INTRODUCTION:

Brain (head) MRI is the procedure of choice for most brain disorders. It provides clear images of the brainstem and posterior brain, which are difficult to view on a CT scan. It is also useful for the diagnosis of demyelinating disorders (disorders such as multiple sclerosis (MS) that cause destruction of the myelin sheath of the nerve). The evaluation of blood flow and the flow of cerebrospinal fluid (CSF) is possible with this non-invasive procedure.

Initial Clinical Reviewers (ICRs) and Physician Clinical Reviewers (PCRs) must be able to apply criteria based on individual needs and based on an assessment of the local delivery system.

INDICATIONS FOR BRAIN MRI:

For evaluation of suspected multiple sclerosis (MS) 1:
- For evaluation of patient with neurologic symptoms or deficits within the last four (4) weeks.

For evaluation of known multiple sclerosis (MS) 1:
- Stable condition with no prior imaging within the past ten (10) months or within the past six (6) months if patient has relapsing disease
- Exacerbation of symptoms or change in symptom characteristics such as frequency or type and demonstrated compliance with medical therapy.

For evaluation of known or suspected seizure disorder: 2,3,4
- New onset of a seizure.
- Medically refractory epilepsy.

For evaluation of suspected Parkinson's disease: 5
- For evaluation of suspected Parkinson's disease as a baseline study.

For evaluation of known Parkinson's disease: 5
- For evaluation of new non-Parkinson symptoms complicating the evaluation of the current condition.
For evaluation of neurologic symptoms or deficits:  
- Acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.

For evaluation of clinical assessment documenting cognitive impairment of unclear cause:  
- Change in mental status with a mental status score of either MMSE or MoCA of less than 26 or other similar mental status instruments showing at least mild cognitive impairment AND a completed basic metabolic workup (such as thyroid function testing, liver function testing, complete blood count, electrolytes, and B12).

For evaluation of known or suspected trauma:  
- Known or suspected trauma or injury to the head with documentation of one or more of the following acute, new or fluctuating:  
  o Focal neurologic findings  
  o Motor changes  
  o Mental status changes  
  o Amnesia  
  o Vomiting  
  o Seizures  
  o Headache  
  o Signs of increased intracranial pressure  
- Known coagulopathy  
- Known or suspected skull fracture by physical exam and positive x-ray.

For evaluation of headache:  
- Chronic headache with a change in character/pattern (e.g., more frequent, increased severity or duration).  
- New onset (< 48 hours) of “worst headache in my life” or “thunderclap” headache. Note: The duration of a thunderclap type headache lasts more than 5 minutes. Sudden onset new headache reaching maximum intensity within 2-3 minutes.  
- New onset of headache with any acute, new or fluctuating neurologic deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes  
- MRI is indicated once in patients with cluster headaches to eliminate secondary causes.  
- Patient with history of cancer, or significantly immunocompromised, with new onset headache.  
- New headache in individual > 55 years old.  
- New temporal headache in person > 55, with sedimentation rate (ESR) > 55 with tenderness over the temporal artery.  
- Acute, sudden onset of headache with a family history (brother, sister, parent or child) of brain aneurysm or AVM (arteriovenous malformation).  
- New severe unilateral headache with radiation to or from the neck. Associated with suspicion of carotid or vertebral artery dissection.  
- New onset of headache in pregnancy.

For evaluation of known or suspected brain tumor, mass or metastasis:  
- Known tumor and new onset of headache.  
- Follow up for known tumor.
• Evaluation of suspected tumor with any acute, new or fluctuating neurologic symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes.

• Known lung cancer, or rule out metastasis and/or preoperative evaluation.

• Evaluation of metastatic melanoma (not all melanomas).

• Known or suspected pituitary tumor with corroborating physical exam (galactorrhea) neurologic findings and/or lab abnormalities.

