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Balloon assisted trapping (BAT) and retrieval of fractured and impacted coronary angioplasty balloon catheter: simple solution to a complex problem

Authors: Santosh Kumar Sinha, Mahmodula Razi, Kumar Himanshu, Puneet Aggarwal

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Balloon assisted trapping (BAT) and retrieval of fractured and impacted coronary angioplasty balloon catheter: simple solution to a complex problem

Santosh Kumar Sinha, Mahmodula Razi, Kumar Himanshu, Puneet Aggarwal
Department of Cardiology, LPS Institute of Cardiology, G.S.V.M. Medical College, Kanpur, India

Abstract
Fracture of catheter fragment in a coronary artery during percutaneous coronary angioplasty is a rare complication, which may result into embolization or impaction leading to complete or near complete occlusion of respective territory, arrhythmia, or rarely sudden death. Here, we report an unusual complication of a broken balloon catheter during angioplasty of a calcified right coronary artery in a 78-year old female which was successfully retrieved by balloon assisted trapping in guiding catheter.
Key words: Balloon Assisted Trapping (BAT); Embolization; Fracture; Retrieval; Sudden death.

Introduction

Complex lesions are frequently being treated percutaneous because of refinement in technology and availability of better hardwares in the form of low profile balloons and stents. However, with increasing complexity of lesion and interventional procedures, hardware-related complications such as stent fracture, twisted or broken coronary balloons, guidewires, guiding catheter, and other hardware are being increasingly reported [1–3]. Postprocedural sequlae arising from broken fragments of angioplasty hardware are though uncommon, but can lead to coronary thrombosis, myocardial infarction, stroke, perforation and rarely sudden death [4, 5]. Retrieval at times may be difficult and dangerous, especially in the coronary arteries. Various nonsurgical methods have been proposed for the retrieval of broken stent-delivery systems [6–8].

Case report

A7 8-year old female was admitted with low effort angina- Canadian Cardiovascular Society (CCS) class III despite guideline directed medical treatment. Her risk factors were chronic cigarette smoking, dyslipidemia, and diabetes. Electrocardiogram showed evidence of left ventricular hypertrophy with strain pattern. An echocardiogram showed mild left ventricular

hypertrophy with preserved ejection fraction. She was further subjected to tread mill test which was strongly positive for stress induced myocardial ischemia. Her coronary angiogram revealed normal left system with diffuse lesion in). Percutaneous coronary intervention (PCI) of RCA was planned after proper consent. The procedure was performed through transfemoral approach using JR 6F guide catheter (Medtronic Inc., USA). A 0.014" runthrough guidewire (Terumo Inc, Japan) was passed through the lesion and parked distally. Then, the lesion was predilated with a 1.5x10, 2.5x10, and 3x10 mm Sprinter balloon (Medtronic Inc. USA) at 10-15 atm pressure as lesion failed to give away initially. Initially, we encountered difficulty to deliver the stent at the lesion site. Stent was finally delivered at the site of lesion with the help of 6F GuideZila (Boston Scientific, USA) mother in child catheter but its further manipulation was not much possible as we could barely push the stent distally. Therefore, distal part of lesion was stented with 3x21 mm Xience Prime Everolimus eluting stent (Abott Vascular; USA) at 12 atm pressure (Fig. 1B). While withdrawing the balloon, it was not coming out easily. As we tried to pull it with a little force, it accidentally got broken. Angiographic image revealed that the severed balloon segment was impacted proximal to proximal edge of the deployed stent (Fig. 2A). The remaining part of the balloon which came out of the guiding catheter revealed that balloon had broken at the junction of the metallic segment and soft part which also mean that some part of the broken segment was lying inside the guiding catheter (Fig. 3B, C). At first, we thought of attempting to retrieve the ruptured balloon by entangling it between two guidewires or using a small goose neck snare. However, we did not proceed with these retrieval techniques as the chances of success were less and probability of injury to coronary intima were more. Since proximal portion of the broken balloon was inside the guiding catheter, we thought of using balloon-supported catheter-assisted retrieval technique.

