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A Novel Technique for Retrieval of a Drug-Eluting Stent After Catheter Break and Stent Loss

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ABSTRACT

Break of a stent delivery catheter and subsequent stent loss (SL) has been a rare event in the drug-eluting stent (DES) era. We here report a case of successful retrieval of a stent after a break of the delivery catheter and SL from a balloon catheter at a culprit lesion. We finally resolved this situation using a simple balloon technique for both the broken stent catheter inside of the guide catheter and the unexpanded stent in the culprit lesion. Thus balloons are an important weapon in our armamentarium in the cardiac catheterization laboratory for urgent retrieval of a lost stent. Their apt use definitely allowed our patient to avoid undergoing emergency cardiovascular thoracic surgery. (**Korean Circ J 2010;40:405-409**)

KEY WORDS: Angioplasty; Transluminal; Percutaneous coronary.

Introduction

Interventional cardiology has grown rapidly following the development of drug-eluting stents (DESs). DES make percutaneous coronary interventions (PCI) simpler, longer lasting and safer. With the advent of these devices, interventions for cases of complex coronary anatomy have increased in numbers, and problems with instrumentation have become apparent. One of the problems is loss of a particular device in the vessel wall.¹⁾ Specifically, stent, catheter or wire loss in the coronary system can lead to thrombosis and myocardial infarction.²⁾ The incidence of stent loss (SL) was reported to be 3.4% earlier, and 0.32% in a recent report.^{2,3)} However, there have been no reports of a stent catheter break described in the literature in the DES era. Here we report a successful retrieval case of two lost DESs by two different methods in a single pa-

tient; one stent was lost due to DES delivery catheter break and the another SL was due to the entrapped DES at the culprit lesion.

Case

A 64 year old male presented with exertional chest pain. The baseline echocardiogram showed a resting regional wall motion abnormality in the apicolateral segment of the left ventricle with an ejection fraction of 55%. An elective coronary angiogram (CAG) showed severe diffuse non-calcified irregular stenosis with a moderate tortuosity in the proximal and mid left anterior descending (LAD) artery (Fig. 1A). The mid circumflex (LCX) artery showed total occlusion with the distal LCX filling up from collaterals from the LAD and right coronary artery (RCA). There was no significant lesion in the left main (LM) artery or the RCA.

The initial target was the mid LAD lesion and informed written consent was obtained. The Extra Back Up (EBU) 3.5 guiding catheter (7F, Medtronic, Minneapolis, MN, USA) was engaged and the LAD and the first diagonal branch (D1) were successfully wired with two Balanced Middle Weight (BMW, Guidant, Indianapolis, IN, USA) wires. The mid LAD lesion was predilated with a 2.0×15 mm Yangtze balloon (Minvasys, Gennevilliers, France) at 8 atm several times. Because a 2.5×33

