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Research Article

The use of Intra-Vascular Lithotripsy (Shock Wave Therapy) in a Severely Calcified RCA Lesion in a Patient With CABG - Status and Breast Cancer, Undergoing Chemotherapy

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Abstract

Introduction: This is the case of a patient with acute coronary syndrome (ACS) and severely calcified RCA lesion with PCI and CABG status and undergoing chemotherapy for breast cancer. The use of the latest technology - intravascular lithotripsy (shock wave therapy) is effective in the treatment of such complex lesion in a patient with multiple risk factors and comorbidities. **Case Presentation:** We admitted a 69 -year-old female patient who presented with symptoms of severe recurrent chest pain on effort (NYHA class III). The patient is a known case of DMT2, essential hypertension, dyslipidaemia, PCI and CABG Status. She is also on chemotherapy for breast cancer. On admission her ECG and cardiac markers showed Non-STEMI, CAG showed severely calcified sub-occlusion of mid RCA (90-95%). Her LIMA graft to LAD was functional and patent. Previously – implanted stent in OM in the previous hospital was also patent with TIMI 3 flow. She had been refused PCI for calcified RCA lesion and was advised for CABG in the previous hospital. **Conclusion:** The present case illustrates that calcified coronary artery lesions present a significant challenge to PCI treatment, especially in a patient with PCI and CABG status in the past and undergoing chemotherapy for breast cancer at present. The use of intravascular lithotripsy (IVL) using shock waves is a novel and effective method in treating such complex cases.

Keywords: Chest pain, Non-STEMI, calcified lesion, CABG status, complex angioplasty, intravascular lithotripsy (IVL)

List of Abbreviations: ECG=Electrocardiogram; WBC=White blood cell; IVL=Intravascular lithotripsy; Hb=Haemoglobin; LAD=Left anterior descending; OM=Obtuse marginal; PCI=Percutaneous coronary intervention; CABG=Coronary artery bypass graft; HTN=Hypertension; DM=Diabetes Mellitus; IVUS=Intravascular lithotripsy; OCT=Optical coherence tomography; ICU=intensive care unit; TLR=Target lesion revascularization; DES=Drug eluting Stent; SC=semi - compliant; NC=Non – compliant

Introduction

Calcified coronary lesions constitute one of the main challenges in the cardiac catheterization laboratory, being present in up to one-third of patients undergoing percutaneous coronary intervention (PCI). The high prevalence is even increasing, considering the trend towards aging of the population and the presence of comorbidities such as diabetes and chronic kidney disease. PCI procedures in such patients are associated with lower procedural success and higher rates of periprocedural complications such as failure to deliver stents, perforations, dissections and other adverse cardiac events. Furthermore, suboptimal stent deployment in the setting of severe calcification is associated with both short and long – term

major adverse cardiac events, including stent thrombosis, MI, in-stent restenosis and target lesion revascularization. A variety of treatment options for these lesions exist, including specialized balloons (cutting, scoring, OPN), atherectomy [3].

Intravascular lithotripsy (IVL) is the latest technology to treat calcified coronary lesions. It uses acoustic shock waves in a balloon-based delivery system to modify severely calcified atherosclerotic coronary vascular lesions in preparation for stent implantation (Figure 1). IVL results in circumferential and longitudinal calcium fracture, which improves transmural vessel compliance, and facilitates a better stent apposition as well as adequate stent expansion [1]. It induces fracture in deep-seated calcium, where rotational atherectomy often fails. Since calcium fragments remain in situ in IVL, there is no risk for distal embolization and slow flow in the coronaries [2].