For retrieval of ruptured balloon, a 2.5x15mm Meverik non-compliant balloon (Boston Scientific, USA) was passed under fluoroscopic guidance up to the tip of the guiding catheter (Fig. 2B). Balloon was inflated at 14 atm pressure to completely trap the proximal end of the broken balloon and whole assembly (*guiding catheter- non-compliant balloon-broken and trapped balloon*) was pulled enmasse (Fig. 4, 5) which helped us to retrieve the severed balloon (Fig. 3 A, D). Inflation of this non-compliant balloon inside the guide catheter assisted us in trapping the broken balloon between the outer surface of the inflated balloon and inner surface of the guide catheter. RCA was finally stented proximally with 3.5x23 mm Xience Prime stent with one strut overlapping with distal stent. It was further post dilated with 3.5x8 mm Meverik non-compliant balloon at 18 atm pressure achieving TIMI III

flow non-compliant balloon (Fig. 6). Patient was discharged after third day and is under regular follow up since then.

Discussion

As complex lesions are being dealt with PCI, complications are also on the rise in the form of fracture, dislodgement, or entrapment of catheters, guide wires, angioplasty balloons, or stents with estimated incidence of 0.1%–0.8% [9]. Among these, impacted and balloon fracture is even rarer. These situations warrants immediate removal from the coronary system as they may portend disastrous consequences like thrombus formation, acute embolization, and myocardial infarction, and sudden death [9]. Every effort should may made to retrieve them percutaneously with help of baskets and snares devices, paired guidewires, balloon inflation technique, micro catheter, and biopsy forceps, with surgery being the last resort [10, 11].

In our case, the impacted balloon was retrieved quickly without extensive manipulation inside the coronary lumen, thus wasting much time and furthermore, avoiding the risk of dissection and thrombosis. A combination of factors probably led to dehiscence of the balloon shaft which included, underlying calcified lesion, excessive force used to push the balloon across the lesion, inadvertent rotational torque being applied to the balloon while it was being pushed, suspected small dissection flap by tip the GuideZila catheter which might have trapped the balloon shaft while it was being withdrawn, and manufacturing defect in the balloon catheter. Hence, although forceful push did result in slight advancement of balloon in RCA, it also resulted in the balloon being entrapped (impacted) such that gentle pull back did not result in any movement. At this point, forceful pullback resulted in complete tearing of the balloon shaft at its weakest point, i.e., at the plastic-steel junction where the monorail starts. Balloon catheter consists of a steel hypodermic tube shaft bonded to a distal plastic segment. Separation mostly occurs at the steel-plastic junction as a result of inadvertent rotation and manipulation of the balloon catheter (Fig. 3 C, D). As there is no evidence-based optimal approach for the management of such cases, the choice of retrieval technique is usually individualized in most cases based on patient's condition, operator experience, and availability of retrieval devices. Hence, an operator should be familiar with different retrieval techniques as management of the breakage of angioplasty devices in the coronary vasculature may be a tough call for them [12].

Earlier, Mehta V et al. [13] reported a successful retrieval of impacted broken balloon by balloon inflation in guiding catheter. Chang WT et al. [14] also described two similar

cases of successful percutaneous retrieval of ruptured coronary balloon during emergency or elective PCI. Snares could have been one of the option but they are useful mostly in proximal arteries or when a part of the equipment protrudes from the coronaries into the ascending aorta [15]. However, snares are rigid and their manoeuvrability is also poor which precludes this approach for more distal and tortuous vessels. In a case where the broken catheter fragment is on the coronary guidewire, all attempts should be made not to let the broken fragment slip off the guidewire as the retrieval of broken fragment may then become difficult or impossible. Our technique is especially unique since it facilitates rapid and complete removal of the entrapped fragment with routine PCI hardware, reducing the time and complexity of the procedure. Because of minimal manipulation, it obviated potential dissection or large thrombus formation inside the coronary lumen. Excessive manipulation of the balloon catheter and relatively forceful pull may have caused breakage of shaft in our case. Hence, deflated balloon should always be pulled with extra care in such situation. With our technique, the balloon fragments never freely protruded into the ascending aorta so there was no risk of embolization to systemic artery as the broken balloon shaft was on coronary guidewire.

