

thus improving cerebral perfusion. The flow observed in the ophthalmic arteries was orthodromic. A transcranial color-coded duplex sonography showed patency of the cerebral arteries. MRA, negative for the presence of cerebral lacunar infarcts, confirmed the presence of vascular anastomoses between the left ascending cervical artery, the left occipital and the left vertebral artery, but did not give any information about the presence of reversal of flow.

It is known that the intra- and extracranial arteries share a common embryonal vascular origin and maintain a

common embryonal 'memory', thus ensuring anastomoses and compensations in situations of occlusion and hypoperfusion. These anastomotic systems are activated depending on the conditions of hemodynamic balance of the vascular territory. In the case of occlusion, a more complex anastomotic system will be activated. As seen in Table 1, collateral circulation of the neck was observed both with color-coded duplex sonography and MRA. However, MRA failed to reveal the anastomosis between the right and left superior thyroid artery and could not give any information about the flow inversions.

**Table 1** Comparison between diagnostic imaging procedures in our patient with bilateral carotid occlusion

Neck and transcranial color-coded duplex sonography	MRA
Left common carotid occlusion	Confirmed
Left internal carotid occlusion	Confirmed
Right internal carotid occlusion	Confirmed
Orthodromic flow in ophthalmic arteries	Not diagnostic
Patency of the posterior cerebral arteries	Confirmed
Patency of the anterior cerebral artery	Confirmed
Revascularization of the left external carotid through reverse flow in	
Left occipital artery	Confirmed
Left superior thyroid artery	Not diagnostic
Supply to the vertebral artery through	
Left cervical ascending artery	Confirmed

On the contrary, the transcranial color-coded duplex sonography gave important information about the cerebral flow direction.

Our patient was asymptomatic and the diagnosis of left common carotid and right internal carotid occlusion was therefore an incidental finding.

In patients with carotid artery occlusion, diagnostic imaging is necessary to assess not only vascular anatomy and patency, but also conditions of altered perfusion, and compensatory mechanisms. For these reasons, we adopted different imaging procedures in our patient, to make a correct diagnosis; however, in some cases such as the one presented here, the neck and brain color-coded duplex sonography alone is able to give all the necessary information about vascular anatomy, patency, and anastomosis.

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## Hemiplegia in Lemierre syndrome: a neuroimaging strategy

D. Touitou<sup>a</sup>, S. Deltour<sup>b,c</sup>, F. Bonneville<sup>a</sup>, T. Similowski<sup>b</sup>, J.-P. Grivois<sup>d</sup>, D. Clero<sup>e</sup>, L. Clech<sup>f</sup>, A. Zouaoui<sup>a</sup> and M. Prella<sup>b</sup>

Departments of <sup>a</sup>Neuroradiology and <sup>b</sup>Intensive Care and Pneumology, <sup>c</sup>Neurovascular Unit, Departments of <sup>d</sup>Infectious Diseases and <sup>e</sup>Otorhinolaryngology, Groupe Hospitalier Pitié-Salpêtrière, Assistance Publique Hôpitaux de Paris, Paris, France; and <sup>f</sup>Department of Pediatrics, Hôpital Antoine Béclère, Assistance Publique Hôpitaux de Paris, Clamart, France

Correspondence: Dr T. Similowski, Department of Intensive Care and Pneumology, Groupe Hospitalier Pitié-Salpêtrière, 47 Bd de l'Hôpital, 75013 Paris, France (tel.: 0033/1 42176797; fax: 00331 42176708; e-mail: thomas.similowski@psl.ap-hop-paris.fr).

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Lemierre syndrome (LS) is a life-threatening oro-pharyngeal infection, characterized by venous thrombosis and metastatic abscesses [1,2]. Thrombosis most often affects the internal jugular veins, but may involve the intracranial sinuses also [2,3]. We report a case with LS who developed cavernous sinus thrombosis (CST) with internal carotid artery (ICA) stenosis and symptomatic stroke. A non-invasive radiological strategy is proposed to evaluate septic neurovascular complications in LS.

A 15-year-old previously healthy boy was admitted to intensive care unit because of fever, headache and confusion. Neurological status was normal, except for moderately altered mental status and right abducens palsy. The patient had bilateral exophthalmia with right-side vis-

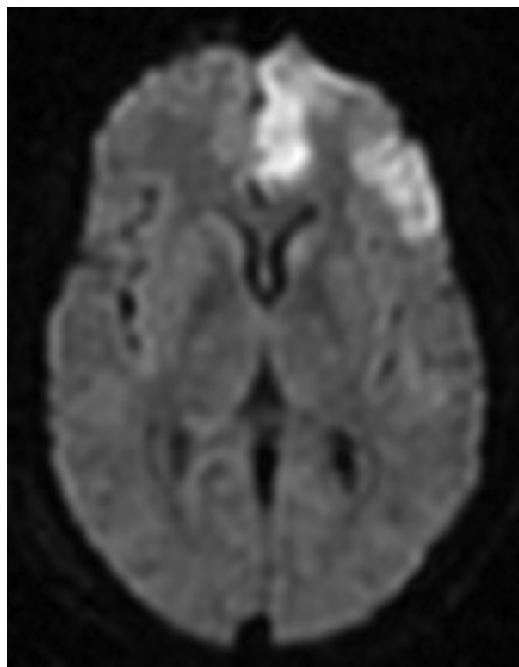
ual loss. His neck was stiff, swollen and tender. Laboratory analysis showed marked inflammatory syndrome, increased serum creatinine level, mild cytolysis and cholestasis. Cerebrospinal fluid examination revealed 591 cells/mm<sup>3</sup> (91% neutrophils), but no bacteria or other infectious organism. Intravenous antibiotic therapy (ceftriaxone, ampicillin and vancomycin) was started.

