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# An Early CT Sign of Ischemic Infarction: Increased Density in a Cerebral Artery

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The diagnosis of ischemic cerebral infarction by CT usually is not possible for 12–24 hr after the event. A sign that allows earlier diagnosis is increased density of a cerebral vessel secondary to a thrombus or embolus. We report 19 cases of increased density in a middle cerebral artery or one of its major branches visible on the initial CT scan of patients subsequently clinically proven to have suffered a cerebrovascular accident. In three cases angiography confirmed the presence of embolus or thrombus as seen on the CT scans. In several cases subsequent CT scans showed the density to dissipate, thereby confirming its nature as thrombus or embolus. Recognition of this finding will allow earlier diagnosis of ischemic infarction, which may be important in instituting an appropriate therapeutic regimen.

The early diagnosis of ischemic infarction by CT depends on the recognition of often subtle changes of reduced attenuation and slight mass effect [1, 2]. A sign of cerebral infarction that may be present shortly after the ictus is increased density in a major cerebral artery. Gacs et al. [3] reported this finding in a retrospective study, and they considered it most likely secondary to intraluminal clot.

We have found this sign to be useful in the early recognition of nonhemorrhagic cerebral infarction. It has been seen in a number of patients in the first 24 hr after the ictus, and frequently it is the only CT finding or is an important corroborative finding in association with other subtle changes of infarction.

## Subjects and Methods

CT examinations were performed on high-resolution scanners. The posterior fossa and basal cisterns were evaluated with contiguous 5-mm thick sections at Cedars-Sinai Medical Center and with 1.5-mm sections at 3-mm intervals at Loma Linda University Hospital, these being the routine examinations at these institutions. At both hospitals the remainder of the brain was studied with 10-mm sections at 10-mm intervals. All examinations were performed without contrast and, in addition, three patients also had contrast examinations.

Nineteen patients had increased density in the middle cerebral artery or one of its major branches, and their clinical information was reviewed and correlated with the radiographic findings. Fourteen of these cases were from Cedars-Sinai Medical Center and were collected from a total of 747 CT brain examinations in patients suspected of having acute cerebral infarction. This results in an incidence of 1.9% in this series. Seven patients underwent a second CT within 10 days of their initial scan. Cerebral angiograms were obtained in three patients within 48 hr of the ictus.

## Results

In all 19 patients with CT scan findings of increased density in the middle cerebral artery, the clinical evaluation indicated signs and symptoms consistent with acute cerebral infarction of the ipsilateral hemisphere. These patients included 10 men and nine women, ranging in age from 36 to 90 years (mean age, 62 years).

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On the basis of suggestive clinical histories—including previous carotid endarterectomy, transient ischemic attacks, cardiac arrhythmias temporally related to the cerebral infarction, bilateral simultaneous infarction, and mitral valve prolapse—10 patients were thought to have had embolic episodes [4].

Fifteen patients showed increased density in the middle cerebral artery on the initial scan (performed within 24 hr after the ictus). An additional two patients also showed increased density in the middle cerebral artery on the initial scan, but the exact time of the ictus could not be determined. One patient had a negative scan on the day of the ictus but increased density of the middle cerebral artery was seen on a scan on day 5. Another patient was scanned only once, 4 days after the infarction, and increased density was seen in the middle cerebral artery. In one patient who was studied by CT both with and without contrast, there was decreased density on the postcontrast scan in the area of increased density seen on the precontrast scan.

Of the 17 patients with density visible in the vessel on the initial scan, nine had no other CT evidence of cerebral infarction, six had only slight edema or minimal mass effect, and

only two had obvious edema. Therefore, in 15 patients, the density in the vessel was either the only abnormality on CT or was helpful in identifying other subtle abnormalities. In five patients, the density diminished on the follow-up scan, which was performed within 1–2 weeks.

Three patients underwent cerebral angiography. In each, an occluded vessel was seen at the site of the increased density shown on the CT scan. In two patients, a 36-year-old woman 3 weeks postpartum and a 42-year-old woman with mild mitral valve prolapse, the angiograms strongly suggested embolus as the cause of the occlusion. In the third patient, occlusion was nonspecific.

