Am J Cardiovasc Dis 2021;11(3):421-428
www.AJCD.us /ISSN:2160-200X/AJCD0127413

Case Report

Left main stenting with stent dislodgement and entrapment in the common femoral artery: a successful transcatheter stent retrieval

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Received December 1, 2020; Accepted May 12, 2021; Epub June 15, 2021; Published June 30, 2021

Abstract: Proximal left main stenting in symptomatic patients with flow-limiting stenosis is an alternative revascularization strategy in individuals with low syntax score and high operative risk. Stent dislodgement is associated with adverse cardiovascular events and retrieval of fully deployed stents is generally prohibited as it increases the risk of severe complications. Stent dislodgement and entrapment in the femoral vascular system occur infrequently during percutaneous coronary interventions. In this report, we illustrate a prompt and safe transcatheter technique to successfully retrieve an expanded and dislodged coronary stent entrapped in the common femoral artery without need for a more invasive surgical approach.

Keywords: Left main stenting, stent dislodgement, entrapment, transcatheter retrieval, CABG

Introduction

Stent dislodgement after deployment and entrapment in the femoral vascular system occur infrequently during percutaneous coronary interventions. Stent dislodgement is associated with major adverse cardiac events. However, retrieval of a fully deployed stent is generally prohibited as it may result in severe complications [1]. A dislodged stent may cause coronary or aortic dissection, coronary perforation, foreign body embolization resulting to myocardial infarction, stroke, mesenteric ischemia, or limb ischemia depending on the site of distal embolization. After full deployment, coronary stents become part of the vessel wall and cannot be repositioned or extracted. Several factors have been associated with stent dislodgement, including undersized or poorly expanded stents, significant vascular tortuosity, heavy vessel calcification, and an attempt to deliver a stent to a distal lesion through a previously implanted proximal stent [1]. Retrieval of a fully expanded stent may be done either surgically or by any one of percutaneous transcatheter techniques including use of balloons, wires, loop snares, or crush technique [1]. We report a complicated case of stent dislodgement after full deployment to the proximal left main coronary artery, and also demonstrate a safe and successful approach to retrieving a dislodged expanded stent that was entrapped in the femoral vascular system.

Case report

A 44-year-old female with a medical history of coronary artery bypass grafting (CABG) presented with persistent Canadian class III angina on optimal medical therapy and was found to have occluded bypass vein graft to obtuse marginal branch and atretic left internal mammary artery (LIMA) graft. Her left ventricular ejection fraction (LVEF) was 60-65%. A year prior to the index presentation, she underwent CABG for a

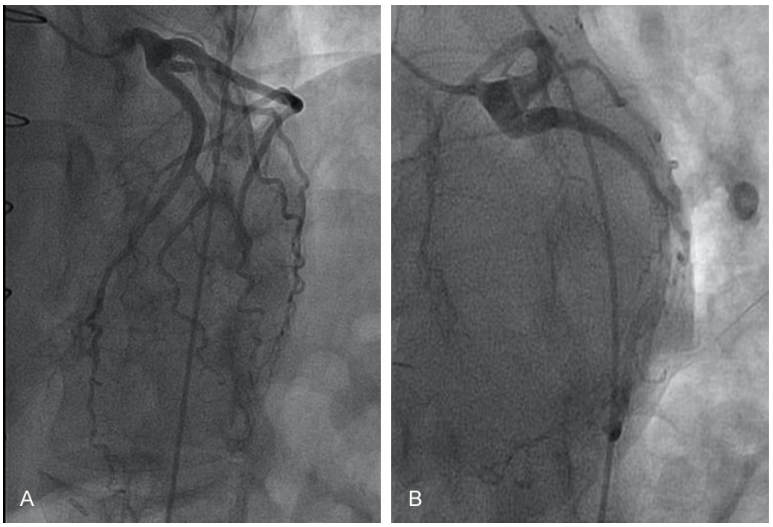

Figure 1. (A, B) Ostial left main stenosis-Left anterior oblique Cranial view (A) and Caudal view (B).

