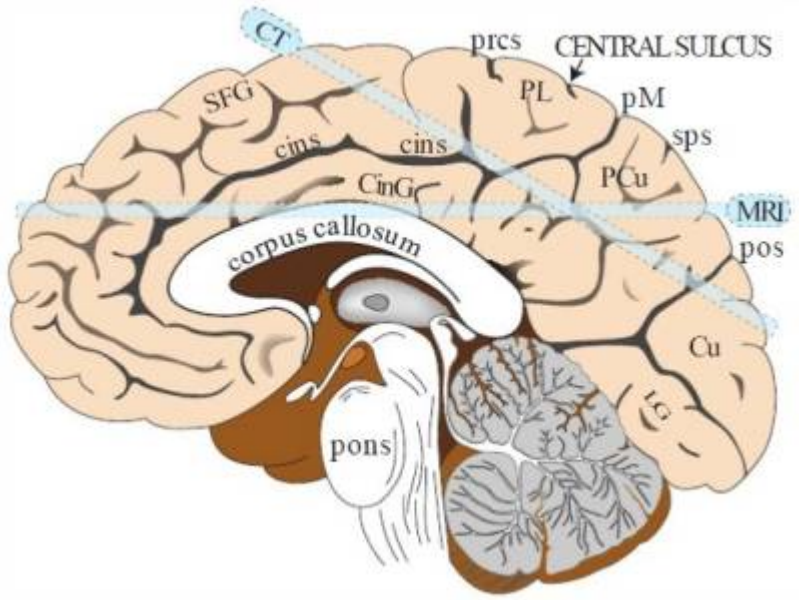
Head computed tomography



Head CT Modalities

This page outlines the main types of head CT imaging, classified by contrast use, protocol, and clinical application.

1. Non-Contrast CT (NCCT)

Uses:

- Head trauma.
- Stroke (ischemic or hemorrhagic).
- Hydrocephalus.
- Seizures.
- Pre-contrast baseline.

Advantages:

- Fast and widely available.
- Excellent for detecting:
  - Acute hemorrhage.
  - Skull fractures.
  - Midline shift or mass effect.

2. Contrast-Enhanced CT (CECT)

Uses:

- Tumor evaluation.
- Abscess or infectious processes.
- Suspected dural sinus thrombosis.
- Postoperative assessment.

Considerations:

- Avoid in contrast allergy or renal impairment.
- Enhances vascular and soft tissue detail.

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3. CT Angiography (CTA)

Uses:

- Aneurysms.
- AVMs (arteriovenous malformations).
- Intracranial stenosis or occlusion.
- Vessel dissection.
- Preoperative vascular mapping.

Technique:

- IV contrast + timed arterial phase acquisition.

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4. CT Venography (CTV)

Uses:

- Cerebral venous sinus thrombosis (CVST).
- Preoperative venous evaluation.

Notes:

- Venous phase acquisition after contrast injection.

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5. CT Perfusion (CTP)

Uses:

- Acute ischemic stroke workup.
- Guides thrombolysis or thrombectomy decision-making.

Parameters analyzed:

- Cerebral blood flow (CBF).
- Cerebral blood volume (CBV).
- Mean transit time (MTT).
- Time to peak (TTP).

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6. 3D Reconstruction CT

Uses:

- Neurosurgical planning.
- Skull fractures.
- Craniofacial deformities or trauma.
- Shunt/catheter evaluation.

Tools:

- Multiplanar and volumetric reconstruction software.

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7. Cone-Beam CT (CBCT)

Uses:

- Sinus imaging.
- Skull base evaluation.
- Dental/maxillofacial surgery planning.

Notes:

- Superior bony detail with lower radiation dose.
- Limited soft tissue contrast.

Summary Table

Modality	Contrast Used?	Clinical Applications
Non-Contrast CT (NCCT)	No	Trauma, stroke, hydrocephalus, hemorrhage
Contrast-Enhanced CT	Yes	Tumors, infections, postop evaluation
CT Angiography (CTA)	Yes	Aneurysms, AVMs, stenosis, stroke
CT Venography (CTV)	Yes	Sinus thrombosis, venous anatomy
CT Perfusion (CTP)	Yes	Stroke: core vs penumbra assessment

Modality	Contrast Used?	Clinical Applications
3D Reconstruction CT	Optional	Planning, fractures, catheter visualization
Cone-Beam CT (CBCT)	No	ENT, dental, sinus, skull base imaging

Indications

Noncontrast CT scans are often employed in emergency situations (to quickly rule out most acute abnormalities), to evaluate bone in great detail, or as a screening test. It excels in demonstrating acute blood (EDH, SDH, IPH, SAH), fractures, foreign bodies, pneumocephalus, and hydrocephalus. It is weak in demonstrating acute stroke (DWI MRI is preferred), and often has poor signal quality in the posterior fossa (due to bone artifact).

