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Revascularization technique with use of lithotripsy of intracranial calcified critical stenosis of the internal carotid artery

Short title: Lithotripsy therapy of intracranial stenosis of carotid artery

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Intravascular lithotripsy (IL) is increasingly becoming a useful method for endovascular management of calcified plaques in different arterial territories (coronary, renal, mesenteric, extremity and extracranial carotid arteries), especially if such stenoses cannot be overcome using cutting balloons or transcatheter atherectomy devices [1–4]. This case report demonstrates successful application of IL of highly calcified lesion in the cavernous (C4) segment of the right internal carotid artery (ICA) in 62-year-old symptomatic patient presenting with transient ischemic attack and 2-months history of right-hemisphere stroke. Computed tomography angiography (CTA) revealed 60% stenosis in the brachiocephalic trunk, 30% stenosis in the cervical (C1) segment and critically stenosed calcified cavernous (C4) segment of right ICA. Since standard management of this lesion was associated with high risk of unsuccessful revascularization, which in turn could result in complete occlusion and life-threatening stroke, we decided to address it using IL. The overall endovascular strategy has been explained to the patient and she gave informed consent. Catheter angiography demonstrated good inflow to the left cerebral hemisphere, but no collateral inflow to the right side. On the right side finding were in line with CTA (Figure 1A). Firstly, a guidewire was navigated into the M1 segment of the middle cerebral artery. Stenosis in the C4 segment of ICA was predilated using balloons under the pressure of 8–16 atm. Such a pressure, which was much higher in comparison with standard angioplasty for intracranial lesions, was used because the target lesion was highly calcified. Then, we introduced the 3.5/12 mm Shockwave C^2 (Shockwave Medical, Santa Clara, CA, US) intravascular lithotripsy catheter (Figure 1B). At the level of calcified plaque, we inflated balloon of this system under the pressure of 2–4 atm. and performed 2, then 4, and again 4 applications of sonic energy, then the lesion was dilated with balloon under the pressure of 6–12 atm. Since the stenosis was recoiling (Figure 1C), we advanced aspiration catheter up to the lesion, and through this catheter implanted the 3.5/12 mm Xience Sierra drug eluting stent (Abbott, Chicago, IL, US) (Figure 1D). This stent is characterized by a higher radial force than typical stents used to address intracranial lesions. Still, there was a considerable risk of recoil, which could not be reopened if standard radial force stent were used. Besides, this stent is of low profile characteristic, which facilitated its navigation to the intracranial part of the ICA. Final angiographic result of the procedure was good (residual stenosis <10%) with correct inflow to the arteries of the right hemisphere (Figure 1E). Postprocedural course (6 months) was uneventful. CTA performed 8 weeks after the procedure did not demonstrated re-stenosis (Figure 1F).

Although the procedure was successful, it should be noted that first two applications of sonic energy were poorly tolerated by patient; she experienced extremely high noise during lithotripsy. Therefore, further applications were performed under analgosedation. We demonstrated that intravascular lithotripsy of a highly calcified critical stenosis in the intracranial part of the ICA is feasible. However, for the time being, safety profile of such procedures remains uncertain.

