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Postpartum cerebral angiopathy: atypical features and treatment with intracranial balloon angioplasty

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Abstract Postpartum cerebral angiopathy (PCA) is an uncommon cause of ischemic and hemorrhagic stroke in young women. It is usually clinically benign and not relapsing. We describe a patient with non-hemorrhagic PCA who had an atypical progressive neurological deficit from bilateral hemisphere watershed ischemia despite treatment with aggressive medical therapy and intracranial balloon angioplasty.

Keywords Postpartum angiopathy · Angioplasty

Introduction

Pregnancy and the peripartum period are significant risk factors for stroke in young women [1, 2]. The commoner causes of stroke associated with pregnancy are venous sinus thrombosis, subarachnoid hemorrhage (SAH) from ruptured aneurysm or arteriovenous malformation, thromboembolism, vasculitis, migraine, coagulopathy, and pregnancy-induced hypertension. Postpartum cerebral angiopathy (PCA), an uncommon condition,

can cause ischemic or hemorrhagic stroke [3]. It usually responds to short courses of high-dose corticosteroids, with rapid improvement and resolution of angiographic findings within weeks of presentation [3, 4, 5]. Its pathogenesis and pathophysiology are unknown; it has been suggested that it is a transient vasoconstriction in the absence of SAH, or a continuum of true inflammatory vasculitis [6, 7]. We describe a patient with strikingly atypical features.

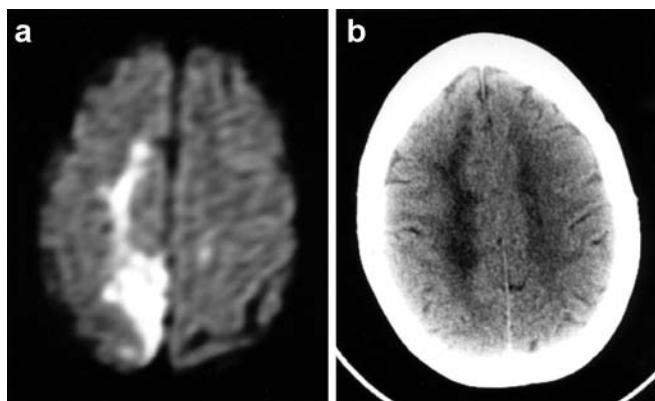


Fig. 1a, b Pretreatment imaging. **a** Initial CT shows bilateral low density in the centrum semiovale, more marked on the right. **b** Diffusion-weighted imaging nearer the vertex shows increased signal consistent with acute or subacute ischemia of the right centrum semiovale and distal cortical territory of the right anterior cerebral (ACA)

Case report

A 42-year-old white woman, 8 days postpartum and with no other significant past medical history, presented with seizures and left-sided weakness. The pregnancy and delivery were unremarkable, and she was not hypertensive during her pregnancy or post-partum. Imaging revealed an acute right watershed and pararo-landic cortex infarct (Fig. 1a, b). Angiography revealed diffuse arterial narrowing, with particular involvement of the right anterior cerebral artery (ACA). The patient was treated with dexamethasone, nimodipine, and magnesium sulfate infusion. On arrival at our hospital she was normotensive with a left hemiparesis (2/5 in arm and leg). The cerebrospinal fluid was normal. Transcranial Doppler sonography (TCD) showed increased velocities, predominately in the right middle cerebral artery (MCA) distribution. The patient was placed on triple H therapy: hypertension, hypervolemia, and hemodilution.

MRI again showed the recent infarct; there was no mismatch between perfusion and diffusion-weighted images. MRA showed diffusely narrowed arteries in both anterior circulations, with less severe narrowing in the posterior circulation. The patient's neurological examination worsened with bilateral hemiparesis and a

decreased level of consciousness. Conventional cerebral angiography confirmed moderately severe narrowing of the supraclinoid segments of both internal