**Indication for combination studies for the initial pre-therapy staging of cancer, OR ongoing tumor/cancer surveillance OR evaluation of suspected metastases:**

- ≤ 5 concurrent studies to include CT or MRI of any of the following areas as appropriate depending on the cancer: Neck, Abdomen, Pelvis, Chest, Brain, Cervical Spine, Thoracic Spine or Lumbar Spine.
  - Cancer surveillance: Active monitoring for recurrence as clinically indicated.

**For evaluation of known or suspected stroke:**

- To evaluate patient with history of a known stroke with new and sudden onset of severe headache.
- Known or suspected stroke with any acute, new or fluctuating symptoms or deficits such as sensory deficits, limb weakness, speech difficulties, lack of coordination or mental status changes or with a family history (brother, sister, parent or child) of aneurysm.
- Symptoms of transient ischemic attack (TIA) (episodic neurologic symptoms).

**For evaluation of known or suspected inflammatory disease or infection (e.g., meningitis or abscess):**

- Intracranial abscess or brain infection with acute altered mental status OR positive lab findings (such as elevated WBC’s) OR follow up assessment during or after treatment completed.
- Meningitis with positive physical findings (such as fever, stiff neck) and positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam.)
- Suspected encephalitis with a severe headache, altered mental status OR positive lab finding, (such as elevated WBC’s).
- Endocarditis with suspected septic emboli.
- Evaluation for Central Nervous System (CNS) involvement in patients with known or suspected vasculitis or autoimmune disease with positive lab findings.

**For evaluation of known or suspected congenital abnormality (such as hydrocephalus, craniosynostosis):**

- Known or suspected congenital abnormality with any acute, new or fluctuating neurologic, motor or mental status changes.
- Evaluation of macrocephaly with child >6 months of age.
- Evaluation of microcephaly.
- Follow up shunt evaluation within six (6) months of placement or one (1) year follow up and/or with neurologic symptoms.
- Evaluation of craniosynostosis and other skull deformities. CT is preferred imaging to assess bony structures: MRI imaging is preferred to assess intracranial soft tissue.
- To evaluate patient for suspected or known hydrocephalus.
• To evaluate patient for prior treatment OR treatment planned for congenital abnormality.

Suspected normal pressure hydrocephalus, (NPH) with symptoms.

Pre-operative evaluation for brain/skull surgery:

Post-operative/procedural evaluation:
• A follow-up study may be needed to help evaluate a patient’s progress after treatment, procedure, intervention or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for a Brain MRI with Internal Auditory Canal (IAC):
• Unilateral non-pulsatile tinnitus.
• Pulsatile tinnitus.
• Suspected acoustic neuroma (Schwannoma) or cerebellar pontine angle tumor with any of the following signs and symptoms: unilateral hearing loss by audiometry, headache, disturbed balance or gait, unilateral tinnitus, facial weakness, or altered sense of taste.
• Suspected cholesteatoma.
• Suspected glomus tumor.
• Asymmetric sensorineural hearing loss on audiogram.

Other indications for a Brain MRI:
• Evaluation of suspected acute subarachnoid hemorrhage (SAH).
• Follow up for known hemorrhage, hematoma or vascular abnormalities.
• Suspected central venous thrombosis.
• Evaluation of neurological findings in sickle cell disease.
• Developmental delay.
• Vertigo associated with headache, blurred or double vision, or a change in sensation after full neurologic examination and initial work-up.
• Abnormal eye findings on physical or neurologic examination (papilledema, nystagmus, ocular nerve palsies, visual field deficit etc).
• Anosmia (loss of smell) (documented by objective testing).
• Evaluation of known or suspected cerebrospinal fluid (CSF) leakage.
• Immunocompromised patient (e.g., transplant recipients, HIV with CD4<200, primary immunodeficiency syndromes, hematologic malignancies) with focal neurologic-symptoms, headaches, behavioral, cognitive or personality changes.
• Initial imaging of a suspected or known Arnold Chiari malformation (ACM)
• Optic neuritis.
• Initial evaluation for a known syrinx or syringomyelia.
• Suspected cholesteatoma.

