

Definitions for Lacunar Syndromes, Lacunar Strokes, Lacunar Infarcts and Lacunes: from Clinical to Neuroimaging

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INTRODUCTION

Lacunar infarcts or small subcortical infarcts, one of the phenotypic subtypes of the cerebral small vessel disease, account for 20-25% of all acute cerebral strokes^[1-3]. Lacunar infarcts have a favorable short term prognosis, with a low early mortality and reduced functional disability at hospital discharge. However, the mid- and longer-term prognoses have an increased risk of death, stroke recurrence and dementia. Based on neuroimaging, lacunar infarcts are usually defined as an ischemic subcortical stroke of less than 15 mm in diameter. The other typical neuroimaging manifestations of the cerebral small vessel diseases or microangiopathy are leukoaraiosis or white matter hyperintensities, cerebral microbleeds, and prominent or enlarged perivascular spaces and these are the most important predictors of cognitive impairment and subcortical vascular dementia in the first-ever lacunar infarct patients^[4,5].

The nomenclature used to define and analyze the lacunar infarcts is sometimes misleading, since very often tend to overlap or confuse with clinical concepts (e.g. lacunar syndrome), with concepts of etiologic stroke subtype (e.g. lacunar infarction or lacunar stroke) and neuroimaging concepts (e.g. lacunes).

It would be suitable to use a precise nomenclature when we refer to the cerebral small vessel diseases and, specifically, to the cerebral strokes of lacunar type, since this will result in a more accurate, appropriate and wise definition and will improve the quality of studies and investigations.

In order to meet the objectives of the current study we drew on the experience of the Sagrat Cor Hospital of Barcelona Stroke Registry^[6] together with a non-systematic hand search of Pubmed and Scopus for neurological studies published in the last 5 years using the following search terms: lacunar stroke, small vessel disease, lacunar

ABSTRACT

A rational use of nomenclature concerning lacunar infarcts is necessary. The term "lacunar syndrome" involves a clinical and semiological aspect; the definition "lacunar stroke" entails a clinical, semiological and neuroimaging aspect; the term "lacunar infarct" implies a particular subtype of ischemic stroke and the definition of "lacune" relates to neuroimaging findings. It would be suitable to use a precise nomenclature when we talk about the cerebral small vessel diseases and, specifically, about cerebral strokes of lacunar type, since this will result in a more accurate, appropriate and wise definition and will improve the quality of studies and investigations.

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Key words: Lacunar stroke; Small vessel disease; Lacunar infarction; Lacunar syndrome; Lacune

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LACUNAR SYNDROMES

We should consider the definition of "lacunar syndromes" in a purely semiological view, regardless of etiology. Lacunar syndromes are usually caused by lacunar strokes in over 70-90% of cases, according to the "lacunar hypothesis" described by Miller Fisher^[1], and the remaining 10-30% of cases may be due to other different entities, mainly non-lacunar ischemic strokes (thrombotic, cardioembolic, essential or unusual etiology), small cerebral hemorrhages or even other conditions different from acute stroke as demyelinating diseases, expansive processes, or subdural hematomas (Table 1)^[7,9].

Typically, classic lacunar syndrome occurs semiologically as a pure motor hemiparesis^[1,10], a pure sensory syndrome^[3,4], a sensorimotor syndrome, an ataxic hemiparesis or a dysarthria-clumsy hand^[1,11]. Atypical lacunar syndrome occurs as a paucisymptomatic form of a classic lacunar syndrome, such as pure dysarthria –partial form of dysarthria-clumsy hand syndrome-, or as isolated dysarthria-facial paresis syndrome –partial or frustrated form of pure motor hemiparesis- or also as an uncommon neurological syndrome such as hemichorea-hemiballismus^[12].

It has also to be taken into consideration that the lacunar hypothesis is validated when different lacunar syndromes are analyzed individually. However sensorimotor stroke is the lacunar syndrome more frequently caused by non-lacunar infarcts (Table 2)^[9], and in a clinical series of lacunar stroke patients, sensorimotor stroke was caused by a symptomatic intracranial small vessel disease in 69.5% of cases. Despite that, other stroke subtypes were found in 30.5% of cases, which is a higher percentage than the observed in other lacunar syndromes.

