

# CLINICAL INQUIRIES

From the Family Practice Inquiries Network

## Which imaging modality is best for suspected stroke?

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### EVIDENCE-BASED ANSWER

Patients exhibiting stroke symptoms should have brain imaging immediately within 3 hours of symptom onset (strength of recommendation [SOR]: **A**, based on systematic review). In the first 3 hours after a suspected cerebrovascular accident (CVA), noncontrast head computerized tomography (CT) is the gold standard for diagnosis of acute hemorrhagic stroke (SOR: **C**, based on expert panel consensus). However, the sensitivity for hemorrhage declines steeply 8 to 10 days after the event. Eligibility guidelines for acute thrombolytic therapy are currently based on use of CT to rule out acute hemorrhagic stroke.

Magnetic resonance imaging (MRI) may be equally accurate in diagnosing an acute hemorrhagic stroke if completed within 90 minutes of presentation for patients whose symptoms began fewer than 6 hours earlier (SOR: **B**, based on a single high-quality cohort study). MRI is more sensitive than CT for ischemic stroke in the first 24 hours of symptoms (SOR: **B**, based on systematic review of low-quality studies with consistent findings) and is more sensitive than CT in the diagnosis of hemorrhagic or ischemic stroke greater than 1 week after symptom onset (SOR: **B**, based on 1 high-quality prospective cohort study).

### CLINICAL COMMENTARY

#### CT without contrast still the best choice for assessing suspected acute stroke

CT without contrast remains the best choice when assessing a patient for suspected stroke. For patients who are candidates for rtPA, this should be performed and read within 45 minutes of entering the emergency department. Remember that IV thrombolytics must be administered within 3 hours of stroke onset to be effective.

As Xenon-enhanced CT (XeCT) and Single Photon Emission CT (SPECT) become more available, these may be considered an adjunct to help risk-stratify patients prior to revascularization with a thrombolytic.<sup>1</sup> After 48 hours, an MRI shows greater sensitivity in detecting both hemorrhagic and ischemic strokes.

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#### ■ Evidence summary

The British National Health Service Health Technology Assessment (HTA) Programme published a systematic review on optimal brain imaging strategies for the diagnosis of stroke in July 2004.<sup>2</sup> The

HTA searched Medline and EMBASE from 1980 to 1999 and found 1903 studies relevant to diagnostic imaging for stroke. Only 25 studies reported the type of stroke diagnosed and the imaging reference standard. Thirteen of these 25

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studies describe the time interval from symptom onset to imaging.

The HTA found a wide range of sensitivities for CT and MRI for both hemorrhagic and ischemic strokes at different time periods (TABLE) and noted that the quality of most of these studies was poor. Most of the studies identified were performed in academic stroke centers and had small sample sizes. Interpretation was masked in only 58% of studies. Few data were available on interobserver reliability, and neuroradiologists usually interpreted images. Two studies, totaling

165 patients, compared CT and MRI scans performed on the same day. However, the most “acute” time period reported was within 48 hours from symptom onset; neither study reported the order in which scans were performed, and only 1 study masked the neuroradiologist to the interpretation of the other modality.

After this systematic review, the HTA performed a prospective cohort study comparing CT with MRI obtained in random order on the day of presentation. They enrolled 228 patients presenting to a general hospital with stroke symptoms: (1) lasting longer than 1 day, but causing little or no decrease in function, or (2) lasting longer than 5 days. The mean time from onset of symptoms to scanning was 21.5 days. CT detected hemorrhagic stroke in 50%, and late hemorrhagic transformation in 20%, of those patients found to have hemorrhagic stroke on MRI, which was considered the criterion standard of chronic stroke diagnosis. The earliest hemorrhagic stroke missed by CT was 11 days old, and the latest hemorrhage correctly identified by CT was 14 days old.

An additional prospective cohort study comparing imaging modalities in the acute time frame has been published since the HTA review.<sup>2</sup> The study enrolled 129 patients with stroke symptoms of less than 3 hours, as well as 71 patients with between 3 and 6 hours of symptoms. Patients underwent multimodal MRI (including gradient recalled echo and diffusion-weighted imaging) and noncontrast CT within 90 minutes of presentation. Two stroke specialists and 2 neuroradiologists, masked to clinical information, read the scans independently at a later date. Interrater reliability was good ( $\kappa = 0.75\text{--}0.94$ ) for identifying acute hemorrhage. There was 96% concordance between the MRI and CT interpretations. The 4 hemorrhages “missed” by CT were hemorrhagic transformations of acute infarct, and the 4 hemorrhages “missed” by MRI were misclassified as chronic when they were acute.

