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Stent Dislodgement During Percutaneous Coronary Intervention: How to Get the Ring Off?

Stent Perkütan Koroner Girişim Sırasında Stentin Yerinden Çıkması: Halka Nasıl Çıkarılır?

CASE REPORT
OLGU SUNUMU

ABSTRACT

Iatrogenic coronary artery dissection is a rare but serious complication during percutaneous coronary intervention. Stent dislodgment or stent loss is another potential complication that can occur under certain circumstances. We herein present a case of stent dislodgment that was intended to treat an iatrogenic left main coronary artery dissection. Several percutaneous techniques for the management of such complication are discussed, and an illustration of the approach used in our case is presented.

Keywords: Complication, percutaneous coronary intervention, stent loss

ÖZET

İyatrojenik koroner arter diseksiyonu, perkütan koroner girişim sırasında nadir görülen ancak ciddi bir komplikasyondur. Stentin yerinden çıkması veya stent kaybı, belirli koşullar altında ortaya çıkabilecek başka bir potansiyel komplikasyondur. Biz bu çalışmada iyatrojenik bir sol ana koroner arter diseksiyonunu tedavi etmek amacıyla yerleştirilen bir stentin yerinden çıkma vakasını sunuyoruz. Bu tür bir komplikasyonun yönetimi için çeşitli perkütan teknikler tartışılmış ve vakamızda kullanılan yaklaşımın bir örneği sunulmuştur.

Anahtar Sözcükler: Akut koroner sendromlar, anjiyoplasti, miyokardiyal revaskülarizasyon, perkütan koroner girişim

Stent dislodgment has nowadays become a rare complication during the percutaneous coronary intervention (PCI) owing to the routine use of balloon pre-mounted low crossing profile coronary stents and refinement in stent delivery systems. Moreover, iatrogenic coronary artery dissection is a serious complication during PCI that can lead to flow impairment, acute myocardial infarction, cardiogenic shock, and death.[1,2]

Case Report

A 66-year-old male, heavy smoker, presented to our institution for recurrent epigastric pain for the last 48 hours, associated with severe upper back pain and nausea. Electrocardiogram showed anterior myocardial infarction with Q waves (Figure 1, Panel I). Transthoracic echocardiography (Figure 1, Panel II and III) showed akinesia of the mid to apical septum, apex, and anterior wall with preserved wall thickness, and an ejection fraction of 40%-45%. No significant valve disease was found. Right ventricle was normal in size and function, with a pulmonary artery systolic pressure of 35 mm Hg. Since the pain characteristics at presentation were suspicious, an urgent computed tomography angiography of the aorta and the coronaries was performed to rule out an associated aortic dissection which may implicate a surgical management. Computed tomography angiography showed an intact aortic wall and a total occlusion of the proximal left anterior descending (LAD) artery (Figure 1, Panel IV). Acute coronary syndrome treatment protocol based on dual anti-platelets and anti-coagulation with unfractionated heparin was initiated, and the patient was transferred to the cardiac catheterization laboratory. Coronary angiogram performed through right radial access using 6-Fr sheath showed ectatic right coronary artery and left circumflex (LCx) artery with no flow limiting lesions.