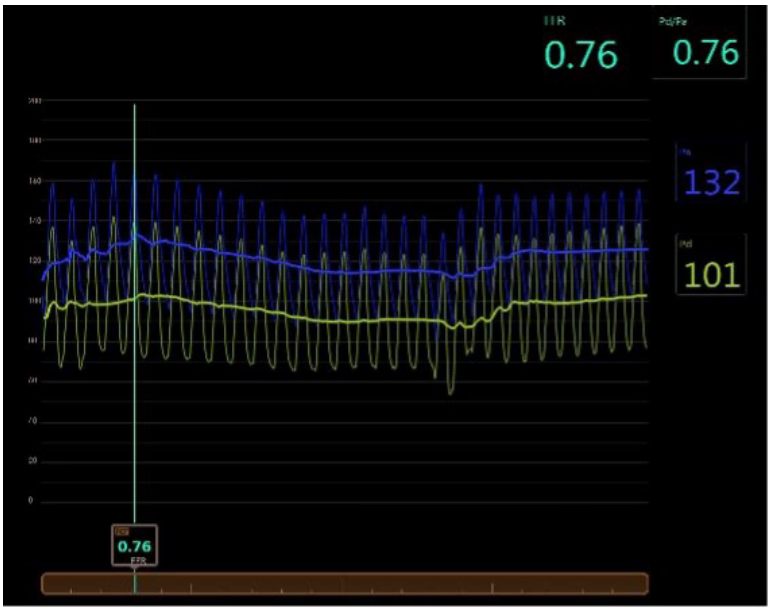

Figure 2. Fractional Flow Reserve (FFR) across the left anterior descending artery.

flow-limiting proximal left main coronary artery (LMCA) stenosis. During the index admission, a diagnostic coronary angiography revealed an extremely short but large diameter LMCA with a 50-60% ostial stenosis **Figure 1**. Otherwise there were normal coronary arteries. She had been optimized on medical therapy. Given persistent angina a physiologic testing was done which confirmed flow-limiting stenosis with an FFR of 0.76 **Figure 2** across the left anterior descending (LAD) artery. Intracoronary imaging with intravascular ultrasound to evaluate the minimal luminal area was not performed since lesion was angiographically and hemodynamically significant in this symptomatic patient. There was no other lesion in the LAD to explain the observed pressure gradient so we elected to proceed with intervention. The right coronary artery (RCA) did not have any significant stenosis **Figure 3**. Using a 6-French JL3.5 guide catheter, both LAD and LCx were engaged and wired with samurai workhorse wires. The LMCA was predilated with a 4.0 × 8 mm compliant balloon. Although the optimal stent size was thought to be 5.0 × 8 mm, this stent size was unavailable in the laboratory. An attempt at using 5.0 × 12 mm stent revealed that stent was well extending into the LAD and was still sticking out in the aorta **Figure 4**. Therefore, a 4.0 × 8 mm synergy stent **Figure 5**, which could be post-dilated to 5.5 diameter was deployed in the proximal LMCA across the stenosis. The stent positioning appeared very good.

However, once the stent balloon was deflated and pulled back the stent immediately dislodged from the LMCA and was found to be partially over the guide catheter **Figure 6**. A 4.5 diameter balloon was then advanced over the samurai wire and distal to the expanded stent **Figure 7**. The compliant balloon was inflated over the wire and pulled back to trap the expanded stent on the guide catheter. The whole unit was then retracted into the right iliofemoral system **Figure 8A-C**. The expanded stent was unable to be slipped off the guide catheter so it was anticipated that once we retracted the system

