Fundamentals of the Neurologic Examination for Patients Undergoing Central Nervous System Interventional Procedures

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Abstract

Keywords

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The basic neurologic history and exam for the interventional radiologist performing intracranial procedures need not be exhaustive and will not supplant that by neurologic specialist. It should include a pertinent history, focused neurologic exam, and a brief physical exam. The interventional radiologist should be familiar with the grading scales commonly used for patients with intracranial pathology to understand the severity and prognosis of various pathologies. The goal of the examination is to mitigate risk, direct the evaluation, aid in medical decision making, and allow the establishment of an appropriate physician–patient relationship.

Objectives: Upon completion of this article, the reader will be able to describe the role of an abbreviated neurologic examination in patients undergoing neurointerventional procedures, and identify the clinical scales commonly used in the examination of such patients.

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The referring physician will likely perform a history and physical examination for most patients undergoing inter-

ventional radiology (IR) procedure. However, contemporary IR is a clinical subspecialty. Consequently, since diagnostic or interventional procedures in the central nervous system carry defined risks and present clinical decision-making opportunities, the interventionalist is compelled to appropriately evaluate the patient prior to any procedure, and in so doing to establish a reasonable physician–patient relationship. The basic neurologic examination will be familiar from medical school. As with all skills, review and practice are essential.

Patients requiring intracranial IR procedures are usually divided into two groups: those presenting with an acute neurologic event such as a subarachnoid hemorrhage or stroke and those presenting for an elective procedure such as a diagnostic angiogram, elective coiling, or embolization of a lesion. The neurologic history and exam driven by the disease and the goals of the examination differ slightly between these two patient populations.

This article reviews the findings pertinent for patients undergoing intracranial IR procedures, and should

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refamiliarize the interventional radiologist with the clinical grading scales used to categorize the severity of commonly presenting pathology.

History

Patient history still remains one of the most powerful tools to deduce underlying pathophysiology and to direct decision making. Patients presenting with intracranial pathology often have very characteristic presentations and histories.

Elective Procedures

Patients who present electively for diagnostic angiography usually have had an incidental lesion such as aneurysm, vascular malformation, or other vascular irregularity found on magnetic resonance angiography or computed tomographic angiography. According to the International Study of Unruptured Intracranial Aneurysms, most patients with aneurysms are asymptomatic and symptoms such as headaches or dizziness are likely unrelated to the aneurysm.¹ In the International Study of Unruptured Intracranial Aneurysms Investigators, the following were cited as the most common clinical scenarios leading to diagnostic imaging: 36% headache or dizziness, 17.6% ischemic cerebrovascular disease, and 15.4% cranial nerve deficits.² Since the majority of these symptoms are probably not directly related to intracranial pathology, it is important to obtain a thorough history of symptom evolution and to document them prior to a procedure. This allows meaningful comparison of symptoms before and after the procedure. ►Table 1 gives a high-yield list of important areas to document in the elective patient's history.

Symptomatic Patients

Two common presentations of acute, symptomatic intracranial pathology that instigate IR involvement are intra-

cranial hemorrhage (subarachnoid or intraparenchymal) and acute ischemic stroke. Patients with subarachnoid hemorrhage can be neurologically intact. The history should document the circumstances surrounding the onset of symptoms, as there is often a sentinel headache. Patients with intraparenchymal hemorrhage or acute ischemic stroke often present with neurologic deficits, making obtaining a history more challenging. Again, the circumstances surrounding the event and the associated symptoms must be carefully documented as they are likely to change or evolve from the time of admission to the period following an interventional procedure. ►Table 1 outlines important points to document in the history of symptomatic patients.

Neurologic Physical Exam

The basic tenets of the neurologic exam are similar for symptomatic and asymptomatic patients. Clinical finding documentation is equal in importance to imaging findings in allowing application of various grading tools. Framing findings for acute pathologies to allow utilization of scales such as the Glasgow Coma Scale, the Hunt and Hess Classification of Subarachnoid Hemorrhage, and the National Institute of Health (NIH) stroke scale is crucial for management decisions (see **Appendices A and B**).

