“Computed Tomography–Negative” Intracerebral Hemorrhage

Case Report and Implications for Management

Andreja S. Packard, MD, PhD; Carlos S. Kase, MD; Ahmed S. Aly, MD; Glenn D. Barest, MD

Background: Noncontrast computed tomographic (CT) scanning of the brain is the main imaging modality recommended for the initial emergency evaluation of acute stroke. The main role of CT in this setting is to rule out intracerebral hemorrhage, especially in subjects who are potential candidates for thrombolytic therapy.

Objectives and Results: We studied a patient who had symptoms suggestive of a transient ischemic attack. Although serial CT scans showed no evidence of hemorrhage, a subacute intracerebral hemorrhage was demonstrated by magnetic resonance imaging.

Conclusions: This case suggests that an alternative to CT scanning should be considered in patients with acute stroke to lower the risk of an undetected intracerebral hemorrhage, especially in patients being considered for thrombolytic or anticoagulant therapy. There is evidence in the literature of other “CT-negative” cases of intracerebral hemorrhage, as well as the availability of alternative imaging techniques such as gradient echo (“susceptibility-weighted”) magnetic resonance imaging sequences, which can enhance the ability of magnetic resonance imaging to detect an acute intracerebral hemorrhage.
lung and concomitant renal cell carcinoma that were treated by surgery, chemotherapy, and radiotherapy (limited to the right lung and right kidney area, without cranial irradiation) more than 10 years previously.

Two days before admission, she noted numbness in her right hand that resolved after 5 minutes. The same pattern of numbness recurred on the day of admission. The patient denied associated headache, weakness, or difficulty speaking or swallowing. Two months before admission, she had fallen and injured her head, but had no loss of consciousness or residual symptoms.

On physical examination, she had regular pulse, and her blood pressure was 144/65 mm Hg. She was alert and oriented and her language and memory were normal. Cranial nerve function was intact. She had no abnormalities of sensation. Motor power, gait, and coordination were normal; the deep tendon reflexes were symmetric; and plantar responses were flexor. Results of laboratory tests, including complete blood cell count, serum electrolytes, liver function tests, and stool guaiac, were normal.

A head CT scan showed the cavity of an old left frontal infarct that appeared unchanged from an MR image obtained 2 years previously (Figure, A-C). A new, subtle focus of hypodensity involving the left frontal lobe was observed (Figure, D). No midline shift or intra-axial or extra-axial hemorrhages were observed. She was admitted with a diagnosis of probable transient ischemic attack and was given a continuous intravenous heparin sodium infusion. An MR image obtained 3 hours after the CT scan demonstrated a subacute hemorrhage in the left frontal lobe (Figure, E-H). The heparin infusion was stopped, and the patient remained asymptomatic. A follow-up CT scan demonstrated no interval change when compared with the previous one; in particular, the area of T1 and T2 hyperintensity on the MR image could not be identified on the CT scan (Figure, I), suggesting the existence of a CT “isodense” hematoma. An electroencephalogram showed a spike focus in the left frontal lobe, suggesting that the episodes of right-hand numbness may have represented seizure activity. She was started on a regimen of phenytoin sodium and was discharged home.

A follow-up MR image obtained 1 month later demonstrated interval evolution of the left frontal hemorrhage, without evidence to suggest underlying metastatic tumor (Figure, J, K). One day after the follow-up MR image, the patient had the sudden onset of aphasia and dense right hemiplegia. A noncontrast CT showed a large hyperdense hematoma in the left frontoparietal region (Figure, L). A craniotomy for evacuation of the hematoma was performed, but 4 days later the patient had a recurrent, fatal ICH. The pathological analysis of brain tissue obtained at the time of the surgical evacuation of the hematoma was consistent with hypertensive vascular changes, without histologic evidence of amyloid angiopathy.

