

# Lacunar Infarctions Due To Cholesterol Emboli

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**Background and Purpose:** Hypertension is commonly considered the major cause of lacunar infarctions. However, in some cases, it has been suggested that lacunes could be caused by cerebral emboli from cardiac or carotid sources. Cholesterol cerebral emboli have been rarely reported as a cause of lacunes.

**Case Description:** We describe a 79-year-old patient with a progressive multi-infarct dementia who developed transient motor aphasia and paresis of the right arm. Computed tomography showed lacunar infarcts in the right caudate nucleus, left thalamus, and left putamen, as well as an old right frontal infarction. Neuropathological examination demonstrated no prominent vascular hyalinosis, but did show multiple cholesterol emboli occluding small arteries around lacunar infarcts and leptomeningeal arteries near cortical infarcts. The cholesterol material presumably originated in the extended atheromatous changes along the aortic arch.

**Conclusions:** Our report confirms that lacunes can be caused by cholesterol emboli in some patients. Small cerebral emboli should not be overlooked as a cause of lacunes. (*Stroke* 1991;22:1440-1444)

Small-vessel occlusive disease related to atherosclerosis or hyalinosis caused by hypertension has been commonly considered as the major cause of lacunar infarctions.<sup>1</sup> However, lacunes have been reported in 30–50% of patients without hypertension.<sup>2,3</sup> Thus, it has been suggested that cerebral emboli from a cardiac or carotid source could be the cause of lacunar infarctions.<sup>4</sup> Yet, this hypothesis remains controversial,<sup>5,6</sup> partly because neuropathological reports are very scarce since the neurological deficits usually are nonlethal. Previous reports have stated that cholesterol emboli from a cardiac or arterial source could be responsible for cerebral infarctions,<sup>7,8</sup> but few neuropathological studies have demonstrated their role in the occlusion of deep cerebral arteries.<sup>8,9</sup> We report a patient with lacunes in whom the neuropathological examination demonstrated multiple cerebral cholesterol emboli occluding small deep perforating cerebral arteries around lacunar infarcts.

## Case Report

A 79-year-old woman was admitted for transient paresis of the right arm, motor aphasia, and hypersomnolence. All symptoms disappeared in 2 hours. Increasing behavioral disturbances, gait disorders, and non-

treated hypertension had been noted for several years. She had not previously experienced transient monocular blindness, transient ischemic attack, or stroke. Neurological examination showed ataxia, arm and face hypokinesia, bilateral grasping, urinary incontinence, and bilateral pyramidal signs. Neuropsychological examination, which was limited by poor cooperation, disclosed space and time disorientation and short-term memory impairment. General examination showed severe dyspnea, pallor, and an aortic systolic murmur. Blood pressure was 190/100 mm Hg. Fundoscopic examination was normal. Laboratory tests showed only a moderate inflammatory syndrome and mild anemia. Serologic reactions for syphilis were negative.

Radiography and computed tomography (CT) of the chest showed a large dissecting aneurysm of the aortic arch, extended to the descending portion of the aorta without abdominal involvement. Irregular thickening of the aortic wall suggested mural thrombi or extended atheromatous plaques (Figure 1). A brain CT scan on admission displayed lacunar infarcts in the right caudate nucleus and in the left thalamus and putamen, as well as an old right frontal infarction (Figure 2). Doppler ultrasonography and digital intravenous angiography of the extracranial arteries showed only bilateral nonstenotic atheromatous plaques at the carotid bifurcation. On two-dimensional precordial echocardiography, mitral and aortic calcified valves and moderate hypertrophic cardiomyopathy were noted. Intracardiac thrombi or an aneurysm of the aortic arch was not found.

