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Tight lesion in underexpanded stent: a contemporary approach based on delayed intravascular lithotripsy

Istotna zmiana w nierozprężonym stencie — współczesne podejście oparte na opóźnionej litotrypsji wewnątrznaczyniowej

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Abstract

A patient with massive calcification of the coronary arteries and an unexpanded coronary stent is reported. Due to the persistence of Canadian Cardiovascular Society class III angina, many endovascular treatment techniques were attempted, but most of them were ineffective. Full expansion of the previously implanted stent and resolution of the lesion in the circumflex artery was finally achieved with the use of intracoronary lithotripsy. After successful treatment, the patient is under the care of a cardiology clinic and remains asymptomatic.

Key words: intravascular lithotripsy, stent, underexpanded, calcified

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Introduction

Despite the progress in percutaneous techniques in coronary artery disease treatment, underexpanded stents in calcified lesions still constitute a challenge. The risk of stent polymer exfoliation remains the contraindication for early use of intravascular lithotripsy (IVL), however, delayed optimisation with the use of IVL has become an alternative option. This valuable technique uses a balloon-mounted ultrasound source which emits sonic pressure waves. The effect of ultrasound wave propagation into the vessel wall results in fragmentation of both superficial and deep calcium deposits, even located under the stent struts, which allows better balloon and stent expansion [1]. As long as the calcified lesion remains uncovered with the stent, rotational atherectomy with increasing diameter of burrs could be effective. The use of rotational atherectomy in underexpanded stents remains an off-label procedure because of the high risk of possible complications. Intravascular lithotripsy is a modern technique dedicated to calcified coronary artery treatment. Unfocused lithotripsy energy is created at the emitters, which are contained in a fluid within a coronary artery balloon catheter. Electrical energy is delivered to the emitters, initiating the creation of steam bubbles, which expand and collapse creating sonic pressure waves. The result is microfractures in the atherosclerotic, calcified coronary artery wall, prone to further expansion during the final balloon or stent implantation.

An effective method combining initial IVL with non-compliant or very-high-pressure balloon post-dilatation should be considered in such cases when the use of in-stent

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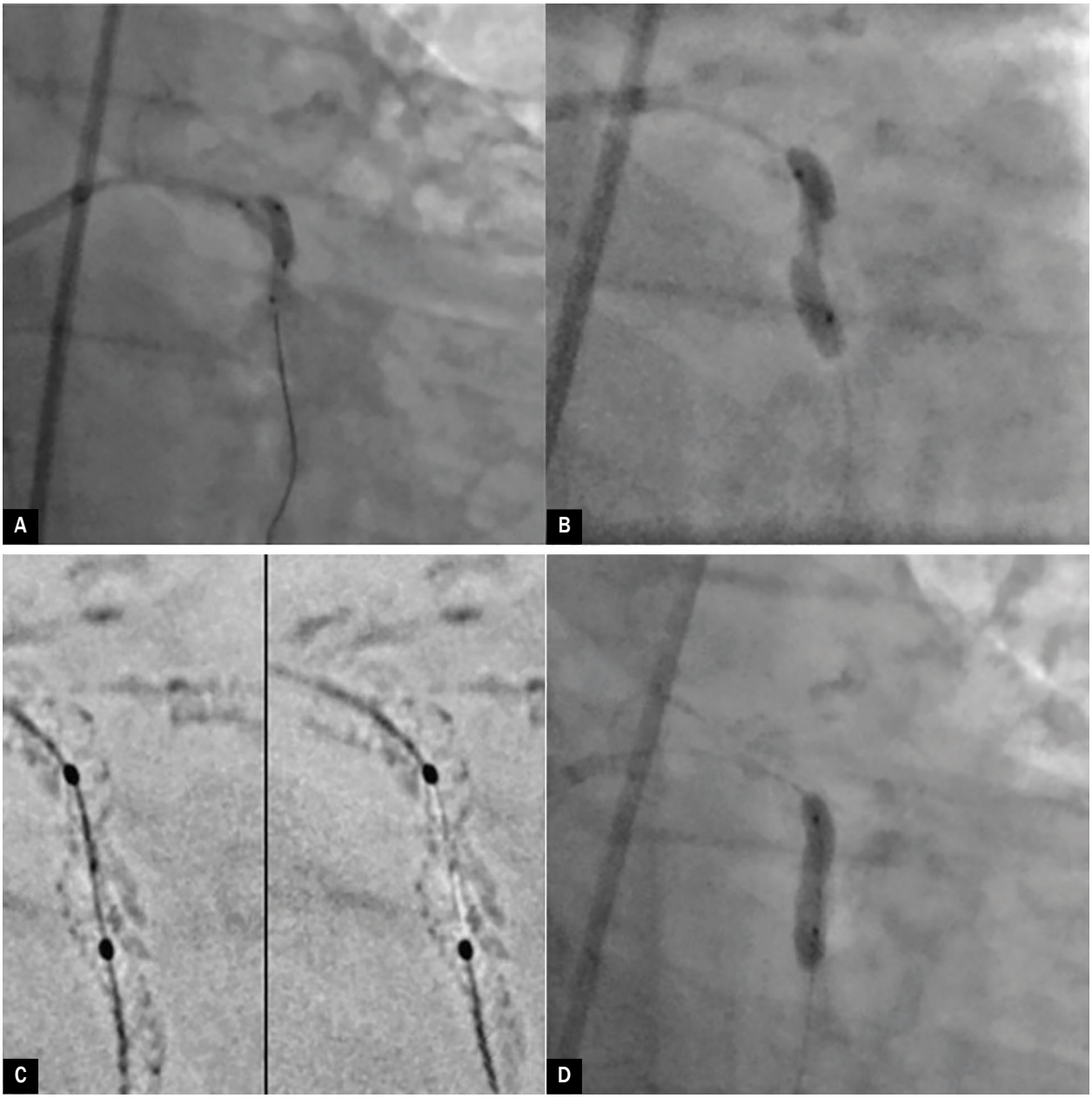

