CASE REPORT

Successful dilatation of underexpanded stent with super-high-pressure balloon: A case report

Süper yüksek basınçlı balon ile yetersiz genişletilmiş stentin başarılı dilatasyonu: Olgu sunumu

Mesud Jamakovic, M.D.,[1] Kenana Aganovic, M.D.,[2] Edin Begic, M.D.[3]

[1]Department for Interventional Cardiology, Clinic for Heart, Blood Vessel and Rheumatic Diseases, Clinical Center University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[2]Intensive Care Unit, Clinic for Heart, Blood Vessel and Rheumatic Diseases, Clinical Center University of Sarajevo, Sarajevo, Bosnia and Herzegovina

[3]Department of Pharmacology, School of Medicine, Sarajevo School of Science and Technology, Sarajevo, Bosnia and Herzegovina

Summary– Dilatation and percutaneous coronary intervention in the presence of calcified lesions is particularly demanding and presents a challenge in the daily work of an interventional cardiologist. Coronary calcification is a marker of the progress of the atherosclerotic process. The existence of calcifying lesions predicts a poorer clinical outcome and is associated with increased mortality and the occurrence of postprocedural major adverse cardiovascular events (MACEs). A male patient who was 61 years old was admitted as a result of ST-elevation myocardial infarction (STEMI) complicated by cardiac arrest caused by in-stent thrombosis of a previously suboptimally expanded stent. The lesion did not respond to a dilation attempt with a non-compliant (NC) balloon; however, an optimal result was obtained with inflation from a super-high-pressure NC balloon (OPN NC) for ultra-high-pressure inflations. Resistant, calcified lesions require a careful and comprehensive approach. The OPN NC balloon has a place in the treatment of this type of lesion. An optimized therapeutic modality after the procedure is imperative to prevent a MACE.

Özet– Kalsifiye lezyonların dilatasyonu ve perkütan koroner girişimi girişimsel kardiyologların günlük pratiğinde sık karşılaştığı bir zorluktur. Koroner kalsifikasyon, aterosklerotik sürecin ilerlemesinin bir göstergesidir. Kalsifiye lezyonların varlığı, daha kötü klinik sonuçları öngörür ve artmış mortalite ve işlem sonrası majör olumsuz kardiyovasküler olaylar ile ilişkilidir. Altmış bir yaşındaki erkek hasta, daha önce suboptimal genişletilmiş stentte gelişen stent trombozunun neden olduğu kardiyak arrest ile komplike olan ST yükselmeli miyokart enfarktüsü (STYME) tanısı ile hastaneye kabul edildi. Lezyon, non-kompliyan (NC) balonların dilatasyonuna yanıt vermezken, süper yüksek basınçlı NC balonun (OPN NC) ultra yüksek basınçta şişirilmesiyle lezyonun dilatasyonunda optimum sonuç elde edilmiştir. Kalsifik, sert lezyonlara girişim kapsamlı ve dikkatli bir yaklaşım gerektirir. OPN NC balonları bu tip lezyonların tedavisinde yer edinmiştir. İşlemden sonra optimize edilmiş tıpsal tedavi de olumsuz kardiyovasküler olayların önlenmesi için vazgeçilmezdir.

Calcified lesions present a real challenge for the cardiologist during percutaneous coronary intervention (PCI). Calcification makes it more difficult to dilate the vessel and perform stent implantation.[1] The use of cutting and scoring balloons, atherectomy devices, and intravascular lithotripsy technology makes it easier to resolve the demands of this pathology.[1,2] Coronary calcification is a marker of the progress of the atherosclerotic process. Its existence predicts a poorer clinical outcome and is associated with increased mortality and the occurrence of postprocedural major adverse cardiovascular events (MACEs).[3] Suboptimal expansion of a coronary stent represents an etiological factor for in-stent thrombosis, myocardial infarction, and a potentially fatal outcome. Optimal lesion preparation

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Correspondence: Dr. Edin Begic. Kranjceviceva 90 Sarajevo - Bosnia and Herzegovina.
Tel: 0038761303375 e-mail: edinbegic90@gmail.com

is important to avoid these complications. Lesion preparation sometimes requires aggressive predilatation with noncompliant (NC) balloons, rotablation, or the use of newer methods. The aim of this article was to describe the therapeutic modality applied in the case of a 61-year-old male patient admitted with the clinical picture of ST-elevation myocardial infarction (STEMI).

