Retrieval of Broken Export Catheter during Primary Angioplasty

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Abstract

Keywords

- export catheter
- primary angioplasty
- retrieval

Broken catheter fragments in a coronary artery during percutaneous coronary interventions although uncommon can potentially result in life-threatening consequences from the attended embolization, thrombus formation, and perforation. We report an unusual complication of a broken export catheter during primary angioplasty, which was successfully managed by inflated balloon-mediated retrieval technique.

The increasing number and complexity of coronary interventions continue to be plagued by unpleasant events of broken/dislodged fragments of angioplasty hardware (catheters, guidewires, angioplasty balloons, and stents). Hence the knowledge of retrieval techniques is of paramount importance. We report percutaneous retrieval of a broken export catheter during primary angioplasty.

Case Report

A 40-year-old male smoker presented in the Heart Attack Unit, Department of Cardiology Emergency, at 2 AM with retrosternal ongoing chest pain of 1 hour duration. At the time of presentation, he was in Killip and Kimball class I with sinus tachycardia and blood pressure of 140/90 mm Hg. Electrocardiogram showed ST segment elevation in leads V₁–V₆, I, aVL, with reciprocal changes in inferior leads. Screening echocardiogram showed severe hypokinesia in the territory of left anterior descending (LAD) artery, with left ventricular ejection fraction of 30 to 35%. After an informed consent and pretreatment with aspirin and prasugrel, he was taken up for primary percutaneous coronary intervention (PCI) of a thrombus containing proximal LAD lesion (►Fig. 1) with thrombolysis in myocardial infarction (TIMI)-II flow (TIMI thrombus grade 4)¹ with a door to balloon time of 35 minutes. Left circumflex and right coronary arteries were normal.

Left coronary artery was engaged with a 7F Judkin's left guiding catheter (Medtronic Inc., Minneapolis, MN) through right femoral access with an 8F sheath. The LAD lesion was crossed with 0.014" Cougar wire (Medtronic Inc.). A large

amount of thrombus was aspirated after three passes of thrombosuction with a 6F export catheter (Medtronic Inc.) with a significant angiographic resolution of thrombus burden. Then, a 2.5 × 15 mm Sprinter balloon (Medtronic Inc.) was advanced over the guidewire for balloon predilatation. When the balloon reached the proximal LAD, three radiopaque markers could be seen in the LAD instead of the expected two (►Fig. 2). Immediately, it became obvious that the third marker was that of the tip of the export catheter as confirmed by carefully inspecting the export catheter (which was just withdrawn from the guiding catheter and now lying on the table) for its intactness. It was rather a precarious situation where a thrombogenic broken export catheter was inside a thrombus containing coronary artery with the operator having lost his control over it. As the distance between the distal marker of the balloon and the third marker was very short, it was inferred that only the tip of the export catheter had broken. After this, another Cougar guidewire was advanced across the lesion and positioned in the distal LAD. A 2-mm Amplatz Gooseneck microsnare (eV3, Plymouth, MN) was monorailed into the LAD over the original coronary guidewire, but it could not catch the broken export catheter (►Fig. 3A). The above attempt rather resulted in broken export catheter tip slipping off the guidewire such that it was now lying free in the distal LAD. There was coronary artery spasm and possible thrombus around the broken export tip in the distal LAD (►Fig. 3B). The snare and the first coronary guidewire were taken out leaving the second guidewire in the LAD. The guiding catheter was then deeply intubated carefully in the proximal LAD and a 2.0 × 10 mm Sprinter balloon was advanced over the second guidewire and

Fig. 1 Thrombus containing lesion in ostial-proximal LAD in RAO caudal view. LAD, left anterior descending; RAO, right anterior oblique.

positioned beyond the tip of the broken export catheter. The balloon was inflated to 4 atm (**Fig. 4**). The inflated balloon was pulled from distal to proximal LAD along with the broken tip of export catheter into the guiding catheter. However, the broken tip could not be caught properly within the guiding catheter and it sprang back into the distal LAD. Next, a larger 2.75×10 mm balloon was taken distal to the broken export tip and was inflated at 1 atm pressure in the distal LAD. The inflated balloon was gradually withdrawn with the broken tip trapped proximal to it. As the inflated balloon reached mid to proximal LAD, the pressure in the balloon was gradually increased from 1 to 7 atm so that the broken tip does not slip again from the side of the inflated balloon. Finally, the

Fig. 2 RAO caudal view showing proximal two markers (arrows) of the balloon and distal single marker (arrowhead) of the export catheter. RAO, right anterior oblique.

Fig. 3 (A) Amplatz Gooseneck snare loop (arrow) in the mid-distal LAD; (B) broken export catheter tip (arrow) in distal LAD with spasm and possible thrombus. LAD, left anterior descending.

broken export was caught at the guiding catheter mouth with firm tug by the inflated 2.75 mm balloon holding the broken export catheter (**Fig. 5A**). The guiding catheter was pulled out along with the inflated balloon, coronary guidewire, and the broken export catheter tip as an assembly (**Fig. 5B**). The retrieved export catheter tip having a radiopaque marker on it was measuring approximately 1 cm (**Fig. 6A, B**). Check angiogram showed no residual stenosis/dissection with TIMI III flow (**Fig. 7**). No stent was deployed. The patient was pain free at the time of shifting out of catheterization laboratory and there was a significant ST segment resolution. He was discharged uneventfully after 2 days of low-molecular-weight heparin therapy with left ventricular ejection fraction

Fig. 4 PA cranial view showing 2×10 mm inflated balloon (on second guidewire) distal to the broken export tip. PA, posterior anterior.