## Case Reports

### Case 1

A 42-year-old woman on oral contraceptives developed a sudden right facial droop with eyes deviating to the left. Her condition progressed to stupor. The initial CT scan performed approximately 6 hr after the ictus showed a small density in the left sylvian fissure but was otherwise normal (Figs. 1A and 1B). An angiogram 24 hr later showed an occluded branch of the middle cerebral artery at the same

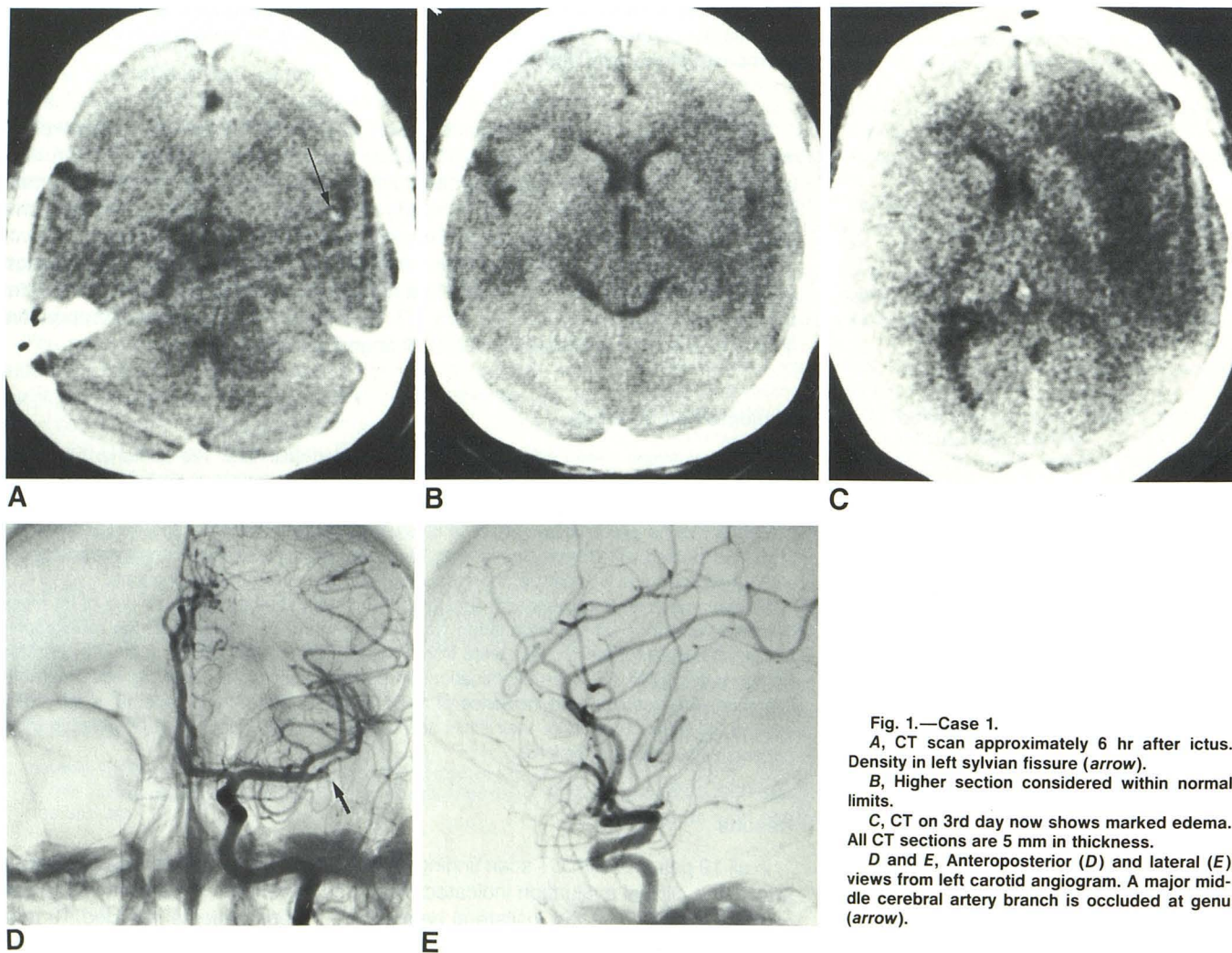


Fig. 1.—Case 1.  
A, CT scan approximately 6 hr after ictus. Density in left sylvian fissure (arrow).  
B, Higher section considered within normal limits.  
C, CT on 3rd day now shows marked edema. All CT sections are 5 mm in thickness.  
D and E, Anteroposterior (D) and lateral (E) views from left carotid angiogram. A major middle cerebral artery branch is occluded at genu (arrow).