Figure 1. A. Simultaneous non-compliant 3.0 × 15 mm balloons inflation; **B.** Stent underexpansion visible in angio; **C.** Stent underexpansion visible in StentViz technique; **D.** Stent after intravascular lithotripsy and drug-coated balloon inflation

rotational atherectomy was ineffective or associated with the unacceptably high risk [2]. The aim of the publication and ongoing trial is the presentation of the clinical outcome of the contemporary approach including the IVL technique with final paclitaxel balloon inflation in tight underexpaned stent lesion.

Case report

The criteria for such a comprehensive approach met a 68-year-old diabetic patient with arterial hypertension, hyperlipidaemia and a history of stroke and myocardial infarction treated 4 months earlier with percutaneous coronary intervention in the circumflex artery. Due to persistent angina (Canadian Cardiovascular Society III class), the patient was qualified for coronary angiography, which revealed the underexpanded stent, critically narrowing the artery lumen. Then the percutaneous coronary intervention *ad hoc* was performed, with the use of various techniques even including simultaneous non-compliant (NC) 3.0 × 15 mm balloons inflation (Figure 1A). None of them was successful, because of massive calcium

deposits located under the stent structure in the 11th segment. Despite the high pressure (24 atm) and prolonged inflation of the 3.5 × 20 mm NC balloon, proper expansion was not achieved (Figure 1B). There was still dog-boning of the balloon and stent underexpansion visible in the StentViz technique (Figure 1C). The patient was clinically stable, and a second attempt with the use of IVL was scheduled in the next 2 months according to IVL producer recommendations. Another procedure was performed using a 3.0 × 12 mm IVL balloon (Shockwave Medical) which, after completing the whole lithotripsy protocol enabled a full expansion of the balloon (6 atm). Finally, the NC balloon inflation (3.5 × 15 mm, 20 atm) followed by prolonged paclitaxel-coated balloon inflation (3.5 × 20 mm, 10 atm, 90 seconds) (Figure 1D) allowed to achieve an optimal angiographic result. Nine months after successful procedure patient remains asymptomatic in ambulatory care.

Discussion

Intravascular lithotripsy constitutes a valuable complement to the available revascularization methods including rotational and orbital atherectomy, non-compliant, ultra-high-pressure, scoring or cutting balloons [3]. Underexpanded stents implanted in heavily calcified segments limit the benefits of coronary revascularization. There is still a lack of scientific data on IVL in in-stent lesions, however, sometimes lithotripsy remains the only method of treatment in the case of underexpanded stents. A hybrid approach based on IVL and non-compliant balloon, followed by drug-coated balloon inflation may be an encouraging treatment option. The final drug-coated balloon inflation allows for avoiding the implantation of another stent layer.

Moreover, it seems that full optimisation of stent expansion based on IVL can also prevent late stent thrombosis and, in such a way, may improve the patient's outcome. Obviously, there is a need for further research and more evidence on this topic.

Conclusion

The contemporary approach including delayed in-stent IVL with final paclitaxel-drug coated balloon inflation may be an encouraging and safe treatment option in underexpanded calcified in-stent lesions. There is still a lack of scientific data on IVL in in-stent lesions so further research and more evidence base data on this topic are needed. When orbital or rotational atherectomy is impossible or ineffective IVL could remain the last chance for a successful and safe method of revascularization.

Article information

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Author contributions
PW, WS, MW contributed to patient diagnosis, management, and clinical data analysis. PW wrote the manuscript draft. MW edited the manuscript. MK contributed to data analysis, interpretation, and intellectual content of critical importance to the work described. All authors had the opportunity to revise the manuscript.

Conflict of interest
The authors declare no conflict of interest.

Ethics statement
This case report was in adherence with the Declaration of Helsinki. The authors declared that written informed consent was obtained from the patient for publication of this case report and accompanying images.

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None.

Streszczenie

W niniejszej publikacji opisano przypadek pacjenta z masywnymi zwapnieniami tętnic wieńcowych oraz nierozprężonym stentem wieńcowym. Ze względu na utrzymujące się dolegliwości dławicowe w klasie III według Kanadyjskiego Towarzystwa Kardiologicznego podjęto wiele prób leczenia wewnątrznaczyniowego, ale większość z nich okazała się nieskuteczna. Pełne rozprężenie uprzednio wszczepionego stentu oraz rezolucję zwężenia gałęzi okalającej lewej tętnicy wieńcowej udało się finalnie uzyskać z użyciem litotrypsji wewnątrzwieńcowej. Po skutecznym leczeniu pacjent znajduje się pod opieką poradni kardiologicznej i pozostaje bezobjawowy.

Słowa kluczowe: litotrypsja wewnątrznaczyniowa, stent, nierozprężony, zwapniały

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