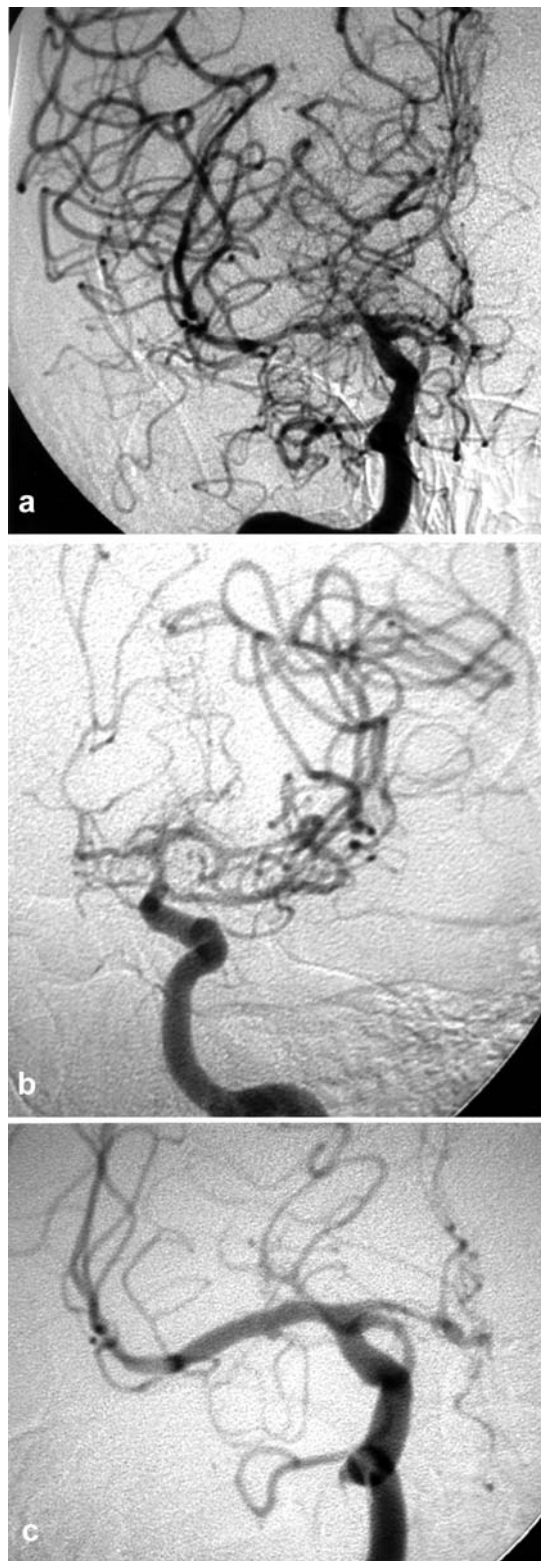


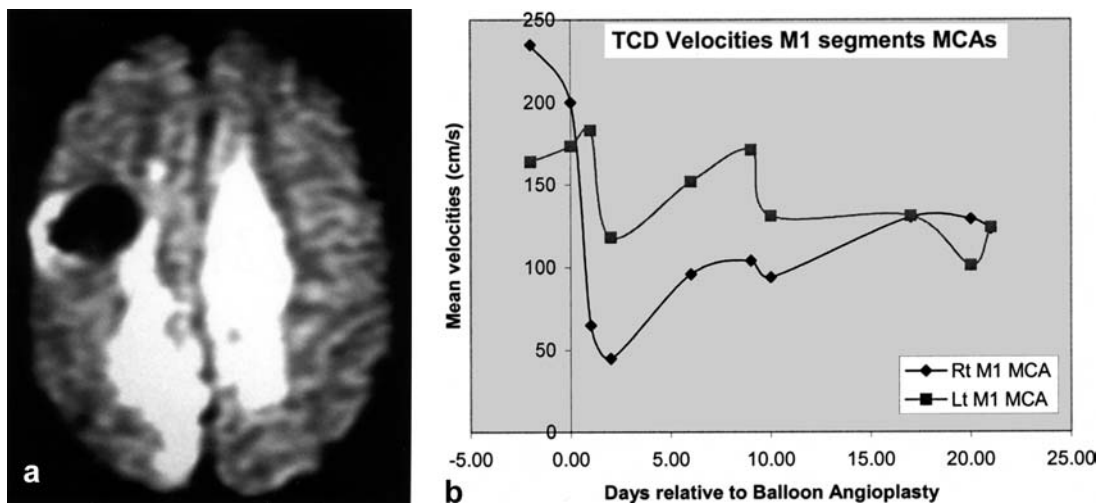
Fig. 2a-c Internal carotid artery injections, frontal projections. **a** Before treatment a right sided injection shows significant narrowing of the distal supraclinoid, M1/M2 and A1 segments. **b** The left side shows similar significant narrowing of same segments. **c** After balloon angioplasty of the right supraclinoid and M1 segments, their caliber is normal and circulation time is faster

carotid arteries, the right M1 and left A1 and A2 segments, and mild narrowing of the basilar artery and proximal posterior cerebral arteries (Fig. 2). We then carried out balloon angioplasty of the right M1 and the supraclinoid segments. Postangioplasty injections showed successful dilation of both segments (Fig. 2).

Comprehensive investigation was undertaken to identify the source of the vasculopathy. Biopsy of the right frontal lobe revealed microglial nodules and perivascular chronic inflammation but no thrombus, significant hyaline degeneration, mural deposits, or evidence of active vasculitis. Despite improvement of proximal perfusion after angioplasty, the patient was unchanged neurologically. MRI the next day showed extension of the right ACA and watershed infarct, plus an acute left ACA and watershed infarct (Fig. 3a), although however, MRA confirmed that the right M1 and supraclinoid segments remained patent.

The patient was continued on nimodipine, magnesium, steroids and triple H therapy. Serial TCD showed gradually decreasing velocities, which then stabilized (Fig. 3b). After 2 weeks, the patient began slowly to improve, following simple commands and moving her arms spontaneously; she patient was transferred to a rehabilitation facility where she continued to improve, moving her toes and fingers and following complex commands.

