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Combined treatment with Shockwave and ultra-high-pressure balloon forseverely calcified common carotid artery in-stent restenosis

Short title: Shockwave and ultra-high-pressure balloon for carotid artery in-stentrestenosis

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An 80-year-old lady with multi-site atherosclerosis, including history of left common/internal artery endarterectomy (2005) and stenting for post-endarterctomy restenosis [2013; self-expanding stent, Xact (Abbott Vascular) 10–8 × 40 mm with optimal result] underwent control angiography as routine Duplex Doppler indicated progressive re-restenosis (320/170 cm/s, peak systolic/end-diastolic velocity). A 5-French right femoral approach was used for initial vascular access. Angiography showed severely calcified restenosis of left common carotid artery, with restenotic material appearing both within and outside the stent (Figure 1A–B, Supplementary material, *Video S1*). A Destination 6 Fr 90 cm (Terumo Europe NV) sheath was then placed, and the lesion was crossed with Emboshield NAV™ 6 (Abbott Vascular, Santa Clara, CA, US) positioned distally as embolic protection system. Despiteseveral high-pressure dilatations with 5.0 × 12 mm and 5.0 × 20 mm noncompliant balloons, the dog-bone effect was observed, and the lesion appeared

unchanged (Figure 1C; Supplementary material, *Video S2*). Therefore, a Pilot 50 (Abbot) guidewire was advanced alongside the Emboshield to facilitate crossing of the lesion with Shockwave M5 IVL peripheral catheter (Shockwave Medical, Inc.) 7.0 × 60 mm (Figure 1D; Supplementary material, *Video S3*). Thus, three cycles of 30 impulses each were delivered achieving partial luminal gain, without adverse effects (Supplementary material, *Video S4*). A decision to implant a new stent was made, due to plaque prolapse in the previously implanted stent and expected suboptimal result with balloon angioplasty. However, stent advancement through the lesion failed and further dilation was performed with an ultra-high pressure OPN NCballoon 4.5 × 15 mm at 35 atmospheres (atm) (Figure 1E; Supplementary material, *Video S5*). After, a 7.0 × 37 mm balloon-expandable stent ICover (IVascular) was advanced and deployed at 14 atm. with a satisfying final angiographic result (Figure 1F; Supplementary material, *Video S6*). The lady was discharged the day after, and the hospital stay was uneventful. Carotid artery in-stent restenosis is frequent, ranging from 2.7% to 33% in different reports; yet, the treatment of this condition is a matter of debate and entails peculiar risks [1, 2]. To date, various mechanisms have been considered responsible for in-stent restenosis, primarily neointimal hyperplasia and the progression of atherosclerosis (that may involve progressive calcification(s)), necessitating diverse therapeutic approaches. In light of this, the role of intravascular imaging seems to be of paramount importance. [3] The absence of intravascular imaging assessment represents a limitation in our insights into the mechanism of progressive re-restenosis in this patient. Among the predictors of in-stent restenosis, residual stenosis after stenting has been identified as an independent risk factor. [4] To reduce residual stenosis, we opted to complete the procedure by placing another stent. Although results with different platforms, including single-layer carotid stents and zotarolimus-eluting stents, have shown promise in treating severely calcified carotid in-stent restenosis, we deemed it important to use a stent with significant radial force [5, 6]. To the best of our knowledge, this is the first report of combined use of intravascular lithotripsy and ultra-high-pressure balloon to enable and optimize endovascular management of the carotid artery highly-calcific in-stent restenosis. The use of this technique allowed the achievement of successful carotid revascularization.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/polish_heart_journal.

Article information

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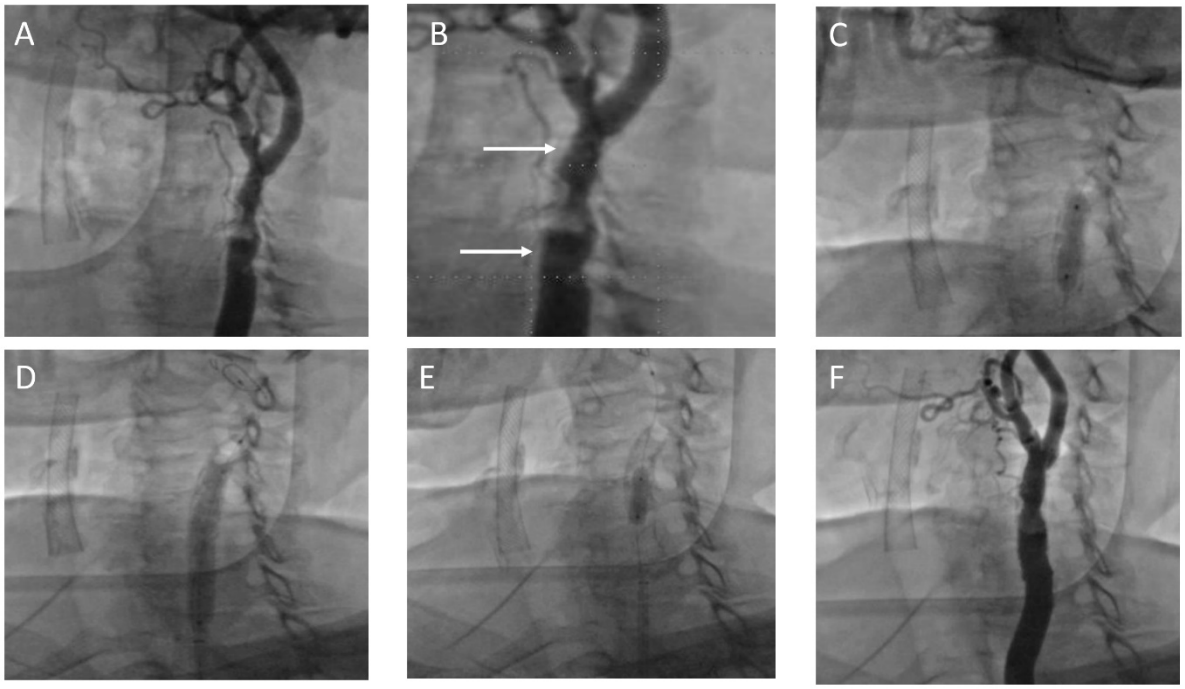

Figure 1. A. Baseline angiography. **B.** Previous implanted stent. **C.** Dog-bone effect with non-compliant balloon. **D.** Intravascular lithotripsy with Shockwave. **E.** Further lesion preparation with ultra-high-pressure balloon **F.** Final result