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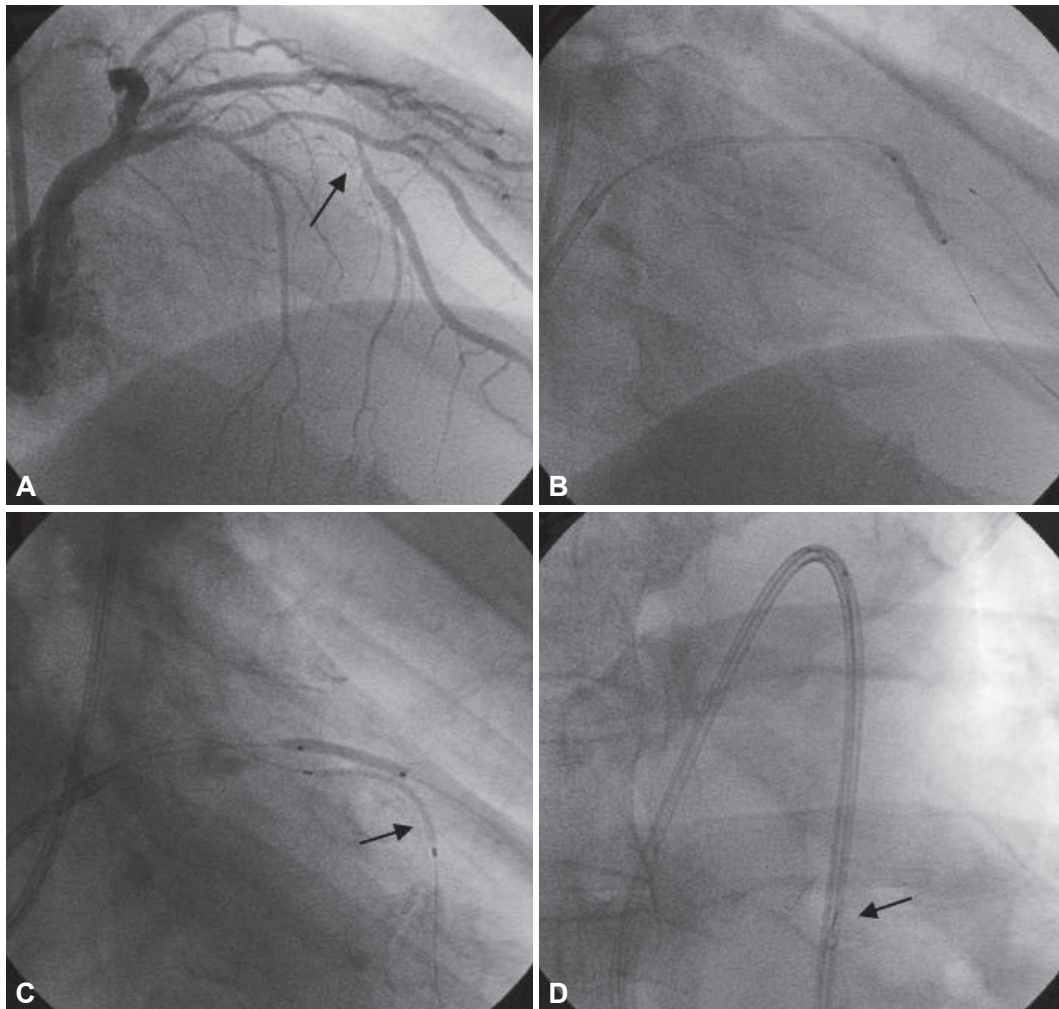


Fig. 1. A: a baseline coronary angiogram in the right anterior oblique view showing the culprit lesion in the mid LAD (arrow). B: predilation was done with a 2.0×15 mm balloon. C: a 2.5×33 mm Taxus stent (arrow) could not cross the culprit lesion in the mid LAD using the 'anchor balloon technique' in the diagonal branch under good guiding catheter support. D: a loop snare (arrow) was then used to grab the broken end of the stent catheter in the guide but it failed to grab it. LAD: left anterior descending artery.

mm Taxus™ {Paclitaxel-eluting stent (PES) Boston Scientific (Natick, MA, USA)} could not pass the culprit lesion, further predilation was performed with a bigger noncompliant balloon (a 3.0×8 mm Quantum Maverick balloon; Boston Scientific) from the distal end of the lesion to the proximal end with varying inflations and durations (Fig. 1B).

A 2.5×33 mm Taxus was used to attempt to cover the lesion, but it failed to cross the culprit lesion, even with the strong support of a side branch (D1) anchor balloon technique (2.0×15 mm Yangtze balloon to D1 at 10 to 14 atm).⁴⁾ While attempting to pull out the stent for further predilation or atheroablative therapy, it was noticed that the stent could not be withdrawn completely, as there was a sudden break in the continuity of the stent delivery catheter. The broken end of the stent delivery catheter was observed in the proximal region of the guiding catheter (Figs. 1D and 2A-C). We attempted to pull out the entire broken catheter and stent assembly using a 2.8F amplatz gooseneck loop snare (Microsnare; Microvena Corporation, White Bear Lake, MN, USA) but failed to grab it

completely (Fig. 1D). We then passed an additional wire and put a 3.0×8 mm Quantum Maverick balloon over this wire and then inflated the balloon to 14 atm. The balloon gripped the broken end of the stent catheter toward the inner wall of the guiding catheter. We pulled out the guiding catheter with the entire system including the stent catheter, the stent wire on which the stent catheter was mounted and the new wire with the inflated balloon ultimately came out from the femoral sheath (Fig. 2A, B and C).