### What are Clinical Inquiries?

**Clinical Inquiries** answer recent questions from the practices of family physicians. Practicing family physicians choose the most relevant questions submitted through a web-based voting system operated by the Family Physicians Inquiries Network (FPIN; online at [www.fpin.org](http://www.fpin.org)).

FPIN is national, not-for-profit consortium of family medicine departments, community residency programs, academic health sciences libraries, primary care practice-based research networks, and other specialists. Once questions are selected, FPIN editors then organize teams of clinicians and librarians to answer them based on systematic review of the world literature. Answers are developed through an explicit, systematic method:

- FPIN librarians and editors identify questions recently answered in best evidence sources (e.g. Cochrane Reviews, Clinical Evidence, the US Preventive Services Task Force, Evidence Based Guidelines, a published systematic review).
- FPIN librarians then conduct systematic and standardized literature searches of best evidence sources, Medline, and other databases in collaboration with an FPIN clinician or clinicians. If a best evidence source has been identified, the search begins from the date of the search conducted for that source. Otherwise, the searches are comprehensive.
- FPIN clinician authors then choose the highest quality original research sources, and critically appraise the research and integrate the findings in the Evidence Based Answer and Evidence Summary section of Clinical Inquiries. Authoritative sources are also quoted in the “Recommendations from Others” section of the Clinical Inquiry.
- Each Clinical Inquiry is reviewed by 4 or more peers or editors before publication in *JFP*.
- FPIN medical librarians are accountable for the thoroughness of the literature search, for recording the databases searched, search hedges used and the search terms. The details of each search is available to any interested reader (contact [managingeditor@fpin.org](mailto:managingeditor@fpin.org)).
- Finally, a practicing family physician or other clinician writes an accompanying commentary to provide a clinical perspective.

#### FAST TRACK

**In the first 3 hours after a cerebrovascular accident, CT is the gold standard for diagnosis of acute hemorrhagic stroke**

TABLE

## Range of sensitivities of CT and MRI for hemorrhagic and ischemic stroke

NEUROIMAGING METHOD	TYPE OF STROKE	TIME SINCE SYMPTOM ONSET			
		>3 HOURS	>6 HOURS	<48 HOURS	>48 HOURS
Head CT without contrast	Sensitivity for hemorrhagic stroke	Evidence limited, assumed 100% in many studies	86%–90%* <sup>3</sup>	93%	17%–58%
	Sensitivity for ischemic stroke	64%–85%	47%–80%	23%–81%	53%–74%
Brain MRI	Sensitivity for hemorrhagic stroke	No MRI studies identified for this time frame	86%–90%* <sup>3</sup>	46%	38%–97%
	Sensitivity for ischemic stroke		65%	84%–88%	94%–98%

\*Sensitivity=86% when other imaging modality used as gold standard, 90% when discharge diagnosis of acute hemorrhagic stroke used as gold standard.

Source: Wardlaw et al, *Health Technol Assess* 2004<sup>2</sup>; Kidwell et al, *JAMA* 2004.<sup>3</sup>

The clinical implications of this study are uncertain. Without recognition of 1 imaging modality as the reference standard, it is difficult to say whether a hemorrhage “missed” on CT was a false negative on CT or a false positive on MRI.

### Recommendations from others

In 2003, the Stroke Council, appointed by the American Heart Association, stated: “For most cases and at most institutions, CT remains the most important brain imaging test. A physician skilled in assessing CT studies should be available to interpret the scan (strength of recommendation grade B).” The Stroke Council further recommends that “[i]n patients seen within 6 hours of onset, CT currently may be preferred as the first imaging study because MRI detection of acute intracerebral hemorrhage has not been fully validated (strength of recommendation grade A).”<sup>4</sup>

The British National Health Service HTA Programme advises “scan all immediately” for diagnosing new neurological deficits with the understanding that CT scans were most available and cost-effective.<sup>2</sup>

### REFERENCES

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2. Wardlaw JM, Keir SL, Seymour J, et al. What is the best imaging strategy for acute stroke? *Health Technol Assess* 2004; 8:1–180.
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**It is difficult to say whether a hemorrhage “missed” on CT was a false negative on CT or a false positive on MRI**