Diagnostic Accuracy and Risk Factors of the Different Lacunar Syndromes

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Background: The lacunar syndrome is characterized by pure motor, pure sensory, or sensorimotor hemisymptoms without cortical deficits. It may be less predictable for a lacunar infarct (LI) than previously believed. The aims of the present study were to evaluate the diagnostic accuracy of the different lacunar syndromes and investigate factors associated with acute LI on diffusion-weighted imaging (DWI). *Methods:* Consecutive patients presenting with an acute lacunar syndrome who were admitted to the stroke unit were enrolled. The patients were examined clinically and underwent magnetic resonance imaging. The sensitivity and specificity of the different lacunar syndromes were assessed using DWI as reference test, and we estimated positive and negative predictive values. Patients were divided into a LI group and a group without LI. Between-group differences were analyzed by χ^2 test, *t* test, and Mann–Whitney U test, as appropriate. Logistic regression was performed to analyze predictors of LI. Candidate variables were pure motor syndrome, age, gender, hypertension, precerebral or intracerebral stenosis, atrial fibrillation, diabetes, coronary heart disease, and smoking. *Results:* Eighty-six patients with lacunar syndrome underwent DWI. The positive predictive value of the lacunar syndrome was 65.1% and 75% for the pure motor syndrome. Of the candidate variables, only pure motor syndrome and male gender had significant associations with LI on imaging. *Conclusions:* The clinical diagnosis of patients with lacunar syndromes is inaccurate, especially among patients with sensorimotor syndrome. DWI is mandatory for obtaining an accurate diagnosis of the infarct. **Key Words:** Lacunar syndrome—lacunar infarct—acute stroke—diffusion-weighted MRI—diagnostic accuracy—cerebral infarction.

Lacunar infarcts (LI) are small subcortical infarcts defined as <15 mm in the chronic phase. Typically, they are located in the basal ganglia, thalamus, internal capsule, corona radiata, or brainstem, and caused by occlusion of a single perforating end artery deep in the brain. LI have been related to cerebral small vessel disease, pathologically characterized by lipohyalinosis,[1] which is a local process in the arterioles in the brain's white matter. However, recent studies[2] have demonstrated other causes of lacunar stroke, for example, cardial and aortic embolism. Thus, the etiology of LI has been under debate during the last decade.

The clinical symptoms in patients with LI found in autopsy studies[3] are characterized by pure motor, pure

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sensory, or sensorimotor hemisymptoms without cortical deficits (aphasia, apraxia, agnosia, neglect phenomena, and so forth) or homonymous hemianopia.[1] The pure motor syndrome was typically associated with LIs in the internal capsule or in the brainstem, whereas the pure sensory syndrome in most cases was explained by lesions in the thalamus. In addition, LIs in the brainstem were related to ataxic hemiparesis or the dysarthria–clumsy hand syndrome. Recent studies,[4,5] however, have shown that lesions in different locations can cause the same clinical syndrome.

The Oxfordshire Community Stroke Project (OCSP) clinical classification was based on symptoms and signs of different stroke syndromes, and proposed 4 defined subgroups of cerebral infarction.[6] A lacunar infarct (LACI) was defined as an infarct confined to the territory of the deep perforating arteries.[7] However, the accuracy of the OCSP classification[8] has been poor in patients with small infarcts, and in addition, the clinical lacunar syndrome comprises a heterogeneous group of patients with stroke including deep infarcts, cortical lesions, and cerebral hemorrhages.

Stroke radiologic diagnosis has been largely improved with early diffusion-weighted imaging (DWI), until now the most sensitive imaging in acute ischemic stroke.[9] However, using radiologic techniques as a gold standard for LIs may be challenging, because not all acute lesions identified as LIs on DWI cavitate and become lacunes,[10,11] that is, cavities filled with cerebrospinal fluid.

In the Northern Manhattan Stroke Study Experience, a lacunar syndrome was found to have a positive predictive value (PPV) of 87% for detecting a LI on brain imaging. However, diffusion-weighted magnetic resonance imaging (DW-MRI) was not performed.[12] In another prospective study,[13] patients were evaluated with perfusion-weighted imaging/DWI, which altered the final diagnosis from a clinical assumed lacunar infarction to a radiologic evident nonlacunar infarction in 13 of 19 patients presenting with lacunar syndromes. One small study with 23 patients showed that almost all patients presenting with lacunar syndrome had acute lesions on DW-MRI, and only a minor proportion (2/23) had cortical lesions.[14] On the other hand, a study including 111 patients with lacunar syndromes reported that 40.5% had nonlacunar infarcts on DWI.[15] One study[16] showed that only 44.1% of the patients with lacunar infarction on DWI had lacunar syndrome, and finally, another study showed that lesions in a variety of locations can cause the same lacunar syndrome.[5] There is also an increasing uncertainty regarding the etiology of LIs. Hence, the value of the clinical classification of stroke into lacunar syndromes is under debate.[17-19]

In most cases, DWI can identify an acute ischemic lesion. However, in many stroke centers, magnetic resonance imaging (MRI) is not available for all patients during the acute phase when a precise diagnosis should be made. Consequently, knowledge about diagnostic accuracy becomes even more important to help the clinician make the correct diagnosis and give the most effective treatment.

The aims of the present study were to compare clinical lacunar syndromes with LIs on DW-MRI, find the diagnostic accuracy of the different lacunar syndromes in predicting LIs, and to investigate risk factors associated with acute LIs identified on MRI.

Materials and Methods

We recruited 119 consecutive patients presenting with an acute lacunar syndrome who were admitted to the stroke unit of Akershus University Hospital from February 2011 to January 2013. The patients underwent standard examination at our stroke unit including blood samples, electrocardiogram (ECG) records, cerebral computed tomography (CT) at admittance, and color duplex of precerebral and intracranial arteries. Presence of symptomatic carotid or middle cerebral artery stenosis greater than or equal to 50% were registered. All included patients were examined clinically by an experienced stroke neurologist (M.A.).

The diagnosis of lacunar syndrome was based on the patients' history and neurologic examination (findings compatible with lacunar syndrome). Patients who were treated with intravenous thrombolysis were included, even when their symptoms lasted less than 24 hours. Exclusion criteria were intracerebral hemorrhage and transient ischemic attack (symptoms lasting <24 hours). Patients who underwent only CT scan and not DW-MRI were excluded.

Assessments

Neurologic impairment was assessed by using an 11-item version of the National Institutes of Health Stroke Scale (NIHSS)[20] on day 1 and at discharge. Global function was evaluated using the modified Rankin Scale (mRS)[21,22] at discharge. In addition, OCSP and Barthel Activity of Daily Living index[23,24] were recorded at discharge. We registered risk factors (hypertension, diabetes, hypercholesterolemia, body mass index [BMI], atrial fibrillation, coronary heart disease [previous myocardial infarction or angina pectoris], mechanical heart valve, smoking, and previous stroke/transient ischemic attack). Evaluations and investigations are listed in Table 1.

Patients underwent MRI within a week to identify acute cerebrovascular lesions. The brain imaging was done on Philips Achieva (Royal Philips, Amsterdam, The Netherlands) 1.5T or 3T MRI scanners using standard sequences, using T1-weighted sagittal, T2-weighted axial, T2/fluid attenuated inversion recovery (FLAIR) weighted coronal, and diffusion-weighted axial imaging. Isolated acute ischemic lesions on DWI were defined as lacunar infarctions if <15 mm and located subcortically or in the brainstem.[25]