



## Stent dislodgement in the distal left main coronary artery and its successful management with balloon crushing technique

Zaglavljivanje stenta u distalnom segmentu glavnog stabla leve koronarne arterije i uspešno rešavanje tehnikom gnječenja balonom

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### Abstract

**Introduction.** Stent entrapment and dislodgement in the coronary arteries is a rare but potentially fatal complication of percutaneous coronary intervention. Different retrieval techniques of dislodged stents have previously been reported with high success rate but all of them are time-consuming, so as not quite useful in hemodynamically unstable patient. **Case report.** A 59-year old female patient with acute ST-elevation myocardial infarction of anterior wall was admitted for primary percutaneous coronary intervention. Unexpectedly, during intervention stent entrapment and dislodgement in the distal left main coronary artery occurred followed by occlusive coronary dissection and compromisation of the coronary flow in the left descending coronary artery with a rapid hemodynamic deterioration. In order to reestablish coronary flow as soon as possible, the dislodged unexpanded stent was crushed against the wall with a balloon in the distal left main. It immediately restored coronary flow in the left descending coronary artery and rapidly improved the patients hemodynamics. Intervention was successfully completed with totally four stents implanted in the left main, the ostio-proximal circumflex coronary artery and the ostio-proximal left descending coronary artery. Later post-interventional hospital course as well as the clinical and angiographic six month follow-up was uneventful. **Conclusion.** This case shows that percutaneous balloon crushing technique can be a safe and effective first option in management of dislodged and unexpanded stent in the left main coronary artery, particularly for a hemodynamically unstable patient.

### Key words:

coronary artery disease; angioplasty, transluminal, percutaneous coronary; stents; treatment outcome.

### Apstrakt

**Uvod.** Zaglavljivanje i zadržavanje stenta u koronarnim arterijama veoma je retka ali potencijalno fatalna komplikacija perkutanih koronarnih intervencija. Različite tehnike izvlačenja zaglavljene stenta prikazane su do sada sa visokim stepenom uspešnosti, ali sve zahtevaju dosta vremena za izvođenje, zbog čega nisu najpogodnije kada je bolesnik hemodinamski nestabilan. **Prikaz bolesnika.** Bolesnica, stara 59 godina, sa akutnim anteriornim infarktom miokarda sa ST elevacijom, primljena je radi primarne perkutane koronarne intervencije. Neočekivano, tokom intervencije, došlo je do zaglavljivanja i zadržavanja stenta u distalnom segmentu glavnog stabla leve koronarne arterije, uz okluzivnu disekciju i kompromitovanje koronarnog protoka u levoj descendentnoj koronarnoj arteriji, praćeno brzim pogoršanjem hemodinamskog statusa. U cilju što bržeg uspostavljanja koronarnog protoka u levoj descendentnoj koronarnoj arteriji, učinjeno je gnječenje zaglavljene i neekspandiranog stenta balonom uz zid distalnog segmenta glavnog stabla. Ovim je odmah uspostavljen koronarni protok u levoj descendentnoj koronarnoj arteriji, što je bilo praćeno i brзом stabilizacijom hemodinamskog statusa. Intervencija je zatim uspešno završena sa ukupno četiri stenta implantirana na glavno stablo, ostioproksimalnom segmentu cirkumfleksne koronarne arterije i ostioproksimalnom segmentu leve descendentne koronarne arterije. Postinterventni bolnički tok, kao i šestomesečna klinička i angiografska kontrola bili su uredni. **Zaključak.** Ovaj prikaz pokazuje da perkutana tehnika gnječenja balonom može biti bezbedna i efikasna prva opcija za rešavanje komplikacije zaglavljene i neekspandiranog stenta u glavnom stablu leve koronarne arterije, posebno kod hemodinamski nestabilnog bolesnika.

### Ključne reči:

koronarna bolest; angioplastika, translumenska, perkutana, koronarna; stentovi; lečenje, ishod.

