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Preliminary Reports . . . work in progress

Retrieval of Undeployed Stents From the Right Coronary Artery: Report of Two Cases

Frank L.M.J. Veldhuijzen, CT, Hans J.R.M. Bonnier, MD, H. Rolf Michels, MD, Mamdouh I.H. El Gamal, MD, and Berry M. van Gelder, BE

Two patients are described in whom an undeployed stent (1 Wiktor and 1 Palmaz-Schatz) was retained in the proximal segment of the right coronary artery during coronary angioplasty. In both cases the stent was caught by a technique using a second guidewire. The stent was removed in the first patient during bypass surgery; in the second patient it was removed from the femoral sheath.

Key words: angioplasty, complication, stent

INTRODUCTION

One of the major acute complications of coronary angioplasty is coronary dissection followed by impairment of coronary flow and subsequent acute closure. Development of intracoronary stents has proven to be a means of alleviating acute or threatened ischemia caused by antecedent coronary dissection [1].

Although the success rate of stent placement is relatively high, it is associated with a minor percentage of complications, e.g., bleeding, unsuccessful stent deployment, and loss of stents (systemic embolization), usually without apparent clinical sequelae [2].

Unlike stents lost in the systemic circulation, undeployed stents in the coronary arteries should be removed immediately. Bypass surgery of course is one option but recently we developed a technique for retrieving undeployed stents from the coronary circulation that can probably avoid surgical intervention.

From the Department of Cardiology, Catharina Hospital, Eindhoven, The Netherlands.

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Address reprint requests to Frank Veldhuijzen, Department of Cardiology, Catharina Hospital, Michelangelolaan 2, 5623 EJ Eindhoven, The Netherlands.

PATIENT 1

A 61-year-old female underwent angioplasty for a 90% stenosis (type B lesion) in the midsegment of the right coronary artery. The right coronary artery was intubated with a right Judkins 4 cm guiding catheter. The lesion was crossed with a 0.014″ high torque floppy guidewire (Advanced Cardiovascular Systems, ACS) and subsequently dilated with a 2.5 mm ACX II balloon (ACS). The balloon was inflated three times for periods ranging from 30 to 60 sec.

Inflation pressure was 6–7 atm. Control angiogram after dilatation showed a longitudinal dissection at the site of the lesion. A fourth inflation with a pressure of 7 atm. was performed for a period of 90 sec without improvement. Because of impairment of coronary flow it was decided to implant a Palmaz-Schatz stent. Medication was started according to the protocol.

The 2.5 mm dilatation balloon was removed—using a DOC extension wire—while the guidewire was kept in position in the right coronary artery. A Palmaz-Schatz stent was mounted on a 3.0 mm ACX II balloon and advanced into the guiding catheter. After entering the proximal segment of the right coronary artery it was impossible to advance the balloon to the dissected area. The balloon was withdrawn into the guiding catheter and during this maneuver, the stent slipped off the balloon and remained in the proximal segment of the right coronary artery. The balloon was removed from the guiding catheter, while the guidewire was kept in place. A second guidewire (0.014″ high torque standard, ACS) was inserted into the guiding catheter and advanced into the right coronary artery across the stent and the dilated segment. Both ends of the guidewires were fixed in a torquer device, which was rotated approximately 15 times, until movement and twisting of the wires was observed inside the coronary artery.

We then tried to pull on the wires; it appeared that the stent was caught by both twisted wires because a strong resistance was felt; but traction with moderate force was unsuccessful in removing wires and stent. Forceful pulling was avoided because we feared perforation of the proximal right coronary artery segment. The patient was transferred to the operation room for emergency bypass surgery. After opening the ascending aorta both wires were visible and a gentle pull by the surgeon was enough to remove the stent and the wires from the right coronary artery without any sign of perforation (Fig. 1). Bypass

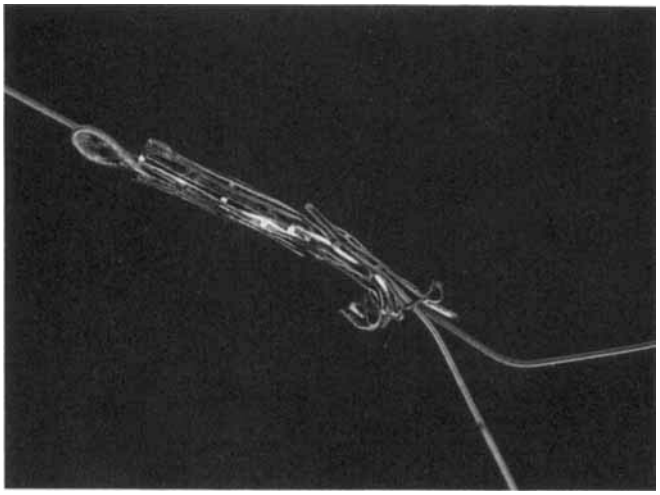

Fig. 1. Palmaz-Schatz stent caught by two guidewires and removed during bypass surgery.

surgery for the right coronary artery was performed without further complications.