Indications for combination studies:
• Brain MRI/Neck MRA –
  o Confirmed carotid occlusion >60%, surgery or angioplasty candidate.
• Brain MRI/Cervical MRI –
  o For evaluation of Arnold Chiari Malformation.
  o For follow-up of known multiple sclerosis (MS).
• **Brain MRI/Orbit MRI** –
  - For approved indications as noted above and being performed in a child under 3 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial tumor (e.g. “trilateral retinoblastoma”).
  - Unilateral papilledema: to distinguish a compressive lesion on the optic nerve or optic disc swelling associated with acute demyelinating optic neuritis in multiple sclerosis from nonarteritic anterior ischemic optic neuropathy (AION), central retinal vein occlusion or optic nerve infiltrative disorders.

**ADDITIONAL INFORMATION RELATED TO BRAIN MRI:**

**MMSE** - The Mini Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The MMSE has been the most commonly used measure of cognitive function in dementia research, but researchers have recognized that it is relatively insensitive and variable in mildly impaired individuals. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely.

**MoCA** - The Montreal Cognitive Assessment (MoCA) was designed as a rapid screening instrument for mild cognitive dysfunction. It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. MoCA differs from the MMSE mainly by including tests of executive function and abstraction, and by putting less weight on orientation to time and place. Ten of the MMSE’s 30 points are scored solely on the time-place orientation test, whereas the MoCA assigns it a maximum of six points. The MoCA also puts more weight on recall and attention-calculation performance, while de-emphasizing language skill. Time to administer the MoCA is approximately 10 minutes. The total possible score is 30 points: a score of 26 or above is considered normal.

**Combination MRI/MRA of the Brain** – This is one of the most misused combination studies and these examinations should be ordered in sequence, not together. Vascular abnormalities can be visualized on the brain MRI.

**MRI for Headache** - Generally, magnetic resonance imaging is the preferred imaging technique for evaluating the brain parenchyma and CT is preferable for evaluating subarachnoid hemorrhage. CT is faster and more readily available than MRI and is often used in urgent clinical situations. Neurologic imaging is warranted in patients with headache disorders along with abnormal neurologic examination results or predisposing factors for brain pathology. Contrast enhanced MRI is performed for evaluation of inflammatory, infectious, neoplastic and demyelinating conditions.

**MRI for Macrocephaly** - Consider ultrasound for child <6 months of age for macrocephaly.

**MRI and Positron Emission Tomography (PET) for Chronic Seizures** – When MRI is performed in the evaluation of patients for epilepsy surgery, almost a third of those with electrographic evidence of temporal lobe epilepsy have normal MRI scans. Interictal
positron emission tomography (PET) may be used to differentiate patients with MRI-negative temporal lobe epilepsy.

**MRI and Multiple Sclerosis** – Current advances in MRI improve the ability to diagnose, monitor and understand the pathophysiology of MS. Different magnetic resonance methods are sensitive to different aspects of MS pathology and by the combining of these methods, an understanding of the mechanisms underlying MS may be increased.

**MRI and Vertigo** – Magnetic resonance imaging is appropriate in the evaluation of patients with vertigo who have neurologic signs and symptoms, progressive unilateral hearing loss or risk factors for cerebrovascular disease. MRI is more appropriate than CT for diagnosing vertigo due to its superiority in visualizing the posterior portion of the brain, where most central nervous system disease that causes vertigo is found. MRI is helpful in diagnosing vascular causes of vertigo.
REFERENCES

1. Traboulsee A; Simon JH; Stone L; Fisher E; Jones DE; Malhotra A; Newsome SD; Oh J; Reich DS; Richert N; Rammohan K; Khan O; Radue EW; Ford C; Halper J; Li D Revised Recommendations of the Consortium of MS Centers Task Force for a Standardized MRI Protocol and Clinical Guidelines for the Diagnosis and Follow-Up of Multiple Sclerosis. *AJNR Am J Neuroradiol.* 2016; 37(3):394-401 (ISSN: 1936-959X)


8—Brain (head) MRI 2018