We changed the guiding catheter from 7F to 8F EBU 3.5 for better support and the LAD and D1 were rewired. After several attempts at additional predilation for the mid LAD lesion using a 3.0×8 mm Quantum Maverick balloon, a 2.0×15 mm Yangtze was crossed over the D1 wire and inflated for anchor balloon technique in order to facilitate stent passage to the mid LAD lesion. Despite all efforts, including using a strong guiding catheter back up, and several tries using predilation, a non-compliant balloon and a side branch anchor balloon technique, another 2.5×16 mm Taxus stent was used

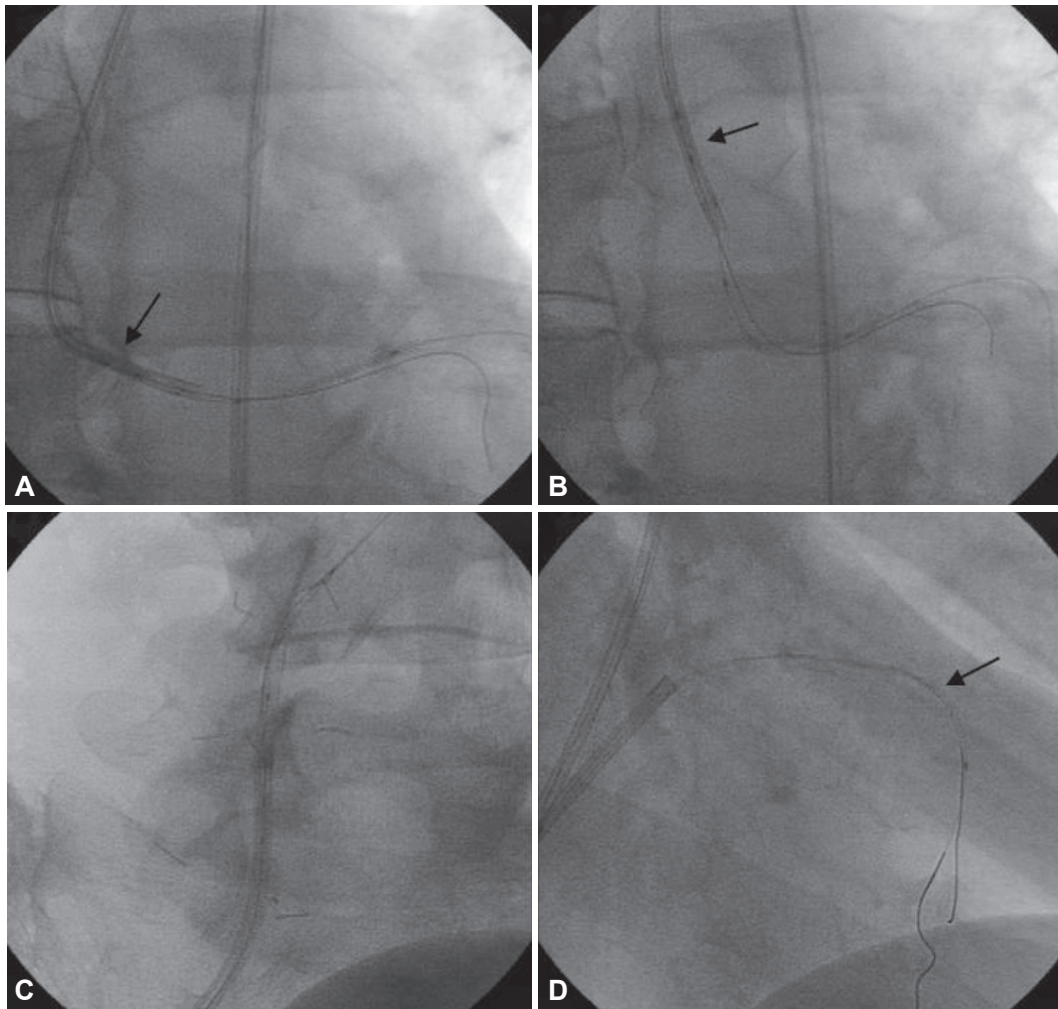


Fig. 2. A 3.0×8 mm semi-compliant balloon (arrow) was inflated to a high pressure (14 atm) in the guide catheter in order to grab the entire assembly (A). B and C show the entire assembly being pulled out at the aortic and sheath levels respectively. After successful rewiring into the second lost unexpanded stent (arrow) in the mid LAD culprit lesion, a 1.5×15 mm balloon was crossed distally over the second lost stent to retrieve it (D).