IV enhanced CT scans are used primarily for imaging neoplasms or vascular malformations, especially in patients with contraindications to MRI. All CT contrast agents contain iodine. A typical IV dose of contrast: 60–65 ml o fe.g.Isovue3 00® which delivers 18–19.5 grams of iodine.

Cranial CT (CCT) scans and hospital admission are increasingly performed to rule out intracranial hemorrhage in patients after minor head injury (MHI), particularly in older patients and in those receiving antiplatelet therapy. This leads to high radiation exposure and a growing financial burden

see Canadian CT Head Rule.

see Postoperative computerized tomography.

see Computed Tomography for chronic subdural hematoma.

Before a biopsy, detailed imaging studies are conducted, typically using techniques such as computed tomography (CT) or magnetic resonance imaging (MRI). These images help identify the location and dimensions of the abnormality.

Repeat head computed tomography

A definitive consensus on the standardization of practice of a routine repeat head CT (RHCT) scan in patients with traumatic intracranial hemorrhage is lacking.

After mTBI, worsening of repeat head CT finding is seen in a third of patients and is associated with worse outcomes. A substantial fraction of patients who require operative intervention will have no clinical changes in the first 8 hours, supporting the value of repeat head CT within this time frame [1].

Neurologic examination can be trusted and is reliable in pediatric blunt TBI patients in determining when an RHCT scan is necessary. Aziz et al. recommend that RHCT is required routinely in patients with intracranial hemorrhage with GCS score of 8 or less and in patients with GCS greater than 8 and that RHCT be performed only when there are clinical indications [2].

Routine repeat head CT scan is not warranted in patients with normal neurologic examination. Routine repeat head CT scan does not supplement the need for neurologic examination for determining management in patients with traumatic brain injury [3].

Emergency department (ED) management of mild traumatic brain injury (TBI) with any form of traumatic intracranial hemorrhage (ICH) is variable.

Since 2000, The Department of Emergency Medicine, University of Cincinnati, Cincinnati, OH, standard practice has been to obtain a repeat head computed tomography (CT) at least 6 hours after initial imaging. Patients are eligible for discharge if clinical and CT findings are stable. Whether this practice is safe is unknown.

Discharge after a repeat head CT and brief period of observation in the ED allowed early discharge of a cohort of mild TBI patients with traumatic ICH without delayed adverse outcomes. Whether this justifies the cost and radiation exposure involved with this pattern of practice requires further study [4].

Hemorrhagic stroke

High rates of head CT use for patients with hemorrhagic stroke are frequently observed, without an association with decreased mortality. A higher number of physicians consulted was associated with high-intensity use of head CT [5].

Time to CT scan

Emergent brain computed tomography (CT) scan allows for the identification of patients presenting with acute severe neurological symptoms in whom medical and surgical interventions may be lifesaving. The aim of the study was to evaluate if the time to CT from arrival at the emergency department exceeded 30 min in patients admitted with acute severe neurological symptoms. This was a retrospective register-based quality assurance study. We identified patients admitted to the emergency department with acute severe neurological symptoms between April 1st, 2016, and September 30th, 2020. Data were retrieved from the registry of acute medical team activations. We considered that time to CT from arrival at the emergency department should not exceed 30 min in more than 10% of patients. A total of 559 patients were included. Median time from arrival at the emergency department until CT scan was 24 min (IQR 16-35) in children (< 18 years), 10 min (IQR 7-17) for adults (18-59 years), and 11 min (IQR 7-16) for elders (> 60 years). This time interval exceeded 30 min for 8.2% (95% CI 6.1-10.9) of all included patients, 35.3% of children, 5.9% of adults, and 8.6% of elders. No children died within 30 days. The 30-day mortality was 21.3% (95% CI 16.4-27) in adults and 43.9% (95% CI 38.2-49.8) in elders. Time from arrival at our emergency department until brain CT scan exceeded 30 min in 8.2% of all included patients but exceeded the defined quality aim in children and could be improved [6].

1)
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2)
Aziz H, Rhee P, Pandit V, Ibrahim-Zada I, Kulvatunyou N, Wynne J, Zangbar B, O'Keeffe T, Tang A, Friese RS, Joseph B. Mild and moderate pediatric traumatic brain injury: replace routine repeat head computed tomography with neurologic examination. J Trauma Acute Care Surg. 2013 Oct;75(4):550-4. doi: 10.1097/TA.0b013e3182a53a77. PubMed PMID: 24064865.
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4) Kreitzer N, Lyons MS, Hart K, Lindsell CJ, Chung S, Yick A, Bonomo J. Repeat neuroimaging of mild traumatic brain-injured patients with acute traumatic intracranial hemorrhage: clinical outcomes and radiographic features. Acad Emerg Med. 2014 Oct;21(10):1083-91. doi: 10.1111/acem.12479. PubMed PMID: 25308130.

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