Article information

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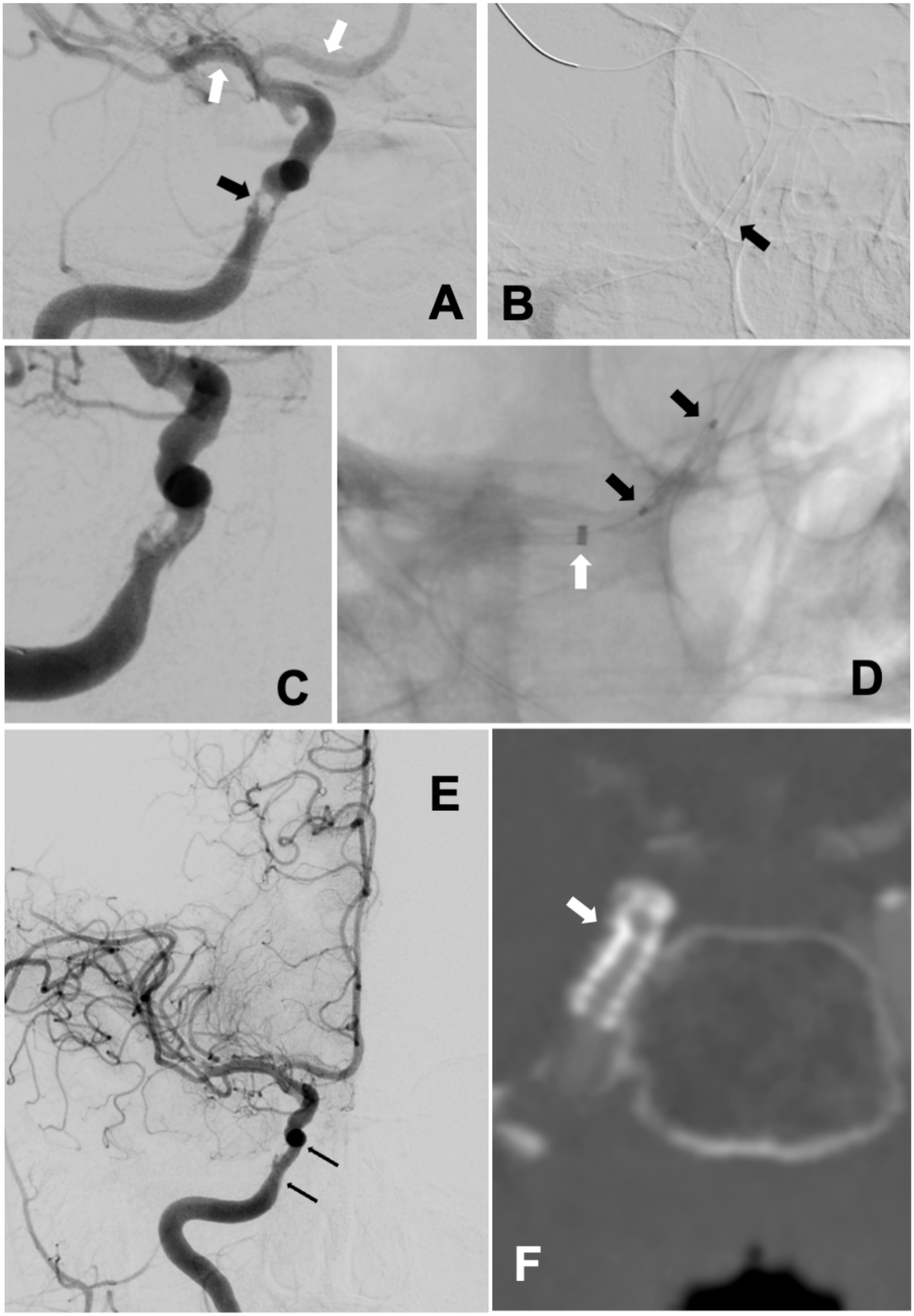
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Figure 1. A. Angiography of the right internal carotid artery, critical calcified stenosis in the cavernous (C4) segment (black arrow), white arrows point to the middle and anterior cerebral arteries. **B.** Lithotripsy balloon at the level of target lesion, black arrows show proximal and distal markers of the device. **C.** Control angiography after 5 minutes, recoil with visible dissection. **D.** Stent prepared for implantation, white arrow points to the end of aspiration catheter, black arrows point to the stent markers. **E.** Control angiography in the anteroposterior view after stent implantation, good result with minor residual stenosis and good inflow to the right anterior and middle cerebral arteries, yet without communication to the left cerebral hemisphere, arrows show implanted stent. **F.** Control computed tomography angiography, patent stent with minor residual stenosis and good inflow to the arteries of right cerebral hemisphere