PAKISTAN JOURNAL OF
Cardiovascular Intervention

OPEN ACCESS

CASE REPORT

Successful Treatment of an Under Expanded Stent using Rotational Atherectomy: First Reported Case of Stent Ablation From Pakistan

Omar Aziz Rana, & Muhammad Shahid Iqbal

Omar Hospital and Cardiac Centre, Jail Road Branch, Lahore-Pakistan

Abstract

Background: Patients with under expanded coronary stents due to coronary artery calcification are at an increased risk of cardiovascular morbidity and mortality. Importantly, these present a challenging subset patients undergoing percutaneous coronary intervention. Rotational atherectomy is a time-tested technique to treat coronary artery calcification. However, its utilization in treating under expanded coronary stents due to coronary artery calcification remains fraught with uncertainty amid the perceived risk of complications.

Case Presentation: We present the case of an 80-year old patient with a previously deployed under expanded coronary stent in his right coronary artery who presented with an acute coronary syndrome to our institute. Coronary angiography revealed severe instent restenosis and the lesion proved to be non-dilatable.

Management and Results: This patient underwent successful rotational atherectomy with a 1.75 mm burr at 160,000 revolutions per minute (rpm) to treat the severe instent restenosis and underexpanded stent (stent ablation) with satisfactory subsequent lesion dilatation followed by another drug eluting stent implantation.

Conclusion: Rotablation remains a viable option to treat under expanded stents as well as non-dilatable in stent restenosis. However, care must be exercised using this technique to avoid the risk of burr entrapment while treating under expanded stents.

Keywords

Rotational Atherectomy, Stent Ablation, Coronary Artery Calcification, In-stent Restenosis, Percutaneous Coronary Intervention.

Citation:
Rana OA, Iqbal MS. Successful Treatment of an Under Expanded Stent using Rotational Atherectomy: First Reported Case of Stent Ablation From Pakistan. PJCVI. 2024; 4(1): 53-59

Corresponding Author Email:
omarrana78@gmail.com

DOI: 10.58889/PJCVI.7.53.59

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflicts of Interests:
Dr Omar Aziz Rana is a Boston Scientific Proctor for rotablation in Pakistan.

Received 04/08/2024
Accepted 14/10/2024
First Published 31/12/2024

Published by Pakistan Society of Interventional Cardiology

Introduction

Coronary artery calcification is seen in up to 20% of cases undergoing coronary angiography[1]. The prevalence of percutaneous coronary intervention procedures dealing with calcified arteries represents a significant cohort due to three main factors. Firstly, globally, interventional cardiologists are treating an increasingly ageing population. Secondly, this includes patients with other co-morbidities and risk factors for example, hypertension, diabetes mellitus, chronic kidney disease, peripheral and cerebrovascular disease to name a few. Finally, and perhaps more importantly, with recent advancements in equipment and refinement of interventional techniques, we are now treating a more complex subset of patients including post coronary artery bypass grafting (CABG) and chronic total occlusions. Stent under expansion is one of the most feared complications of percutaneous coronary intervention. It has been associated with an increased risk of stent thrombosis, instent restenosis (ISR) acute coronary syndrome and cardiac mortality[2,3]. Coronary artery calcification has been associated with an increased risk of stent under expansion. Moreover, it has been widely recognised that coronary artery calcification is not always easily recognised on coronary angiography[1]. This may lead to underestimation of the severity of coronary artery calcification and inadequate or no lesion preparation at all prior to stent deployment and hence may lead to the final and undesirable outcome of an under expanded stent in a coronary artery.

While the armamentarium of treating coronary artery calcification prior to stent deployment include many options such as non-compliant (NC), high-pressure non compliant (OPN), cutting and scoring balloons as well as atherectomy devices including rotational atherectomy (rotablation, RA) and excimer coronary laser atherectomy (ELCA). The options of treating coronary artery calcification in the scenario of an under expanded stent are severely limited and are restricted by the depth and arc of calcification as well the minimal lumen area of the under expanded stent at the level where its expansion is most curtailed.
RA has been in clinical use for over four decades and its role in treating coronary artery calcification as part of lesion preparation prior to stent deployment are well recognised and undisputed[4]. However, there are no studies examining the safety of RA in treating under expanded stents due to coronary artery calcification and the collective evidence-base rests on anecdotal case reports and individual experience.

