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## Neurovascular disease

# Microvascular retinal abnormalities in acute intracerebral haemorrhage and lacunar infarction

## Anomalies microvasculaires rétinienne après infarctus lacunaire ou hémorragie intracérébrale aiguë



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### ABSTRACT

**Background.** – Retinal microvascular changes have been previously associated with cerebral MRI markers of small vessel disease (SVD). Whether retinal changes differ between patient with intracerebral haemorrhage (ICH) and patients with lacunar infarction (LI) caused by small vessel disease has been poorly investigated.

**Objective.** – The study aims to compare the frequency of retinal changes between patients with LI and patients with ICH at the acute stage of stroke-related SVD.

**Methods.** – Microvascular wall signs (arteriolar occlusion, arteriovenous nicking, focal arterial narrowing) and retinopathy lesions (microaneurysms, cotton wool spots, retinal haemorrhages, hard exudates) were assessed by retinography up to three months after stroke onset.

**Results.** – Forty-eight non-diabetic patients with acute stroke-related to SVD (26 LI, 22 ICH) were recruited prospectively in the study. Retinal wall signs (arteriovenous nicking, and focal arterial narrowing) were found in more than three quarters of subjects and most often bilaterally in both groups. Retinopathy lesions (cotton wool spots, retinal haemorrhages) were found more frequently in ICH patients than in LI patients (22.2% vs. 15.4%, 50% vs. 34% respectively,  $P > 0.005$ ). The frequency of bilateral cotton wool spots and of bilateral retinal haemorrhages was significantly higher in ICH patients than in LI patients (12.5% vs. 0%,  $P = 0.012$ , 41.2% vs. 7.7%,  $P = 0.029$  respectively).

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Hématome intracérébral  
Rétinographie  
Réseau microvasculaire rétinien

*Conclusion.* – These results confirm the high frequency of microvascular alterations in patients with hypertension-related SVD leading to LI or ICH and suggest that retinal tissue alterations are more frequent in ICH than in LI. Further investigations are needed to investigate the mechanisms underlying this difference.

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## R É S U M É

Les anomalies microvasculaires rétiniennes représentent un marqueur indépendant du risque vasculaire et sont associées aux marqueurs IRM de maladie des petites artères cérébrales (MPA). Il pourrait s'agir d'un marqueur microvasculaire non invasif chez des patients ayant eu un AVC lié à une MPA.

*Objectif.* – Analyser les anomalies rétiniennes observées dans 2 sous-groupes de patients avec infarctus lacunaire (IL) ou hémorragie intracérébrale (HIC) récents.

*Méthode.* – Rétinographie réalisée dans les 3 mois après un IL ou une HIC secondaires à une MPA non diabétique.

*Résultats.* – Quarante-huit patients (26 IL, 22 HIC) ont été évalués de façon prospective. Les anomalies microvasculaires rétiniennes (rétrécissement focal, croisement artério-veineux) sont retrouvées chez plus de trois quarts des patients dans les 2 groupes, souvent de façon bilatérale. Les signes de rétinopathie (nodules cotonneux, microhémorragies, microanévrismes) sont plus fréquents dans le groupe HIC et l'existence de signes de rétinopathie bilatérale est significativement plus fréquente chez les patients ayant une HIC.

*Conclusion.* – Ces résultats confirment que les anomalies microvasculaires rétiniennes sont fréquentes chez les patients MPA non diabétique et suggèrent que les anomalies tissulaires rétiniennes sont plus fréquentes chez les patients avec HIC. Ces données pourraient correspondre à des processus physiopathologiques sous-jacents distincts au sein des MPA.

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## 1. Introduction

Various retinal conditions have been associated with stroke, reflecting possible concomitant pathological processes affecting the retinal and brain vessels (Baker et al., 2008; Doubal et al., 2009). During the recent decade, various signs of vascular retinopathy have been related to the risk factors (Wong et al., 2001a; Nguyen and Wong, 2006; Liew et al., 2008), prevalence (Doubal et al., 2009) or incidence (Wong et al., 2001b, 2002; Mitchell et al., 2005; Yatsuya et al., 2010) of stroke in large population-based studies, which also indicates that the association between retinal vascular abnormalities and stroke is mainly driven by small vessel disease (SVD). The rate of microvascular retinal signs is larger among subjects with lacunar stroke than in those with large artery stroke (Yatsuya et al., 2010; Lindley et al., 2009; Baker et al., 2010a). In addition, these signs are strongly related to the load of lacunar infarctions (LI) and to the extent of white-matter lesions on Magnetic Resonance Imaging (MRI), two markers of ischemic SVD severity at the cerebral level (Kwa et al., 2002; Cooper et al., 2006; Cheung et al., 2010). Since SVD not only accounts for 20–30% of ischemic stroke but also for 75% of intracerebral haemorrhage (ICH) (Bamford et al., 1990), the question whether retinal microvascular alterations can differentially reflect the cerebral microvascular changes underlying either LI or ICH can be hypothesized. This question has been only addressed in a retrospective way by Baker et al. (2010b) who did not observe any difference in retinal imagery between patients with LI and those with ICH.

In the present study, we aimed to assess prospectively in acute stroke patients the retinal microvascular changes associated either with LI or ICH in the absence of diabetes.

## 2. Material and methods

### 2.1. Study population

We prospectively screened all patients admitted in Stroke Intensive Care Unit of Lariboisière hospital for acute stroke-related to a non-diabetic SVD between 2007 and 2009.

Before inclusion, all patients underwent the usual work-up for ischemic or hemorrhagic stroke (including brain MRI T1, FLAIR, T2\*, and diffusion weighted-images, 3D-Time of Flight intracranial Magnetic Resonance Angiography, cervical duplex ultrasonography, EKG and transthoracic echocardiography). Patients were classified by two stroke experts (HC, CG) either in the LI group or in the ICH group based on the following inclusion criteria:

- LI group: characteristic imaging features of a small infarction (diameter < 15 mm) in the territory of a perforating artery within the hemispheric white-matter, basal ganglia, pons or brainstem;
- ICH group: characteristic imaging features of a lobar or deep intracerebral haemorrhage possibly associated with intraventricular haemorrhage but without any evidence of vascular malformation.

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