The Hunt and Hess Classification of Subarachnoid Hemorrhage system was developed in 1968 to determine the factors that contribute to surgical risk in patients with ruptured aneurysms.³ It is still widely used today for initial assessment of patients with subarachnoid hemorrhage. Documentation of grade is often required in hospitals with certified stroke centers (**Appendix B**).

The NIH stroke scale is a tool used to quantify the impairment caused by a stroke. The scale is used by clinicians to make decisions about thrombolytics and other treatment options for stroke patients. A full version of this scale can be found at: http://www.ninds.nih.gov/doctors/NIH_Stroke_Scale.pdf.

Table 1 Pertinent points to document in a patient's history

Asymptomatic patients	Symptomatic patients
Headache/Dizziness: location, onset, nature, severity, frequency, duration, exacerbating/relieving factors	Symptoms such as headache/aphasia/weakness: activity just prior to onset of symptoms, history of similar symptoms, location, nature, severity, frequency, duration, exacerbating/relieving factors
Presence or absence of blurry vision, changes in vision, painful vision, tinnitus, vertigo, difficulty swallowing, weakness of any extremity	
Past medical/surgical history: any health issues or previous surgeries	
Family history: history of vascular disease, aneurysms, vascular malformations	
Social history: smoking, alcohol intake, illicit drugs	
Medications: prescription and over the counter	
Allergies	

The basic neurologic exam should consist of documenting the following: mental status, cranial nerve function, and motor exam. Mental status consists of two important facets. First, orientation to person, place, and time is determined.

Second, alertness is also documented. Many patients with subarachnoid hemorrhage may appropriately answer questions about orientation but fall asleep while responding. Though oriented, alteration of alertness indicates a more

Table 2 Basic neurologic examination⁵

Orientation	What is your name? Where are you? What is the month and year?
Mental status	1. Patient wide awake 2. Drowsy, but oriented 3. Falling asleep during questions and needs continual prompts to pay attention 4. Intubated but following commands 5. Intubated not following commands
Cranial nerves	
I	Olfactory: Smell can be tested at the bedside with an alcohol swab
II	Optic: Can see the patient see light out of each eye? Full fundoscopic exam should be deferred to ophthalmology
III	Oculomotor: Assess the following: 1. Pupil size: number of millimeters 2. Shape: is pupil round, oval or misshapen? If misshapen, is there a history of a surgical procedure on that eye? 3. Symmetry: are pupils the same size on each side? 4. Reaction to light: document that the pupil either contracts or dilates with exposure to direct and indirect light (light shown in contralateral pupil). <i>Note:</i> Postsurgical pupils often do not react well to light but the pupil size is much smaller than a CN III palsy. 5. Movement: Does the eye move medially, laterally, superiorly, and inferiorly? CN III palsy: Pupil is dilated and unreactive and pupil points down and out (due to intact superior oblique [CN IV] and lateral rectus [CN VI] muscles). Often a symptom of a posterior communicating artery aneurysm.
IV	Trochlear: Can the eye move down and up?
V	Trigeminal: Document sensation to light touch over forehead (V1), cheek (V2), and jaw (V3). Assess masseter strength by asking patient to bite down
VI	Abducens: Can the eye move laterally?
VII	Facial: Does forehead wrinkle, can patient puff cheeks out, is smile symmetric? CN VII palsy: Peripherally, forehead cannot wrinkle. Centrally forehead motion is intact
VIII	Vestibular/Cochlear: Can patient hear out of each ear?
IX	Glossopharyngeal: Can patient cough?
X	Vagus: If awake, is palate elevation symmetric? If intubated, is gag reflex intact?
XI	Accessory: Can patient shrug shoulders?
XII	Hypoglossal: Is tongue midline? CN XII palsy: If peripheral, tongue deviates to the side of lesion. If central, tongue deviates to the opposite side of the cortical lesion.
Extremities	Assess strength globally by seeing if patient has pronator drift as this can quickly localize weakness of one side of the body. After assessing for drift, examine each of the following muscle groups for strength and grade accordingly: Upper extremities: deltoid, biceps, triceps, hand grip, and intrinsic hand musculature Lower extremities: iliopsoas, quadriceps, dorsiflexion, extensor hallucis longus, and plantar flexion Muscle strength grading: 5: full strength 4: reduced but contract against resistance 3: move against gravity but not resistance 2: cannot move against gravity 1: trace movement Decorticate posture: Flex upper extremities and extend lower extremities Decerebrate posture: Extend upper and lower extremities

