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Reviews

Combined Rotational Atherectomy and Intravascular Lithotripsy for the Treatment of Severely Calcified in-Stent Neoatherosclerosis: A Mini-Review

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ABSTRACT

Coronary calcifications remain associated to increased rate of complications and worse clinical outcomes, particularly in the setting of in-stent restenosis. We present the first reported case of combined rotational atherectomy and intravascular lithotripsy for the treatment of heavily calcified neoatherosclerosis.

Contents

1. Introduction

Percutaneous coronary intervention (PCI) remains up to date challenging in the setting of severely calcified coronary vessels [1]. Despite the use of rotational or orbital atherectomy, and scoring/cutting balloons, coronary calcifications continue to result in prolonged procedural times, higher complication rate, and worse device- and patient-oriented outcome [2–4]. In-stent restenosis (ISR), a frequent phenotype of stent failure, has been associated to stent underexpansion due to severe coronary calcifications [5,6].

Intravascular lithotripsy (IVL) has been recently proposed as an alternative to rotational atherectomy (RA) for the treatment of calcified de-novo coronary lesions [7]. However, in-stent neoatherosclerosis is also frequently characterized by calcifications within the neointima, especially in implants with long follow-up duration [8]. We hereby present the first documented description of combined used of these two techniques for the treatment of severely calcified in-stent neoatherosclerosis.

2. Case description

A 61-year-old man with previous coronary artery bypass graft (CABG) and ´repeated PCI of the right coronary artery (RCA) was admitted in our hospital with chest pain and troponin elevation. Coronary angiography showed significant ISR of the previously implanted drug-eluting stents (DES) in RCA (Fig. 1, panel A). Baseline optical coherence tomography (OCT) showed circumferential neointimal calcification between the first and the second overlapping stent (Fig. 1, panel B). An initial run of rotational atherectomy using a 1.5 mm burr (Boston Scientific Corp., MA, USA) was performed to facilitate delivery of intracoronary imaging and balloon catheters. Optical coherence tomography showed persistence of heavily calcified neointimal areas of neoatherosclerosis despite the focal disruptive passage of the rotational atherectomy burr (Fig. 1, panel C). Therefore, a lithotripsy balloon 4.0 × 12 mm was locally inflated to 4 atm, delivering each time 10 pulses, followed by dilatation

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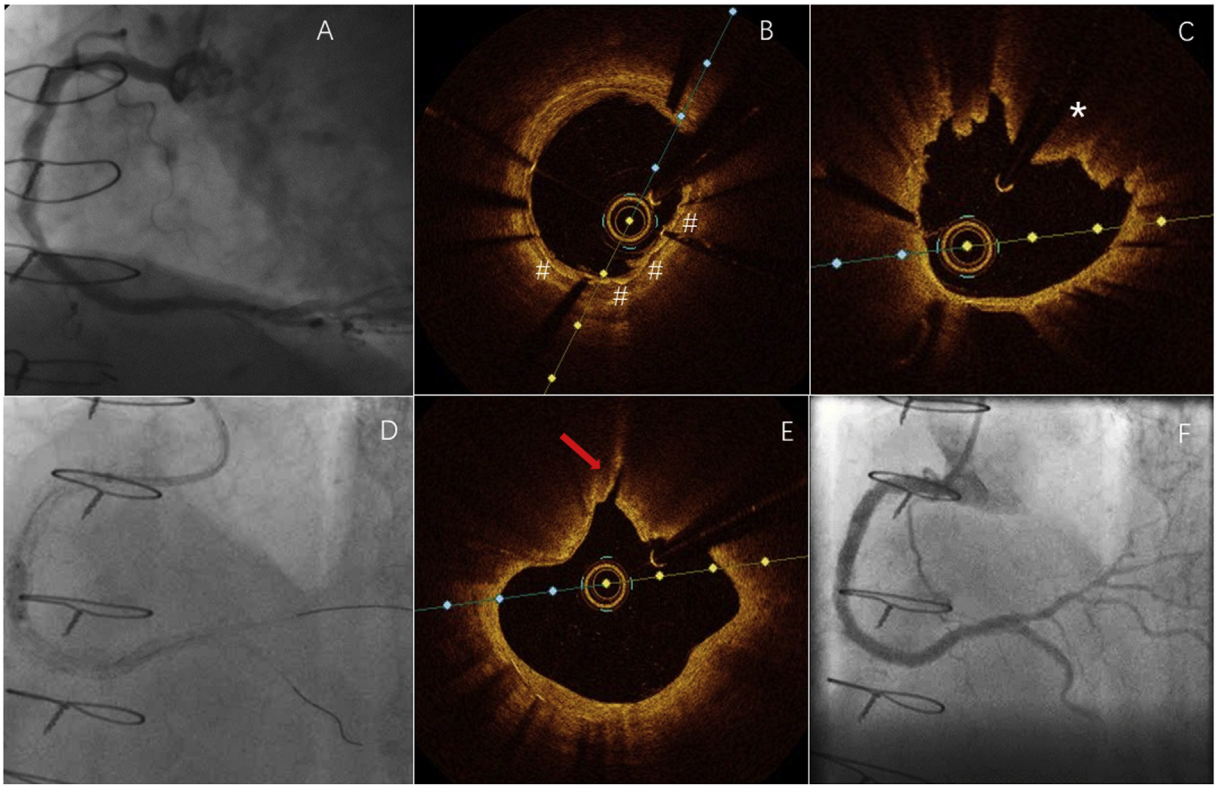