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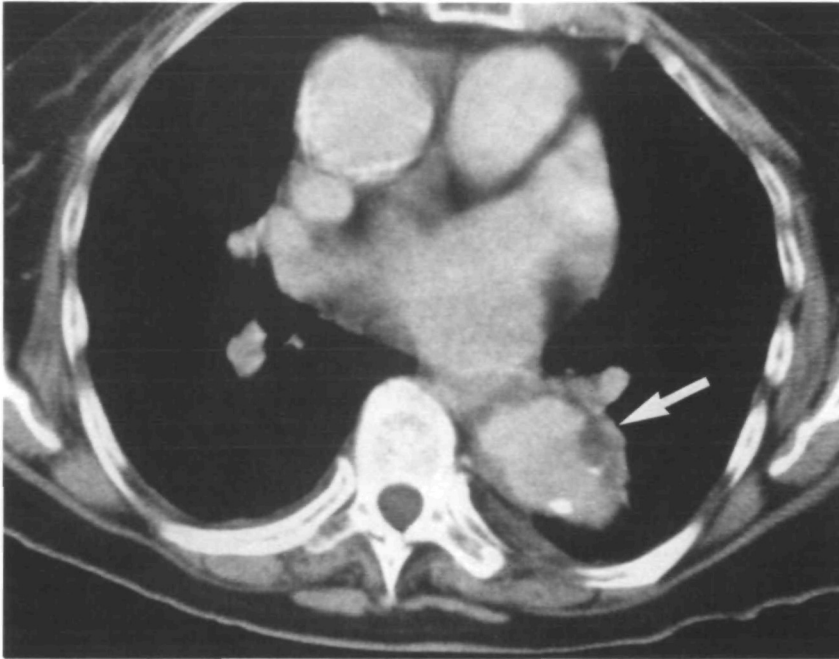
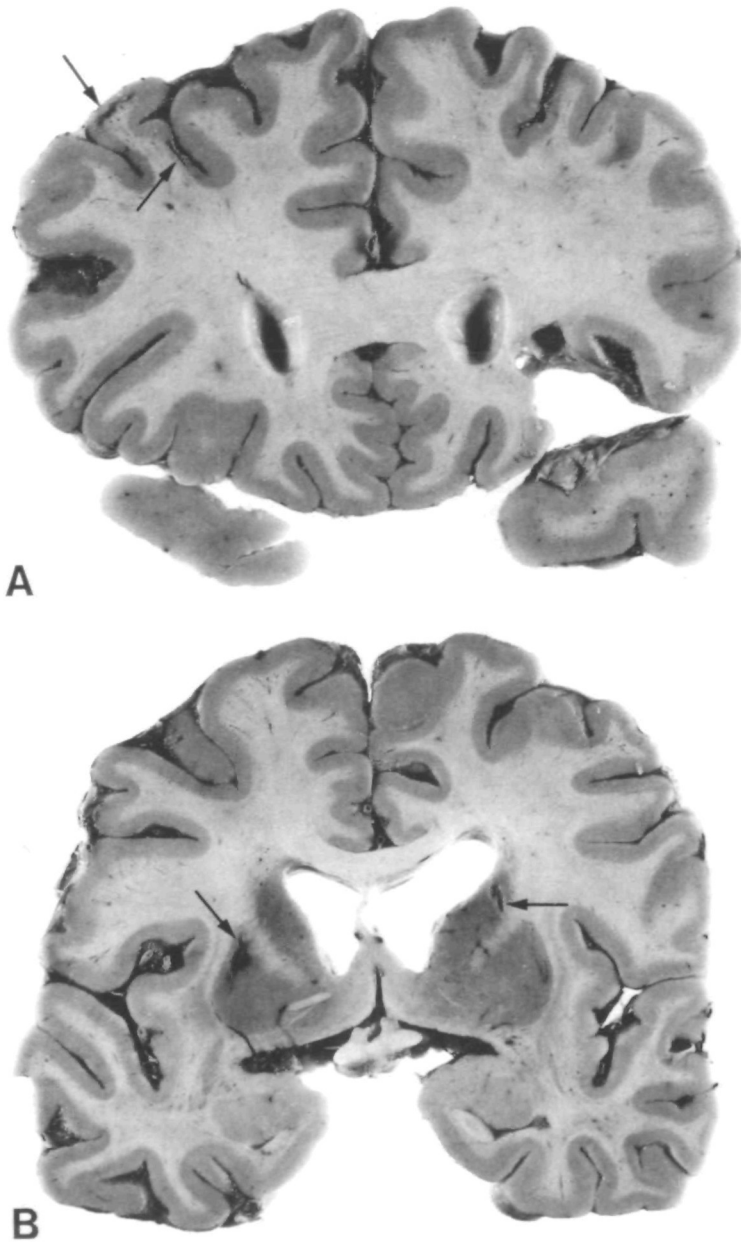


FIGURE 1. Computed tomography of the chest showing aortic aneurysm with irregular thickening of the wall suggesting mural thrombi or extended atheromatous plaques.