Contrast-enhanced head computed tomography (CT) scan showed pansinusitis and bilateral mastoiditis, with dilatation of the right superior ophthalmic vein and convex and enlarged right cavernous sinus, confirming the diagnosis of CST. Cervical CT scan showed neck cellulitis, but ruled out internal jugular vein thrombophlebitis. Lung CT scan demonstrated multiple nodules consistent with metastatic abscesses. Transoesophageal echocardiography was normal. The patient underwent sphenoidotomy and intravenous heparin therapy was started. Blood samples were positive for *Fusobacterium necrophorum*. LS was diagnosed on

the basis of sinusitis, *F. necrophorum* septicemia, CST and pulmonary abscesses. Antibiotherapy was changed to metronidazole and amoxicillin.

Seven days later, the patient developed right leg monoplegia. Cerebral magnetic resonance imaging (MRI) revealed hyper-signal intensities in left frontal lobe corresponding to ischaemic lesions involving both anterior and middle cerebral artery

territories (Fig. 1). Angiographic sequences showed bilateral intracavernous ICA stenosis (Fig. 2), confirmed by CT angiography (CTA). Antibiotics and anticoagulation were maintained. The patient improved, with resolution of right leg monoplegia, abducens palsy and exophthalmia within 4 weeks. The ICAs disappeared gradually on follow-up MRI on day 30 and 150 (Fig. 2).

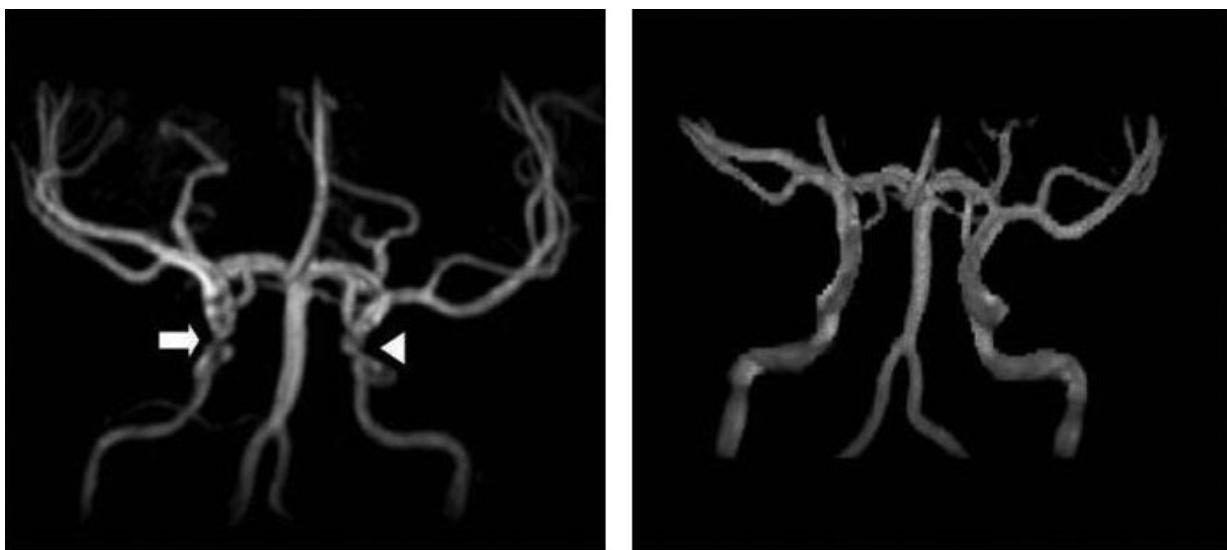


**Figure 1** Diffusion weighted MRI: hypersignal intensities in left frontal lobe.

This case confirms the vascular tropism of *F. necrophorum*, which may lead not only to CST but also to reversible ICA stenosis. The pathogenesis of ICA stenosis in this setting remains unclear. Vasospasm as well as extension of inflammation from an infected cavernous sinus to carotid sheath has been proposed [4,5]. Moreover, the endoluminal involvement of the carotid artery cannot be excluded, as *F. necrophorum* promotes platelet aggregation through the production of a haemagglutinin [6]. However, filling defects suggesting intravascular clotting were not found on the CTA of our patient.