If withdrawal of an embolised balloon is not possible, it may be crushed by another stent while deployment. In our case, heavy calcification was a hurdle in preparing the vessel for stenting. Despite graduated predilation with many balloons, the vessel was still unprepared for stenting and instead of trying forceful placement we should have tried to predilate it with a bigger size balloon, rota-ablation, and cutting balloon [16, 17]. However, one should not try to stent the poorly prepared artery. Luckily, the stent was not dislodged around the coronary system and as soon as we observed the demounted stent at the guiding tip, we retrieved by simple trapping with help of a balloon. It was easy, convenient and cost saving as conventional snare was not used. The novel balloon technique that was exercised in our case has the advantage of simplicity.

Conflict of interest

None

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Figure legends

Figure 1. Right coronary artery (RCA) showing mildly calcified diffuse lesion in mid part (A); distal part of lesion was stented with 3x21 mm Xience Prime stent (B) at 12 atm pressure

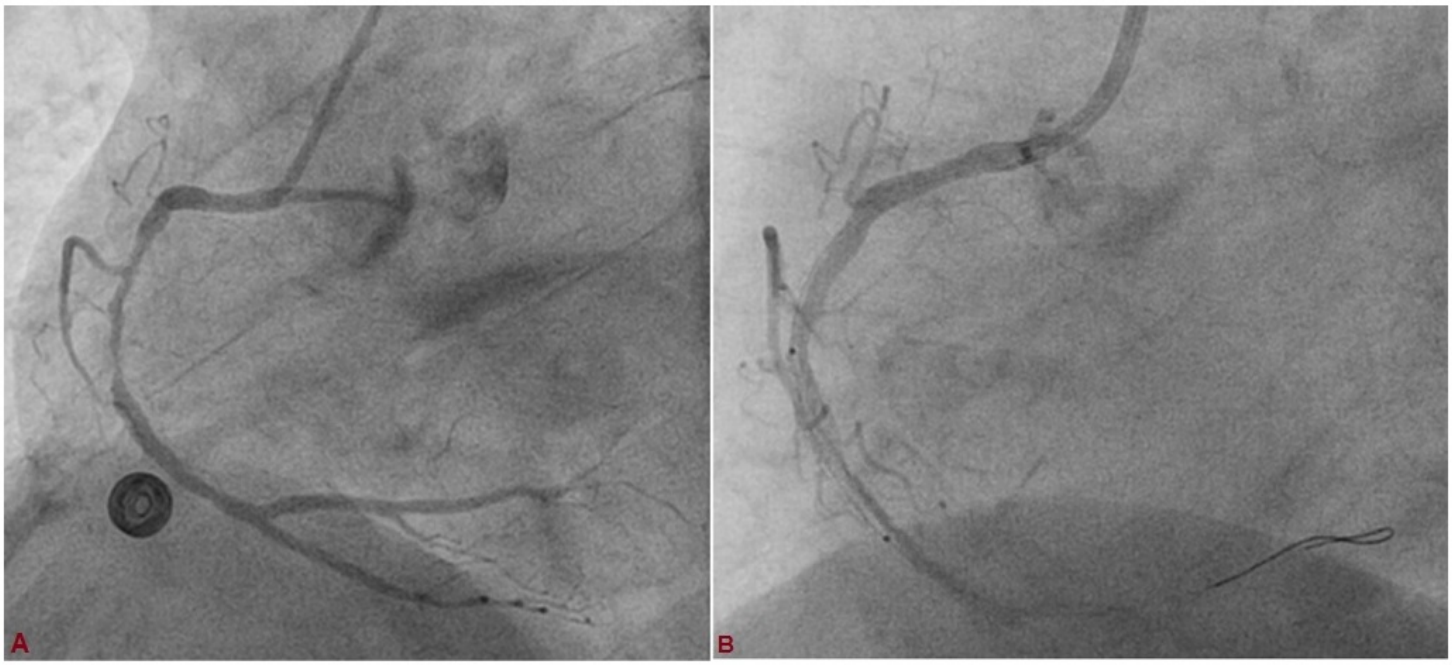
Figure 2. Severed balloon segment (white arrow) was impacted proximal to proximal edge of the deployed stent (A); 2.5x15mm Meverik non-compliant balloon (red arrow) was passed under fluoroscopic guidance up to the tip of the guiding catheter to trap the proximal end of severed balloon (white arrow, B)

Figure 3. Severed balloon segment (A); Proximal end of the remaining part of balloon catheter (B); Point of breakage of shaft of balloon (C); Balloon catheter with proximal and distal end (D)