FIGURE 2. Brain computed tomography. Lacunar infarcts (small arrows) in the left thalamus, in the left putamen, and in the right caudate nucleus. Right large frontal infarct (large arrow).



**FIGURE 3.** Coronal sections of the brain. Panel A: Large cystic infarct in the right frontobasal area, and two small, old pseudolaminar necroses (arrows) in the cortex of the left frontal convexity. Panel B: Lacunes in the right nucleus caudatus and the left putamen (arrows).

Despite intensive care, the patient died suddenly 3 days after admission.

Postmortem examination revealed an enlarged heart (weight, 530 g) with signs of mild ischemic cardiomyopathy, small atrophic kidneys (weight, 100 g), and a fatal rupture of the thoracic aortic aneurysm. Microscopically, numerous old or recent cholesterol emboli were noted in arteries of kidneys, spleen, pancreas, and adrenals. The lungs and myocardium seemed to be spared. The wall of the aortic arch was dissected and filled with extended atheromatous changes containing large amounts of cholesterol crystals. There was a marked nonstenotic arteriosclerosis of the large cerebral arteries. On sectioning the brain (Figure 3), lacunes and small infarcts of various ages were scattered in the cerebral

cortex, in the left thalamus and putamen, and in the caudate nuclei. A recent, ill-defined cortical infarction of the left parietal convexity extended into the subcortical white matter. Furthermore, a large cystic infarct was found in the right frontobasal area. The cerebellum and brain stem were normal. There was no temporal atrophy. Microscopically, several ischemic necrotic foci were scattered in the cerebral cortex and basal ganglia. Some small leptomeningeal and perforating arteries, especially near lacunar infarcts, were partly or totally occluded by several emboli of cholesterol crystals (Figure 4). Some of them were sometimes embedded in an old, recanalized thrombus. The size of the embolized arteries ranged from 14 to 480  $\mu\text{m}$  (i.d.) and from 38 to 830  $\mu\text{m}$  (o.d.). There were very few vascular hyalinoses.

