Double stent loss during multivessel percutaneous coronary intervention in non-ST-segment elevation acute coronary syndrome

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Abstract

The following description presents a case of a 75-year-old female patient with non-ST-segment elevation acute coronary syndrome in whom there occurred an infrequent complication of percutaneous coronary angioplasty: uncontrolled intracoronary stent displacement from a balloon catheter. During the attempt to retrieve the device using the "small-balloon" technique, further slippage of the stent from the balloon catheter to the right deep femoral artery was observed. Therefore, it was decided to provide a commercial intravascular microloop, whereby the stent was successfully retrieved outside the vascular system.

Key words: acute coronary syndromes/non-ST elevation myocardial infarction, percutaneous coronary intervention, stent fracture/failure.

Introduction

Coronary artery stents revolutionized the practice of interventional cardiology after they were first introduced in the mid-1980s [1]. Since then, there have been significant developments in their design, the most notable of which has been the introduction of drug-eluting stents. However, despite the continuous technological progress and safety improvements, the implementation of invasive treatment still remains associated with the occurrence of various types of periprocedural complications which may cause worse outcomes [2]. One of the possible life-threatening complications of percutaneous coronary intervention (PCI) is uncontrolled stent loss within the coronary or peripheral arteries [3–14]. Such a situation may result in intracoronary or peripheral embolization and lead to occurrence of myocardial, lower limb, brain and other organs ischemia. Since the device loss is currently an infrequent complication, there is no clear algorithm for management of such situations.

Case study

A 75-year-old female patient with chronic stable angina was admitted to the clinic due to exacerbation of anginal pain at rest with a typical radiation to the left arm (class IV of the CCS). The patient's medical history showed the following cardiovascular risk factors: 10-year history of treated hypertension, status after conservatively treated myocardial infarction (1989) and family history of coronary artery disease. At admission to the clinic sinus rhythm (70 bpm) and elevated blood pressure (145/85 mm Hg) were observed. There were no further significant deviations in the physical examination. The electrocardiogram (ECG) revealed the presence of pathological Q waves in leads I and aVL, inverted T waves in II, III, aVF, V1–V6, and horizontal ST segment depressions in V3–V5. In transthoracic echocardiography examination normal diameters of heart cavities, correct global contractility, preserved ejection fraction (50%) with impaired left ventricular diastolic function and mild aortic regur-

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gitation were demonstrated. There was also visualized a small area of regional wall motion abnormalities including the basal segments of the intraventricular septum and inferior wall. Laboratory tests showed normal levels of myocardial necrosis biomarkers. Normocytic anemia and increased levels of leukocytes were demonstrated.

Due to the overall clinical image and the additional test results, the patient was diagnosed with unstable angina and qualified for further invasive diagnostics. Performed with the right femoral access, selective coronary angiography revealed the presence of multivessel coronary artery disease with hemodynamically significant stenoses in the medial segment of the right coronary artery (RCA; diameter stenosis, DS 70%) and the distal segment of the left anterior descending artery (LAD; DS 80%; Figure 1). Analysis of the angiographic image and clinical data led us to consider that the lesion responsible for the manifestation of non-ST elevation acute coronary syndromes (NSTE-ACS) was stenosis in the RCA. Therefore, a bare metal stent (Multi-Link 8 Abbott Vascular, 3.50/18 mm, 16 atm) was implanted into the significant lesion in the medial segment of the RCA using the "direct stenting" method. The final result was deemed satisfactory with Thrombolysis In Myocardial Infarction (TIMI) flow 3 and the fully expanded stent. Regarding the presence of hemodynamically significant narrowing in the distal LAD, the decision to conduct angioplasty of this vessel was taken. Because of strong intramural calcification within the lesion, triple balloon predilatation was performed (balloons: 2.00/12 mm, 12 atm and 2.50/12 mm, 14 atm, Figure 2 A). During the attempt to implant an everolimus-eluting stent (Xience Abbott Vascular, 2.50/15 mm) while passing through the calcified stenosis, it slipped off the balloon catheter and displaced to the bifurcation of the LAD and left main coronary artery (LM) (Figure 2 B). Through the entrapment location an additional guidewire and then balloon catheter were placed. After balloon expansion to the pressure of 4 atm, the stent with the whole system was evacuated from the LM/LAD bifurcation into the aorta (Figure 3). During the attempt to retrieve the device, a further procedure complication was observed. The stent slipped off the balloon catheter again and moved to the right deep femoral artery (Figure 4 A). Therefore, it was decided to perform the contralateral femoral access and provide a commercial intravascular microloop (Amplatz Goose Neck EV3), whereby the stent was successfully retrieved outside the vascular system (Figure 4 B).