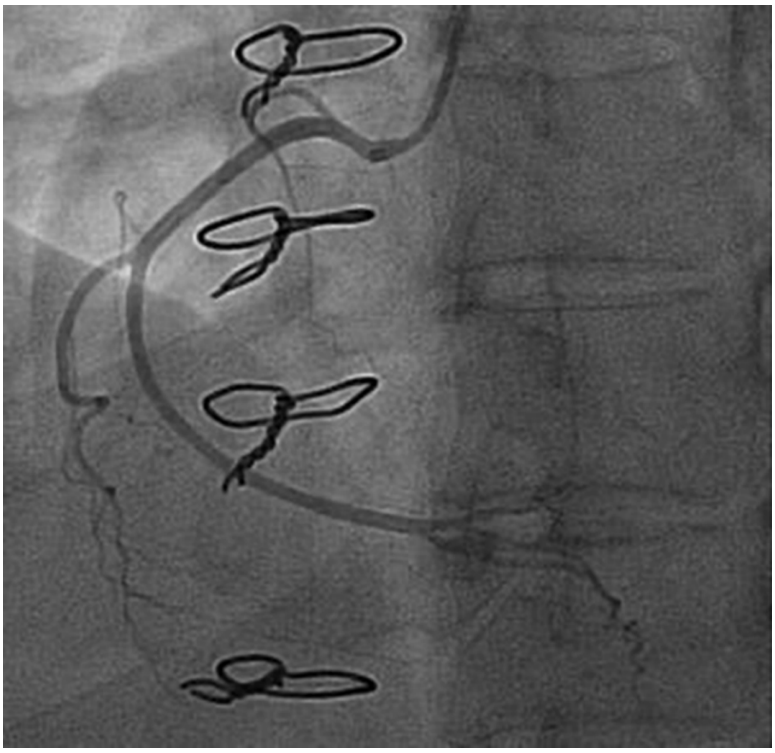

Figure 3. Right coronary artery-Left anterior oblique view.

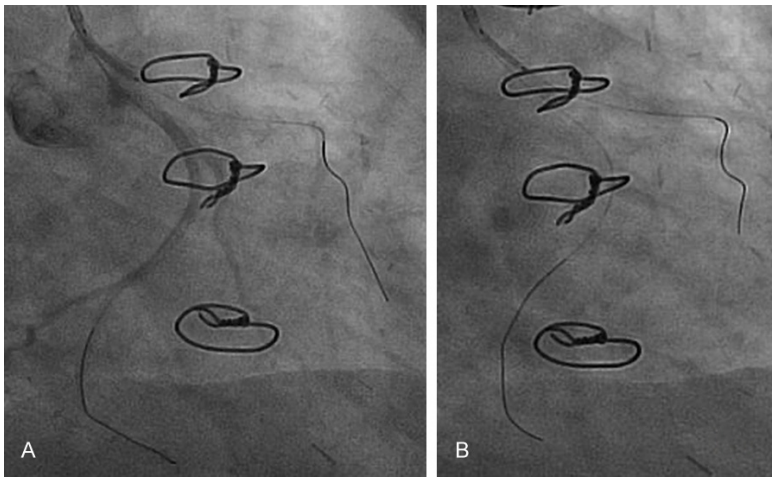

Figure 4. A, B: Right anterior oblique caudal views for stent sizing of left main coronary artery with 5.0 × 12 mm stent.

down to the sheath, the stent would catch on the tip of the sheath and slide back over the coronary workhorse wire allowing it to be easily snared.

Unfortunately this did not happen. The stent retracted over the sheath and was now trapped over the 6-French sheath in the right common femoral artery (RCFA) **Figure 8D**. At this point we were confident that stent would not embolize distally as it was already trapped in the femoral sheath which had a workhorse wire that was well advanced into the aorta. A follow-up angiogram of the LMCA showed a fairly good result with plain balloon angioplasty with only residual 30-40% stenosis and no dissection was noted **Figure 9**. The coronary catheter was then removed and a contralateral access was secured using an 8-French sheath. We then sought the expertise of a vascular surgeon to assist with retrieval of the trapped stent which was now over the sheath in the RCFA. An 0.035 wire was advanced through the right CFA access and the coronary workhorse wire was removed. An aortoiliac angiogram was obtained **Figure 10A**. We secured a left CFA access and an angiogram was obtained **Figure 10B** to confirm access location. The Ensnare was introduced from the left CFA up to the aortic bifurcation. The Ensnare was then used to capture the 0.035 wire which was then exteriorized through the left CFA access creating a through and through wire **Figure 10C**. An ensnare sheath was then advance over the wire from the left CFA access into the right external iliac artery, then over the 6-French sheath and then over the stent entrapped in the sheath located in the right CFA. Another safety wire was advanced through the right CFA access into the descending aorta. The stent was captured with the snare. With simultaneous gentle counter-traction on the 6-French RCFA sheath and the snare, the stent was dislodged from the 6-French sheath. The safety wire was pulled back and the captured stent was successfully retracted into the 8-French left CFA sheath and out of the body. The stent