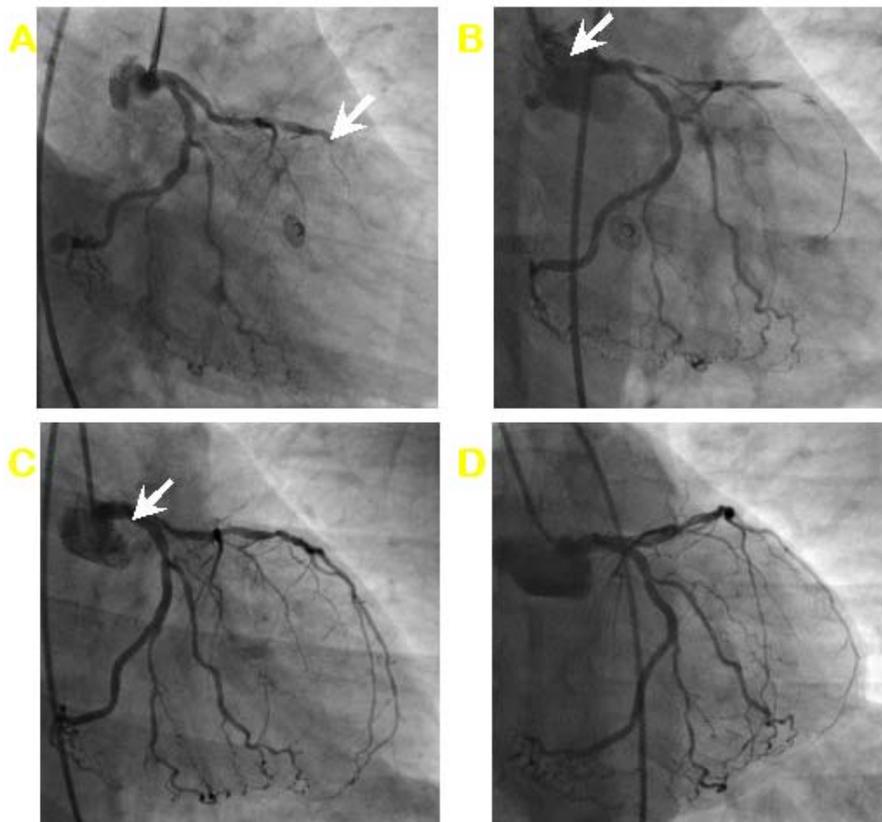
## Introduction

Stent entrapment and dislodgment in the coronary arteries is a rare but life-threatening complication of percutaneous coronary intervention (PCI), occurring with the incidence of 0.02%<sup>1</sup>. It may cause coronary or systemic embolisation, thrombus formation, myocardial infarction, and eventually death<sup>2</sup>.

Different retrieval techniques of dislodged stents have previously been reported which include the use of balloon catheters, basket devices, loop snares, twisted wires, etc, with a high success rate<sup>3</sup>. In emergency cases when time is crucial and because percutaneous retrieval is a time-consuming procedure, the crushing of an entrapped and dislodged stent against the wall has been proposed as alternative option<sup>4</sup>. However, the crushing technique in the treatment of dislodged stent in the left main still has not been widely accepted due to the increased risk of stent thrombosis and restenosis. Finally, a surgical removal of a dis-

lodged stent should be the last option in case when percutaneous treatment fails<sup>5</sup>.

with ST-segment elevation (STEMI) of anteroseptal localization, six hours after the chest pain onset. She was a smoker and diabetic, and reported previous treatment for high blood pressure and dyslipidaemia. An electrocardiogram at admittance showed the sinus rhythm with Q-waves and persistent ST-elevation in the leads V2-V6. Physical examination showed hypotension 95/75 mmHg and pulmonary congestion (Killip class II). A bedside transthoracic echocardiography revealed akinesis of the distal half of anterior wall, anterior septum and apex of the left ventricle, with severely depressed global systolic function (left ventricular ejection fraction 35%) and mild ischaemic mitral regurgitation (MR) 1-2+. She was immediately referred to the Cardiac Catheterization Laboratory for primary angioplasty. Her coronary angiogram revealed thrombotic occlusion of the medial left anterior descending coronary artery (LAD), whereas the dominant circumflex coronary artery (CX), the obtuse marginal (OM) branch and the right coronary artery (RCA) were without significant disease (Figure 1A).