To manage the lesion in the distal segment of the LAD, another everolimus-eluting stent was used (Xience Abbott Vascular, 2.5/15 mm, 16 atm). In the control angiography, correct location of the stent with an optimal angiographic effect and TIMI 3 flow were imaged. Physical condition and control diagnostic tests did not show any signs of myocardial or peripheral ischemia. The later course in the hospital was uneventful and the patient was discharged in a stable condition on day 6 of hospitalization.

Discussion

In the case report of a patient with NSTE-ACS there was presented an infrequent but potential life-threatening complication of invasive treatment which is uncontrolled stent loss within the coronary arteries. In previous reports, there may be observed significant variability in the occur-

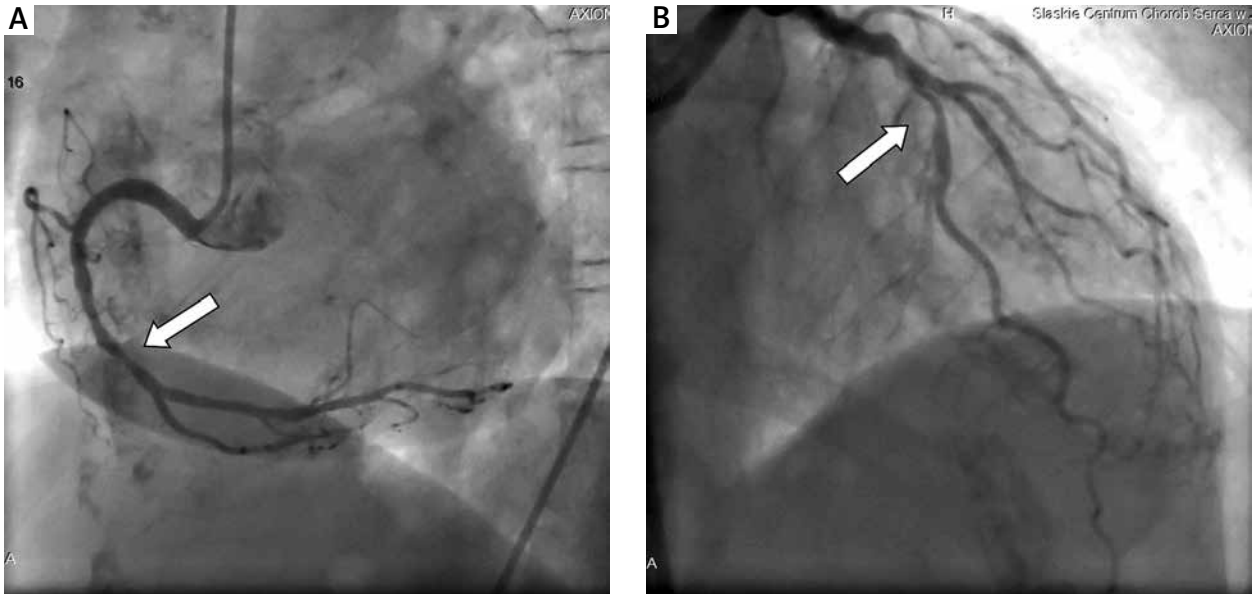

Figure 1. Coronary angiography of presented patient: hemodynamically significant stenoses in the medial segment of the right coronary artery (**A**) and the distal segment of the left anterior descending artery (**B**)

