INTRODUCTION:

Computed tomography (CT) is an imaging technique used to view the structures of the brain and is useful in evaluating pathologies in the brain. It provides more detailed information on head trauma, brain tumors, stroke, and other pathologies in the brain than regular radiographs.

INDICATIONS FOR BRAIN CT:

**For evaluation of neurological symptoms or deficits:**
- Acute, new or fluctuating neurologic symptoms or deficits such as tingling (paresthesia), numbness of one side, spastic weakness (hemiparesis) of one side, paralysis, loss of muscle control, inability to speak, lack of coordination or mental status changes.

**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:
  - Focal neurologic findings
  - Motor changes
  - Mental status changes
  - Amnesia
  - Vomiting
  - Seizures
  - Headache
  - Signs of increased intracranial pressure
- Known or suspected skull fracture by physical exam and/or positive x-ray.

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

**For evaluation of headache:**
- Chronic headache with a change in character/pattern (e.g. more frequent, increased severity or duration) and MRI is contraindicated or cannot be performed.
- 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 headache in occipitomuchal region in individual > 55 years old and MRI is contraindicated or cannot be performed.
• New temporal headache in person > 55, with Sedimentation Rate (ESR) > 55 and tenderness over the temporal artery and MRI is contraindicated or cannot be performed.
• Patient with history of cancer, HIV, or immunocompromised with new onset headache and MRI is contraindicated or cannot be performed.

For evaluation of known or suspected brain tumor, mass, or metastasis:
• For patient with history of cancer with suspected recurrence or metastasis [based on symptoms or examination findings (may include new or changing lymph nodes)].
• Evaluation of patient with history of cancer that had a recent course of chemotherapy, radiation therapy (to the brain), or has been treated surgically within the last two (2) years.
• Evaluation for a bone tumor or abnormality of the skull.

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
  o Cancer surveillance excluding small cell lung cancer: Every six (6) months for the first two (2) years then annually thereafter.
  o Cancer surveillance – small cell lung cancer: Up to every 3 months for the first two years then annually thereafter.

For evaluation of known or suspected stroke:
• To evaluate patient with history of a known stroke with new and sudden onset of severe headache.
• To evaluate patient with a suspected stroke or history of a known stroke with a family history (brother, sister, parent or child) of stroke or aneurysm.

For evaluation of known or suspected aneurysm or arteriovenous malformation (AVM) and MRI is contraindicated or cannot be performed:
• With history of known aneurysm or AVM with new onset headache.
• With history or suspicion of aneurysm or AVM with family history (brother, sister, parent or child) of aneurysm or AVM.

For evaluation of known or suspected inflammatory disease or infection, (e.g., meningitis, or abscesses) and MRI is contraindicated or cannot be performed:
• With positive lab findings.
• 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.
• Inflammatory disease (i.e. vasculitis), sarcoid or infection for patient presenting with a fever, stiff neck and positive lab findings (such as elevated white blood cells or abnormal lumbar puncture fluid exam).
• 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.

For evaluation of known or suspected congenital abnormality (such as hydrocephalus, craniosynostosis):
- Treatment planned within four (4) weeks for congenital abnormality (such as placement of shunt or problems with shunt: surgery).
- Known or rule out congenital abnormality with any acute, new or fluctuating neurologic, motor or mental status changes.
- Evaluation of macrocephaly with child >6 months of age or microcephaly.
- Follow up shunt evaluation within six (6) months of placement or one (1) year follow up and/or with neurological symptoms.

Suspected normal pressure hydrocephalus, (NPH) with symptoms.

For evaluation of known or suspected congenital abnormalities and MRI is contraindicated or cannot be performed:
- To evaluate patient for suspected or known hydrocephalus or congenital abnormality.
- To evaluate patient for prior treatment OR treatment planned for congenital abnormality.

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.