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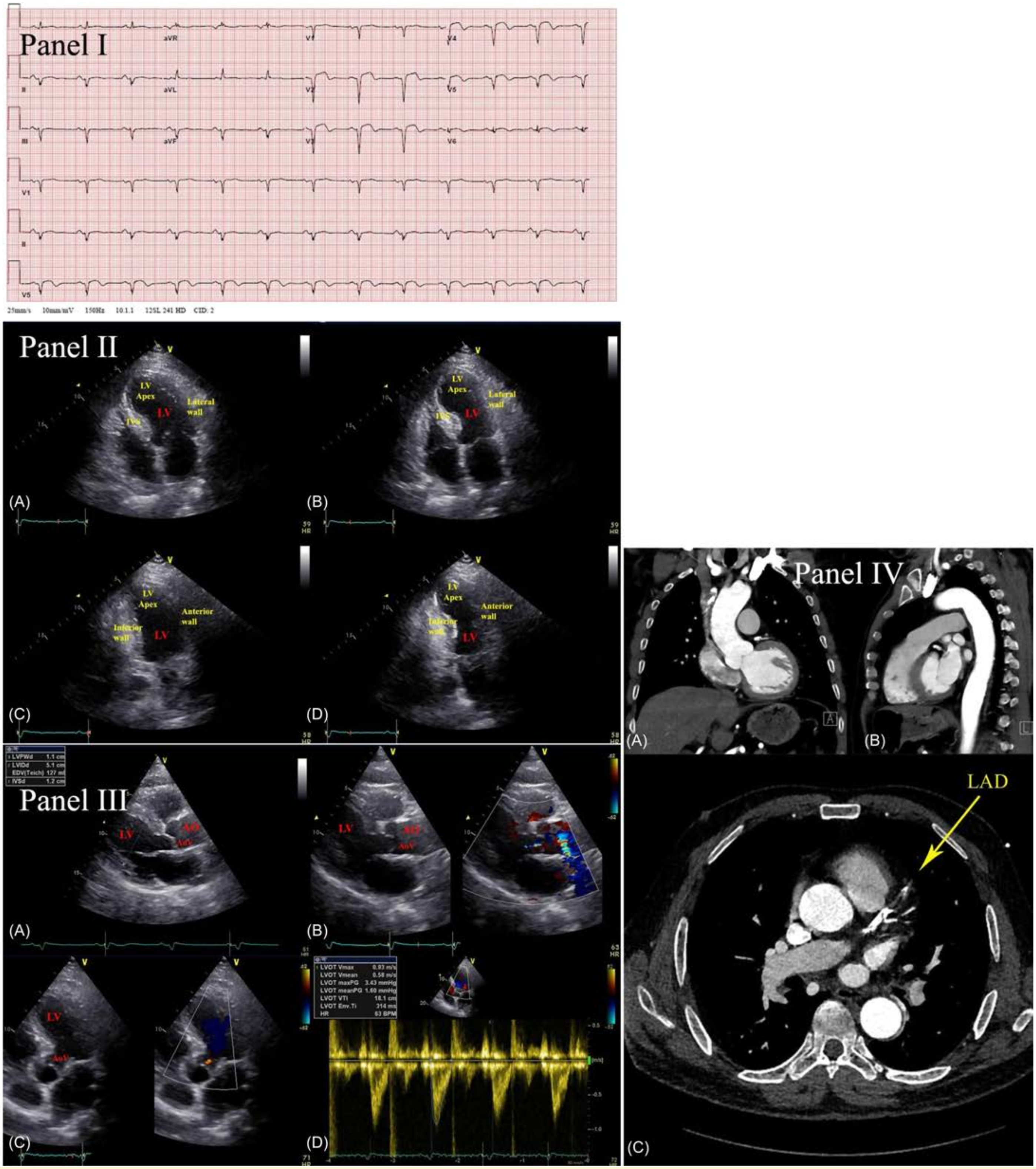

Figure 1. Electrocardiogram (ECG) showing anterior myocardial infarction with Q waves (Panel I). Transthoracic echocardiography (TTE) (Panel II) showing akinesia of the mid to apical septum with preserved wall thickness in apical 4-chamber view during diastole (A) and systole (B) and akinesia of the anterior wall and apex with preserved wall thickness in apical 2-chamber view during diastole (C) and systole (D). TTE (Panel III) showing left ventricle of normal size (A), with no evidence of aortic root dissection (B), and trivial aortic valve regurgitation in color Doppler parasternal long-axis view (B), in color Doppler apical 5-chamber view (C), and in continuous-wave Doppler of aortic flow (D). Computed tomography angiography (CTA) (Panel IV) shows no evidence of ascending aorta, aortic arch and descending aorta dissection (A and B), and total occlusion to the proximal left anterior descending (LAD) artery (C). AO, aorta; AoV, aortic valve; IVS, interventricular septum; LV, left ventricle.

