart failure and contribute to poorer outcomes. Furthermore, treatment of atrial fibrillation (see next learning objective) is impacted by whether heart failure is present.
         References: 1

   b. **Dysrhythmias**
      i. **Objective: Select a rate control or rhythm control strategy for atrial fibrillation and manage rapid ventricular response when present**

         Methods: Problem-based learning, simulation (educational)

Details:
Domains: cognitive; applying, analyzing
Rationale: Atrial fibrillation, often with rapid ventricular response, is incredibly common in acutely neurologically ill patients. The nature of the neurologic injury often dictates the therapeutic strategy that can be used. Being able to analyze the cardiac and neurologic situation and manage this condition is essential for avoiding more morbidity and mortality.
References: 1, 2, 3

4. **Renal**
    a. **AKI**
        i. **Objective: Interpret the clinical data to support or refute a diagnosis of acute kidney injury**

        Methods: Problem-based learning

        Details:
        Domains: cognitive; analyzing
        Rationale: Acutely neurologically ill patients frequently present with, or develop, acute kidney injury. The necessary workup and management of AKI requires that it is first recognized.
        References: 1

5. **Gastrointestinal**
    a. **Enteral tube placement**
        i. **Objective: Interpret plain film abdominal radiography to determine if enteral tube placement is correct**

        Methods: Problem-based learning

        Details:
        Domains: cognitive, analyzing
        Rationale: Acutely ill neurologic patients frequently develop oropharyngeal dysphagia that necessitates enteral tube placement. Confirmation of tube placement in the GI tract rather than bronchopulmonary tree is essential.
        References: 1, 2

6. **Infectious disease**
    a. **Neurologic**
        i. **Objective: Interpret clinical and radiographic data in diagnosing meningoencephalitis and distinguishing between the infectious etiologies (e.g. bacterial, viral, fungal)**

        Methods: Problem-based learning

Details:
Domains: cognitive; analyzing
Rationale: Identifying CNS infection is a common reason for consultation and may clue in the neurologist as to what other complications must be considered, such as abscess formation or elevated intracranial pressure.
References: 1, 2, 3, 4

b. Pulmonary

i. Objective: Interpret clinical and radiographic data to support or refute a diagnosis of pneumonia or pneumonitis

Methods: Problem-based learning

Details:
Domains: cognitive; analyzing
Rationale: Pneumonia is incredibly common in neurologically ill patients, but there is no single test that confirms the diagnosis. Instead, several data points must be interpreted. Aspiration pneumonitis is often misdiagnosed as pneumonia. As infection is often thought to be a trigger for exacerbation of chronic neurologic illnesses, accurate diagnosis must be made to avoid premature diagnostic satisfaction and minimize inappropriate antimicrobial therapy. ATS and IDSA have consensus guidelines on the diagnosis and management of patients with community-acquired, hospital-acquired, and ventilator-associated pneumonia.
References: 1

c. Urologic

i. Objective: Interpret clinical data to support or refute a diagnosis of urinary tract infection

Methods: Problem-based learning

Details:
Domains: cognitive; analyzing
Rationale: Urinary tract infections are commonly found in patients with acute neurologic injury, whether as a cause for their symptoms or even as a result of their deficits. However, UTIs are frequently over-diagnosed, which can negatively impact patient outcomes and contribute to antimicrobial resistance. As infection is often thought to be a trigger for exacerbation of chronic neurologic illnesses, accurate diagnosis must be made to avoid premature diagnostic satisfaction.
References: 1

7. Palliative care

a. Communication

i. **Objective: Develop a structure for, and independently run, family meetings**

Methods: Small group discussion, supervised clinical experience, lecture

Details:
Domains: cognitive, psychomotor; applying
Rationale: Neurologists are often called to help with family meetings, whether as primary providers or consultants. Family meetings are an opportunity to ensure continued collaboration between medical staff and families, and having a well-defined structure, with opening with the latter's understanding of the situation and a headline statement, is essential for clear and efficient communication.
References: 1, 2, 3

ii. **Objective: Share prognostic information, including conveying prognostic uncertainty, in family meetings**

iii. **Objective: Support family and team members in navigating decision-making in the face of uncertainty**

Methods: Simulation (educational), role-playing, small group discussion

Details:
Domains: cognitive, psychomotor; applying, evaluating
Rationale: The nature of many neurologic illnesses mandates that a key skill neurologists must have is that of articulating prognostic uncertainty and helping guide others in decision-making in the face of this uncertainty. This is a key feature that differentiates family meetings in the neurocritically ill population from typical palliative care practice.
References: 1, 2, 3

iv. **Objective: Identify the components of NURSE statements for responding to emotion and articulating empathy**

Methods: Reading

Details:
Domains: cognitive, affective; understanding
Rationale: NURSE, which stands for Naming, Understanding, Respective, Supporting, and Exploring, is a communication tool used to respond to emotion that will surface in communication with families, whether informal at the bedside or formal in structured family meetings.
References: 1, 2, 3

b. End-of-life care

i. **Objective: Discuss the ethical considerations surrounding brain death**

Methods: Small group discussion, lecture

Details:
Domains: cognitive; understanding
Rationale: Brain death is often misunderstood. As the subject matter experts, neurologists must be able to explain the ethical considerations when managing patients and communicating with other teams and the patients' loved ones.
References: 1, 2, 3

References

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