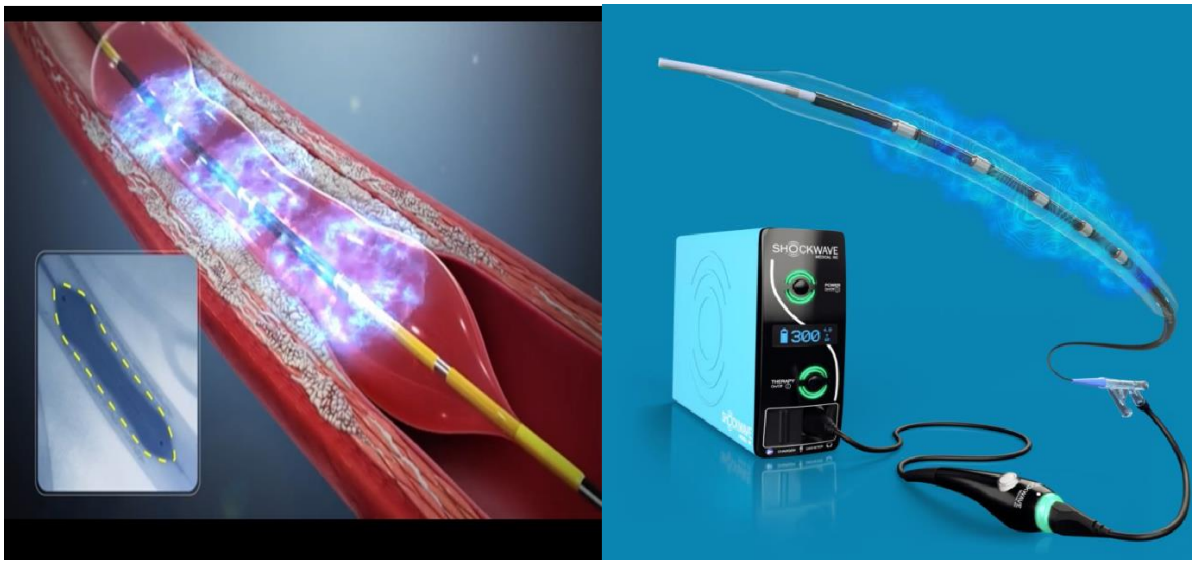

Figure 1: IVL device generating acoustic shock waves with the balloon-based delivery system

Case Report

This is a 69 - year old female, who was seen in ER with symptoms of severe left-sided chest pain. The chest pain was there on and off for the past 7 days, but had increased significantly since the morning of the presentation day. The patient is a known case of DM T2, essential hypertension and dyslipidemia. She is also a known case of CAD, CABG status (2004), angioplasty status (2005). The patient is also diagnosed with breast cancer and is currently receiving chemotherapy.

Her initial vital signs revealed temperature 36.8 degrees C, pulse rate 77 beats per minute, Blood Pressure 114/60 mm Hg. Respiratory rate 18 cycles per minute. Oxygen saturation 100%, Pain Score 3/10.

Her ECG taken in the ER showed sinus rhythm with nonspecific T wave abnormalities in infero- lateral leads (Figure 2).

Figure 2: Resting ECG on admission shows sinus rhythm at a rate of 77beats/minute, non- specific T wave changes in inferior leads. QRS duration of 103 milliseconds, QT duration of 360 milliseconds and normal QRS axis

The patient was admitted to ICU for blood tests and 2 D ECHO examination.

Her blood tests showed elevated cardiac enzymes (troponin I 62, troponin T 28), sodium 142, potassium 4.1, chloride 107, bicarbonate 21, CK-MB 1.2, hemoglobin 12. 1, hematocrit 36.6, WBC 3.9. neutrophils 34%, platelets 245,000.

A 2 D ECHO was done for her, which showed normal LV dimension and systolic function with grade I diastolic dysfunction of LV and a normal EF of 62%. No regional wall motion abnormalities were detected,

The patient was then taken to the Cath-Lab, where CAG showed severely calcified RCA sub-occlusion in the mid segment (99%), 70-75% stenosis in the proximal RCA (Figure 3). Her LIMA graft to LAD was functional and patent. Previously – implanted stent in OM was also patent with TIMI 3 flow.