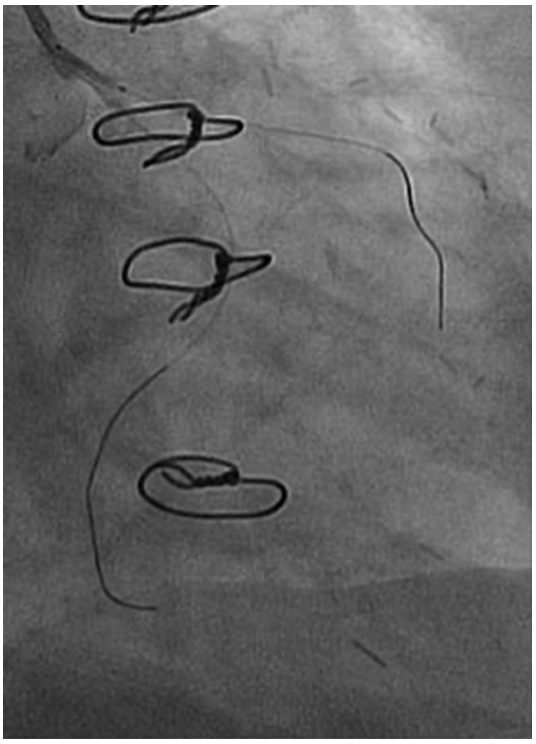

Figure 5. Stent Positioning-Right anterior oblique caudal view.

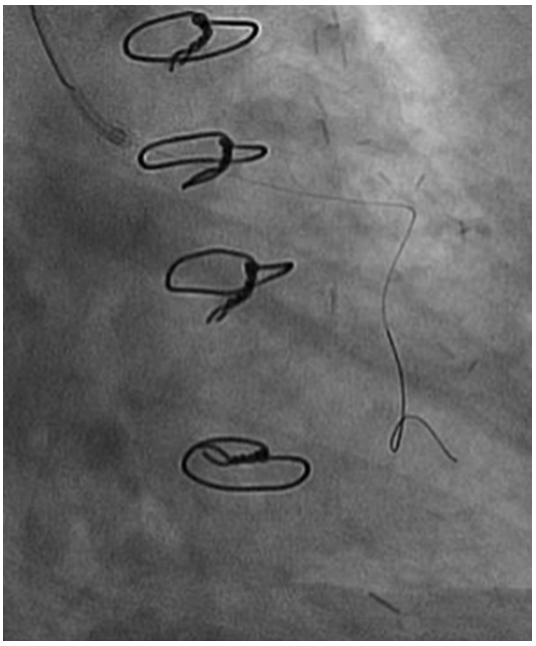

Figure 6. Stent dislodged and stuck on guide catheter.

was confirmed to be completely retrieved on the snare once the snare was removed from the body. Although deformed, there was no evidence of stent fracture or retained fragments. Completion arteriogram revealed good patency of bilateral iliofemoral arteries without any contrast leak to suggest perforation, vascular injury or access site complications **Figures 10D** and **11**. The patient continued to have exercise-limiting angina in the weeks following the procedure so had a PCI with 5.0 × 12 mm DES to LMCA into the LAD. She has since remained asymptomatic.

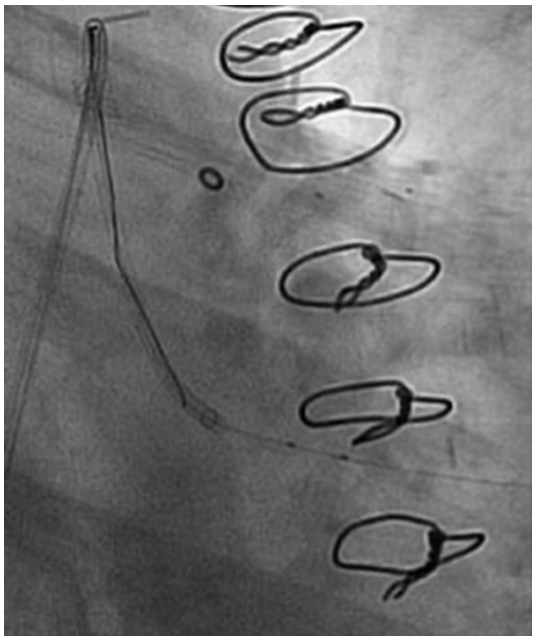

Figure 7. Distal balloon advancement.

