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Use of rotational atherectomy for treatment of in-stent restenosis with coronary double-mesh stent underexpansion. Case report

Uso de aterectomia rotacional para tratamento de reestenose intra-stent com subexpansão de dupla malha de stents coronarianos. Relato de caso

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ABSTRACT – Treatment of in-stent restenosis lesions, especially calcified lesions, with stent underexpansion, generally requires more complex techniques, such as rotational atherectomy. The case reported is a male patient with a 99% in-stent focal restenosis lesion at the origin of the first diagonal branch, where two stents were implanted 14 years ago. After failure of balloon angioplasty alone, ablation of the plaque and part of the stent struts was performed using the rotational atherectomy technique, which allowed the implantation of a new stent which was totally expanded.

Keywords: Atherectomy; Coronary atherectomy; Coronary restenosis; Stents

RESUMO – O tratamento de lesões reestenóticas intra-stent, principalmente as calcificadas, com subexpansão do stent, geralmente requer o uso de técnicas mais complexas para sua execução, como a aterectomia rotacional. O caso se trata de um paciente do sexo masculino com lesão reestenótica focal intra-stent de 99% na origem do primeiro ramo diagonal, local onde foram implantados dois stents há 14 anos. Após falha da angioplastia apenas com balões, realizou-se a ablação da placa e de parte das hastes dos stents pela técnica de aterectomia rotacional, o que possibilitou o implante de novo stent com sua expansão total.

Descritores: Aterectomia; Aterectomia coronária; Restenose coronária; Stents

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INTRODUCTION

Percutaneous coronary intervention (PCI) with stent implantation is a technique widely used since the 1990s for the treatment of obstructive coronary lesions caused by atheromatous plaques. Proper treatment of these lesions is of great importance, since underexpansion of the stent placed over them will result in an increased risk of in-stent restenosis/thrombosis. Heavily calcified lesions deserve special attention, as they are often associated with stent underexpansion, because the balloons used for their expansion are not capable of causing the expected increase of the struts over the vessel lumen, considering the irregularities resulting from the calcifications.[1]

In this scenario, the use of the rotational atherectomy (RA) has proved to be very useful in the treatment of these lesions, and it can also be used for the ablation of underexpanded stents implanted in the region of these plaques.[2] In this case report, we show the use of the RA technique for the treatment of a calcified plaque and the ablation of a double mesh stent placed over the lesion, followed by an everolimus-eluting stent (EES) implantation.

The Research Ethics Committee of the *Hospital de Urgências de Goiânia*, associated with the *Plataforma Brasil*, approved the present study (CAAE: 94882318.7.0000.0033).

CASE REPORT

A 69-year-old male patient with hypertension (HTN), dyslipidemia (DLP), and coronary atherosclerotic disease (CAD), was admitted to the Cath Lab on February 25, 2021, for cardiac catheterization, after performing an exercise stress test, which was positive for myocardial ischemia.

The patient had previously undergone coronary angiography on December 16, 2004, which showed a 90% lesion in the proximal third of the first diagonal branch (Dg1), and an 80% lesion in the middle third of the left anterior descending artery (LAD). PCI was performed on December 17, 2004, with the implantation of drug-eluting stents in the proximal third of the LAD (3.5x39mm) and in the proximal third of the Dg1 (3.0x16mm). However, due to recurrence of angina, the patient underwent a new cardiac catheterization on July 3, 2005, which showed a 95% in-stent restenosis lesion at the proximal edge of the origin of Dg1 and parietal irregularities in the LAD. In view of these findings, a new PCI was performed, at the same time, with implantation of a paclitaxel-eluting stent (3.0x16mm) at the origin of Dg1 and redilation of the distal segment of the stent previously implanted in LAD with a 3.5x20mm balloon.