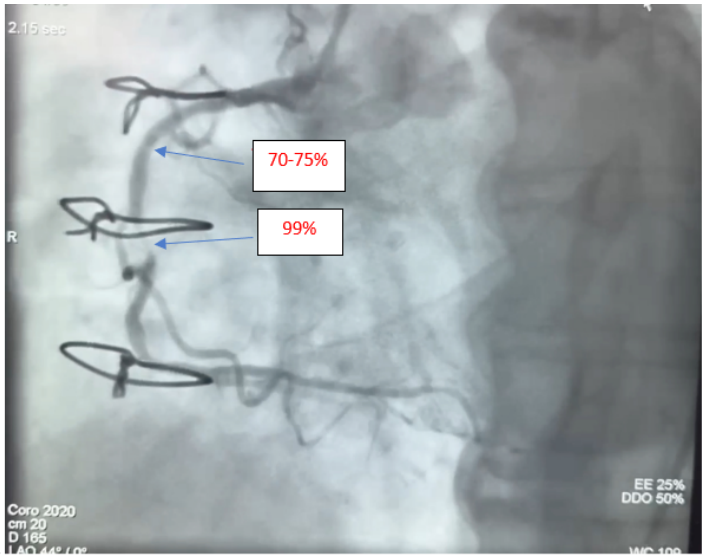

Figure 3: CAG showing highly calcified sub-occlusion of mid RCA (99%), stenosis of proximal segment (70-75%)

PCI was done using the standard method: RCA ostium was engaged using a 6F AL guiding catheter, and a 0.014" x 190 cm BMW guide wire was crossed through the RCA sub- occlusion. Then the lesion was dilated using a 2 x 10 mm SC balloon at 10 atm. pressure, followed by a 2.5 x 12 mm NC balloon, inflated at 16 atm. pressure. Then a 2.5 x 12 mm shock wave IVL balloon was used and after dilatation to 4 atm. pressure serial shock waves (6x10 pulses) were delivered for the severely calcified RCA stenosis. This was followed by further dilatation and optimization of the artery using a 2.75x15 NC balloon, inflated at 16 atm. pressure. Next a 2.75x23 mm everolimuis-coated DES was used to stent mid RCA, inflated at 12 atm. pressure and another everolimuis-coated DES 3 x 28 mm was used in the proximal RCA. inflated at 12 atm. pressure, overlapping with the mid stent. Post dilatation of the stents was done using a 3.0 x 15 mm and 3.25 x 15 mm NC balloons for distal and proximal stents respectively at 16 atm. pressure. Immediate angiography showed excellent end result with TIMI 3 flow (Figure 4).

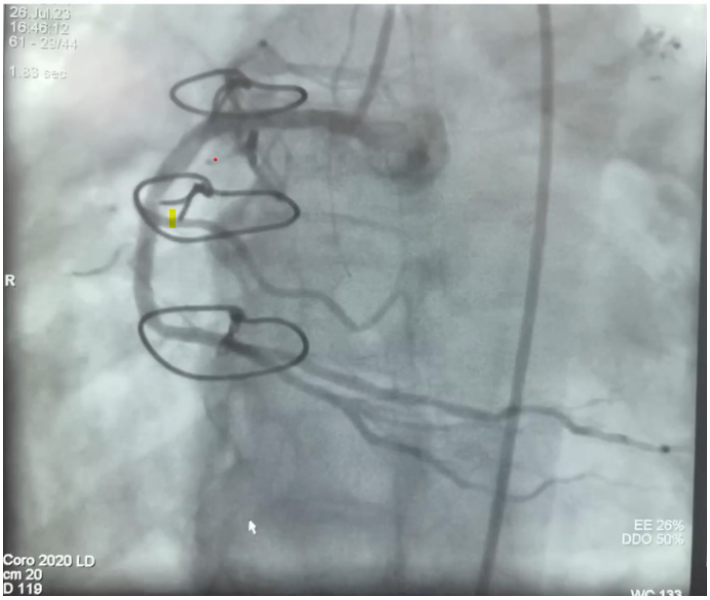

Figure 4: CAG after IVL and stent implantation in RCA, showing recanalized RCA with TIMI 3 flow

The patient was discharged home in a stable condition after 48 hrs. of stay in ICU. She continues to follow up with another hospital for her cancer treatment. CT CAG done after 6 months showed patent RCA with TIMI 3 flow. patient was discharged home in a stable condition after 48 hrs. of stay in ICU.