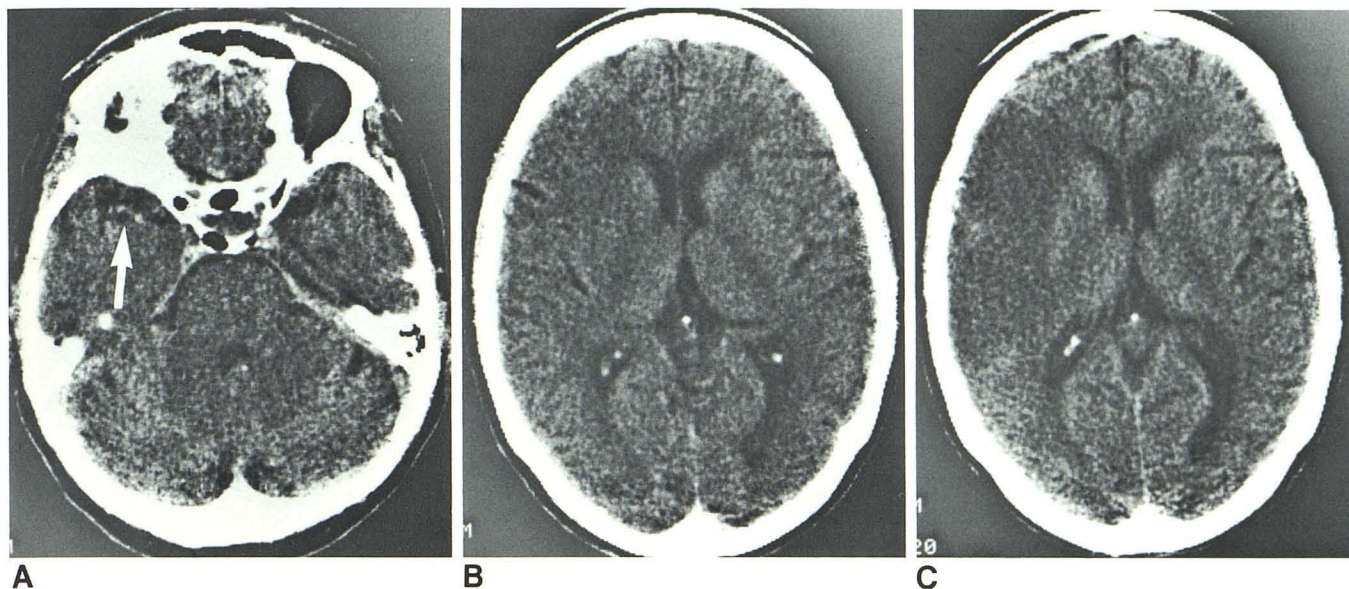


Fig. 2.—Case 2.

A, CT scan approximately 5 hr after onset of left hemiparesis. Density is present along course of horizontal right middle cerebral artery (arrow).

B, Higher section at same time as A shows questionable edema in right hemisphere.

C, CT scan on 10th day, at same level as B, now shows definite edema on right. A is 1.5 mm in thickness and B and C are 10 mm in thickness.

location as the increased density seen on the CT scan. There was some retrograde filling of the middle cerebral artery branches. The shape of the occlusion suggested an embolus. A follow-up CT scan on the third day showed edema in the left temporal lobe and an even more obvious area of increased density within the middle cerebral artery (Fig. 1C). The patient gradually improved but was left with a profound aphasia.

#### Case 2

A 73-year-old woman had undergone a right radical mastectomy 14 years previously. Two days before the onset of left hemiparesis a lump on her right chest wall was removed. Approximately 5 hr after the development of left hemiparesis a CT scan showed increased density in the distribution of the right middle cerebral artery with questionable associated edema (Figs. 2A and 2B). A CT scan on the 10th day showed reduction of the density within the vessel distribution with development of definite edema (Fig. 2C).

#### Case 3

A 72-year-old woman developed acute right hemiparesis and aphasia. A CT scan within the first 24 hr showed increased density along the course of the horizontal left middle cerebral artery without edema (Figs. 3A and 3B). At approximately 36 hr a CT scan showed the development of basal ganglia edema. A CT scan performed on the 10th day showed that the density in the left middle cerebral artery had almost totally resolved (Fig. 3C).

#### Discussion

The increased density seen on the CT scans of these 19 patients may reasonably be presumed to represent thrombus or embolus in the middle cerebral artery for the following

reasons: (1) in all cases the location of the increased density was along the course of the middle cerebral artery or one of its major branches; (2) in five patients the density that was seen on the initial scan had diminished or disappeared on the follow-up scan performed within 10 days; (3) in one patient the density developed on the fifth day but was not present on the first day; (4) in the three patients who underwent angiography, all had occlusion of the middle cerebral artery in a location corresponding to the CT finding; (5) in all cases there was clinical evidence of acute cerebral infarction in the distribution of the middle cerebral artery. Furthermore, the densities clearly followed the contours of the vessels and their appearance could not be explained either by parenchymal or subarachnoid hemorrhage.