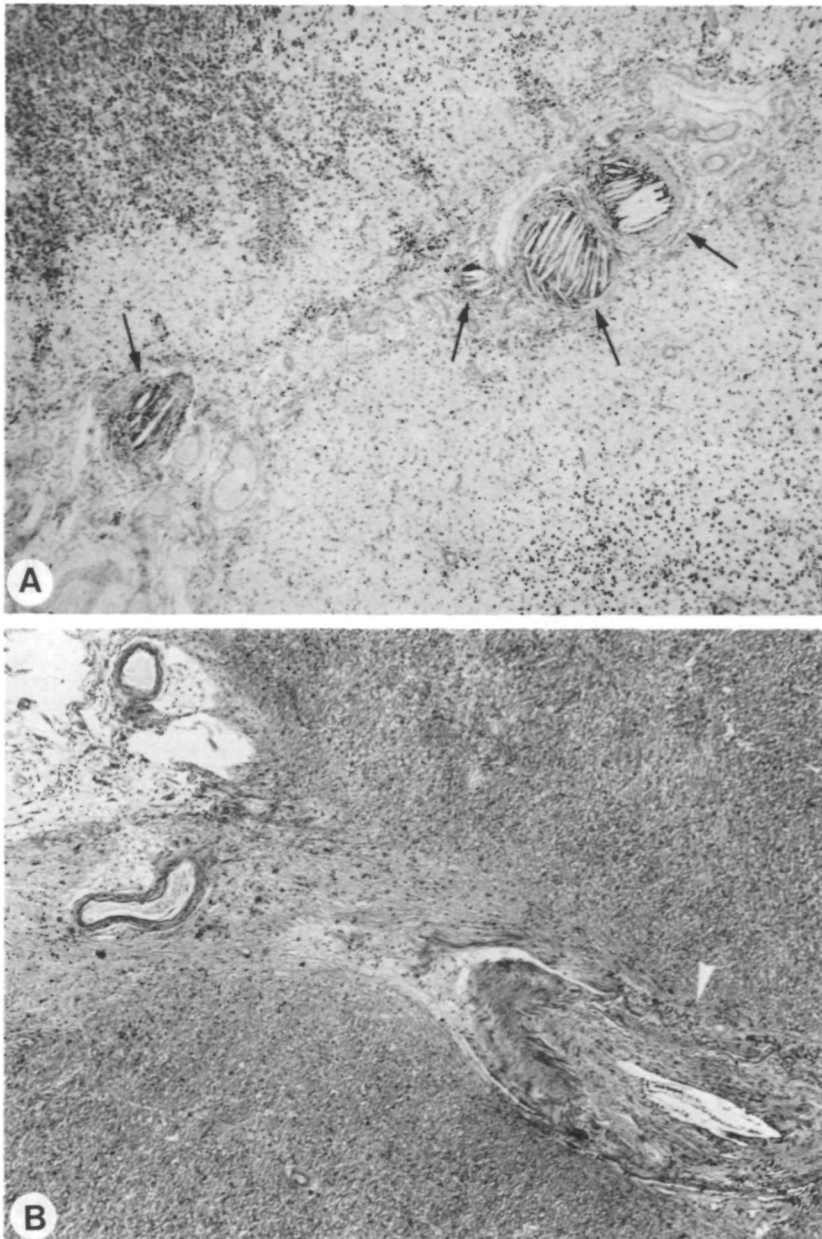


FIGURE 4. Panel A: Small arteries (arrows) filled with cholesterol crystals in a sulcus of the left occipital lobe in the vicinity of cortical necrotic foci. Panel B: Cholesterol crystals emboli occluding a narrowed artery (arrow head) near a lacune (upper left) in the left putamen. (Paraffin. Panel A: Klüver-Barrera; magnification,  $\times 33$ . Panel B: Masson's trichrome; magnification,  $\times 53$ .)

Neurofibrillary tangles and senile plaques were rare in the hippocampus and parahippocampal gyrus.

#### Discussion

Brain CT and neuropathological examination demonstrated multiple cerebral infarctions and lacunes likely responsible for a progressive vascular dementia, without any pathological changes of Alzheimer's disease. The transient ischemic attack, clinically localized in the left cortical middle cerebral artery territory, was correlated with a recent infarction of the left parietal convexity.

As regards the underlying mechanism of the ischemic lesions, there was neither severe stenotic carotid atheromatosis nor emboligenic cardiopathy. Despite a mild, nontreated hypertension, the pathological findings did not show any prominent hyalino-

sis of the deep perforators. Yet, leptomeningeal arteries near cortical infarcts and perforating arteries near lacunes in the basal ganglia were occluded by multiple cholesterol emboli. Computed tomography of the chest and neuropathological examination showed extended atheromatous changes along the aneurysmal aortic arch from which the cholesterol material was likely spontaneously dislodged. Furthermore, at autopsy, multiple cholesterol emboli were found in the kidneys, pancreas, spleen, and adrenals. Muscle biopsy, which may be useful to demonstrate cholesterol emboli,<sup>10,11</sup> was not done in our case.

Cholesterol emboli are known to issue from disrupted, ulcerated carotid or aortic atheromatous plaques and involve numerous cholesterol crystals embedded in a lipidic material, usually occluding small arteries with an inner diameter of 17–585

$\mu\text{m}$ .<sup>9,12</sup> Recurrent amaurosis fugax<sup>13</sup> or transient ischemic attacks, stroke, epilepsy, and neuropsychological disturbances are the main reported symptoms related to retinal emboli or cerebral infarcts.<sup>7,9</sup> To our knowledge, cholesterol emboli as in the present report have only been demonstrated neuropathologically in two cases of lacunar infarcts in the thalamus<sup>8</sup> or the basal ganglia.<sup>9</sup>

Thus, if lacunes are commonly related to hypertension, they may be due to cholesterol emboli in some cases. Small cerebral emboli should not be overlooked as a cause of lacunes.

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KEY WORDS • cholesterol • embolism • lacunar infarction

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