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The patient was hospitalized in the intensive care unit at the University of Sarajevo Clinical Center due to severe chest pain radiating to both shoulders and subsequent sweating that had started 1 hour prior to arrival. An electrocardiogram performed at admission showed an acute inferoposterior myocardial infarction with ST segment elevation in leads II, III, and aVF, and ST segment depression in leads V2-V3.

Invasive coronary angiography due to stable angina pectoris had been performed 42 months earlier. At that time, a drug-eluting stent (DES) was implanted in the left anterior descending artery (LAD). After more than 3 years, he was admitted because of chest pain and invasive coronary angiography was indicated. Multivessel disease was confirmed with observation of a patent LAD, significant 80% stenosis in the proximal LAD, and 70% stenosis in the mid LAD. There was also 50% stenosis of the mid left circumflex artery and 60% stenosis of the proximal right coronary ar-

Abbreviations:

CPR	*Cardiopulmonary resuscitation*
DES	*Drug-eluting stent*
LAD	*Left anterior descending artery*
MACE	*Major adverse cardiovascular event*
NC	*Noncompliant*
pPCI	*Primary PCI*
PCI	*Percutaneous coronary intervention*
RCA	*Right coronary artery*
STEMI	*ST-elevation myocardial infarction*
TIMI	*Thrombolysis in Myocardial Infarction*