Figure 4. Whole assembly (guiding catheter- non-compliant balloon- broken and trapped balloon) was pulled *enmasse* (A; B)

Figure 5. Severed and trapped balloon was pulled successfully using balloon assisted trapping technique (A; B)

Figure 6. RCA was finally stented proximally with 3.5x23 mm Xience Prime stent with one strut overlapping with distal stent (A; B)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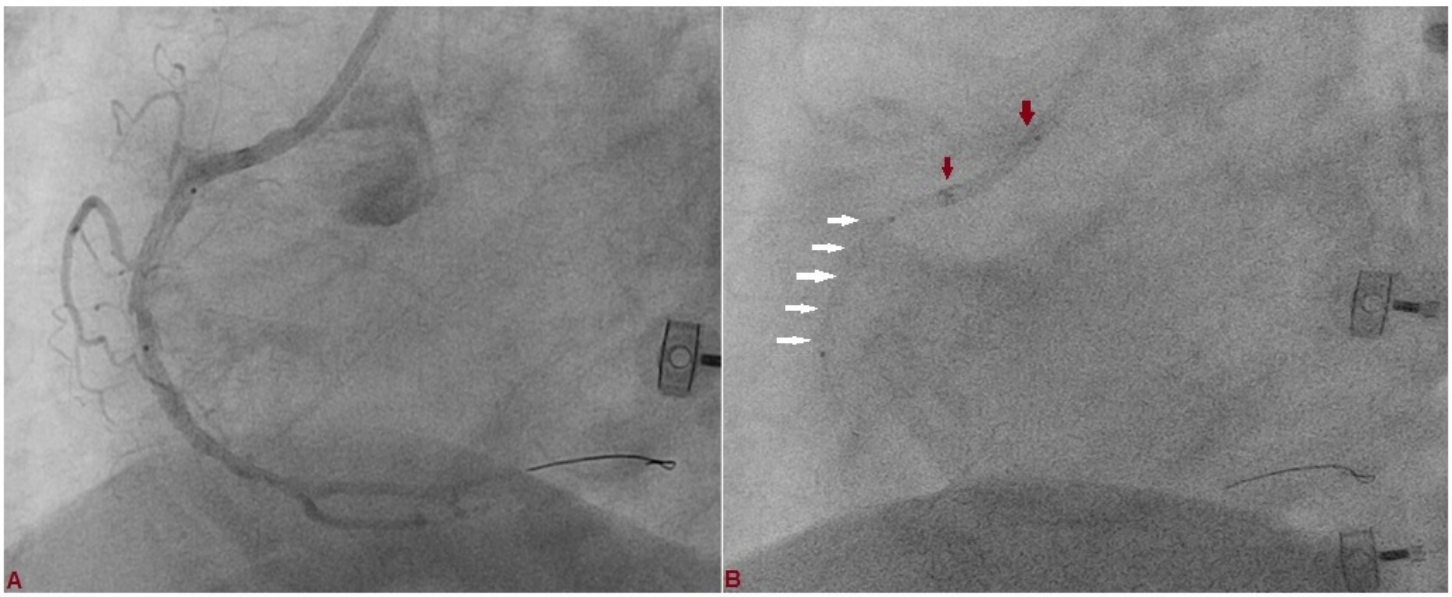