While investigations in LS are usually limited to cervical Doppler ultrasonography and thoracic tomodensitometry, the possibility of LS-related ICA stenosis emphasizes the importance of a thorough neuroradiological evaluation [4,7]. In our case, the carotid lesions were identified only after the stroke. They may have been overlooked if the left ICA stenosis had remained, as the right, asymptomatic, especially since arterial stenosis were reversible. We believe that patients with LS should get systematic, non-invasive, angiographic explorations by CTA and MRA to monitor intracranial venous sinuses and carotid arteries, especially in case of sphenoid sinusitis.

Our observation highlights the potential severity of LS neurological complications. As a result of the specificity of treatment required, clinicians cannot afford to overlook this rare, but currently re-emerging life-threatening syndrome.



**Figure 2** Initial (left) and follow-up (right) 3D TOF MR angiography: the initial angiographic sequences show stenosis of right intracavernous ICA (arrow), also visible but less pronounced on the left intracavernous ICA (arrowhead). Five months later, MR angiography shows complete resolution of ICA stenosis.

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### Real-time monitoring of recanalization after intravenous thrombolysis for acute ischemic stroke

R. Delgado-Mederos, M. Ribó, J. Montaner, J. F. Arenillas, M. Rubiera, J. Alvarez-Sabin and C. A. Molina

Neurovascular Unit, Department of Neurology, Hospital Vall d'Hebron, Barcelona, Spain

Correspondence: Raquel Delgado-Mederos MD, Neurovascular Unit, Department of Neurology, Hospital Vall d'Hebron, Passeig Vall d'Hebron 119–129, 08035 Barcelona, Spain (tel.: 934894257; fax: 932746235; e-mail: 3706rdm@comb.es).

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Sir,

Arterial recanalization in stroke patients treated with tissue plasminogen activator (tPA) is a dynamic process that often precedes clinical improvement, as a result of early restoration of brain perfusion [1]. Both speed and timing of recanalization has been considered to be important predictors of clinical recovery [2,3]. Transcranial Doppler (TCD) has proved to be a valuable method to identify presence and location of intracranial artery occlusion in the acute stroke setting, providing real-time information of the recanalization process during thrombolysis. We present an illustrative case in which after tPA administration repeated microembolization detected on continuous TCD monitoring heralded a complete recanalization and dramatic clinical recovery.

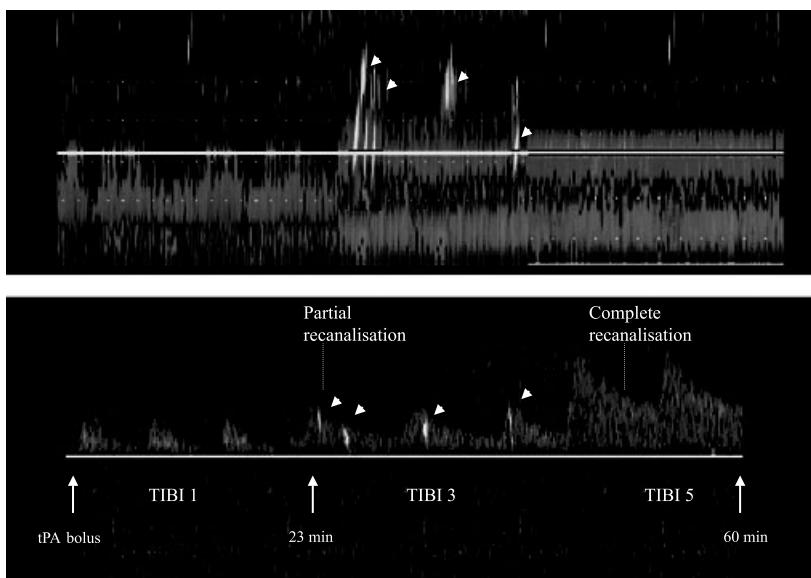
### Case report

A 69-year-old man with a global aphasia and right-sided hemiparesis was admitted in our institution at 121 min after stroke onset. The National Institutes of Health Stroke Scale (NIHSS) score on admission was 21 points. The brain computed tomography revealed no early signs of infarction or hemorrhage. A power-motion Doppler (PMD-TCD), a method that allows simultaneous display of arterial flow at multiple insonation depths, was performed at the emergency room, identifying a proximal left middle cerebral artery (MCA) occlusion at an insonation depth of 56 mm. According to published guidelines, the patient received intravenous tPA therapy at 160 min after stroke onset. PMD-TCD probe was fixed with a head frame to keep constant the insonation

angle during continuous TCD monitoring. At 23 min after tPA bolus, a stepwise flow improvement until complete recanalization was identified on PMD-TCD accompanied by multiple microembolic signals (MESS), indicating proximal clot disruption and distal embolization (Fig. 1). At the end of tPA infusion, normal flow restoration was associated with a rapid dramatic clinical recovery (NIHSS score of 6 points at 2 h and 1 point at 24 h of tPA bolus). No re-occlusion was detected during the first 2 h of continuous TCD monitoring.

### Discussion

Beneficial effect of tPA in ischemic stroke is attributable to an accelerated clot dissolution and arterial recanalization, leading to early restoration of cerebral blood



**Figure 1** PMD-TCD monitoring showing a stepwise flow improvement until complete recanalization accompanied by multiple microembolic signals (arrows), indicating proximal clot disruption and distal embolization.