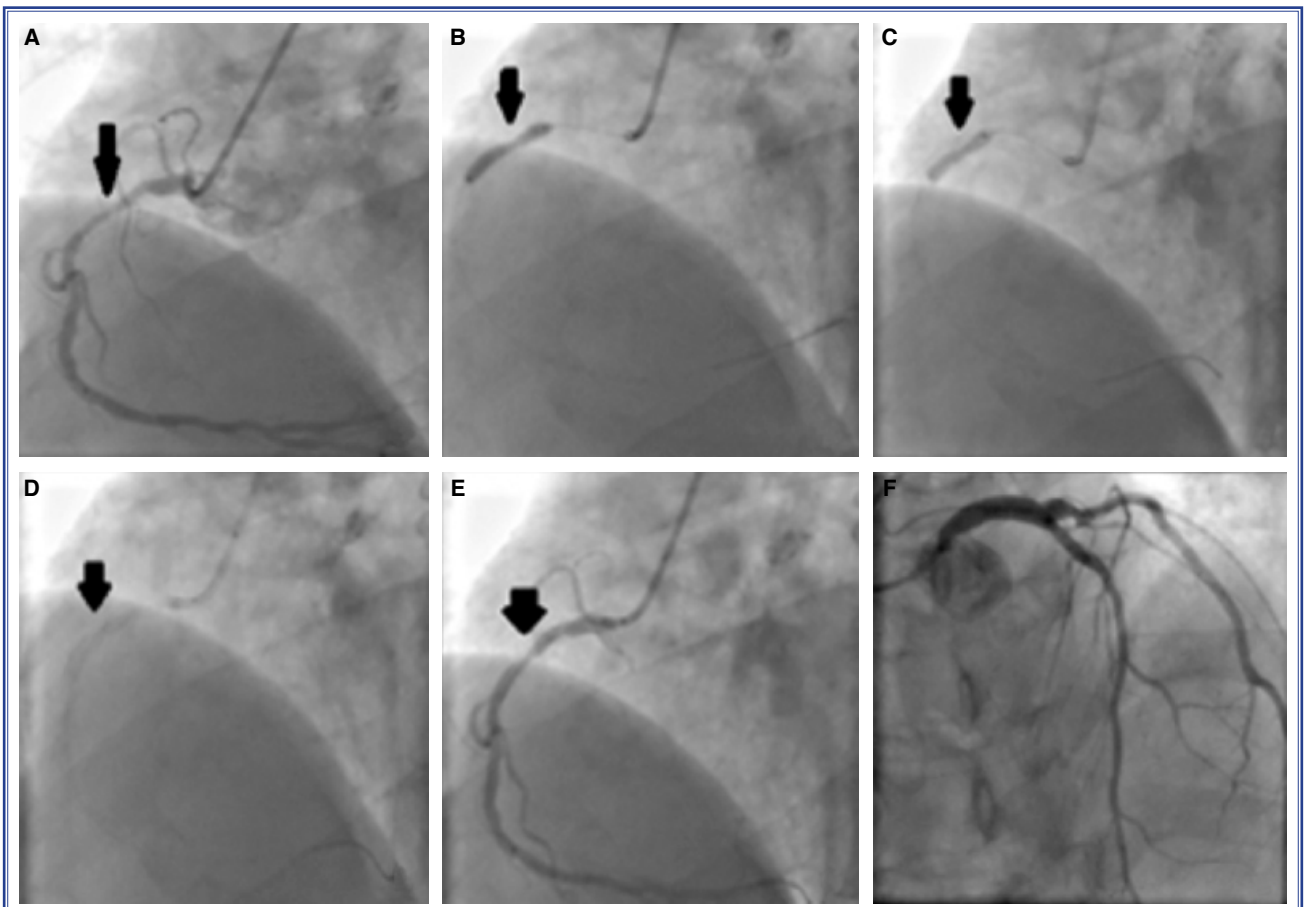

Figure 1. **(A)** Coronary angiography revealed significant stenosis of the proximal segment of the right coronary artery; **(B)** Implantation of the drug-eluting stent (3.0x22 mm) with suboptimal expansion; **(C)** Suboptimal expansion of the noncompliant balloon (3.5x20 mm); **(D)** Suboptimal expansion of the stent; **(E)** Suboptimal expansion of the stent and final result; **(F)** Final angiographic result of the left coronary system.

tery (RCA) (Fig. 1). During the same procedure, PCI of the LAD was performed and 2 additional DESs were implanted in the proximal and mid LAD with a good angiographic result.

Two months later, the patient was admitted again with chest pain. Coronary angiography was repeated, and PCI of RCA was indicated. A DES (3.0x22 mm) was implanted in the proximal RCA using inflation of 18 atm with suboptimal stent expansion in the middle section due to severe calcification of that part of the vessel (Fig. 1). Additional postdilation was performed using a 3.5x20 mm NC balloon (Fig. 1), but without effect; there was significant residual stenosis of 60% (Fig. 1). During the coronary angiography, predilation of the RCA was not performed and the operator's assessment was that the lesion was suitable for direct stenting, which was accomplished. A Thrombolysis in Myocardial Infarction (TIMI) 3 flow score was regularly verified and the patient was discharged 2 days later with the standard medication recommendations, including acetylsalicylic acid and clopidogrel. At a control examination 1 month after the last PCI, the patient had no significant complaints, with stable angina scored as Canadian Cardiovascular Society grading scale class I. Dual antiaggregation therapy (aspirin, clopidogrel) and angiotensin-converting-enzyme inhibitor, beta blocker, glyceryl trinitrate, diuretic, and high-intensity statin therapy were prescribed.