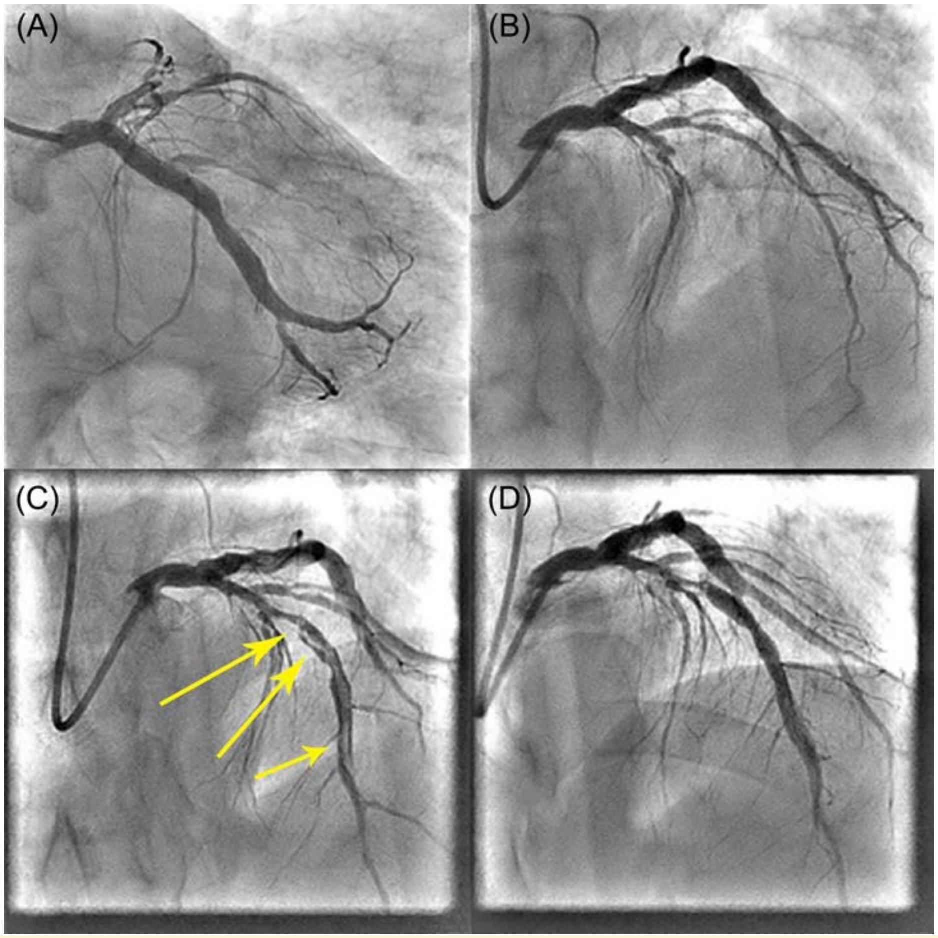

Figure 2. Coronary angiogram showing thrombotic total occlusion of the proximal left anterior descending (LAD) artery (A and B; Video 1*) with a huge snake-like thrombus after balloon dilatation (C, yellow arrows; Video 2*) and reduction of the thrombus burden after thrombus aspiration (D; Video 3*).

Proximal LAD presented thrombotic total occlusion with a thrombolysis in myocardial infarction (TIMI) 0 flow (Figure 2A and 2B; Video 1*). Intravenous bolus of eptifibatide (180 µg/kg) was administrated. Ad hoc PCI was decided. A 6-Fr contralateral left support (CLS 3) guiding catheter (GC) (Boston Scientific, Maple Grove, Minnesota, USA) was used to engage the left main (LM) coronary artery. A 0.014-inch balance middleweight (BMW) guidewire (Abbott Vascular, Santa Clara, California, USA) was advanced through the occlusion into the distal LAD. Predilatation of the thrombotic occlusion with a 2.0 mm × 15 mm semi-compliant balloon was performed restoring the flow to the LAD; however, a huge snake-like thrombus was present in the LAD (Figure 2C; Video 2*). Thrombus aspiration with an Export Advance aspiration catheter (Medtronic Inc, Minneapolis, MN, USA) was successful to reduce the thrombus burden of the clot (Figure 2D; Video 3*). A 4.0 mm × 38 mm Resolute Onyx stent (Medtronic Inc, Santa Rosa, California, USA) was advanced into the proximal LAD and was deployed at 14 atmospheres. However, the stent balloon failed to deflate completely, even after several deflation attempts and its forceful pullback led to a deep engagement of the GC causing a type C dissection of the LM coronary artery with contrast appearing outside of the vessel lumen as an extraluminal cap and persisting dye staining even after contrast cleared off the lumen (Figure 3A and 3B; Video 4*). Blood flow was not impaired. Hemodynamic parameters and clinical condition of the patient remained unchanged. Intravascular ultrasound (IVUS) of the LM coronary artery was performed to study the extension of the dissection and showed unharmed distal LM coronary artery (Figure 3C and 3D). Stenting of the proximal and midshaft LM coronary artery was decided. A 5.0 mm × 12 mm Resolute Onyx stent was advanced and parked into the LM coronary artery to cover the whole length of the dissection. After inflation, the stent got dislodged from the balloon, came backward over the GC, and settled as a "ring" around the GC at the level of the brachiocephalic trunk (Figure 4A and 4B).