Case Presentation

An 80-year old gentleman presented to our centre with cardiac sounding chest pain. His physical examination was unremarkable apart from a mid-line sternotomy scar.

His past medical history included type II diabetes mellitus, hypertension and ischemic heart disease. He underwent CABG twenty years ago with a left internal mammary artery (LIMA) graft to his left anterior descending artery (LAD) and a saphenous vein graft (SVG) to his obtuse marginal (OM) vessel. Four years ago, he underwent primary angioplasty to his mid right coronary artery (RCA) with one drug eluting stent (DES) and made an uneventful recovery. Subsequently, he underwent coronary angioplasty to his proximal RCA and SVG to OM with one DES each five months ago in the same sitting following a non-ST elevation myocardial infarction. His LIMA to LAD graft had been patent at the time. However, on reviewing his procedure, the proximal RCA DES appeared to be angiographically under expanded due to coronary artery calcification at the site (Figure 1).

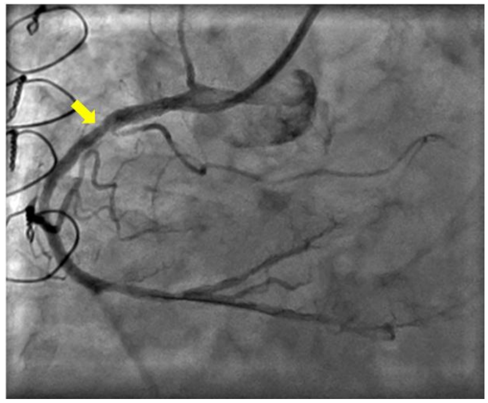

Figure 1: Final result of our patient's PCI to RCA immediately prior to the index procedure demonstrating angiographically an under expanded stent (arrow)

Of note, he had not been compliant with his antiplatelet regimen for the past two months.

Diagnostic Assessment

His electrocardiogram revealed sinus rhythm with T-wave flattening in the pre cordial leads. His troponin levels were elevated and an echocardiogram revealed an ejection fraction of 48% with hypokinesis of the inferior and posterior walls of the left ventricle but no valvular pathologies. The patient underwent a trans-femoral coronary angiogram and graft study at our centre which revealed occluded left main stem artery and a patent LIMA graft to his LAD. However, the SVG to OM had a severe in stent restenosis (ISR) at the insertion point. In addition, the RCA appeared calcified with a severe ISR at the site of the most recent DES implantation (Figure 2).

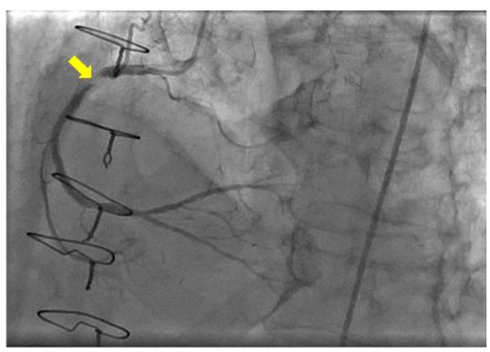

Figure 2: Angiographic image of our patient's RCA during the index admission clearly showing an ISR at the site of the previously under expanded stent (arrow).

Therapeutic Intervention

We decided to treat his SVG ISR first. The vessel was engaged with a 6Fr JR4 guide catheter (Cordis, Miami Lakes, FL) after which a Sion Blue wire (Asahi Intecc, Japan) was advanced distally into the vessel. The lesion was pre-dilated with a 2.0 x 15 mm balloon at 14 atm and then stented with a 2.75 x 16 mm Promus Elite DES (Boston Scientific, Natick, MA) at 14 atm. Finally, the DES was post-dilated with a 3.0 x 12 mm NC balloon at 20 atm.

We then elected to treat this gentleman's RCA ISR segment with the potential use of RA as back up. The RCA was engaged with a 6 Fr JR4 guide catheter (Cordis, Miami Lakes, FL) and a Sion Blue (Asahi Intecc, Japan) wire was successfully advanced into the distal vessel. Following this a 3.0 x 12 NC was used to pre-dilate the lesion and despite inflating the balloon up to 26 atm, the balloon could not be fully expanded (Figure 3)

.