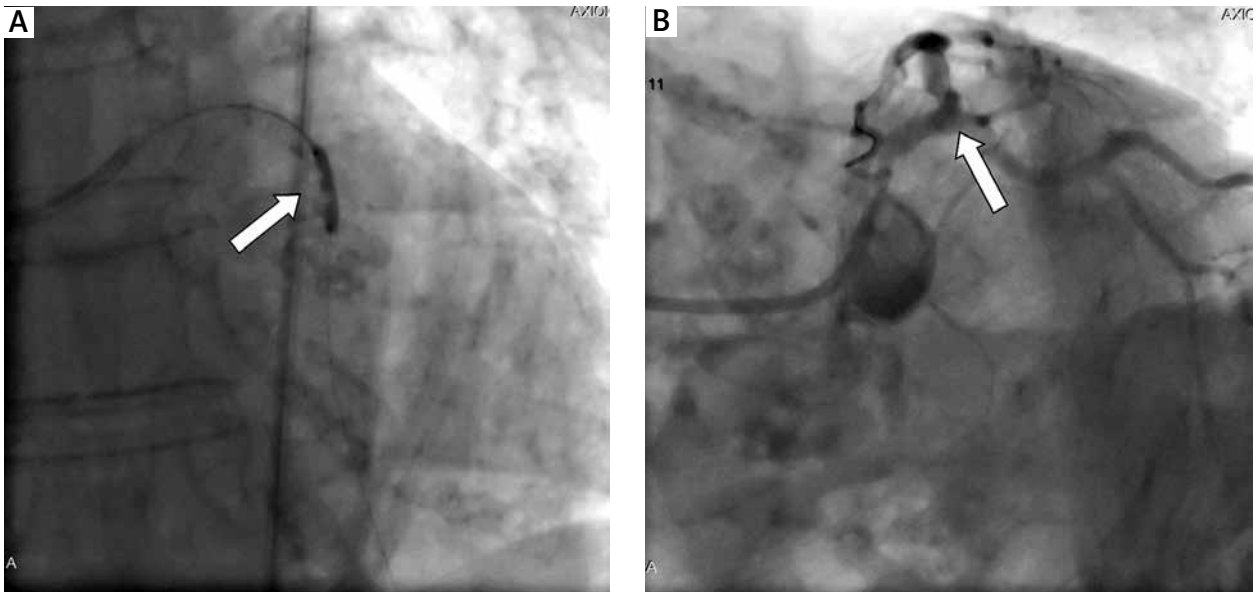

Figure 2. Balloon predilatation of the significant stenosis in the distal segment of the left anterior descending artery (**A**). Displaced stent in the bifurcation of the left anterior descending artery and left main coronary artery (**B**)

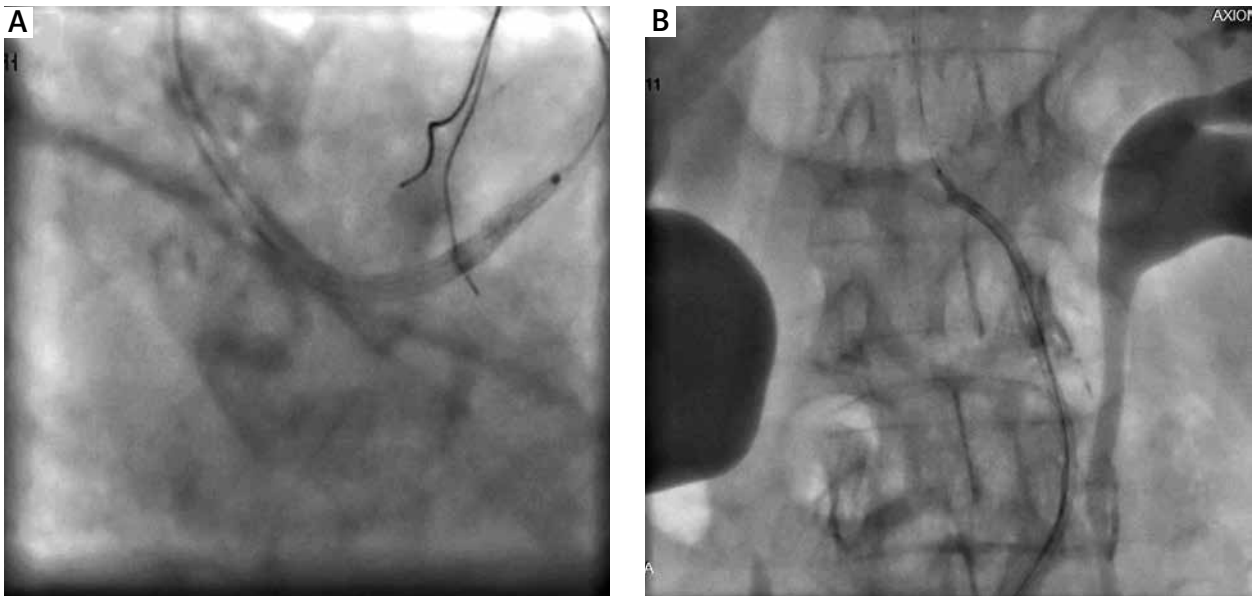

Figure 3. Retrieval of displaced stent with use of the "small balloon" technique from the coronary artery system (**A**) and then through the aorta (**B**)