Fig. 5 A 2.75 × 10 mm inflated balloon on the second guidewire and the broken export tip caught at the mouth of the guiding catheter (A) in the LAD and (B) in the groin. Note the third marker of export catheter tip (arrow). LAD, left anterior descending.

of 50%. At 2 months follow-up, patient has quit smoking and is asymptomatic.

Discussion

The incidence of broken retained PCI hardware in older literature is approximately 0.2%.² Although the hardware has got refined over the past decade, the increasing number and complexity of percutaneous procedures continue to experience hardware breakage inside the intravascular compartment. Several reports on retrieval of broken catheters, guidewires, balloons, unexpanded, and expanded stents from the intracoronary tree using different techniques are available.²⁻⁴ It is worthwhile to be acquainted with different retrieval techniques since there is no single technique which will succeed in all situations. To the best of our knowledge, this is the first case report of retrieval of a broken export catheter during primary angioplasty.

The common factors contributing to fracture of coronary hardware include excessive torque, forceful withdrawal of the hardware entrapped in an arterial segment, especially through a noncoaxial catheter in a tortuous or calcific vessel. The above is more likely to happen with hardware reuse and polymer aging,³ but may rarely be seen due to a manufacturing defect. The navigation of export catheter in small tortuous and calcified vessels may be difficult and traumatic. The high profile of the export catheter may prevent crossing of the occlusion, and in this case, the device should not be forced. Predilatation with a small 1.5 mm diameter balloon may facilitate the passage of the aspiration catheter though at the cost of increased risk of distal embolization. Any forceful attempt to cross the lesion with the aspiration catheter especially in patients with a difficult anatomy should be avoided.

The kinking of coronary hardware during introduction in guiding catheter should be avoided which was possibly the reason of breakage of export catheter in our case. The partially

Fig. 6 The broken export catheter tip (A) caught at the mouth of guiding catheter (arrow) by firm tug on the inflated balloon; (B) after its retrieval.

Fig. 7 Coronary angiogram in RAO caudal view showing no residual stenosis in the proximal LAD. LAD, left anterior descending; RAO, right anterior oblique.

broken and kinked export catheter got fully transected during its withdrawal from the Tuohy-Borst valve where it got lodged and when the balloon was advanced, the export catheter tip got pushed by the balloon into the LAD.

As the broken fragment in the coronary artery might serve as a nidus for thrombus formation leading to acute occlusion, myocardial infarction and arrhythmias, perforation, and embolic phenomena,⁵ the removal of the broken fragment is mandatory. In our patient due to thrombogenic environment with thrombus proximal to the broken catheter, there was a much higher chance of thrombus formation around the broken tip. Therefore, it was absolutely necessary to retrieve the broken export tip quickly.

Historically, the usual approach for foreign body retrieval had been surgical. The first nonsurgical removal of a fractured segment of a steel spring guide in a patient with mitral insufficiency was reported in 1964.⁶ In 1971 came a report of a series of 29 transvascular foreign body retrieval, 6 of which were done percutaneously.⁷ Since then, percutaneous retrieval of foreign bodies has become a preferred procedure, being more appealing and less invasive.

Recommended strategies include intracoronary vasodilators to relieve spasm⁸ or passage of a second wire and balloon to dilate the area of entrapment⁹ to free the entrapped foreign body. Broken wire tips have occasionally been retrieved with the help of other wires using intertwining technique,⁴ however in most other situations, snares or retrieval forceps/basket are used.^{10,11} The activated clotting time (ACT) should be kept at least 50 seconds higher than usual ACT during angioplasty of 250 to 300 seconds by giving extra dose of heparin so as to prevent thrombus formation around the foreign body.

We believe that once a broken catheter fragment is detected in the coronary artery, all attempts should be made to prevent it from slipping off the coronary guidewire. Unfortunately in our case, the export tip slipped off the guidewire to lie free in the distal LAD. Also if the broken fragment had gone very distal in LAD, it would not have been possible to take any balloon distal to the broken export tip. Hence cautious passage of balloon across the broken tip was necessary so as not to push the broken tip any further as it was already in distal LAD. Further, careful removal was necessary with balloon-assisted retrieval in our case because broken export could have slipped during removal and embolized to other locations especially left circumflex artery. In our case, we intubated the guiding catheter deeply into the proximal LAD because of suitable coronary anatomy (straight large caliber vessel) and this prevented the embolization into the left circumflex artery.

A very small fragment may sometimes be left within an occluded vessel especially if the patient is not a coronary bypass surgery candidate. Some of these fragments may get endothelialized and may have a relatively benign course especially on long-term antiplatelet medications.⁵ However, there are no firm pathological data to support the above.² In fact with the above approach there are possible risks of late

perforation, infection, arrhythmia, and proximal propagation of thrombus resulting in myocardial infarction.⁴ Hence in most cases percutaneous retrieval should be attempted and surgery should be considered if the percutaneous approach either cannot be done or is unsuccessful.

Conclusion

PCI hardware should be handled gently and carefully and strictly according to the manufacturers' instructions for use. The kinking of catheters during introduction in the guiding catheter should be avoided. All angioplasty hardware should be checked for their integrity once taken out of the body of the patient. Balloon-assisted retrieval may be attempted in suitable cases if retrieval by snare is unsuccessful.

Conflict of Interest

We report no financial relationships or conflicts of interest regarding the content herein.

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