ABBREVIATIONS

BMW	Balance middleweight
CLS	Contralateral left support
GC	Guiding catheter
IVUS	Intravascular ultrasound
LAD	Left anterior descending
LCx	Left circumflex
LM	Left main
PCI	Percutaneous coronary intervention
TIMI	Thrombolysis in myocardial infarction

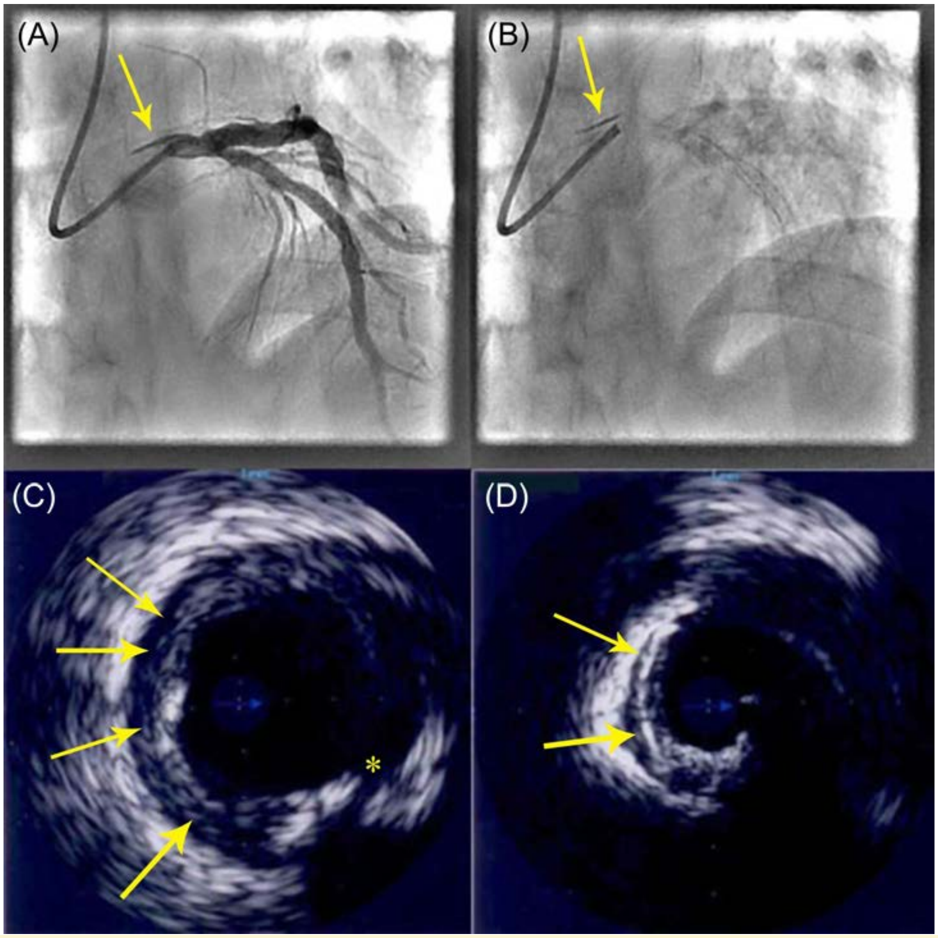

Figure 3. Coronary angiogram post left anterior descending (LAD) stenting showing left main (LM) coronary artery dissection (A, yellow arrow; Video 4*), with contrast appearing outside of the vessel lumen as an extraluminal cap and persisting dye staining even after contrast cleared off the lumen (B, yellow arrow). Intravascular ultrasound (IVUS) to the LM (C and D) showing the dissection with the entry point (*) and the false lumen (yellow arrows).

A second BMW guidewire was advanced into the LCx, and a new 5.0 mm × 12 mm Resolute Onyx stent was successfully implanted into the LM coronary artery ceiling completely the dissection (Figure 4C-F; Video 5, 6, and 7*).