**Fig. 1 – Angiographic images: A) Thrombotic occlusion in the medial left descending coronary artery (LAD) (arrow); B) Entrapped stent in the distal left main and proximal LAD (arrow) with occlusive dissection in the proximal LAD; C) Final positive angiographic result after successful management of the complication; D) Control coronary angiogram after six months with only insignificant diffuse in-stent restenosis.**

lodged stent should be the last option in case when percutaneous treatment fails<sup>5</sup>.

## Case report

A 59-year-old female patient was admitted to our hospital with the symptoms and signs of acute myocardial infarction

After a bolus of heparin (100 IU/kg), left coronary system was engaged with EBU 3.5–6 Fr guiding catheter and coronary wire BMW was advanced through the thrombotic occlusion and placed in the distal segment of LAD. Several balloon predilatations (Sprinter Legend 2.0 × 15 mm at 16 atmosphere) in the mid LAD restored the TIMI-III flow, but created a non-occlusive dissection type B in the medial segment of LAD

proximally to the culprit lesion. A Micro-Driver bare metal stent  $2.5 \times 20$  mm was deployed over the culprit lesion in the mid LAD, but the dissection was not fully covered. Another stent Micro-Driver  $2.5 \times 20$  mm was advanced but it could not be overlapped with the previous one, so we decided to pull it back and perform additional predilatation. However, during pull-back resistance was felt in the ostial LAD, and eventually the whole system consisting of the guiding catheter, wire and stent was completely stucked and could not be further manipulated (Figure 1B). The patient complained on intense chest pain and suddenly developed severe bradycardia (30 beats *per* minute) with a drop in blood pressure to 60/40 mmHg. As we could not pull back the stent-balloon system which was stucked with the guiding catheter and the wire, we decided to forcefully and rapidly pull out the whole system, e.g. stent-balloon together with the wire and the guiding catheter. It was followed immediately by application of atropine and saline infusion which resulted in hemodynamic stabilization of the patient. However, the stent was dislodged and lost in the distal left main and ostial LAD, with angiographic signs of occlusive coronary dissection in the proximal LAD. Immediately, we introduced a new guiding catheter EBU 3.5–7 Fr, and rewired LAD with a new BMW wire. Subsequently, balloon Sprinter Legend  $2.5 \times 15$  mm was advanced in the distal LAD, confirming that a wire was not between the stent struts, and thereafter the dislodged stent was crushed against the wall in the distal left main and ostioproximal LAD with the same balloon, inflating it up to 16 atmosphere. This resulted in a rapid blood flow restoration in LAD (TIMI-III), though there was some plaque shifting in the ostial CX. We performed also additional predilatation in the medial LAD with the same balloon. Stent MicroDriver  $2.5 \times 20$  mm was overlapped with the previously implanted stent in the medial LAD, covering the dissection at the same time. Another coronary wire BMW was advanced in the distal CX. Over the crushed stent in the distal left main and ostioproximal LAD additional stent Driver  $3.0 \times 26$  mm was deployed, as well as over the ostial CX stent Driver  $3.0 \times 15$  mm, with final balloon kissing. The final angiographic result (Figure 1C) was optimal with uneventful later in-hospital course. The patient was discharged on the sixth day.

A follow-up during the next six months showed good patient health with the absence of ischemic symptoms. Coronary angiography was performed after six months which showed only a non-significant diffuse in-stent restenosis (Figure 1D).

## Discussion

The incidence of stent entrapment and dislodgement during PCI has significantly decreased over the last twenty years, from 8.3% to currently 0.02%<sup>1</sup>. This is largely due to improvements in stent design, such as the use of factory premounted stents instead of previous manually crimped stents<sup>6</sup>. However, having in mind that stents are used in contemporary practice in more than 98% of PCIs, along with increasingly complex interventions, this serious and

potentially fatal complication of PCI will stay an important issue in interventional cardiology.

Stent entrapment and dislodgement in the left main coronary artery is an extremely rare but a serious and life-threatening complication which may produce hemodynamic instability, intracoronary thrombosis, stent embolization, myocardial infarction and sudden death.