LACUNAR STROKES AND LACUNAR INFARCTS

We should consider the definition of "lacunar strokes" from both a semiological and neuroimaging perspective. That is, although the majority of lacunar strokes would be caused by lacunar infarcts, the term "lacunar stroke" may also include hemorrhagic lacunar

Table 1 Etiologic diagnosis on 286 consecutive patients with an acute lacunar syndrome studied during a period of 7 years*. Lacunar infarcts were found in 80% and lesions other than lacunar infarcts in 20%^{**[7]}.

Lacunar syndromes (n=286)
Lacunar strokes (n=283; 90%)
Lacunar infarcts (n=227; 80%)
Hemorrhagic lacunar strokes (n=30; 10%)
Lacunar syndromes due to non-lacunar ischemic subtypes (n=26; 9%)
Lacunar syndromes due to conditions other than acute stroke (n=3; 1%) ^{***}

*The patients were consecutively recorded in the Department of Neurology from an unselected hospital-based stroke registry. **Sex, male in 68% of lacunar infarcts and in 63% of patients with lesions other than lacunar infarcts. ***Multiple sclerosis (n=1), metastasis (n=1), arteriovenous malformation (n=1).

Table 2 Variables associated with lacunar syndrome not due to lacunar infarct^[9].

Variable	β	SE (β)	Odds ratio (95% CI)	P
Model based on demographics, vascular risk factors and clinical variables*				
Atrial fibrillation	1.532	0.301	4.62 (2.56–8.36)	0.0001
Sensorimotor syndrome	1.396	0.294	4.05 (2.28–7.19)	0.0001
Limb weakness	0.738	0.363	2.09 (1.03–4.26)	0.042
Sudden onset	0.721	0.253	2.06 (1.25–3.37)	0.004
Age	-0.038	0.011	0.96 (0.94–0.98)	0.001

* $\beta = -0.521$; SE (β) = 0.825; goodness-of-fit $\chi^2 = 3.675$; df = 8; $p = 0.885$; area under the ROC curve = 0.753; sensitivity 67%; specificity 74%; positive predictive value 33%; negative predictive value 92%; correct classification 73%.

strokes due to small capsular, ganglio-basal or thalamic intracerebral hematomas which manifest clinically as a lacunar syndrome. In a clinical series, hemorrhagic lacunar stroke accounted for 3.8% of all cases of lacunar syndrome (n=439) and 7.4% of all cases of intracerebral hemorrhage (n=229) entered in the database. In those cases neuroimaging data confirmed the hemorrhagic etiology of the lacunar syndrome^[8].

We should define "lacunar infarcts" in a semiological and neuroimaging perspective (CT scan and/or cerebral MRI) plus the results of the supplementary diagnostic tests routinely performed on patients with acute cerebral ischemia (i.e.: ultrasound imaging and Doppler sonography, transthoracic echocardiography, Holter, etc.)^[13]. Lacunar infarcts are small cerebral infarctions (less than 15 mm in diameter) located in the blood supply territory of brain penetrating arterioles (lenticuloestriate, thalamogeniculate, thalamoperforating and paramedian pontine) (Figure 1) caused mainly by microatheromatosis or intracranial atheromatous branch disease, in the absence of emboligen heart disease, severe stenosis of supra-aortic trunks or another unusual etiology (i.e.: hematologic, infectious or systemic diseases)^[14-16].

LACUNES

Instead, we could define "lacunes" from a strict neuroradiological view, referring to those lesions observed in brain imaging on CT or MRI (CSF-like hole in the brain) that are more consistent with silent lacunar infarcts than with symptomatic ones^[17]. The silent lesions tend to be due to a cerebrovascular lipohyalinosis in the perforating arterioles or arteriolar endothelial dysfunction^[18].

We must bear in mind that in patients with a first-ever lacunar infarct, 40% of them shows "lacunes" that are clinically silent^[19]. From an academic point of view, it has been classically considered that lacunar infarcts do not cause neuropsychological disturbances during the acute phase of the illness. However recent studies have found that 56% of patients with a first-ever lacunar infarction may show neuropsychological disorders compatible with mild cognitive impairment of vascular type^[20,21]. Furthermore, current studies clearly show that neuropsychological dysfunction in the initial phase relates more to silent lacunar infarction than to leukoaraiosis or periventricular white matter hyperintensities^[22]. This contrasts with the fact that in more advanced stages of the disease, leukoaraiosis will have the greatest importance and greater weight in cognitive impairment of vascular type in patients with cerebral small vessel disease^[19,20]. Recurrent lacunar infarction can also cause cognitive impairment. Hypertension and diabetes mellitus are the main factors predicting recurrent lacunar infarctions in a recent study^[23].