and also failed to cross the mid LAD culprit lesion. While we were attempting to withdraw the stent, which was entrapped at the mid LAD, it suddenly slipped out from the stent catheter and the unexpanded stent was lost. The stent balloon and the coronary guide wires came out from the guiding catheter. There was a long mid LAD dissection and the patient became hypotensive due to flow limitation to the distal LAD. After we rewired through the unexpanded stent lumen, the 2.8F amplatzer a gooseneck loop snare was again tried to pull out the stent, but it failed to retrieve it. Then, a 1.5×15 mm Maverick balloon was inserted and crossed over the wire to the distal end of the unexpanded stent (Fig. 2D). We inflated the balloon up to 10 atm and tried to pull the unexpanded stent into the guiding catheter. Unfortunately, the stent moved proximally a little but became partially deployed at the proximal LAD. The inflated balloon came out from the guiding catheter (Fig. 3A). Because the clinical situation demanded immediate attention, we deployed the stent proximally in the LAD and dilated the entire segment of the LAD again with bigger

sized balloons (2.5×20 mm Maverick, 2.5×30 mm Stormer; Medtronic, Minneapolis, MN, USA) (Fig. 3B). We used a longer balloon (2.5×30 mm Stormer) from proximal to distal LAD to calm down or minimize the dissection and enough predilation to restore hemodynamic and further stenting. It took less than 5 minutes to escape from hemodynamic compromise due to stent entrapment and diffuse dissection under inotropic agent support.

Finally we deployed a 2.75×24 mm Taxus stent in the mid to distal LAD with its proximal end overlapping with the 2.75×32 mm Taxus stent. The 2.75×32 mm Taxus stent was overlapped proximally with the distal end of the 2.5×16 mm Taxus stent which was lost (Fig. 3C). The final result showed 10% residual stenosis in the proximal LAD with Thrombolysis in Myocardial Infarction (TIMI) III antegrade flow without visible intimal dissection (Fig. 3D).

We completed the procedure by crossing the total occlusion lesion in the mid LCX with a Pilot 50 (Guidant) wire with a 2.0×15 mm balloon support and stenting with a 2.75×24