Fig. 1. Panel A: baseline angiographic assessment of the RCA; panel B: baseline OCT (# depicts circumferential neointimal calcifications); panel C: post-rotational atherectomy OCT (* indicates irregular tissue disruption, typical following rotational atherectomy); panel D: local delivery of lithotripsy balloon catheter using pulsatile mechanical energy; panel E: OCT following intravascular lithotripsy (arrow indicates the typical focal disruption of calcium); panel F: final angiographic result.

to nominal pressure (Fig. 1, panel D). Optical coherence tomography performed after IVL showed focal disruption of calcium (Fig. 1, panel E), which allowed DES delivery and expansion with a satisfactory angiographic result (Fig. 1, panel F).

3. Discussion

To our knowledge, this is the first report of combined IVL and RA for the treatment of in-stent neoatherosclerosis with severe neointimal calcification. Rotational atherectomy allowed adequate lesion preparation and delivery of the IVL balloon-catheter, the latter aiming to the circumferential treatment of in-stent coronary calcium deposits.

The role of RA for the treatment of ISR remains controversial. The findings of the randomized Angioplasty Versus Rotational Atherectomy for Treatment of Diffuse In-Stent Restenosis Trial (ARTIST) suggest that the use of RA followed by a low-pressure balloon angioplasty was associated to worse angiographic and clinical outcomes vs. balloon angioplasty alone [9]. On the contrary, the investigators of the Randomized trial of Rotational Atherectomy Versus Balloon Angioplasty for Diffuse In-stent Restenosis (ROSTER) showed lower target lesion revascularization (TLR) rates in the subgroup of patients treated with RA vs. balloon angioplasty alone [10]. In both trials, however, RA was used for tissue and material (i.e. previously implanted stent) debulking, in comparison to current standards of lesion preparation using smaller burrs [11].

Excimer laser coronary atherectomy (ECLA) was suggested as an alternative approach for the treatment of ISR, aiming to overcome the limitations of RA. The investigators of the *Excimer Laser LEsion Modification to Expand Non-dilatable sTents* (ELLEMENT) study used ECLA with high energy during contrast injection within underexpanded stents in 28 patients with high procedural success (96.4%), confirming feasibility of this method [12]. However, this approach is limited by intracoronary bubble formation that may lead to relatively high periprocedural myocardial infarction rates, as well as transient slow-flow phenomena, particularly when catheters larger than 0.9 mm are used.