Recently, the importance of cerebral microbleeds and prominent perivascular spaces has been emphasized as a significant neuroradiological manifestation of small vessel disease^[17]. Recent contributions to the literature have led to show that brain atrophy may be related to lacunar infarctions^[24] and contribute to the cognitive impairment of the patients with small vessel disease.

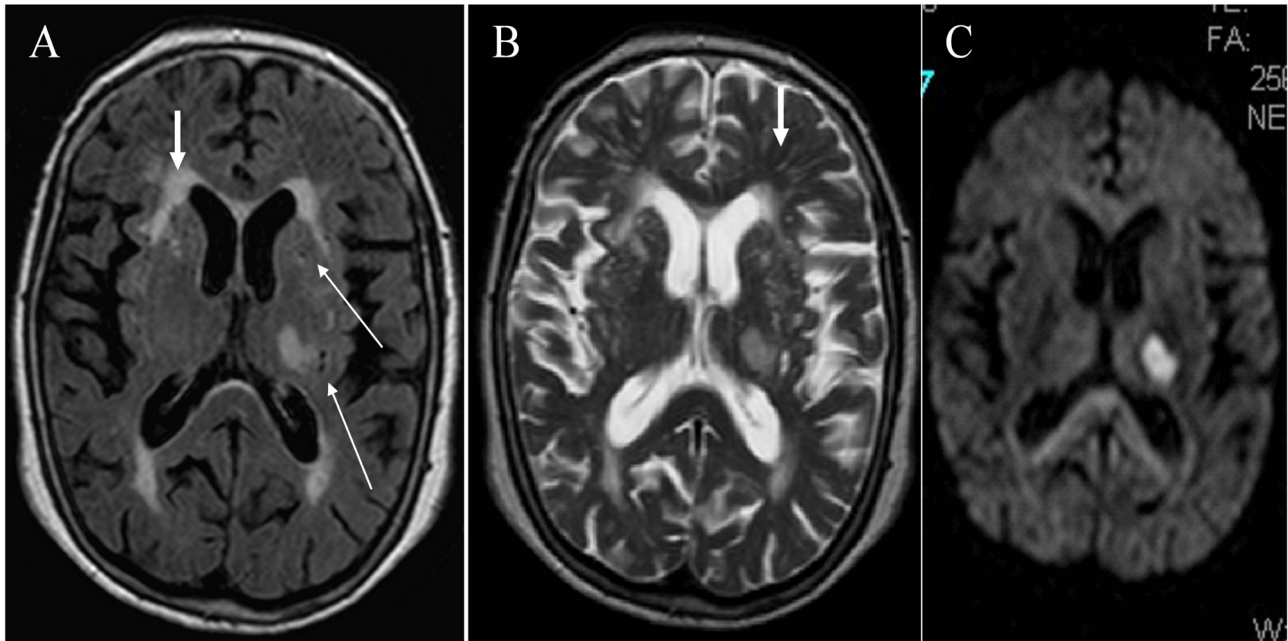


Figure 1 Patient with a right pure motor hemiparesis (the most frequent lacunar syndrome) secondary to a lacunar ischemic stroke. A) MR, FLAIR sequence. Periventricular white matter hiperintensities (arrow) and small cavitated silent lacunes with peripheral gliosis (long arrows). B) MR, T2 sequence. Enlarged perivascular spaces in the lenticular nucleus and, most especially, in the subcortical white matter (arrow). C) MR, diffusion-weighted image. Acute left capsular lacunar infarct.

Table 3 Nomenclature on lacunar infarctions based on clinical, neuroimaging and supplementary diagnostic tests.

Terms	Clinical	Neuroimaging	Other diagnostic tests ^[13]
Lacunar syndrome	+	-	-
Lacunar stroke	+	+	-
Lacunar infarct	+	+	+
Lacune	-	+	-

CONCLUSIONS

A rational use of nomenclature in the jungle of definitions concerning lacunar infarcts would be both necessary and useful (Table 3) both in research and routine clinical practice. The term "lacunar syndrome" involves a clinical and semiological aspect; the term "lacunar stroke" entails a clinical, semiological and neuroimaging aspect; the term "lacunar infarct" implies a particular subtype of ischemic stroke and the term "lacune" would relate to neuroimaging findings.

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CONFLICT OF INTERESTS

The Authors have no conflicts of interest to declare.

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