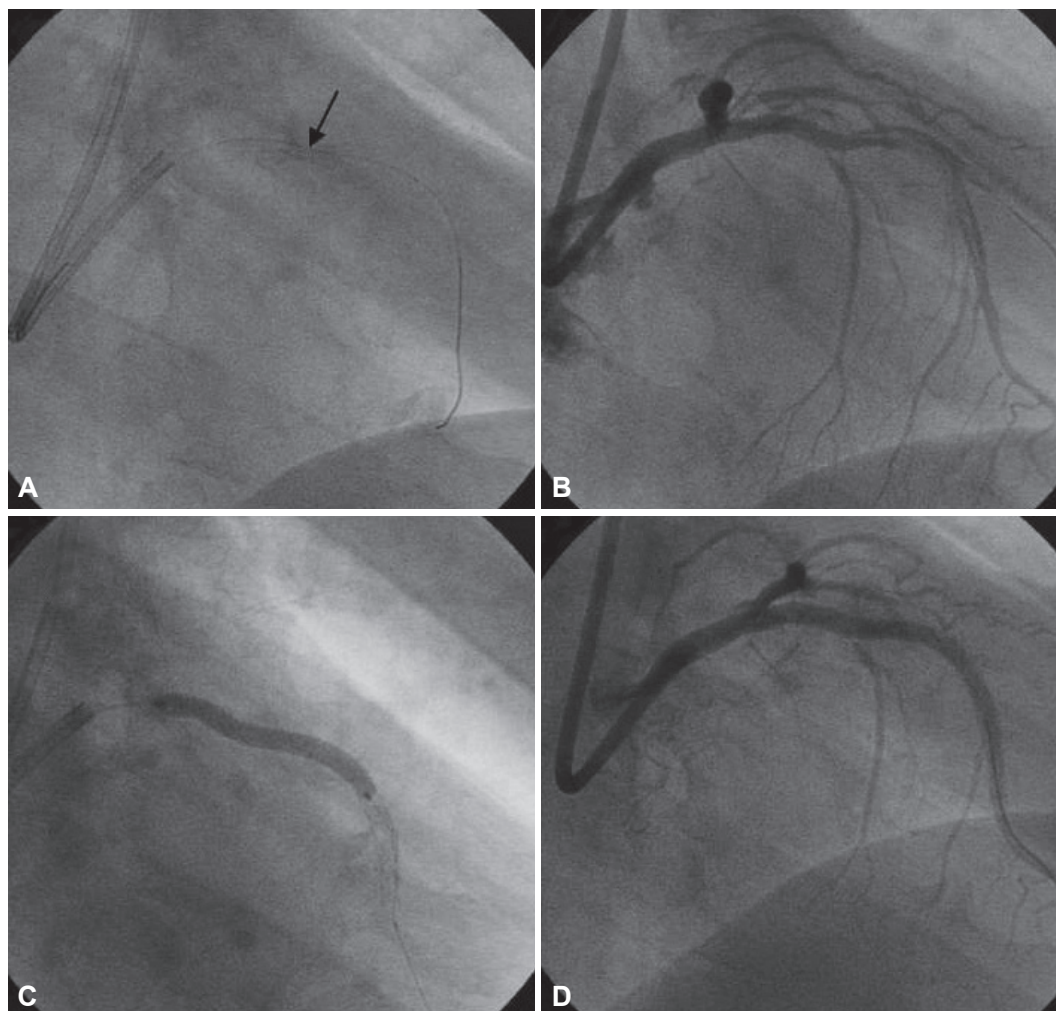


Fig. 3. A simple balloon technique using a 1.5×15 mm balloon distal to the unexpanded stent (Taxus 2.5×16 mm) failed to retrieve it and the stent was partially deployed (arrow, A). The underexpanded lost stent was completely deployed over the proximal LAD using a larger 2.5×20 mm balloon (B). The two 2.75 mm Taxus stents were successfully deployed distal to the lost stent (C) to give an excellent final result (D).

mm Taxus stent to give good TIMI III antegrade flow and complete revascularization.

Discussion

The incidence of SL due to stent catheter break is very rare in the DES era and has not yet been reported in the literature. We failed to grip the stent catheter with the amplatz goose neck loop snare. Hence, we decided to use a 'simple balloon technique' of inflating the balloon inside of the guiding catheter to grip the broken and redundant stent catheter toward the inner wall of the guiding catheter. We decided to use a non-compliant balloon with high pressure inflation rather than a compliant balloon to firmly grab the broken stent delivery catheter assembly. This technique has not been described for a stent catheter break in the DES era. We searched the earlier literature and found a similar retrieval method described for an angioplasty balloon catheter break from India and Taiwan.^{4,5)} The mechanisms for the stent delivery catheter break

in our case remain elusive as we did not apply excess pressure to kink the balloon catheter. The break occurred around 15 cm from the wire balloon interface in the monorail system. The stripping of the catheter like an onion core peel off when we tried to pull the catheter is not explainable as the force we applied was minimal. One hypothesis is that we forcefully pushed the stent delivery catheter to achieve a proper stenting position using the anchor balloon technique and this possibly had an impact on a weak point in the stent delivery catheter. However, this may not be the critical reason. Because this is a very rare occurrence, the industry should take a note of this unexpected complication and strengthen their stent catheter systems.

There has been a decrease in the incidence of SL in recent years. The reason for this decline is the proper and complete crimping of the stents and better stent designs. In earlier eras, stents were manually crimped and thus were prone to loss as they were unevenly crimped. The area which was not in contact with the balloon gave way and caused SL. The stents are

circumferentially evenly crimped to the stent balloon catheter with the advent of machine crimping and this might have significantly reduced the SL.^{2,3)} Other possible predisposing factors promoting SL are anatomical and technical aspects during the procedure. Among anatomical issues, complex lesion subsets such as severely tortuous, diffuse long, severely angulated and heavily calcified lesions may need special attention to prevent stent entrapment and subsequent SL during the pull back. Regarding technical issues, forceful maneuvering of the stent without enough predilation or a debulking process can cause deformation and distortion of the stent itself. Thus pulling back of the unexpanded stent in this situation increases the risk of SL.

If the lost stent is not immediately retrieved from the coronary artery by percutaneous devices, it can cause coronary thrombosis and subsequent myocardial infarction, which would complicate the clinical situation and would require urgent open heart surgery for stent removal.²⁾ SL in the ascending aorta may cause severe neurological events by systemic embolization.²⁾ Peripheral embolization of the lost stent usually is not associated with side effects requiring intervention.^{2,3)}

There are a variety of stent retrieval methods described in the literature such as using a snare device, a multipurpose basket, a variety of forceps, even Angioguard (a distal protection device), simple balloon and just crushing of the stent into the vessel wall by a balloon.²⁽⁶⁻⁹⁾ We lost another stent after retrieval of the broken stent delivery catheter but this time it was the slippage of the stent itself out of the stent delivery catheter. We tried to retrieve the lost stent using a loop snare and by a simple balloon technique using small balloon inflation distal to the unexpanded stent; but we failed. While pulling out the unexpanded stent using this inflated small balloon distal to the stent, the inflated balloon slipped back into the guiding catheter and the stent was partially deployed at the proximal LAD. In this critical situation there is no option but to deploy the stent completely using a bigger balloon, or to crush the stent at the LAD lumen. We fully expanded the entrapped stent using a bigger balloon to restore hemodynamic stability quickly in this bailout situation. This restored good patency of the proximal LAD which enabled subsequent successful stenting in the proximal to mid LAD.

