

Case Report

‘Every Breath You Take, I’ll Be Watching You’ Ostial Stent Mal-deployment and Embolization Due to a Deep Breath: A Case Report and Literature Review

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Abstract

Ostial stent deployment is technically difficult and is sometimes associated with stent mal-deployment and embolization. This risk is higher from the radial approach due to excessive catheter movement and instability due to respiratory motion. We describe a case of left main stent mal-deployment and subsequent embolization during radial PCI due to a patient’s variable breathing pattern. An Amplatz Goose Neck Snare was able to snare and retrieve the embolized stent from the subclavian artery via the femoral approach before successful stenting via the femoral approach. Strategies to reduce excessive respiratory excursions during stent deployment and techniques of embolized stent retrieval are discussed.

Keywords: interventional cardiology, procedural complications, radial complications

Introduction

Stent loss and embolization during percutaneous coronary interventions (PCI) is a rare but serious complication. Here we describe a difficult case of stent loss and embolization due to exaggerated patient breathing patterns during radial PCI. Discussed are various techniques that can be employed in dealing with this rare scenario.

Case Report

A 68-year-old male veteran with history of coronary artery disease and multiple prior percutaneous coronary interventions (PCI), presented with progressive angina and dyspnea on exertion. His past history was significant for hypertension, chronic obstructive pulmonary disease, hyperlipidemia, obesity, and sleep apnea. Diagnostic cardiac catheterization showed a 50% eccentric lesion of the ostial left main coronary artery (Figure 1). There were no other significant lesions in the LAD or other vessels. A 6-Fr guiding catheter showed ventricularized waveforms upon engagement. A careful fractional flow reserve (FFR) with standard IV Adenosine infusion was done after equalizing

both pressures in the aorta. The Pd/Pa ratio at rest was 0.85 and the FFR was 0.75. The FFR pullback confirmed obstruction in the ostial left main. He was recommended for coronary artery bypass surgery but in view of his COPD, obesity and obstructive sleep apnea he was deemed at high risk for peri-procedural complications. After much discussion he refused coronary artery bypass surgery and sought PCI.



Figure 1: Eccentric 50% ostial left main lesion

After receiving 1mg midazolam and 50 mcg fentanyl intravenously a 10cm Terumo Medical 6.0 French sheath was placed in the right radial artery. Intravenous heparin was given and a 6 Fr Cordis Medical XBLAD 3.5 guide was used to engage the left main coronary artery. A balanced middle weight (BMW) guide wire was easily passed across the lesion into the distal left anterior descending artery (LAD). Due to the sedation medications and his underlying obstructive sleep apnea the patient had spells of large respiratory excursions followed by shallow breathing and apnea. He was easily arousable but could not stay awake for adequate periods of time. His breathing pattern was assessed over several cycles before attempting to deploy a 4.0 × 8.0 mm Abbott Medical Xience Alpine drug eluting stent in the ostial LAD during the shallow portion of his respiratory cycle. During deployment, the patient took an unexpected exaggerated deep breath resulting in the guide being pulled away from the ostium resulting in the stent being deployed just proximal to the left main ostium in the ascending aorta. With every subsequent heart beat the fully expanded but mal-deployed stent migrated proximally over the XBLAD guide into the right subclavian artery over the guide (Figure 2).

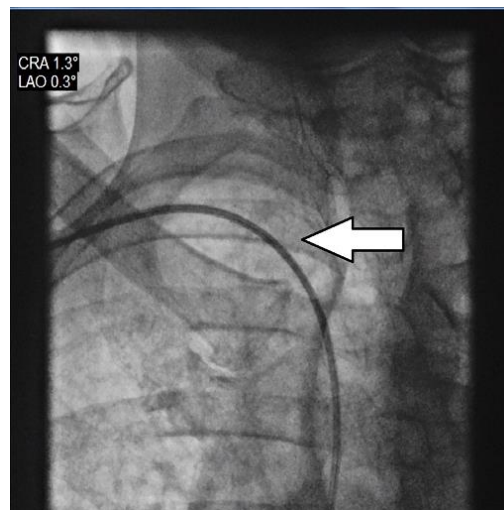


Figure 2: The embolized stent (white arrow) is seen over the guiding catheter in the right subclavian artery

The patient remained hemodynamically stable and there was no angiographic complication. It was decided to snare the embolized stent before attempting to stent the Left Main lesion. The coronary guide wire was removed. The guiding catheter tip was positioned in the transverse arch and a 0.035 exchange length wire (250 cm) was guided into the right femoral artery. The right femoral artery was accessed, and an 8 French 10 cm femoral sheath was placed. A Goose Neck Snare was used to pull the 0.035" wire into the femoral sheath and out of the body. Using the 0.035" wire as a rail, the Goose Neck Snare was advanced around the guiding catheter to the location of the embolized stent in the right subclavian artery. The stent was snared, pulled back over the guide wire, pulled out through the femoral sheath, and removed from the patient.