In the angiographic study carried out on February 25, 2021, a 99% in-stent focal restenotic lesion at the origin of Dg1 with the presence of calcifications (Figure 1A), a 70% lesion in the proximal third and a 90% lesion in the middle third of the left circumflex artery (Cx) (Figure 1B), and an 80% segmental lesion in the proximal third of the diagonal artery (Figure 1C) were observed. After discussing the exam with the Heart Team, formed by two experienced interventional cardiologists and a clinical cardiologist, it was decided to perform an *ad hoc* PCI, with implantation of three EES stents, one in the CX artery (Figure 2A), one in the LAD/Dg1 bifurcation (Figure 2B), and one in the Dg1 (Figure 2C).

Figure 1. Significant lesions observed in the angiographic study of February 25, 2021. (A) A 99% in-stent restenosis lesion at the origin of the first diagonal branch with presence of calcifications. (B) A 70% lesion in the proximal third and a 90% lesion in the middle third of the left circumflex artery. (C) An 80% lesion in the proximal third of the diagonal artery.

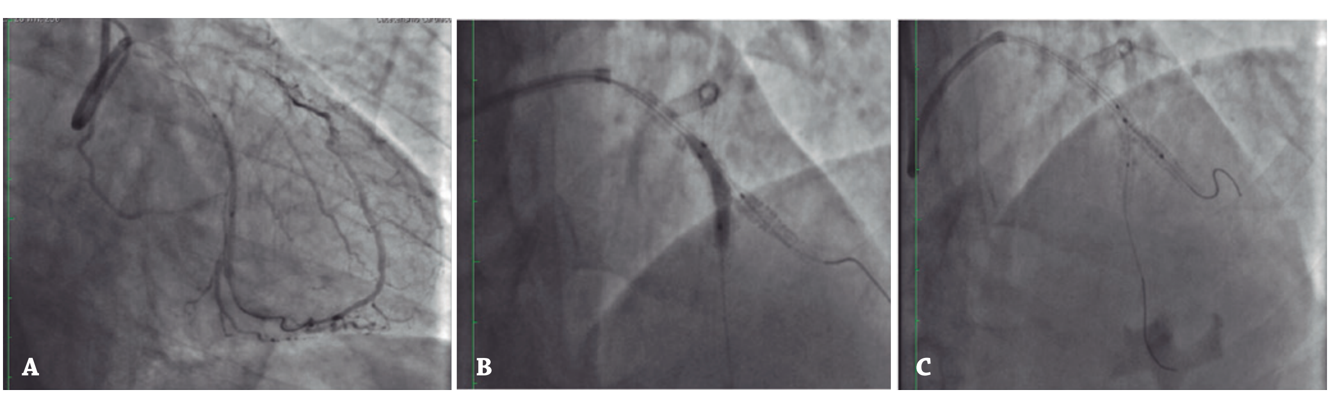

Figure 2. Percutaneous coronary intervention with implantation of three drug-eluting stents on February 25, 2021. (A) Implantation of a drug-eluting stent in the left circumflex artery. (B) Implantation of a drug-eluting stent in the left anterior descending artery/Dg1 bifurcation. (C) Implantation of a drug-eluting stent in the Dg1 branch after rotational atherectomy.

The lesion on Dg1 was a fibrocalcified lesion, and an initial attempt to predilate the vessel with a non-compliant balloon (Figure 3A) failed. Then, we tried to use a cutting balloon (Figure 3B) to make radial incisions through the calcified tissue, but also without success. Therefore, atheroabrasion of the plaque and part of the stent struts was performed by AR, using a 1.75mm burr (Figure 3C), followed by a new EES stent implantation, resulting in adequate coronary flow (*Thrombolysis in Myocardial Infarction* – TIMI – 3), with no clinical or angiographic complications during the procedure (Figure 4).

The patient had a good clinical course, and was discharged for outpatient follow-up with an attending cardiologist on the third day of hospitalization. He was maintained on aspirin 100mg once daily, clopidogrel 75mg once daily, atorvastatin 80mg once daily, metoprolol succinate 100mg once daily, ezetimibe 10mg once daily, and telmisartan/hydrochlorothiazide 80/25mg once daily.