Discussion

This is the case of a 69-year-old female patient who was denied PCI in a previous hospital she had visited and was advised for CABG due to severely calcified RCA lesion, that could not be treated in the cath-lab.

The patient is a known case of chronic ischemic heart disease (CABG Status for LAD in 2004 and PCI for OM in 2006), and had refused for repeat CABG for RCA sub- occlusion. She is also a known case of DM T2, essential hypertension, dyslipidaemia. She also has been diagnosed with breast cancer and is currently being treated with chemotherapy in another hospital.

With all these risk factors and comorbidities, and the highly calcified RCA lesion, this patient represents a high risk for PCI using conventional balloon-based techniques.

Heavily calcified lesions may be difficult to dilate adequately with conventional balloons and stents, which causes frequent periprocedural complications and higher rates of Target Lesion Revascularization (TLR) [2].

High-pressure non-compliant (NC) balloon angioplasty may be of insufficient force to modify calcium and, even when successful, may be limited in its ability to modify the entire calcified lesion. Scoring and cutting balloons hold theoretical value but data to support their efficacy are lacking and, because of their high lesion crossing profile, they often fail to reach the target lesion. Rotational and orbital atherectomy target superficial calcium: however deep calcium, which may still impact on vessel expansion and luminal gain, is not affected.

Intravascular lithotripsy (IVL) is a new technology that delivers pulsatile sonic pressure waves converted to mechanical energy to modify vascular calcium IVL modifies calcific atherosclerotic lesions by inducing calcium fracture before stent deployment with the aim of facilitating drug-eluting stent (DES) expansion and apposition [2].

Imaging (IVUS and OCT) plays a crucial role in the diagnosis of calcified lesions, providing important information related to lesion characteristics. It also provides guiding in lesion preparation, stent implantation and assessment of post PCI result [7].

In our patient, after debulking procedure and lesion preparation with shock wave therapy (60 pulses were delivered), expansion with 1:1 NC balloon was performed, followed by stent implantation and post-dilatation, with a good end result and TIMI 3 flow.

Despite its success, IVL is not without its limitations and potential complications such as coronary artery perforation, dissection and the risk of arrythmias could occur. However, the relatively low incidences of these adverse events when compared to the high success rate of stent delivery and a significant reduction in restenosis underscores the safety and effectiveness of IVL as a therapeutic modality [9].

Disrupt CAD III represents the largest long - term (2 year) analysis of coronary IVL to date.

This study showed that IVL treatment prior to coronary stent implantation in severely calcified lesions was associated with low 1-year rates of MACE, TLR and stent thrombosis [5].

Conclusion

This case report highlights the efficacy of intravascular lithotripsy (IVL) or shock wave therapy in the management of highly calcified coronary artery lesions.

Intravascular lithotripsy (IVL) using shock waves is recommended in severely calcified, balloon-non-dilatable coronary artery lesions in patients with CAD and multiple risk factors and comorbidities.

Consent for Publication

Written informed consent for publication of the case report and any accompanying images was obtained from the patient.

Standard of Reporting

CARE guidelines were followed.

Availability of Data and Materials

The data supporting the findings of the article is available in the patient's electronic medical records at RAK Hospital, Ras al Khaimah.

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Author Contribution

Sokhrab Khorram is primarily responsible for communication with the journal during the manuscript submission, peer review and publication process. He has performed the Cath-lab intervention, and is the cardiologist-in charge of the patient during the OPD visit and hospital stay.

Akhil Jith is responsible for assisting during the intervention as a Cath-lab technician, providing the materials from the intervention for the article, helping in preparing the article for publication.

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