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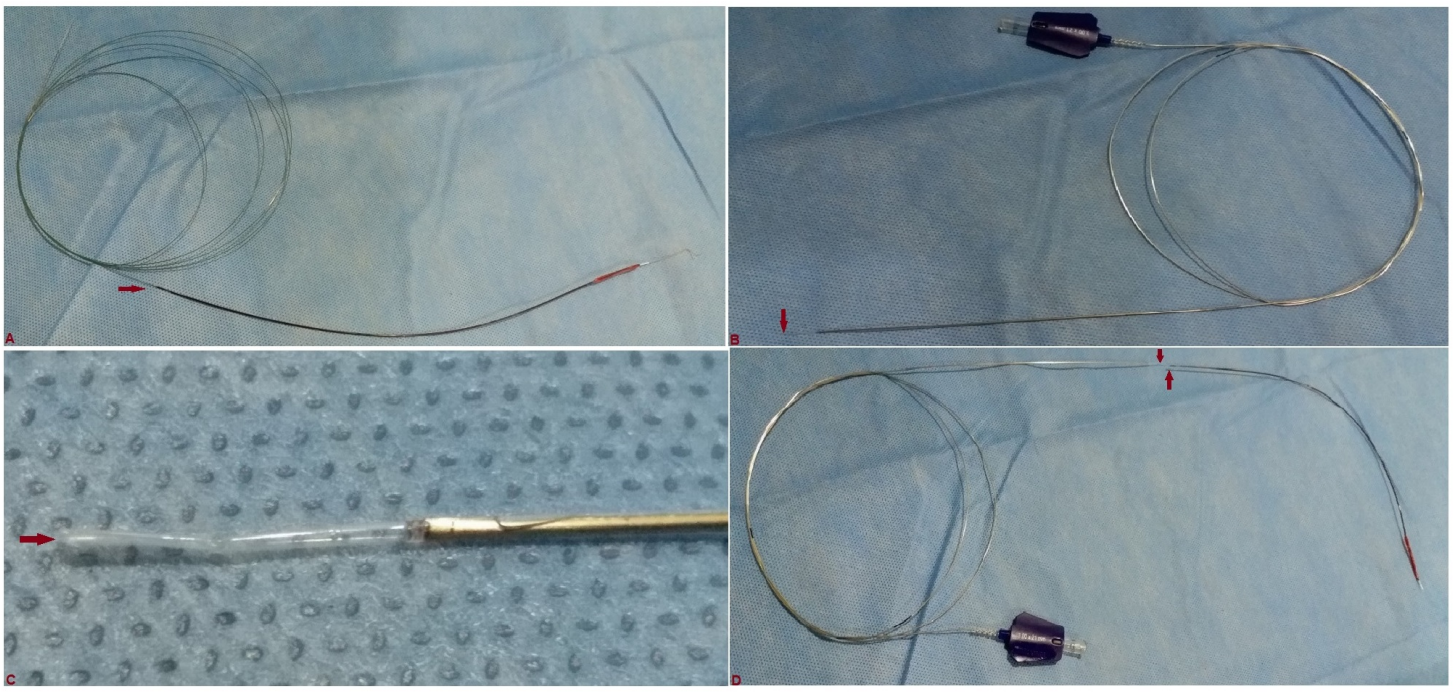
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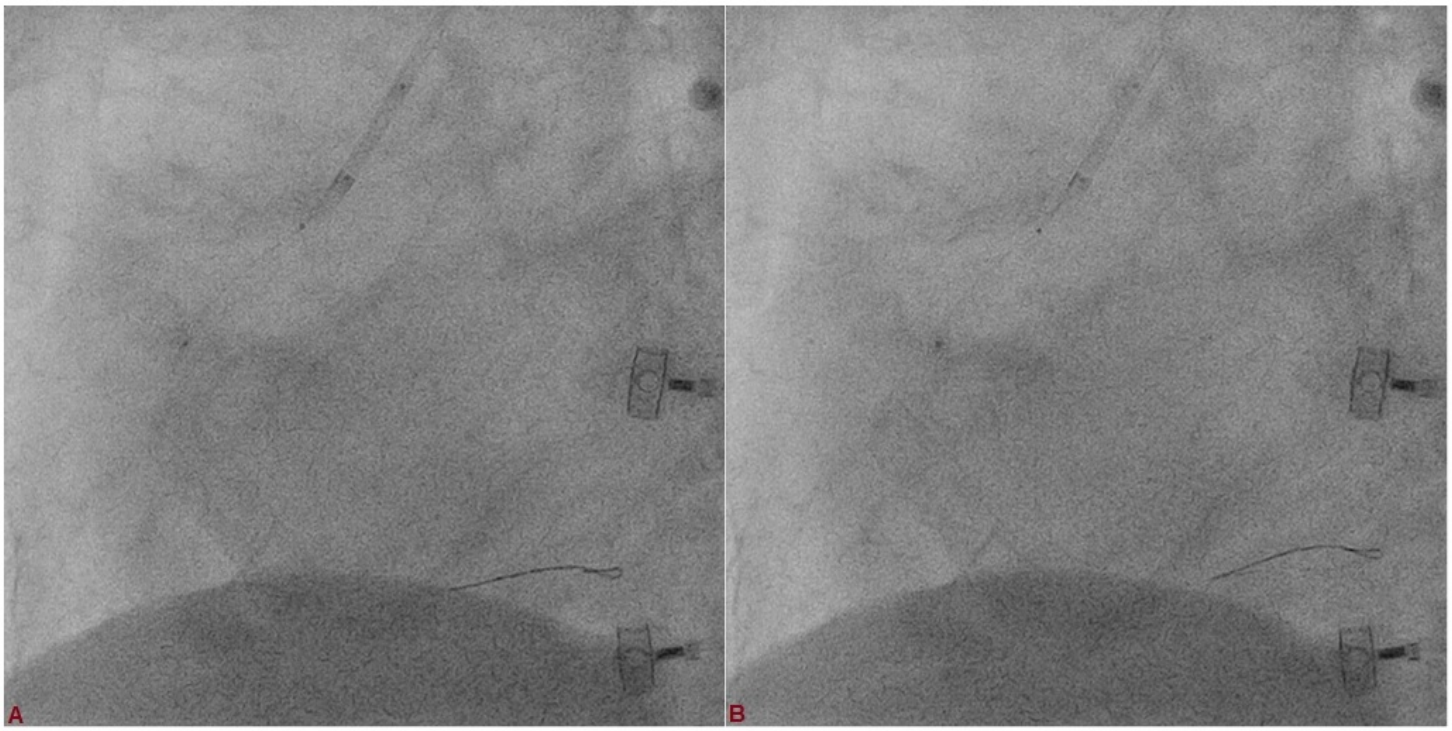