While keeping the patient awake, the left main coronary artery was re-accessed with an XBLAD 3.5 guide through the femoral approach. This time the breathing was coordinated by making the patient count from 1 to 20 while the nurse held his left hand and squeezed it regularly. Several practice runs were done to ensure awake status and optimal breathing during deployment. After confirming optimal ostial positioning, a 4.0 × 8.0 mm Xience Alpine stent was deployed satisfactorily, and post-dilation was performed with a 4.5mm non-compliant balloon ensuring optimal expansion (Figure 3). The femoral access site was closed with a Perclose device and the radial access site was sealed with a TR band. The patient had an uneventful overnight stay and was discharged the following day without complications.



Figure 3: Final result of the ostial left main stent through the femoral approach

Discussion

Stent loss during percutaneous coronary intervention is a rare complication occurring more frequently in vessels with calcification and significant proximal angulation. Patients in whom stent loss occurs have a higher incidence of complications such as myocardial infarction, stroke, bleeding requiring transfusion and emergency coronary artery bypass surgery [1]. Ostial stent deployment is difficult because there is poor guide support for stability, positioning, and contrast opacification. Intravascular ultrasound (IVUS) and optical coherence tomography (OCT) can help visualize the ostium clearly but during the actual deployment of the stent only surgical or calcific landmarks can be used with gentle contrast puffs to guide optimal stenting.

Exaggerated respiratory excursion of guide and stent also has to be contended with during stent positioning and deployment. This effect is felt less in femoral artery access but felt significantly more in radial artery access since

the subclavian artery lies over the apex of the lung and moves appreciably with each breath. Radiology studies have shown there is significant movement of the heart even during breath holds caused by a combination of diaphragm and heart motion [2]. Therefore, catheter or guide dislodgement is not uncommon with radial artery catheterization despite using radial-specific guides. The operator managing the catheter and guide often has to have both hands on the catheter to maintain position and optimal torque while the imaging gantry is moved to different angles by the second operator. In difficult cases a deep breath is used to help engage vessels but letting go of the breath can lead to disengagement. Another contributing factor to catheter motion and instability is the large cardiac output after a premature beat which can cause significant motion of the stent during positioning and contribute to mal-deployment.

Methods for guide stabilization include the use of a firmer guidewire or by a buddy wire or anchor wire system such as the transradial Szabo technique. The Szabo technique [3] involves a low-pressure inflation of the stent exposing the proximal strut. A wire is then passed through the proximal strut of the stent. This wire is then placed in the aorta to stop forward motion of the stent at the vessel ostium. The stent is then deployed, and the anchor wire removed. Overall this technique appears to be safe and feasible with a high procedural success rate [4,5]. This technique will help accurately stent the ostium and prevent the stent from migrating forward, but it will be unable to prevent proximal mal-deployment with deep breath-induced pull on the guide and stent system.

Breathing control and coordination is essential for radial artery procedures. Mild sedation is necessary to help a patient stay relaxed but sedation causing drowsiness or sleep can work against the operator who cannot rely on the regular breathing of the patient or obtain a patient's cooperation in requests to take deep breaths. We recommend the following techniques to try to control breathing during ostial stent deployment:

- Less sedation
- Keep patient awake with structured verbal activity (counting 1-20) while nurse repeatedly squeezes hand and encourages counting and wakefulness
- Dry runs of stent deployment before actual deployment
- Breath holding - this has to be practiced thoroughly because if the patient suddenly lets go then the stent will be mal-deployed
- Reverse sedation with naltrexone or flumazenil (done as a last resort)

There are multiple reports of ostial stent mal-deployments from the femoral approach [9-15]. Considering the fact that the conditions for stent mal-deployment from the radial approach are high due to the breathing factor it is surprising that this is the first case report of this complication due to breathing. Stent mal-deployment can occur distally or proximally. Distal mal-deployment could result in unnecessary stenting of normal vessel, jailing, or occlusion of a branch vessel. Although rare, angiographic complications such as dissection [6] or perforation [7] by the larger stent into a smaller distal vessel can also occur. Mal-deployment proximally can lead to similar unintended consequences and also can lead to stent embolization outside the vessel. If stent mal-deployment and embolization is appreciated, then it can be addressed appropriately. Unretrieved stents can cause stroke, renal artery occlusion, coronary artery occlusion, heart failure, and death [8]. In transradial coronary stenting, retrieval of a deployed, dislodged, or disfigured stent can often be difficult or traumatic due to the smaller size of the radial artery [9]. Many novel approaches to stent retrieval have been utilized including forceps [9], angioplasty balloon [10], goose neck snare [11,12], biliary forceps, multipurpose basket [12], combinations of devices [13], and other improvised devices [14,15]. Professional collaboration is often necessary when there is an unexpected complication and interventional radiologists who have special expertise in retrieving vascular material and embolized equipment in vessels can

provide great help. Retrieving embolized stents thru the radial approach is possible but there is a small risk of brachial or radial artery injury while pulling the snared stent through it.

The technique of transfemoral retrieval we demonstrated in the case allowed continuous guidewire-rail control of the embolized stent ensuring that it would not dislodge and migrate to an inaccessible region.

Conclusion

Stent mal-deployment and embolization, while infrequent is a real problem when stenting ostial lesions from the radial approach due to the effect of breathing on cardiac movement. Having a more awake patient helps maintain normal and regular breathing thereby facilitating optimal stent deployment. In somnolent patients a regular pattern of respiration can be achieved by a structured oral activity and intermittent tactile stimuli to facilitate optimal stent deployment.

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