Fig. 3a,b Follow-up imaging. **a** Diffusion-weighted imaging 6 days after apparently successful angioplasty there is progression of bilateral, predominantly watershed territory ischemia, with confluent restricted diffusion in both centra semiovalia. Right frontal low signal is due to hemorrhage after brain biopsy. **b** Graph showing mean velocities on transcranial Doppler sonography in the right and left M1 segments with respect to time of angioplasty



Discussion

PCA is a relatively rare cause of ischemic stroke in young women. The few available reports of nonhemorrhagic focal neurological deficit in postpartum women have described associations with labile hypertension, pre-eclampsia, and vasospastic drugs such as ergonovine, bromocriptine, and sympathomimetics [2, 8, 9, 10, 11, 12]. In the remaining cases, the diagnosis of ischemic PCA was presumed, as no etiology was found despite extensive investigation for risk factors, with cerebral angiography showing multiple intracranial vessels stenoses and ectasia, suggesting diffuse spasm or vasculitis [4, 6, 7, 13]. The clinical course of PCA is typically benign, with resolution, sometimes rapid, of neurological deficits [3, 4, 7].

We found one other report of ischemic PCA with an aggressive clinical course. Geraghty et al. [6] reported a 27-year-old woman who presented on postpartum day 13 with intermittent, then persistent left hemiparesis, with MRI (without diffusion-weighted imaging) at 16 days showing no evident abnormality. Angiography revealed widespread, mild, irregular stenoses proximally and distally. Despite treatment with corticosteroids, the patient deteriorated, CT revealing bilateral cortical infarcts in the right ACA and posterior left MCA territories. She subsequently became comatose, CT then showing diffuse edema with extensive bilateral MCA and left ACA infarcts that led to death. Our patient differed in that the proximal vessels were markedly more involved, similar to the picture seen in vasospasm from aneurysmal SAH. Stenoses of the proximal supraclinoid carotid, M1, and A1 segments probably led to perfusion compromise and watershed ischemia rather than extensive cortical MCA and ACA infarcts. TCD indicated worsening stenoses in the proximal MCA territories. Diffusion-weighted MRI clearly demonstrated the acute/subacute ischemic nature of the confluent bilateral

centrum semiovale white matter and distal right ACA cortical low density seen on CT. In one report of a 39-year-old woman with hemorrhagic PCA, bilateral centrum semiovale ischemic changes were also suggested [3]; however, the lesions were focal, small and not confluent and the patient recovered almost completely within a week of treatment with corticosteroids.

Treatment for PCA has typically consisted of corticosteroids, but calcium channel blockers, aspirin, cyclophosphamide, and intravenous nitrogen mustard have been used [3, 6, 7]. As our patient unexpectedly worsened despite corticosteroids, triple H therapy was instituted, using the same protocol as for symptomatic vasospasm from SAH. Despite maximal medical therapy, she continued to deteriorate. Velocities of both MCA territories continued to increase, indicating severe narrowing of the right proximal MCA (mean velocity > 200 cm/s). Despite the poor selection criteria for intracranial balloon angioplasty [14] (low density on CT, > 12 h of worsening symptoms, uncertain correlation of neurological deterioration and implicated vessel segment), intracranial balloon angioplasty was carried out, using the technique employed for SAH-related vasospasm. To achieve mechanical vessel dilation, we used a higher-pressure low profile balloon (2.5 mm in diameter, 15 mm long).

Experimental data suggest that acute hypertension can produce areas of vasospasm and dilation [11], and transient hypertension has been a feature of some reported cases of PCA [4, 9]. This may suggest that vessel narrowing might be protective and dilation using angioplasty might actually interfere with this protective mechanism. Although it may contribute to the generally

relatively benign course of PCA, in our patient this "protective" mechanism was causing worse, debilitating watershed infarcts, and angioplasty was therefore pursued with the goal of salvaging any ischemic penumbra. It has been hypothesized that PCA is a hormonally mediated effect on the intima precipitated by acute elevations in blood pressure [6, 15, 16], and this is supported by the autopsy findings of slight intimal proliferation [6].

Calabrese et al. [7] suggested that PCA may represent a continuum of vascular pathology with initial vasospasm leading to vasculitis. As it is not known whether PCA is an inflammatory vasculitis, balloon angioplasty in this setting was of questionable utility. McKenzie et al. [17] described in four patients with presumed vasculitis in whom they had poor results, as all five segments on which they carried out balloon angioplasty progressed to occlusion within 48 h, after initial improvement. In our patient, as the dilation of the right M1 MCA and supraclinoid internal carotid artery after balloon angioplasty lasted for more than 7 days, the response of the vessels in PCA to angioplasty appears different from that in vasculitis. Despite the technical success of angioplasty, the ischemic damage extended, probably because the tissue was no longer viable at the time of angioplasty. As in the setting of acute thromboembolic stroke and symptomatic vasospasm, the timing of intervention is crucial in determining whether reperfusion leads to reversal of ischemia and salvage of penumbra or to no change in outcome. Given the vessel response to balloon angioplasty, earlier, more aggressive balloon angioplasty might have improved the clinical outcome of our patient.

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