Discussion

Our patient had occluded and atretic grafts occurring only a year after a CABG for an ostial LMCA stenosis. Her LMCA may be considered unprotected since her LIMA graft was atretic and graft to obtuse marginal branch was totally occluded. She continued to have persistent angina despite OMT. She was found to have flow-limiting LMCA stenosis with a syntax score of 16. Given her age and the rapidity of graft occlusion after her CABG, there was concern for graft re-occlusion even if she were to undergo a repeat CABG. The patient was deemed high risk for a redo sternotomy and CABG. In addition, the benefit of a redo CABG was questionable given the uncertainty of graft patency since the previous grafts failed only a year after the initial CABG. After discussion of risks,

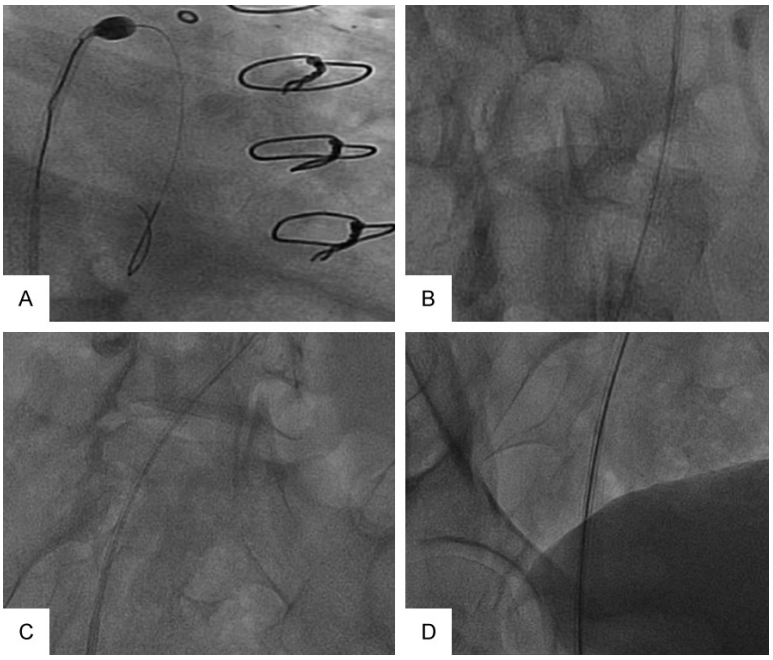

Figure 8. Stent retrieval with stent in the aorta and inflated distal balloon (A); Stent near aortoiliac bifurcation (B); Stent in the right iliac artery (C); Stent over the arterial sheath (D).

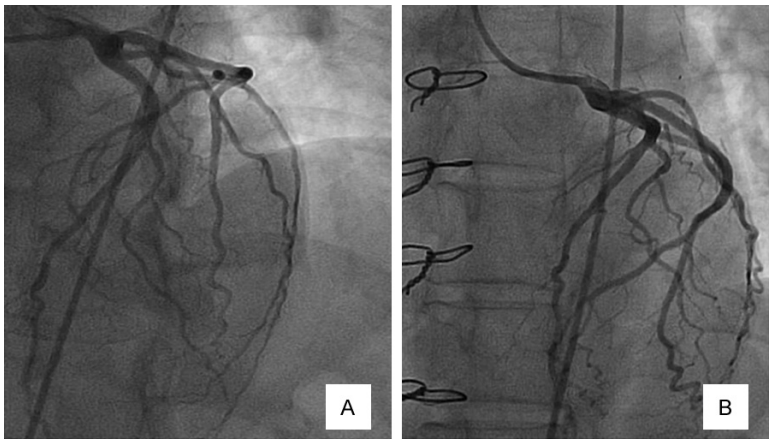

Figure 9. Repeat left main coronary artery angiogram-Left anterior oblique cranial view (A), and left anterior oblique view (B).

benefits and alternatives with the patient and heart team, the patient opted for a PCI if it was necessary. An attempt at proximal LMCA PCI was complicated by stent dislodgement so procedure was aborted. Our patient continued to have typical exercise-limiting angina in the weeks following the procedure so was scheduled for an elective LMCA PCI. Her angina resolved after PCI of the LMCA which supports the argument that her LMCA stenosis was indeed hemodynamically significant.