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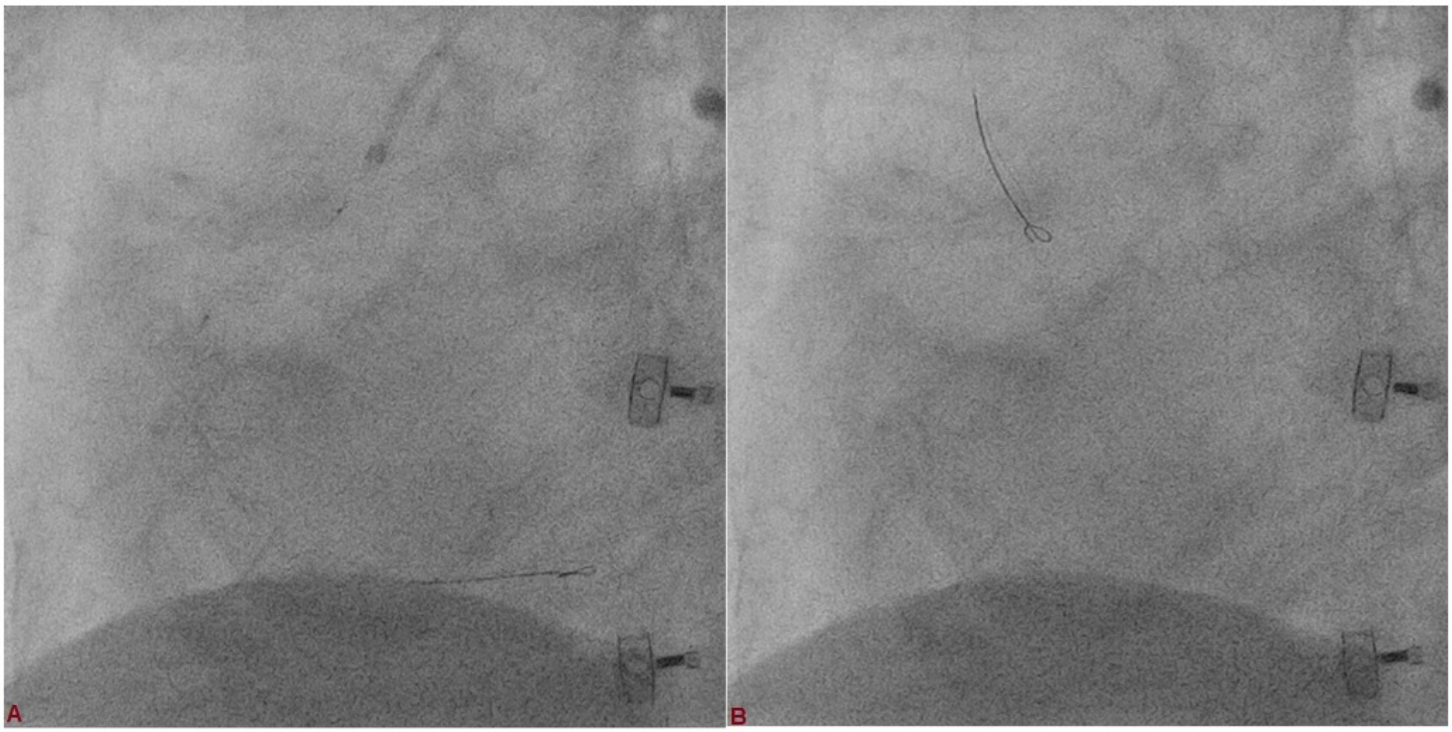
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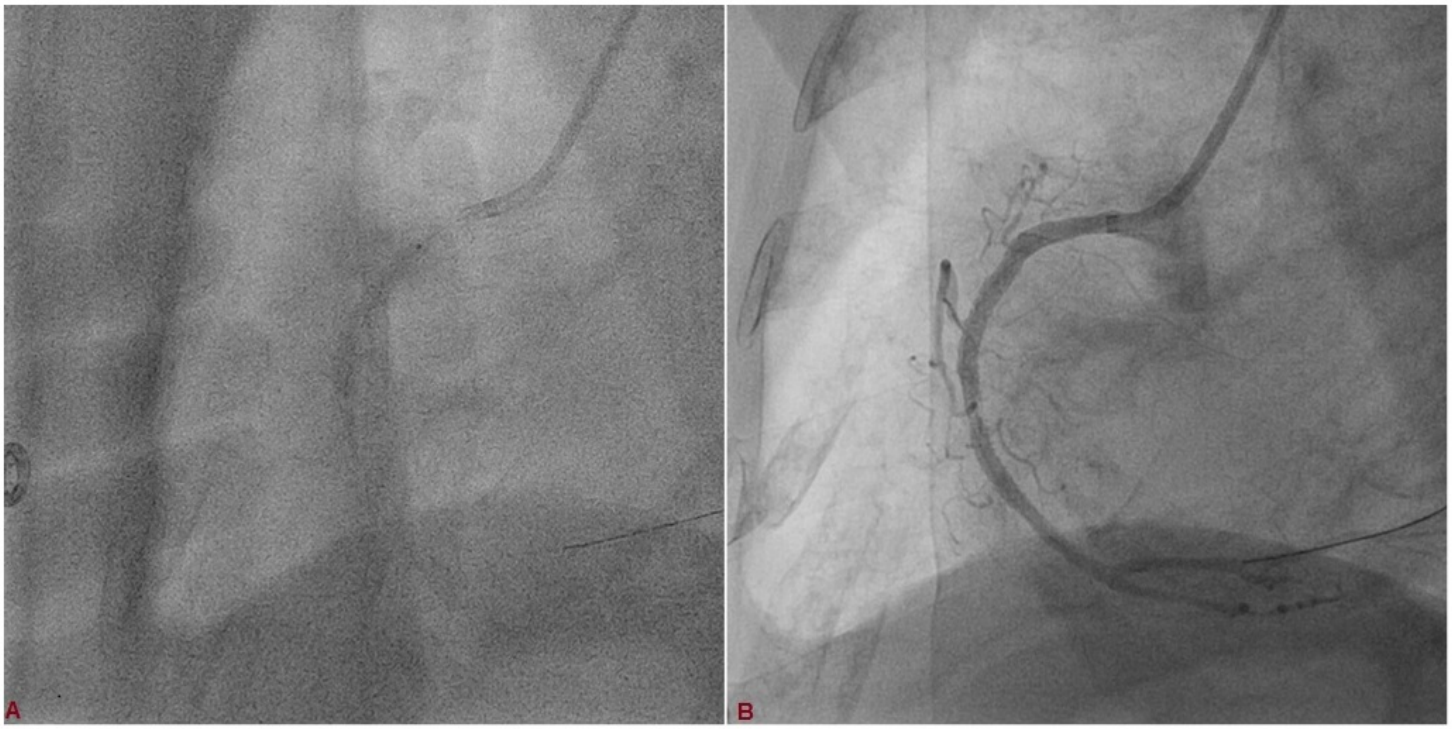
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