If the wire is exactly in the lumen of the unexpanded stent, one should consider deploying the stent only if it nearly matches the reference diameter. In our case there was a minimal difference of only 0.25 mm between the reference vessel and the stent diameter. If the reference diameter had been more than 0.5 mm, we would have crushed this stent with another bigger diameter stent to achieve a larger stented area.

Retrieval techniques for SL in different situations require different methods, but the use of a simple balloon remains an important weapon in the interventional laboratory. In our case,

their apt use avoided major cardiovascular/thoracic surgery.

Because this patient was treated in 2005, in the early period of the DES era, many devices were not available at that time. Currently, for an easier, safer and quicker procedure, we have more options. We can try parallel wiring with stiffer wire using Grandslam wire (Asahi, Nagoya, Japan) which can make straight the tortuous target vessel and give stronger back up support for stent delivery. Another excellent option is to use the 'Child-in Mother catheter' technique using a 5F Heartrail catheter (Terumo, Tokyo, Japan). By deeply engaging and approaching the target lesion with a 5F Heartrail catheter using a main branch anchor balloon technique in the mid LAD, one may be able to more easily deliver the stent into the proper position. In addition, we have more options in current generation DES including the Everolimus-eluting stent and the Zotarolimus-eluting stent, which are more deliverable in tough lesion subsets.

For a better understanding of lesion characteristics and successful procedures, examination by intravascular ultrasound (IVUS) would have given more information regarding distribution of calcification and plaque. Although we have hesitated to use IVUS for fear of failing to cross the lesion or developing complications, we might have selected more aggressive lesion preparation before stenting if we have done the IVUS examination.

REFERENCES

- 1) Hur JM, Jeon JI, Jo KG, Choi JW, Moon CH. *Two cases of non surgical removal of intravascular foreign bodies. Korean Circ J 1997; 27:922-6.*
- 2) Eggebrecht H, Haude M, von Birgelen C, et al. *Nonsurgical retrieval of embolized coronary stents. Catheter Cardiovasc Interv 2000;51: 432-40.*
- 3) Brilakis ES, Best PJ, Elesber AA, et al. *Incidence, retrieval methods, and outcomes of stent loss during percutaneous coronary intervention: a large single-center experience. Catheter Cardiovasc Interv 2005; 66:333-40.*
- 4) Fujita S, Tamai H, Kyo E, et al. *New technique for superior guiding catheter support during advancement of a balloon in coronary angioplasty: the anchor technique. Catheter Cardiovasc Interv 2003;59: 482-8.*
- 5) Trehan V, Mukhopadhyay S, Yusuf J, C Ramgasetty U, Mukherjee S, Arora R. *Intracoronary fracture and embolization of a coronary angioplasty balloon catheter: retrieval by a simple technique. Catheter Cardiovasc Interv 2003;58:473-7.*
- 6) Foster-Smith KW, Garratt KN, Higano ST, Holmes DR Jr. *Retrieval techniques for managing flexible intracoronary stent misplacement. Cathet Cardiovasc Diagn 1993;30:63-8.*
- 7) Eeckhout E, Stauffer JC, Goy JJ. *Retrieval of a migrated coronary stent by means of an alligator forceps catheter. Cathet Cardiovasc Diagn 1993;30:166-8.*
- 8) Kim MH, Cha KS, Kim JS. *Retrieval of dislodged and disfigured transradially delivered coronary stent: report on a case using forcep and antegrade brachial sheath insertion. Catheter Cardiovasc Interv 2001; 52:489-91.*
- 9) Berder V, Bedossa M, Gras D, Paillard F, Le Breton H, Pony JC. *Retrieval of a lost coronary stent from the descending aorta using a PTCa balloon and biopsy forceps. Cathet Cardiovasc Diagn 1993;28:351-3.*