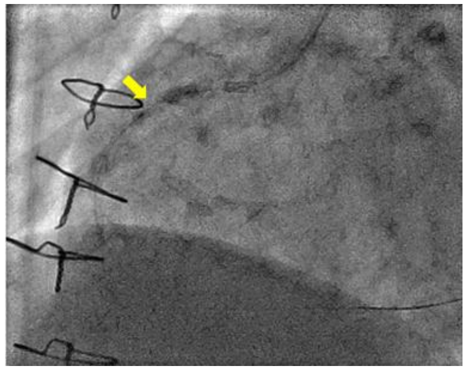

Figure 3: A 3.0 x 15 mm NC balloon was inflated to 26 atm which was unable to successfully predilate the under expanded stent segment (arrow).

Subsequently, the NC balloon was removed and a Finecross microcatheter (Terumo Medical Corp, NJ) was advanced on the Sion Blue wire using a 2.0 x 15 mm trapping balloon inflated at 14 atm inside the guide cathteter having not advanced on the guide wire. Once the tip of the microcatheter was in contact with the balloon the trapping balloon was deflated and the microcathter was advanced into the RCA. Following this, the trapping balloon was removed and the hemostatic valve was allowed to bleed back to allow any air to escape that had been introduced inadvertently. After this the Sion Blue wire was removed and a RA floppy wire (Boston Scientific, Natick, MA) was introduced into the microcatheter and advanced into the distal RCA. Subsequently, the microcatheter was withdrawn under fluoroscopic guidance ensuring optimal RA floppy wire position. We then advanced a 1.75 mm RA burr (Boston Scientific, Natick, MA) on the RA floppy wire into the guide catheter up to the RCA ostium under fluoroscopic guidance. Once we were satisfied with the position of our burr in relation to the ISR segment, we commenced RA using the 1.75 mm burr at 160,000 rpm (Figure 4).

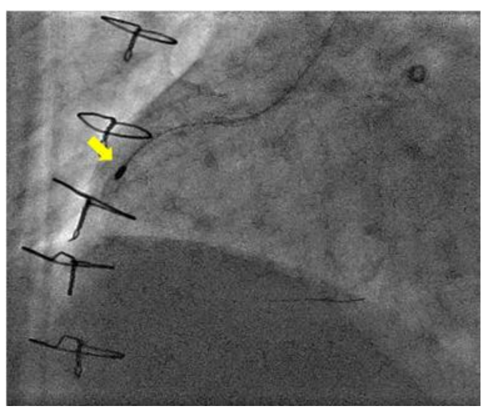

Figure 4: The lesion was successfully crossed with a 1.75 mm RA burr at 160,000 rpm (arrow).

Following the final polishing run the burr was withdrawn using dynaglide under fluoroscopic guidance. At this stage, the Sion Blue wire was reintroduced into the RCA while the rota floppy wire was removed. We were able to successfully dilate the lesion with visually appreciable full balloon expansion using a 3.0 x 15 mm NC balloon at 24 atm (Figure 5).

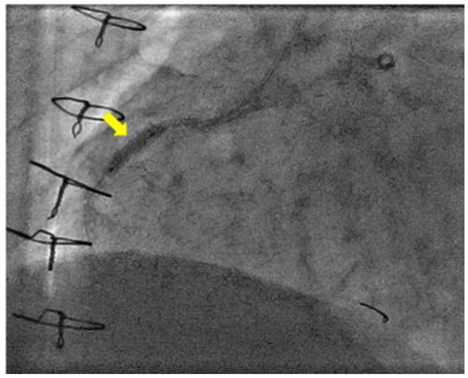

Figure 5: Following RA, the lesion was successfully dilated with a 3.0 x 15 mm NC balloon at 24 atm (arrow).

Once we were satisfied with adequate lesion preparation as evidenced by full balloon expansion, the lesion was stented with 3.0 x 20 mm Promus Elite DES at 16 atm (Boston Scientific, Natick, MA) (Figure 6).