Preliminary findings suggest safety and effectiveness of the Shockwave Coronary Rx Lithotripsy System (Shockwave Medical, Fremont, California) in treating severely calcified coronary vessels [7]. Intracoronary imaging using OCT revealed multiple circumferential calcium fractures without the need for high-pressure balloon inflation, which may have led to the low rate of coronary dissections and perforations observed [7].

In the present case, two techniques of heavily calcified lesion preparation were used complementarily: [1] rotational atherectomy, using a small 1.5 mm burr, to enable initial lesion preparation and ease the passage of balloon catheters; [2] intravascular lithotripsy, using an IVL-balloon catheter to allow focal treatment of the in-stent neoatherosclerosis and low-pressure acute luminal gain (balloon sized 1:1 to the reference artery diameter). The complimentary use of both techniques needs to be systematically studied in large patient populations, as it may prove beneficial in terms of procedural and clinical outcome.

References

[1] Genereux P, Madhavan MV, Mintz GS, et al. Ischemic outcomes after coronary intervention of calcified vessels in acute coronary syndromes. Pooled analysis from the HORIZONS-AMI (harmonizing outcomes with revascularization and stents in acute myocardial infarction) and ACUITY (acute catheterization and urgent intervention triage strategy) trials. J Am Coll Cardiol 2014;63:1845–54.
[2] Abdel-Wahab M, Richardt G, Joachim Buttner H, et al. High-speed rotational atherectomy before paclitaxel-eluting stent implantation in complex calcified coronary lesions: the randomized ROTAXUS (rotational atherectomy prior to taxus stent treatment for complex native coronary artery disease) trial. JACC Cardiovasc Interv 2013;6:10–9.
[3] Abdel-Wahab M, Baev R, Dieker P, et al. Long-term clinical outcome of rotational atherectomy followed by drug-eluting stent implantation in complex calcified coronary lesions. Catheter Cardiovasc Interv 2013;81:285–91.

[4] Clavijo LC, Steinberg DH, Torguson R, et al. Sirolimus-eluting stents and calcified coronary lesions: clinical outcomes of patients treated with and without rotational atherectomy. Catheter Cardiovasc Interv 2006;68:873–8.
[5] Mintz GS. Intravascular imaging of coronary calcification and its clinical implications. JACC Cardiovasc Imaging 2015;8:461–71.
[6] Mintz GS. Clinical utility of intravascular imaging and physiology in coronary artery disease. J Am Coll Cardiol 2014;64:207–22.
[7] Ali ZA, Brinton TJ, Hill JM, et al. Optical coherence tomography characterization of coronary lithoplasty for treatment of calcified lesions: first description. JACC Cardiovasc Imaging 2017;10:897–906.
[8] Otsuka F, Byrne RA, Yahagi K, et al. Neoatherosclerosis: overview of histopathologic findings and implications for intravascular imaging assessment. Eur Heart J 2015;36:2147–59.
[9] vom Dahl J, Dietz U, Haager PK, et al. Rotational atherectomy does not reduce recurrent in-stent restenosis: results of the angioplasty versus rotational atherectomy for treatment of diffuse in-stent restenosis trial (ARTIST). Circulation 2002;105:583–8.
[10] Sharma SK, Kini A, Mehran R, Lansky A, Kobayashi Y, Marmur JD. Randomized trial of rotational atherectomy versus balloon angioplasty for diffuse in-stent restenosis (ROSTER). Am Heart J 2004;147:16–22.
[11] Tomey MI, Kini AS, Sharma SK. Current status of rotational atherectomy. JACC Cardiovasc Interv 2014;7:345–53.
[12] Latib A, Takagi K, Chizzola G, et al. Excimer laser lesion modification to expand non-dilatable stents: the ELLEMENT registry. Cardiovasc Revasc Med 2014;15:8–12.