Seven weeks after the PCI of the RCA, the patient was readmitted with STEMI as described above. The patient once again underwent invasive coronary angiography. At admission, patient was conscious, with a blood pressure of 110/60 mmHg and a heart rate of 65/bpm. As premedication, clopidogrel 300 mg and aspirin 300 mg were administered along with unfractionated heparin 100 IU/kg and he was sent to the catheterization lab with the intention of performing a primary PCI (pPCI). During the preparation for the pPCI,

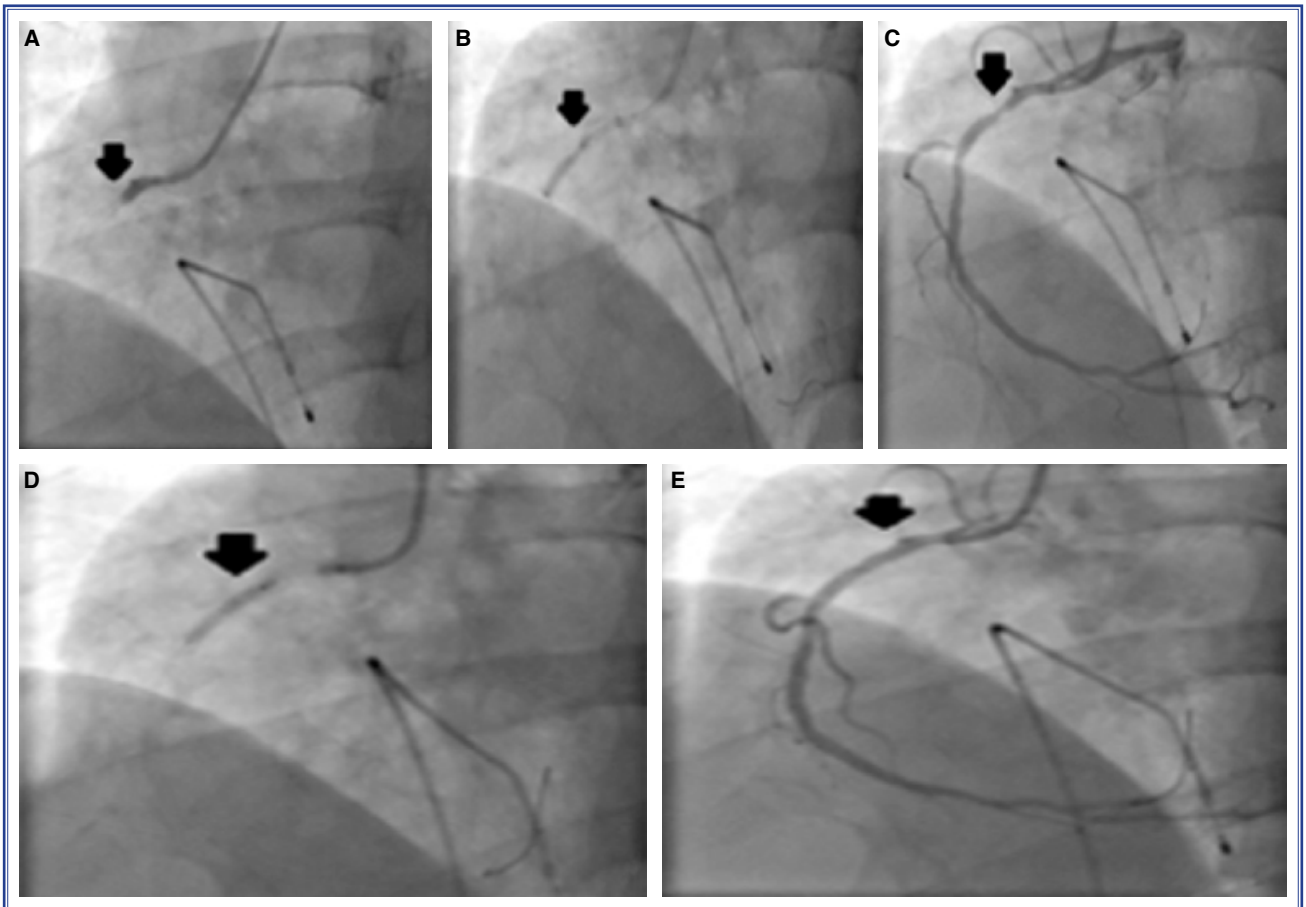

Figure 2. **(A)** Acute occlusion of the stent at the site of the residual stenosis; **(B)** Predilatation with the noncompliant balloon (2.5x15 mm, 26 atm); **(C)** Residual stenosis after predilatation; **(D)** Fully expanded super-high-pressure noncompliant balloon (2.5x15 mm, 40 atm); **(E)** Final result with optimally expanded stent and Thrombolysis in Myocardial Infarction 3 flow.