A heart team approach to revascularization is recommended in patients with unprotected LMCA [2]. PCI is an alternative revascularization strategy in patients with proximal LMCA stenosis with low syntax score especially if they have high or prohibitive operative risk [2]. Although stent dislodgement during PCI is associated with major adverse cardiac events, retrieval of a fully deployed stent is generally prohibited as it may result in severe complications [1]. Complications that have been associated with stent dislodgement include coronary artery dissection, myocardial infarction, cerebrovascular accident, peripheral embolization with entrapment, and death [3]. When stent dislodgement occurs, retrieval can be performed either surgically or percutaneously using a variety of retrieval techniques. Some of the favored techniques include deploying and crushing the stent in a distal and appropriately sized coronary bed using balloons [4], inflating a catheter balloon distal to the undeployed stent and trapping into the guide catheter [5], twirling 2 wires around the stent [5], using a loop snare [6] or forceps [7] to retrieve the stent. In our patient, the expanded stent fell back unto the guide catheter so could not be crushed in the coronary arteries, and it was too small to be crushed in the iliofemoral vessels either. We used a catheter balloon and loop snare to retrieve the stent. Like in our patient, stent dislodgement can occur if suboptimal stent size is selected, or stents are under-expanded. The risk of stent dislodgement is higher with arterial tortuosity, arterial calcification, or non-coaxial engagement of the guide catheter [8]. Optimal pre-dilatation to allow adequate stent expansion and apposition may help prevent stent dislodgement. The main find-

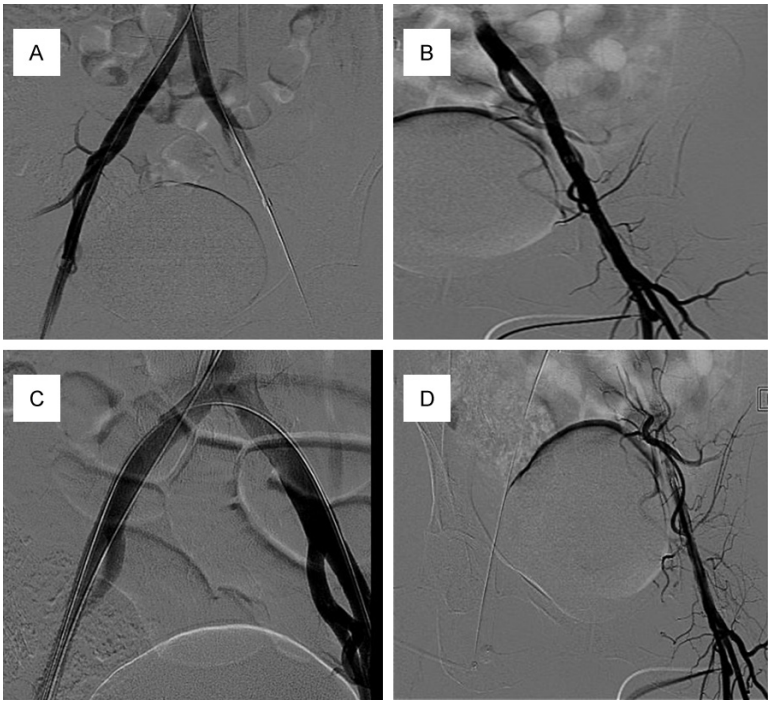

Figure 10. Aortoiliac angiogram (A); Left iliofemoral angiogram (B); Exteriorized workhorse wire (C); Stent over right sheath completely retrieved with an ensnare (D).