DISCUSSION

One of the main risk factors for restenosis and in-stent thrombosis is the underexpansion of the stent. Therefore, an adequate preparation of the coronary bed, before implanting the stent, is of fundamental importance to ensure its adequate expansion and reduce the incidence of complications.[3]

For adequate treatment of calcified or fibrocalcified lesions, which often result in inadequate expansion of the stent, the techniques used may involve balloons (non-compliant, cutting or scoring balloons), laser, intracoronary and RA lithotripsy.[3] However, whether due to technical difficulties or the need for a rapid restoration of flow down the obstructed coronary artery in a patient who is unstable, a stent implantation over a highly calcified lesion may result in stent underexpansion, requiring another intervention. In this context, RA is an alternative in the management of stent underexpansion.[4]

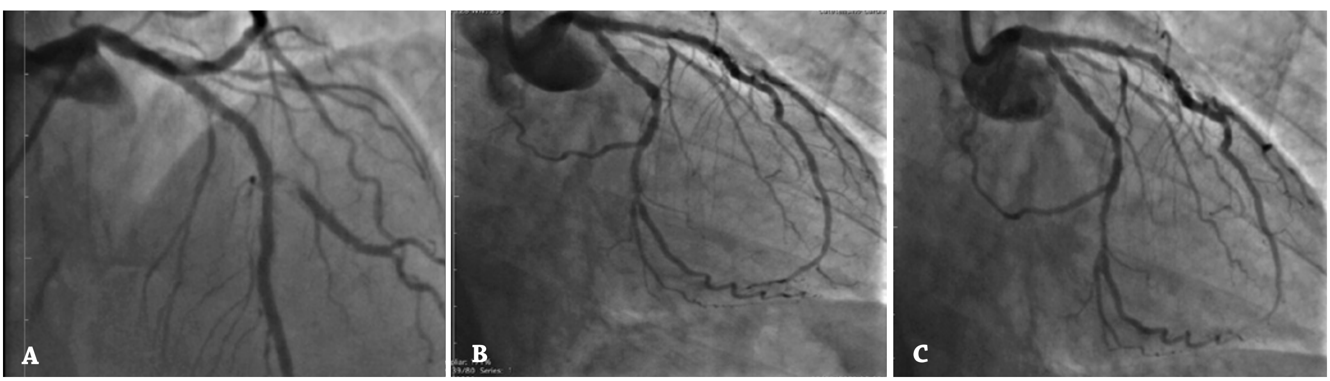

Figure 3. Devices used in the treatment of in-stent fibrocalcified lesion. (A) Attempted predilation with a non-compliant balloon. (B) Predilation attempt with a cutting baloon. (C) In-stent rotational atherectomy with 1.75mm burr.

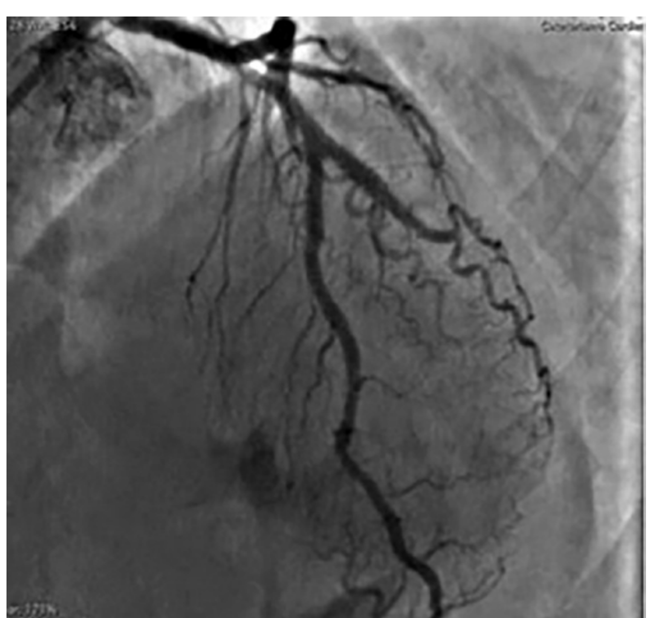

Figure 4. Result of percutaneous treatment.