rence of device loss during the PCI procedure ranging from 0.21% to 8.30% with a pooled estimate of 1.3% [3–14]. The reasons for these differences may be found in the number of analyzed groups, the use of various types of stents (i.e. previous use of stents manually crimped on the intracoronary balloons) and experience of the centers participating in the individual studies. It is also worth noting that the incidence of such complications has a downward trend in recent years (5.3% in studies published between 1991 and 1999 to 0.38% in studies published between 2005 and 2012), mainly due to the improvement of the devices' properties, stent delivery systems and stenting techniques [12–14]. The most common factors contributing to stent loss during PCI are: complex morphology of stenosis including the presence of intramural calcifications, vessel tortuosity, failed stent retraction into the guide catheter, an attempt to pass by a previously stented lesion, the type of stent and use of the "direct stenting" technique. It was demonstrated that appropriate preparation of a complex atherosclerotic lesion (balloon predilatation, atherectomy, etc.) enables one to optimize the effect of stenting and reduces the occurrence of this kind of periprocedural com-

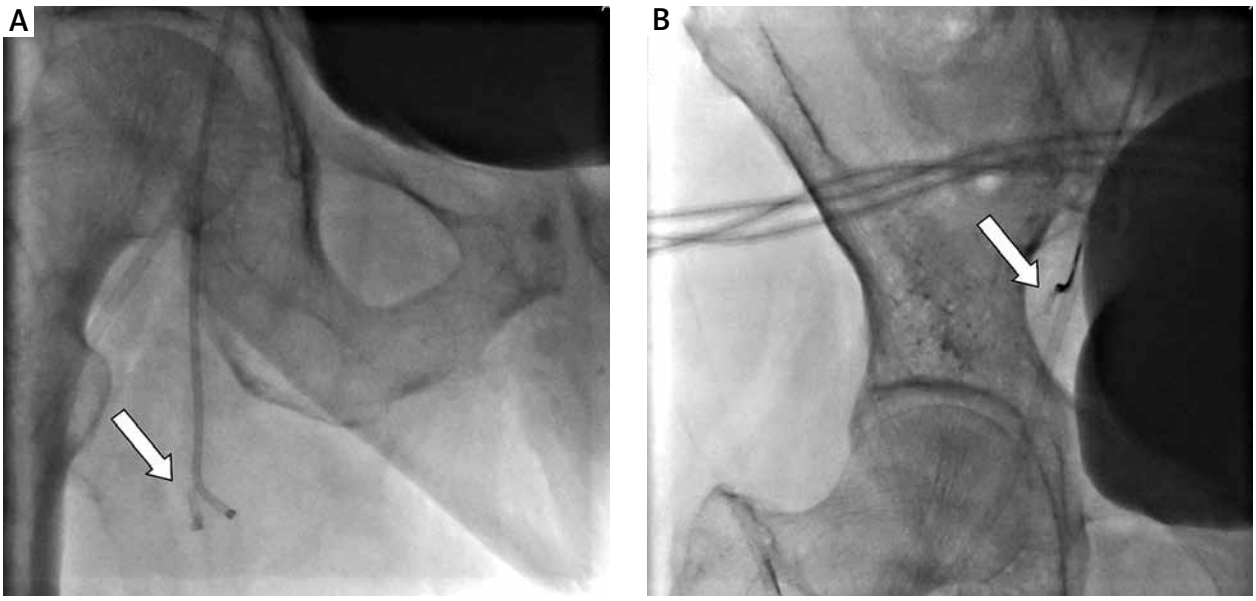

Figure 4. Subsequent displacement of the stent to the right deep femoral artery (**A**) and its removal using an intravascular microloop for removing foreign bodies from the vascular system (**B**)

plications [10]. Moreover, it appears that in case of the necessity to use more than one stent, implantation distally to proximally allows one to reduce the risk of stent loss, but in some situations the use of this method may not be possible.

Clinical symptoms and prognosis after stent loss depend mainly on the location of the displaced stent and the possibility of its retrieval from the vascular system. Bolte *et al*. analyzed the data of 387 patients in which there occurred 411 stent losses (185 in the coronary arteries, 224 in the peripheral arteries) [7]. In the stent loss group compared to patients in whom there have been no such complications, significantly higher incidence of non-fatal myocardial infarction (6.4% vs. 1.7%; $p < 0.001$) and in-hospital mortality (6.2% vs. 1.2%; $p < 0.001$) was noted. It is also noteworthy that the percentage of myocardial infarction (14.8% vs. 5.4%; $p < 0.001$) and mortality (17.0% vs. 4.2%; $p < 0.001$) was the highest in the case of unsuccessful attempts to retrieve the stent in comparison to patients in whom it was successful. Furthermore, in patients with stent loss during PCI there was more frequent need for emergency cardiac surgery. In the group with extracoronary stent displacement, except for one case of transient ischemic attack, there was no occurrence of stroke, kidney or other peripheral organ ischemia. In the meta-analysis by Alomar *et al.* including 919 patients with stent loss, the rate of in-hospital major adverse cardiovascular events was approximately 17% [14]. The most common events in this group were emergency cardiac surgery with a pooled estimate rate of 9.4%, mortality with 5.8% and myocardial infarction with 5.1%.