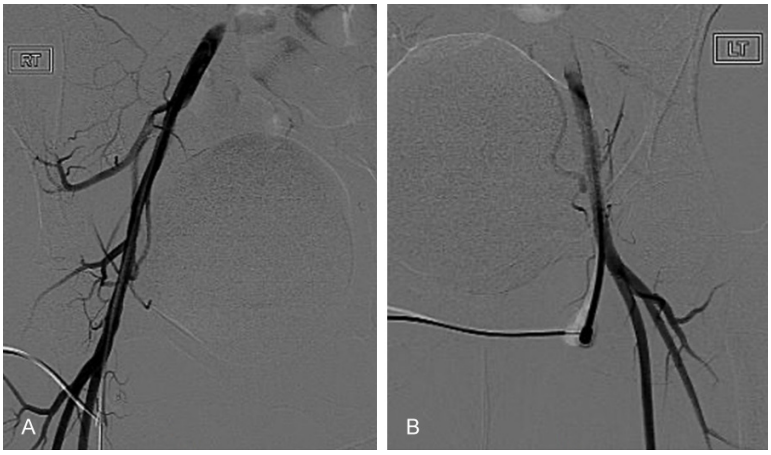

Figure 11. Post-intervention right iliofemoral angiogram (A); Post-intervention left iliofemoral angiogram (B).

ings from similar previous studies have been summarized in **Table 1**.

Conclusion

Expanded stent dislodgement is infrequently encountered. Optimal stent sizing and balloon expansion is crucial to reduce the likelihood of dislodgement especially in large diameter vessels. Monitoring stent position during deflation and withdrawal of stent balloon is key to early recognition of stent dislodgement. Employing prompt and safe retrieval techniques is helpful to avoid stent loss and stent embolization. It is reasonable to avoid retrieval of the dislodged stent to the level of the vascular sheath to avoid stent entrapment over the sheath. Trapping an expanded stent with a balloon and contralateral femoral access to snare an entrapped stent are safe transcatheter options to successfully retrieve a dislodged and entrapped stent without need for a more invasive surgical approach. Employing the expertise of a vascular surgeon is advisable to avoid vascular complications.

Acknowledgements

Left Main Stenting with Stent Dislodgement and Entrapment in the Common Femoral Artery: A Successful Transcatheter Stent Retrieval. The need for ethical approval was waived by the hospital research oversight committee for this case reports where protected health information has not been disclosed. The need for ethical approval was waived by the hospital research oversight committee for thiscase reports where protected health information has not been disclosed. The authors acknowledge the Grady Health System Hospital administration for their support towards clinical research.

Verbal consent for publication was obtained from patient on the grounds that report does not contain any personal data nor protected health information. The authors confirm that this report does not contain any personal data nor protected health information.

Table 1. Summary and discussion of main findings of similar previous studies

Ref*	Findings	Comments
1	Complications may arise during retrieval of a fully deployed stent. A good understanding of the coronary anatomy and previous coronary interventions is critical in successfully extracting a fully deployed or dislodged stent.	Similarly, we report a complication of extracting a fully deployed stent and highlight a successful bail-out approach.
3	Stent dislodgement and its attendant complications is known to occur early after coronary artery stenting. However, late stent dislodgement may occur and present with similar consequences.	Our patient had early stent dislodgement complicated with stent entrapment in the femoral artery system.
4	Retrieval of dislodged stents may be done surgically or by various percutaneous strategies. Crushing the stents with balloons or deploying in another appropriately sized arterial bed are favored bail-out percutaneous strategies.	We did not crush or deploy the dislodged stent in our case. The dislodged stent was completely retrieved.
5	In the case of stent dislodgement, balloon-assisted retrieval method is a simple, safe, and cost-effective way to avoid complications.	Similarly, our case highlights the use of balloon-assisted technique for retrieval of the dislodged stent.
6	Acute stent dislodgement with embolization to the femoral artery system can be successfully retrieval with a loop snare via contralateral femoral access.	In our case, the dislodged stent was entrapped in the femoral artery system. Similarly, we employed the use of contralateral loop snare.
7	Although several surgical and percutaneous techniques have been employed, crushing a dislodged stent is a safe technique to avoid further complications.	Although deformed, we retrieved the dislodged stent in our patient. We did not utilize the stent crush technique.
8	Stent deployment and crushing may be a good alternative technique for retrieving a dislodged stent.	We retrieved the dislodged stent in our patient. We did not utilize the stent crush technique.

REF* Number corresponds to the referenced article at the end of the manuscript.

Disclosure of conflict of interest

None.

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