Some mechanisms have been proposed to explain why rotational ablation may facilitate stent expansion. The two most accepted mechanisms are: the frictional heat generated results in liquefaction of the atheromatous plaque behind the stent structure, facilitating balloon expansion; direct ablation of the metallic stent and the fibro-calcified tissue.[5,6] The objective of the RA, in these cases, is not to completely remove the stent or plaque material, but to modify the lesion enough to enable the expansion of the already implanted stent, or to allow the newly placed stent to be fully expanded after balloon dilation.[4]

Imaging tools, such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT) are of great help in the treatment of coronary lesions and stent underexpansion. These technologies can further clarify the nature of the lesion (whether more calcified or more fibrotic), its size and extent, providing greater accuracy in choosing the size and diameter of the stent, in addition to minimizing geographic losses.[7] Despite the benefits, these tools are still poorly available, due to their high cost, and health insurance plans in Brazil often do not cover their use, which is why we could not use such resources for the patient in the case reported.

The first published case report using RA for stent ablation was by Kobayashi et al., in 2001. In this report, RA was used to treat a case of in-stent restenosis due to stent underexpansion, because the stent was placed over a highly calcified plaque. Ablation of some stent struts and part of the plaque was performed, allowing complete expansion of the newly placed stent. A control coronary angiography performed 3 months after the procedure showed no sign of restenosis at the site.[8]

In addition to some other case reports over the years, four case series were published, from 2016 to 2021.[9-12] In these series, the success rate of the stent ablation procedure ranged from 87.5% to 100%, and the rate of in-hospital major adverse cardiac events (MACE) ranged from 0% to 6.3%. However, short- and medium-term follow-up, ranging from 6 to 26 months among these studies, showed MACE rates of 9.1% to 50%, and mortality ranged from zero to 25%.[4,9-12]

The RA procedure for stent ablation is still considered an off-label procedure, and there is a consensus that it should be performed only by experienced interventional cardiologists, with back-up surgical support for the treatment of potential complications.[3,4,13] Some technical recommendations are well established, such as initially using smaller diameter burrs, respecting an initial ratio of 0.6 between the burr and the vessel diameters; gradually increasing the size of the burr, if required; performing the ablations at a speed close to 150,000rpm; avoiding a direct ablation time longer than 20 to 30 seconds to prevent thermal injury; avoiding drops greater than 20,000rpm in speed to prevent the release of larger particles that may increase the risk of the no-reflow phenomenon.[13] It is worth mentioning that all these precautions have been taken when the procedure was conducted in the case of the reported patient.

Our study group has accumulated experience in RA for stent ablation and in the treatment of its complications.[1,14,15] Therefore, in the case of our patient, a 99% in-stent focal restenosis area was observed at the origin of Dg1, which was of great importance. The RA technique was used after failure of balloon angioplasty, achieving a good luminal area and complete expansion of the newly implanted stent. Despite being a method with a high success rate in the treatment of restenosis lesions and stent underexpansion, RA can result in serious complications, such as the no-reflow phenomenon, in- or post-lesion trapping of the burr, in addition to the risk of coronary dissection and perforation.[3,4,13]

Although we still do not have prospective randomized controlled studies in the literature that could generate more solid evidence on the use of RA in the treatment of in-stent lesions or stent underexpansion, the current literature suggests that the procedure actually has a high success rate (about 90%), in addition to good results concerning in-stent restenosis or in-stent thrombosis. It should be noted that the approximate long-term follow-up of the available studies, so far, is up to 26 months.[4,9,13]

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None.

CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: FPB and GG; data collection: DMF and DFRR; data interpretation: DMF, DFRR, MLP, PFDB, FPB and GG; text writing: DMF, DFRR and GG; approval of the final version to be published: Freitas DMF, DFRR, MLP, FPB, PFD and GG.

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