however, the patient suffered cardiac arrest. Immediate cardiopulmonary resuscitation (CPR) was commenced with comprehensive drug support (adrenaline, amiodarone, oxygen therapy). The patient was placed on mechanical ventilation and more than 10 defibrillations with 200J and 300J were applied due to repeated ventricular fibrillation. Finally, after 40 minutes of CPR, a spontaneous heart rhythm was obtained. The patient was treated with atropine, noradrenaline, 1000 mL 0.9% sodium chloride, and 60 mL of sodium bicarbonate. A temporary transvenous cardiac pacemaker was implanted via the right femoral vein. Coronary angiography was performed using the right femoral artery access and acute occlusion of the stent in the RCA was confirmed (Fig. 2). After a few attempts, a balance middleweight guidewire was passed through the occlusion and the tip of the wire was positioned in the distal part of the RCA. Predilation was achieved with a 2.5x15 mm NC balloon with inflation up to 26 atm, and a TIMI 3 flow throughout the RCA was established despite significant residual stenosis in the proximal part of the RCA (suboptimal expansion of the previously implanted stent) (Fig. 2). An intracoronary injection of tirofiban was given (500 mcg) and maintained with intravenous administration according to the standard technique. A super-high-pressure NC balloon (OPN NC Super High Pressure Balloon; SIS Medical AG, Frauenfeld, Switzerland) 2.5x15 mm in size was positioned at the site of the stenosis and inflated to the maximum recommended inflation pressure of 35 atm (SIS Medical inflation device; SIS Medical AG, Frauenfeld, Switzerland), but without result. The OPN NC balloon was then inflated to the supramaximal pressure of 40 atm and the stent was optimally expanded after 15 seconds (Fig. 2). The procedure was completed successfully. A loading dose of 60 mg of prasugrel was administered via the nasogastric tube. After the procedure, the patient remained stable, and was awakened and extubated a few hours later. The sheath from the right femoral artery as well as the temporary pacemaker were removed 6 hours after the tirofiban administration. The patient fully recovered during hospitalization, was without neurological deficit, and was discharged home 7 days after the procedure.

DISCUSSION

Calcified, resistant lesions present demanding circumstances for interventional cardiologists, especially during acute myocardial infarction. Balloon dilation appears to be essential to allow successful stent implantation in calcified coronary lesions.[3] Suboptimal expansion of the coronary stent presents great potential for in-stent thrombosis leading to myocardial infarction and a potentially fatal outcome. Optimal lesion preparation is important to diminish the chance of these complications. Lesion preparation sometimes requires aggressive predilation with NC balloons or rotablation. Newer methods (laser atherectomy, shock wave lithotripsy) are also increasingly used.[4–6] Previously implanted and suboptimally expanded stents are an undesirable medium for rotablation or other complementary methods. An OPN NC balloon is a valuable option for some undilatable lesions in cases where classic NC balloons have failed. This can be lifesaving, especially in catheterization labs with limited infrastructure. There are a few reports of OPN balloons having been inflated to a pressure greater than that recommended by the manufacturer, even to 50 atm, without serious complications.[7–9] However, extreme pressure loading of balloons could result in balloon rupture followed eventually by rupture of the coronary vessel. A covered stent should be always ready, especially when the maximum recommended pressure is exceeded. As in our case, an OPN balloon with a slightly lower profile than the vessel diameter can be used before aggressive dilatation with a full-size balloon to minimize the possibility of coronary perforation. Calcified lesions are a challenge for the cardiologist and require a careful and comprehensive approach. Implementation of an optimized therapeutic modality after the procedure is imperative.

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Anahtar sözcükler: Stent içi tromboz; OPN balonu; STEMI; yetersiz stent genişlemesi.