Thereafter, under fluoroscopy, the GC was slightly pulled back from the LM and kept in the ascending aorta, while the LAD guidewire and the uninflated 5.0 mm × 12 mm stent balloon were kept in the coronary system (Figure 5A). Then, the assembly (GC and stent balloon) was partially pulled back over the guidewire taking off the "ringed" stent from the GC and keeping it over the guidewire and the balloon catheter. The proximal tip of the GC was parked upstream of the proximal edge of the dislodged stent, and the proximal edge of the stent balloon was parked into the distal edge of the dislodged stent over the guidewire. Then, the stent balloon was inflated serving as an anchor to facilitate pulling of the dislodged stent without getting it lost in the aorta. Thereafter, the whole system (GC, dislodged stent, and inflated stent balloon) was gently pulled back from the brachiocephalic trunk through the sub-clavian artery to the brachial artery (Figure 5B and 5C; Video 8, 9, and 10*). When the whole system got into the lower part of the brachial artery, the stent balloon was deflated and completely retrieved leaving the dislodged stent over the guidewire (Figure 5D). A 6.0 mm × 20 mm Pacific Plus balloon (Medtronic Inc, Minneapolis, MN, USA) was advanced over the guidewire into the dislodged stent and was inflated leading to optimal stent apposition into the brachial artery with no vessel injury or laceration (Figure 5E-G; Video 11*). The patient was discharged the next day and remained symptoms-free at the 1-year follow-up.

Discussion

Iatrogenic LM dissection during PCI is a serious complication that can jeopardize patient's outcome especially when antegrade blood flow deteriorates. Risk factors include atherosclerotic changes like LM lesions, catheter and guidewire manipulation, forceful injection of contrast media, balloon dilatation, and stenting.[1,2] In our case, the LAD stent balloon failed to deflate completely possibly due to inappropriate contrast media–saline dilution proportion and mixing into the inflator system or due to a balloon stent manufacture defect. Repetitive forceful retrieval maneuvers have led to