Regarding the quoted data, it is worth considering if in each case of stent loss we should attempt to evacuate it from the cardiovascular system. Bolte *et al*. suggest that because of the high rate of adverse cardiovascular events among patients with an intracoronary stent displacement, every effort to retrieve it should be made, and when this is not possible, it should be evacuated at least to the aorta [7]. On the other hand, due to low incidence of the described complication and consequently limited data, it seems advisable that the decision about further management should be taken on an individual basis. Similarly to frequency of device loss, efficacy of successful retrieval of them from the cardiovascular system in previous studies has an extreme variability (45–100%), which is dependent on the clinical and angiographic condition of the patient, location and type of the stent, operator and center experience, availability of retrieving devices and cardiosurgery support [3–14]. However, recent analyses indicate that the majority of lost stents can be successfully evacuated using invasive methods [12–14]. There are several techniques by which, according to the circumstances and location of the displaced stent, an attempt of percutaneous retrieval can be performed. One of them, which can be utilized when the dislodged stent remains on the guidewire, is the "small-balloon" technique [6]. The balloon catheter is lodged into the vascular system and positioned in the distal part of the stent. Subsequently, it is inflated with low pressure and then withdrawn with the stent. Another option is the "two-guidewire" technique, where an additional guidewire located parallel to the first one is used [3]. It should be positioned outside of the displaced stent. The next step is several-fold rotation of the guidewires in order to achieve "entanglement" in the distal region of the vessel; it creates an opportunity to withdraw the whole system

outside the vascular system. To evacuate the lost stent one can also apply loop snares intended for removing foreign bodies from the vessels (commercial devices such as Amplatz Goose Neck snare EV3, Micro Elite snare Vascular Solution, etc.) or optionally other devices (for use only within the aorta or iliac arteries: forceps used in surgery, Cook system to remove the electrodes, forceps applied to endomyocardial biopsy, etc.) [4, 11]. Nevertheless, retrieval of the lost stent often requires more than one of the above and in the case of ineffectiveness, it is reasonable to consider "safe" leaving to minimize complications [12, 13]. The left stent can be displaced and deployed with the catheter balloon in the safest possible location in the artery. Another option is to "crush" the lost stent into the vessel wall using an additional stent lodged into its lumen and inflated. According to the Bolte *et al*. study, in the case of intracoronary localization and inability to retrieve or "safely" leave the stent, it is necessary to perform emergency cardiac surgery [7]. In turn, results of the study including relatively benign prognosis of patients with a stent left within the peripheral arteries may suggest the possibility to avoid surgical procedures provided there are no clinical symptoms. In this situation it is necessary to extend the observation period of the patient.

The direct cause of stent dislocation in the reported case of a 75-year-old female patient was the presence of massive calcifications in the treated distal LAD segment. Therefore the decision of triple balloon predilatation was made, which unfortunately did not prevent stent displacement to the LAD/Cx bifurcation. A potential factor conducive to occurrence of the presented complication could also be the decision to perform multivessel percutaneous coronary intervention. Despite the controversy about performing multivessel PCI in the course of NSTE-ACS, in the majority of publications increased risk of periprocedural complications related to this strategy has not been found [15]. Nevertheless, there is a lack of data about stent loss during multivessel PCI. Due to the clinical state and presence of multivessel coronary artery disease, the heart team decided to treat the stenosis in the LAD. Because of the intracoronary localization and access maintained by a guide wire, the decision of stent removal from coronary arteries with the "small balloon" technique was made. Removal of the whole system was complicated by another slippage and displacement of the stent to the ostium of the right deep femoral artery. The location allowed the use of a loop to release the stent from the vessel, which led to its successful removal from the vascular system. Another everolimus-eluting stent was implanted in significant LAD stenosis with optimal angiographic effect.

Conclusions

Summarizing the case report of a 75-year-old female patient and presented data, stent displacement is a rare complication associated with significantly worse in-hospital outcomes. Previous analyses which included an optimally large population indicate that in every case of intracoronary stent dislocation it is necessary to attempt its removal. Due to lack of a sufficient number of trials comparing each stent removal technique, choosing the technique should be based on the clinical and angiographic state of the patient, access to cardiac surgery and experience in the discussed subject.

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