severe pathology and worsened prognosis than the patient who is wide awake with just a headache. Conversely, a patient with a stroke in the dominant speech area may not be able to answer questions about orientation but may remain completely alert. The cranial nerve examination usually includes cranial nerves II–XII, with particular attention paid to the pupillary and extraocular movement findings. This part of the exam can be very sensitive for discerning whether there is a compressive etiology to the patients' symptoms.^{4,5} Gross strength and coordination can be assessed by examining the extremities. ► **Table 2** outlines the salient points to cover in this basic neurologic examination.

Gross Physical Exam

The neurologic exam will cover most of the information that needs to be assessed in patients with intracranial pathology. However, a brief physical exam to confirm the overall patient status and appropriateness of an intervention should also include inspection and documentation of groin or arterial access site, examination of distal pulses, assessment for evidence of peripheral vascular disease, and a brief baseline evaluation of cardiac and respiratory function by auscultation of the chest. Any conditions suggesting systemic or local infection should be noted as well.

Conclusion

The basic neurologic history and exam for the interventional radiologist performing intracranial procedures need

not be exhaustive and will not supplant that by neurologic specialist. It should include a pertinent history, focused neurologic exam, and a brief physical exam. The interventional radiologist should be familiar with the grading scales commonly used for patients with intracranial pathology to understand the severity and prognosis of various pathologies. The goal of the examination is to mitigate risk, direct the evaluation, aid in medical decision making, and allow the establishment of an appropriate physician–patient relationship.

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Appendix A Glasgow coma scale⁶

Score	Eye opening	Verbal response	Motor response
1	None	None	No movement
2	Open to painful stimulation	Incomprehensible sounds	Extends to pain
3	Open to voice	Inappropriate words	Abnormal flexion to pain
4	Open spontaneously	Confused, disoriented	Withdraws to pain
5	–	Oriented, converses	Localizes to painful stimulus
6	–	–	Obeys commands

Notes: The Glasgow Coma Scale was developed to assess the depth and duration of impaired consciousness and coma.⁵ For patients presenting with neurologic pathology, it is helpful to assign the patient a Glasgow Coma Score, as this aids clinicians across specialties in determining the severity of presentation and possible duration of impairment.

Appendix B Hunt and Hess classification of subarachnoid hemorrhage³

Classification of patients with intracranial aneurysms according to surgical risk	
Category ^a	Criteria
Grade I	Asymptomatic, or minimal headache and slight nuchal rigidity
Grade II	Moderate-to-severe headache, nuchal rigidity, no neurologic deficit other than cranial nerve palsy
Grade III	Drowsiness, confusion, or mild focal deficit
Grade IV	Stupor, moderate-to-severe hemiparesis, possibly early decerebrate rigidity, and vegetative disturbances
Grade V	Deep coma, decerebrate rigidity, moribund appearance

^aSerious systemic diseases, such as hypertension, diabetes, severe arteriosclerosis, chronic pulmonary disease, and severe vasospasm seen on arteriography, result in placement of the patient in the next less favorable category.