Calcification of the vessel wall was excluded in five patients by the disappearance of the density on the follow-up scan within 10 days and, in another patient, by its development on the second scan when it was not present on the initial scan 5 days previously. One other possible consideration would be subintimal hemorrhage, which cannot be excluded in the patients who did not undergo angiography.

The clinical diagnosis in each of these patients was consistent with the radiologic diagnosis of acute infarction in the distribution of the vessel with the increased density. Ten patients were thought to have had embolic episodes on the basis of clinical circumstances, including previous carotid endarterectomy, transient ischemic attacks, cardiac arrhythmias temporally related to the cerebral infarction, bilateral simultaneous infarction, and mitral valve prolapse [4]. However, at this time, we cannot suggest that there is any specificity of the CT findings with regard to embolus vs thrombus.



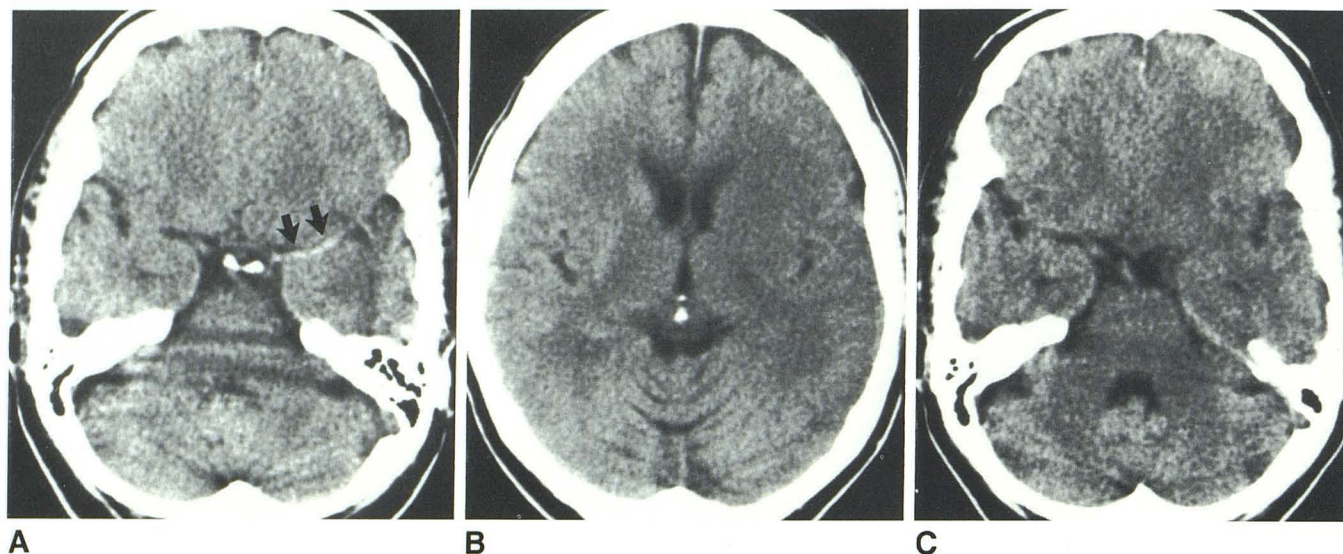


Fig. 3.—Case 3.

A, CT scan within 24 hr of onset of right hemiparesis. Increased density along course of left middle cerebral artery (arrows).

B, Section at higher level considered within normal limits.

C, On 10th day, density in left middle cerebral artery has resolved. All CT sections are 5 mm in thickness.

Recognition of increased density along the distribution of a major intracranial vessel may be extremely valuable in the early CT diagnosis of infarction. In 15 patients the density in the vessel was either the only abnormality or was helpful in properly identifying other subtle abnormalities. It may be especially useful in the first 24 hr, when there are frequently no other CT changes to suggest infarction.

It is quite likely that the CT technique used in our institutions increased the frequency with which increased density within the basal vessels was seen. Patients were evaluated with 1.5-mm or 5-mm-thick sections through the posterior fossa and basal vessels, these being the routine examinations at each of these institutions. Ten-millimeter (10-mm) sections would probably decrease the likelihood of recognizing this finding. Obtaining thinner sections through basal vessels in patients studied for the possibility of acute cerebral infarction, therefore, merits consideration.

Early positive diagnosis of acute cerebral infarction may

become more significant as new therapeutic regimens are developed. Recognition of increased density in the middle cerebral artery, one of its major branches, or in other major cerebral arteries (Gacs et al. [3] reported a case involving the posterior cerebral artery in their series), will allow the neuro-radiologist to make an earlier and/or more definitive diagnosis of cerebral infarction.

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