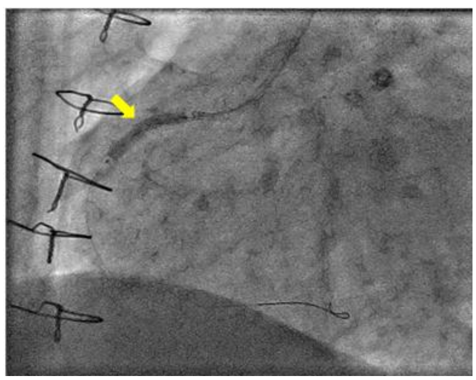

Figure 6: The lesion was stented with a 3.0 x 20 mm Promus Elite DES at 16 atm with full expansion of the stent balloon (arrow).

Finally, the newly deployed DES was post-dilated with a 3.25 x 15 mm NC balloon at 20 atm to complete the procedure (Figures 7 and 8).

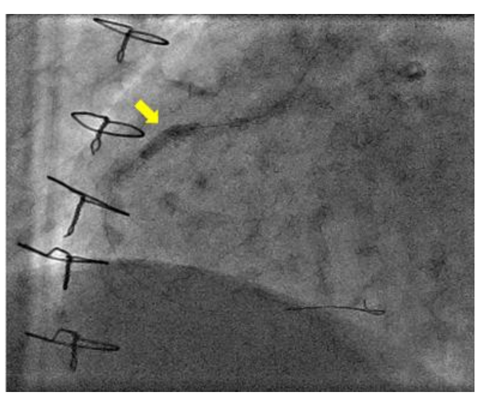

Figure 7: The stent was post dilated with a 3.25 x 15 mm NC balloon at 20 atm again demonstrating adequate balloon expansion (arrow).

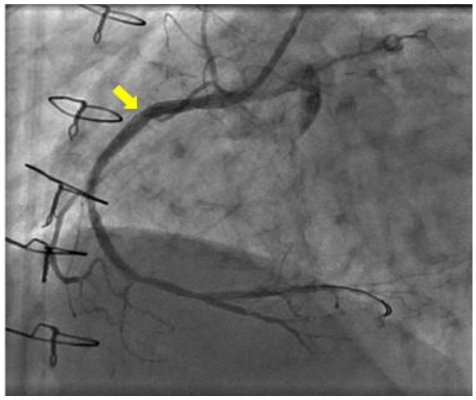

Figure 8: Final result (arrow).

Follow-up and Outcomes

The patient made an uneventful recovery and was discharged the next day. Subsequently, he was reviewed in clinic and remains angina-free and compliant with his medicines following the procedure.

Discussion

An under expanded stent in a calcified vessel manifests a technical challenge, that has limited therapeutic options for a successful resolution. In addition, such an outcome can increase the risk of stent thrombosis, ISR, acute coronary syndrome and cardiac mortality[2,3]. ELCA and intravascular lithotripsy (IVL) have recently been demonstrated to successfully treat under expanded stents[5,6]. There is a general reluctance among the interventional cardiologists in using RA to treat a recently or freshly deployed under expanded stent. This is understandable due to the perceived risk of burr entrapment. Consequentially, the use of RA in treating under expanded stents has remained largely under-explored and unresolved.

ELCA uses the principle of thermal energy generated by plaque irradiation using ultra-violet light. The photons emitted from the ELCA catheter, placed on a work-horse wire, within the coronary artery lumen at the site of under expansion lead to a rapidly enlarging thermal bubble that disseminates energy allowing photo ablation and vaporization of plaque. However, the nature of this rapidly evolving bubble is such that the energy delivered through ELCA is delivered through pulses. Importantly, localized vessel wall dissection and perforation are recognized complication of using ELCA to treat coronary artery calcification and under expanded stents[5]. IVL uses the principle of delivering sonic pressure waves, which are converted to mechanical energy, to modify coronary artery calcium. These waves selectively interact with calcified coronary lesions and by the application of this energy in pulses, the calcium is fractured leading to successful lesion dilatation. IVL catheter consists of a disposable catheter that includes a lithotripsy balloon with emitters and radio opaque markings to allow optimal positioning. Each IVL has to be sized according to the vessel wall lumen using a 1:1 ratio. These devices are bulkier in comparison to the available non-compliant and high-pressure non-compliant balloons and may present a delivery challenge across the lesion in an already under expanded stent. This may necessitate pre-treatment with non-compliant or high-pressure non-compliant balloons as well as the use of buddy wires, guide catheter extension devices and even atherectomy devices. Unsurprisingly, this may increase the procedural cost and more importantly, increase procedure complexity, time and contrast volume usage thereby affecting procedure-related morbidity[6]. Presently, both ELCA and IVL are not available in Pakistan at the time of writing this article thus severely narrowing the options of treating under expanded stents in our setting.