According to the literature data, the most common cause of stent entrapment and dislodgement during PCI was attempt to deliver a stent though a previously deployed stent and pull-back<sup>7</sup>. Other common causes include poor support of the guiding catheter, vessel tortuosity and sharp angle proximal to the lesion, as well as severe vessel calcifications and use of longer stents<sup>8</sup>. In our case, there was a combination almost all of previously mentioned causes such as sharp angle of ostial LAD with tortuosity of proximal segment, poor and inadequate preparation of a calcified lesion in the medial LAD, previously implanted stent, and finally a longer stent. Probably, the most important causes of stent loss in our case were poor predilatation of the calcified lesion in the mid LAD and a sharp angle between the left main and ostial LAD.

Management of stent dislodgement in the coronary arteries depends on several issues. The most important issue is hemodynamic state of the patient as well as the coronary flow in the vessel with entrapped and unexpanded stent. If the patient is hemodynamically unstable with compromisation of the coronary flow, as in reported case, it is crucial to stabilize the hemodynamics first and promptly reestablish the coronary flow. Furthermore, in certain cases stent entrapment may be followed by getting stuck of the whole system of guiding catheter, stent-balloon and the wire, as happened in our case. In this situation, manipulation with the stent-balloon system can be completely blocked, caused by an entrapped stent within the angulated segment of the coronary artery, as in our case the stent was entrapped within the angle of the distal left main and ostial LAD. So, in this situation the only way to go further with the procedure was to forcefully pull back the whole system of the guiding catheter with the stucked stent-balloon and the wire. Although it led to the loss of the wire from the distal segment of LAD and it potentially could have further compromised the coronary flow, it seemed as the best management option in a hemodynamic unstable patient. Furthermore, the next step in the emergent management was to restore the coronary flow as quickly as possible, with the most simple and fastest way, which was balloon crushing technique. However in these settings, before crushing an unexpanded and dislodged stent, it is necessary to make sure that the guide wire is outside of the stent to be crushed, in order to prevent entrapment of the wire. So before crushing the stent, one should pass a balloon distally to the stent and withdrawing partially inflated balloon indicating that the wire did not pass though the stent struts. Then a procedure of crushing the unexpanded stent against the wall can be safely deployed, as we showed. However, this technique has not been widely accepted for the left main and proximal LAD because it may pose later an increased

risk for both stent thrombosis and restenosis due to excess metal layer<sup>9</sup>.

For hemodynamically stable patients, the first option would definitely not be the balloon crushing technique, but the percutaneous retrieval of entrapped stent. Several techniques for retrieval of entrapped unexpanded stents from the coronary artery have been previously described with the success rate as of 86%, but all of them are time-consuming<sup>1-3</sup>, so as not suitable for hemodynamically unstable patients. The most simple and most commonly used is low-profile balloon inflation up to 4–6 atmospheres within an unexpanded stent or distally to the lost stent<sup>10</sup>. Deployment of other techniques depend on operators experience and skills as well as locally available equipment, and it may include the use of myocardial biopsy or biliary forceps, two twisted guide wires, basket devices, loop snares and other devices<sup>11</sup>.

Surgical intervention should be definitively the last option for the removal of entrapped stent<sup>12</sup>, so as before transferring a patient to the surgery all alternative percutaneous options should be attempted cautiously and in consultation

with the senior and more experienced interventional cardiologist, including different attempts for percutaneous removal or balloon crushing technique.

Finally, the management of entrapped and dislodged stent in the coronary arteries includes also the full heparinization of a patient in order to prevent thrombus formation around an undeployed stent<sup>1</sup>.

### Conclusion

The presented case demonstrated that balloon crushing of entrapped and dislodged stent in the distal left main and ostial left anterior descending coronary artery in a hemodynamically unstable patient is a feasible, safe and effective option for management of this life-threatening complication. Interventionalists should always keep in mind that angulated and tortuous segments of the coronary arteries as well as the heavily calcified lesions may reduce the possibility and success of stenting. Every effort should be made to prepare lesions adequately and to avoid stenting of extremely angulated and tortuous vessels in order to prevent possible complications such as entrapment, dislodgement and loss of a stent.

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