### COMMENT

This case suggests that adhering to currently recommended guidelines in stroke protocols might at times lead to potentially serious consequences. A literature review disclosed at least 2 recent reports of “CT-negative” ICH.8,9 Features common to these cases, including ours, were the lack of plausible explanations, such as severe anemia, that might have accounted for the negative CT findings, and the fact that the hematomas were subacute rather than very recent in onset. The latter is not surprising, since the density of ICH on CT images steadily decreases, by an average of 0.7 Hounsfield units per day, from the initial hyperdensity of approximately 40 to 50 Hounsfield units to CT isodensity with the brain tissue, and ultimately to hypodensity.10 In contrast to the relatively large size of the lobar hemorrhage detected in our case, previously reported hemorrhages were relatively small and involved the basal ganglia. Of the 3 CT-negative ICHs reported, 2 were related to previous traumatic brain injury and 1 to chronic hypertension. The mechanism of the recurrent ICHs in our patient remains uncertain. The lack of evidence of intracranial vascular lesions with bleeding potential, history of cranial irradiation, or cerebral metastases suggested cerebral amyloid angiopathy as their underlying mechanism, possibly precipitated by the head trauma that preceded her first ICH. However, that diagnosis was not confirmed by histologic examination of tissue obtained at the time of the surgical drainage of her second ICH. In the absence of an autopsy study, however, we cannot rule out cerebral amyloid angiopathy as the underlying cause of her ICHs.

Computed tomography–negative microhemorrhages, detectable by MR imaging as T2 hypointensities of up to 5 mm, are of particular interest, since their prevalence in the general population appears to be far from negligible. They have been documented in 5% to 10% of healthy elderly individuals,11-13 and in a recent report from the Framingham Study their prevalence increased after age 75 years to 16.3%.14 Furthermore, 68% of patients with multiple lacunar strokes15 and 54% of patients with symptomatic ICH16 show evidence of multiple chronic microhemorrhages on brain MR images.

This high rate of coexistence of ischemic and hemorrhagic lesions is not surprising, since small-vessel vasculopathies can cause, depending on the circumstances, either ischemic lesions or ICH. Microhemorrhages can be viewed as markers for vessel-wall disorders, since their detection by MR imaging strongly correlates with the histologic demonstration of various types of small-vessel disease, such as hypertensive lipohyalinosis and cerebral amyloid angiopathy.17 The risk of spontaneous bleeding and bleeding after anticoagulation or fibrinolytic therapy could therefore be inferred by the detection of microhemorrhages.18,19 This idea is supported by an association of amyloid angiopathy with the development of ICH after intravenous fibrinolysis or anticoagulation.20-22 In addition, ICH associated with oral anticoagulants may also develop from microhemorrhages, and it has been postulated that oral anticoagulants may cause enlargement of subclinical microhemorrhages into symptomatic ICH.23

Intravenous tissue plasminogen activator is an established therapy for acute ischemic stroke, based on evidence from a controlled clinical trial.24 The same type of evidence is lacking for the use of intravenous heparin in patients with transient ischemic attacks or acute ische-
mic stroke. However, intravenous heparin continues to be commonly used, especially in patients with transient ischemic attacks and with acute nonhemorrhagic stroke of presumed embolic mechanism. The controversy about this issue is illustrated by current opinions in favor or against its use. It is likely that the controversy will not be resolved until the completion of the ongoing Rapid Anticoagulation Prevents Ischemic Damage trial. In this multicenter European trial, patients with nonlacunar ischemic stroke are being randomized to either continuous intravenous heparin or placebo, to test the efficacy and safety of heparin in this setting. Depending on the results of this trial, use of intravenous heparin may or may not be a therapeutic consideration in the future, thus making the issue of excluding hemorrhagic lesions either essential or moot. However, the issue will remain a critical one for patients who are candidates for thrombolysis, as well as for those who may be treated with aspirin, a treatment found to be of value in 2 randomized clinical trials.
What imaging modalities should be substituted for CT scanning in stroke protocols? Concerns that MR imaging cannot detect acute ICH have resulted in reluctance to use it as the only imaging method before initiation of anticoagulation or thrombolytic therapy. Recent studies, however, have demonstrated that T2-weighted and susceptibility-weighted (also known as gradient echo) MR imaging sequences can reliably detect ICH between 2.5 and 6 hours and even as early as 30 to 120 minutes from the onset of symptoms. Furthermore, specific patterns of hypointense, isointense, and hyperintense signal in these MR imaging sequences (progressing from the periphery of the hematoma to the center) allow the determination of hemorrhage evolution over time. Finally, the demonstration of chronic microhemorrhages, as discussed earlier, could be of value in the assessment of a patient’s risk of ICH after anticoagulant or thrombolytic treatment. Since the scan time required to complete a basic stroke protocol with multiple MR imaging sequences does not exceed 15 minutes, MR imaging is a useful alternative to CT imaging in screening stroke patients before the institution of thrombolytic or anticoagulation therapy.

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Corresponding author and reprints: Carlos S. Kase, MD, Department of Neurology, Boston University Medical Center, 715 Albany St, B-605, Boston, MA 02118 (e-mail: cskase@bu.edu).

REFERENCES