RA uses the principle of differential cutting while treating calcified lesions[1,4]. In practice, when a diamond-tipped RA burr comes into contact with coronary vessels, it is deflected off soft elastic tissue representing normal vessel intima and abrades calcified lesions and stent struts in the case of under expanded stents, by breaking the ablated particles to less than 10 microns in diameter which are subsequently removed from the reticulo-endothelial system. The RA burr is advanced on a dedicated rota wire and once inside the coronary artery and proximal to the under expanded stent, it can be advanced manually by moving forward the advancer knob at speeds typically between 160,000 to 180,000 rpm. The classical manoeuvre is termed 'pecking motion' whereby gradual advancement is made across the lesion by gently advancing and retracting the burr to its starting position after each run which should not last more than 10-15 seconds. In this manner a few seconds are spent with each run on the actual lesion and gradually the lesion is ablated until finally, the burr emerges on the other side. This is followed by a polishing run to ensure that the lesion is smooth and the burr can pass unimpeded. With regards to dealing with an under expanded stent, it is extremely important not to oversize the burr as this increases the risk of burr entrapment. Secondly, although some operators advocate using low speed RA for ablating calcified lesions with speeds of around 140,000 rpm, in our experience this is not recommended while treating an under expanded stent as this can increase the risk of burr stalling and entrapment. Thirdly, the RA will not affect deep wall calcification and only treats superficial vessel wall calcification so care must be taken to spend enough time on the actual lesion with the burr to allow maximal tissue ablation which results in fracturing the calcium under the under expanded stent. Once this calcium ring has been fractured only then will subsequent dilatation with non-compliant or high-pressure non-compliant balloons be successful culminating in the deployment of a new stent as illustrated in our case. Finally, the risk of burr entrapment remains significant while using RA to treat under expanded stents and this procedure must be carried out by experienced RA operators.

Conclusion

Under expanded stents present a challenging subset of coronary lesions and have been demonstrated to be associated with adverse outcomes. Therefore, it is important for interventional cardiologists to be familiar with treatment strategies that are available to deal with this scenario. We have described Pakistan's first reported case where RA was used successfully to treat an under expanded stent (stent ablation). RA remains a viable therapeutic option in treating under expanded stents albeit in experienced hands.

Acknowledgment

We would like to express our gratitude to the cardiac catheter lab staff at our institute for their valuable assistance in this case.

References

1) Madhavan MV, Tarigopula M, Mintz GS, Maehara A, Stone GW, Généreux P. Coronary artery calcification: pathogenesis and prognostic implications. J Am Coll Cardiol. 2014;63(17):1703-14.
2) Rozemeijer R, Wing Wong C, Leenders G, et al. Incidence, angiographic and clinical predictors, and impact of stent thrombosis: a 6-year survey of 6545 consecutive patients. Neth Heart J. 2019;27(7-8):321-9.
3) Yin D, Mintz GS, Song L, et al. In-stent restenosis characteristics and repeat stenting underexpansion: insights from optical coherence tomography. EuroIntervention. 2020;16(4).
4) Fitzgerald S, Allali A, Toelg R, et al. Angiographic predictors of unplanned rotational atherectomy in complex calcified coronary artery disease: a pooled analysis from the randomised ROTAXUS and PREPARE-CALC trials. EuroIntervention. 2022;17(18):1506-13.
5) Kodoth V, Rana O, Sambu N, et al. Establishing interventional technologies to treat underexpanded stents: a role for excimer coronary laser atherectomy. Pak Heart J. 2018;51(2):82-5.
6) Dini CS, Tomberli B, Mattesini A, et al. Intravascular lithotripsy for calcific coronary and peripheral artery stenoses. EuroIntervention. 2019;15(8):714-2