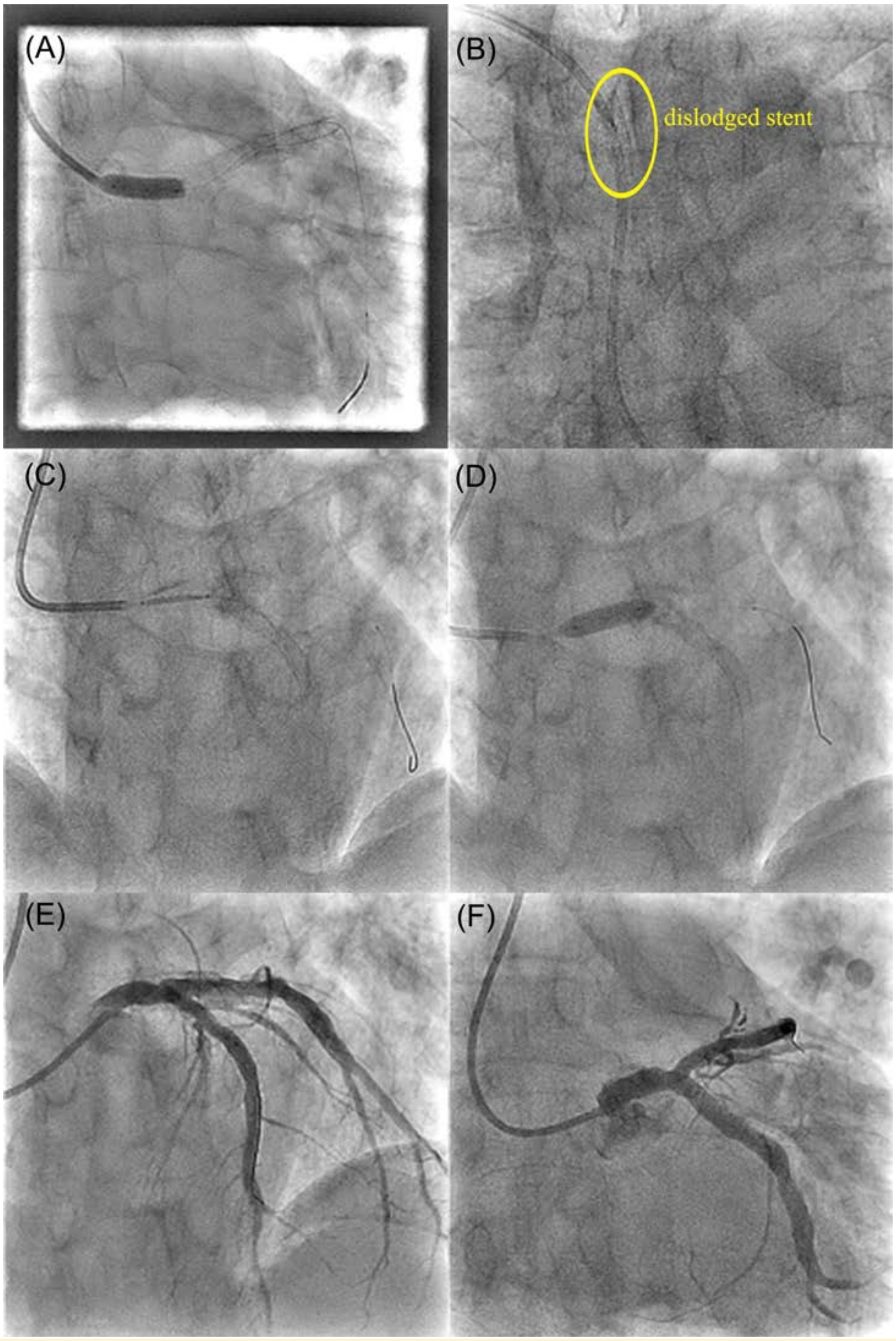

Figure 4. Fluoroscopy showing left main (LM) stent during deployment (A) and after dislodgement around the guiding catheter (GC) as a "ring" at the level of the brachiocephalic trunk (B, yellow circle). Fluoroscopy showing a new 5.0 mm × 12 mm Resolute Onyx stent parked into the left main (LM) coronary artery (C; Video 5*) and deployed to cover the dissection (D). Note the presence of a second BMW guidewire that was advanced into the LCx. Coronary angiogram showing good result post-LM stenting (E and F; Video 6 and 7*).

inappropriate GC position and deep intubation causing iatrogenic LM dissection. Under such circumstances, this complication can be potentially prevented by partially disengaging the GC prior to balloon retrieval. Moreover, contrast media injection should be limited in case of coronary artery dissection to avoid its spreading which can potentially lead to coronary flow limitation. Intracoronary imaging such as IVUS is a useful tool to understand the extension of the dissection guiding thereby stent positioning and assisting PCI strategy.

On the other hand, stent dislodgment or stent loss during PCI is a rare complication but with potential serious clinical implications. Its incidence was more frequent when stents were manually crimped onto the balloons and became rare with factory