Other indications for a Brain CT:
- Evaluation of suspected acute Subarachnoid Hemorrhage (SAH).
- For the evaluation of a single study related to new onset of seizures or newly identified change in seizure activity/pattern AND cannot have a Brain MRI.
- Initial evaluation of a cholesteatoma.
- Follow up for known hemorrhage, hematoma or vascular abnormalities.
- Developmental delay where MRI cannot be performed.
- 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).
- For evaluation of known or suspected cerebrospinal fluid (CSF) leakage.
- Immunocompromised patient (e.g. transplant recipients, HIV, primary immunodeficiency syndromes, hematologic malignancies) with focal neurological symptoms, headaches, behavioral, cognitive or personality changes.

Indication for Brain CT/Cervical CT combination studies:
- For evaluation of Arnold Chiari malformation where MRI cannot be performed.
**Brain CT/Orbit CT:**
- 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 (NAION), central retinal vein occlusion or optic nerve infiltrative disorders.

**Brain CT/Neck CTA:**
- Confirmed carotid stenosis >60%, surgery or angioplasty candidate (significant lesion can flip off emboli, looking for stroke).

**ADDITIONAL INFORMATION RELATED TO BRAIN CT:**

**CT scan for congenital abnormalities:** While MRI is preferred to CT for evaluation of most congenital CNS abnormalities, in some clinical situations CT is preferred (craniosynostosis) or equivalent to MRI. CT is appropriate in the follow up of hydrocephalus or VP shunt function where the etiology of hydrocephalus has been previously determined or in patients for which MRI evaluation would require general anesthesia.

**CT scan for Head Trauma** – Most types of head injury are minor injuries; clinical signs and symptoms help predict the need for brain CT following injury. A patient who presents with certain clinical risk factors may be more likely to benefit from CT imaging. Some of the clinical risk factors that may be used as a guide to predict the probability of abnormal CT following minor head injury are vomiting, skull fracture and age greater than 60 years. Patients with a Glasgow Coma Scale of 15 or less who also have vomiting or suspected skull fracture are likely to show abnormal results on CT scan.

**CT scan 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.

**CT scan for Head Trauma** – CT has advantages in evaluating head injury due to its sensitivity for demonstrating mass effect, ventricular size and configuration, bone injuries and acute hemorrhage. CT has been used routinely as a screening tool to evaluate minor or mild head trauma in patients who are admitted to a hospital or for surgical intervention. CT is useful in detecting delayed hematoma, hypoxic-ischemic lesions or cerebral edema in the first 72 hours after head injury.

**CT scan for Stroke** – Patients presenting with symptoms of acute stroke should receive prompt imaging to determine whether they are candidates for treatment with tissue plasminogen activator. Non-contrast CT can evaluate for hemorrhage that would exclude the patient from reperfusion therapy. Functional imaging can be used to select patients for thrombolytic therapy by measuring the mismatch between “infarct core” and “ischemic
penumbra” which is a target for therapy. Contrast enhanced CT angiography (CTA) may follow the non-contrast CT imaging and may define ischemic areas of the brain with the potential to respond positively to reperfusion therapy.

**CT scan and Meningitis** – In suspected bacterial meningitis, contrast CT may be performed before lumbar puncture to show beginning meningeal enhancement. It may rule out causes for swelling. CT may be used to define the pathology of the base of the skull and that may require therapeutic intervention and surgical consultation. Some causes of the infection include fractures of the paranasal sinus and inner ear infection.

**REDUCING RADIATION EXPOSURE:**

Brain MRI is preferred to Brain CT in most circumstances where the patient can tolerate MRI and sufficient time is available to schedule the MRI examination. Assessment of subarachnoid hemorrhage, acute trauma or bone abnormalities of the calvarium (fracture, etc) may be better imaged with CT.

**CT for Macrocephaly or Microcephaly** - Consider ultrasound for child <6 months of age for Macrocephaly or Microcephaly.
REFERENCES


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