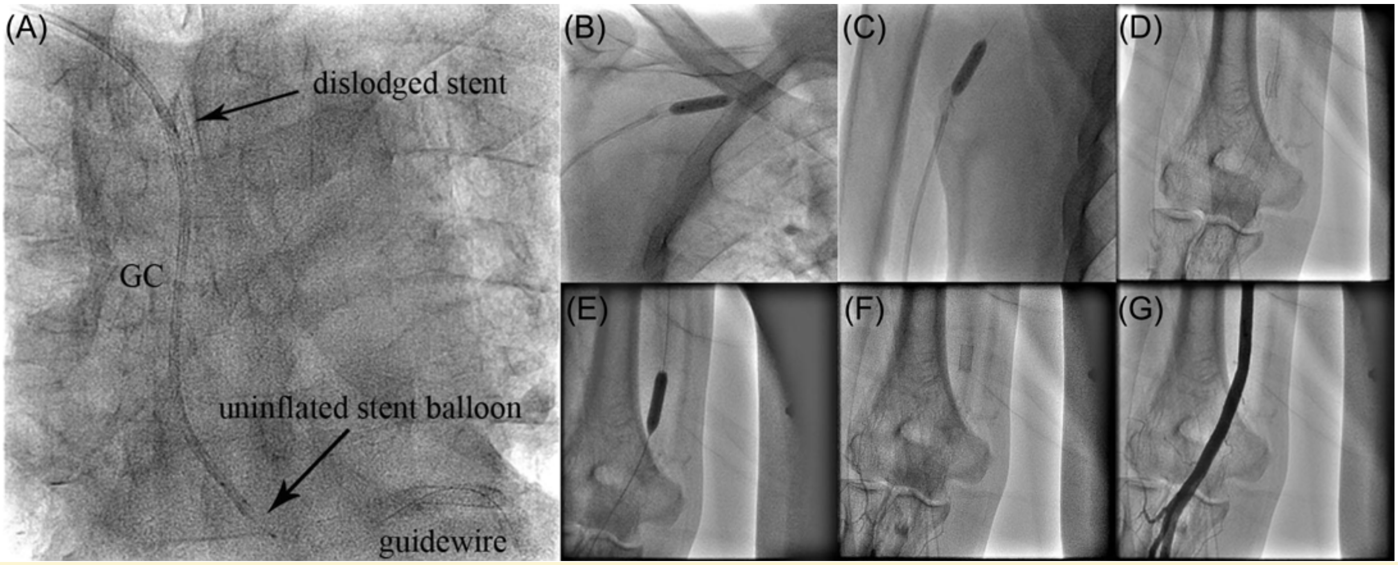

Figure 5. Fluoroscopy showing the guiding catheter (GC) being slightly pulled back from the LM and kept in the ascending aorta while the left anterior descending (LAD) artery guidewire and the uninflated 5.0 mm × 12 mm stent balloon was kept into the coronary system (A). Fluoroscopy showing the whole system (GC, dislodged stent, and inflated stent balloon) being pulled back from the brachiocephalic trunk through the sub-clavian artery to the brachial artery (B and C; Video 8, 9 and 10*). Fluoroscopy shows the dislodged stent over the guidewire at the lower part of the brachial artery (D). Fluoroscopy showing the 6.0 mm × 20 mm Pacific Plus balloon through the dislodged stent (E) with optimal stent struts apposition after inflation (F). Angiogram to the brachial artery showing no vascular injury (G; Video 11*).

pre-mounted systems. Several factors may contribute to stent detachment from its balloon: coronary characteristics including lesion heavy calcification, vessel tortuosity with marked angulation, or procedural factors such as aggressive manipulation and repetitive attempts to deliver a stent to a distal lesion through a previously implanted proximal stent.[3] In addition, stents of short length and large diameter have been particularly associated with this complication, especially if rapidly or promptly deployed. Stents embolization in coronary circulation can have both short- and long-term complications, while those embolized to peripheral circulation can have local vascular complications. Different approaches were used to deal with stent dislodgement including stent crushing against the coronary wall by another stent, stent extraction, or stent deployment at an unintended site.[4,5] Retrieval techniques include attempts using low-profile angioplasty balloon catheters, myocardial biopsy forceps, gooseneck snare, basket retrieval device, and twirling multiple guidewires around the stent. Surgical treatment with urgent coronary artery bypass graft remains a bail-out option in case of percutaneous management failure.[3]

In our case, dislodgement of the first LM coronary artery stent occurred after being fully deployed and this might be due to either rapid and prompt stent inflation or inappropriate GC motion that could have pulled back the stent after deployment. This complication could be potentially prevented either by slower inflation or by selecting a longer stent that provides additional stability during and after deployment. The second guidewire inserted into the LCx has contributed to a more stable GC with predictable motion. Moreover, after the LM dissection, keeping the guidewire in place into the coronary system is a major key factor to increase the chance of successful percutaneous management since rewiring and getting into the true lumen might be extremely challenging, particularly if the dissection got spread.

While many reported cases were of undeployed stents loss, our case is of the management of a fully deployed stent.[6] In this situation, conventional retrieval techniques might be very challenging since the dislodged stent was already fully deployed which may jeopardize the chance of its retrieval and on the other hand, the manipulation of such a fully deployed stent may increase the risk of endothelial injury, dissection, or vessel perforation. In our case, we managed to gently roll back the dislodged stent over the GC from the brachiocephalic trunk and to deploy it into the lower part of the brachial artery where there was no diameter mismatch between the stent and the vessel. This maneuver should be performed under fluoroscopy, with caution to avoid vascular injury and stent loss.

Conclusion

In case of complication during PCI, a major step is to keep calm and think carefully to understand the mechanism and eventually to select the best management option for the patient's benefit. In the case of iatrogenic coronary artery dissection as well as stent dislodgement, a key factor for management success is to keep the guidewire in place. In addition, deployment of the stent at an unintended peripheral site can be potentially a safe bail-out option.

*Supplementary video files associated with this article can be found in the online version of the journal.

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