PATIENT 2

A 52-year-old male underwent repeat angioplasty of a lesion in the mid-segment of the right coronary artery. There was a 70% stenosis associated with a dissection from the previous PTCA (Fig. 2). Because of restenosis and residual dissection it was decided to implant primarily a Wiktor (Medtronic, Inc.) stent. The right coronary artery was intubated with an 8F right Judkins 4 cm guiding catheter. A 0.014″ high torque floppy guidewire (Advanced Cardiocascular Systems) crossed the lesion with difficulty. The balloon mounted stent could not be advanced beyond the proximal segment of the right coronary artery. During an attempt to withdraw the balloon in the guiding catheter, the Wiktor stent slipped off the balloon and remained in the proximal segment of the right coronary artery. Subsequently a DOC extension wire was connected to the high torque floppy guidewire and the balloon was removed from the guiding catheter. An attempt to cross the stent with a second high torque floppy guidewire failed. A 0.014″ Schneider guidewire could be advanced into the proximal segment of the right coronary artery and just passed the Wiktor stent (Fig. 3) but could not be advanced distally. A subsequent attempt to cross the stent with a high torque standard 0.018″ guidewire was successful. Both guidewires were inserted in a torquer device (Fig. 4) and rotated approximately 15 times, until movement and twisting of the wires in the coronary artery was observed. The guiding catheter was advanced into the proximal segment of the right coronary artery, and by a forceful pull on the guiding catheter and

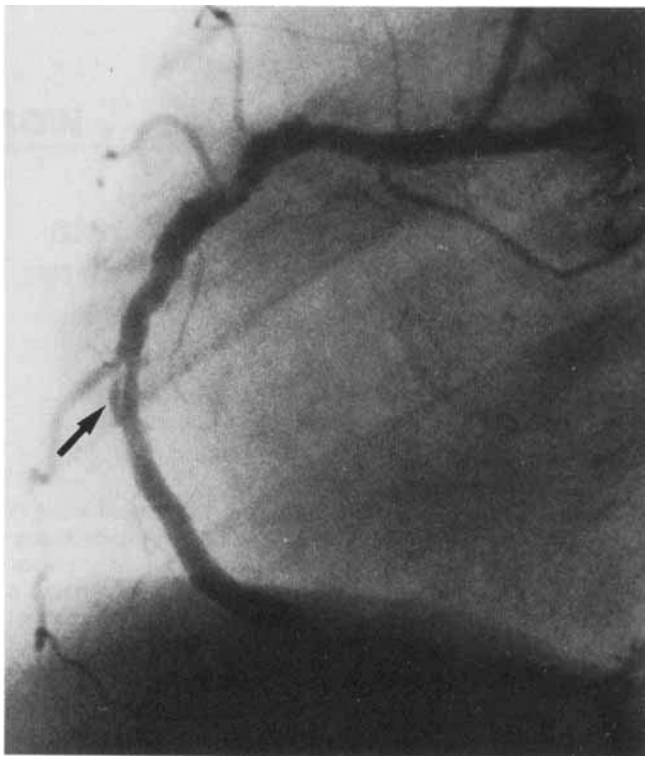

Fig. 2. Angiogram of the right coronary artery (patient 2), left anterior oblique position, showing a 70% lesion with dissection (arrow) in the midsegment.

guidewires the stent was removed from the coronary artery (Fig. 5). Removal from the sheath was performed without any problem.

Angiography revealed a patent vessel without any visible damage at the site of stent removal. Because flow was unimpaired in the right coronary artery no further intervention was required.

DISCUSSION

An increasing number of case reports describe equipment used for coronary intervention and its entrapment, fracture, and retention inside the coronary arteries [3–16]. Fracture of guidewires and detachment of tips of balloons on wire have been frequently reported. The long term sequelae of retained guidewire fragments in patent coronary arteries is still uncertain. Only one report [17] describes diffuse narrowing of the arterial segment that contained a retained guidewire fragment from a PTCA 3 months previously. This experience supports the general opinion that is in favour of removal of undesired foreign bodies from the coronary artery.

Several techniques have been reported for retrieval of angioplasty wire fragments from a coronary artery, varying from commercially available systems [18] to home

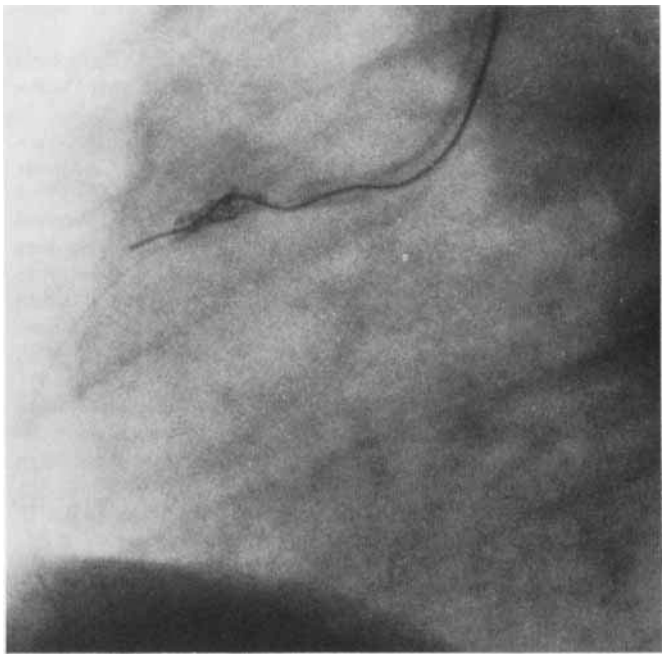

Fig. 3. Left anterior oblique view showing the undeployed, retained Wiktor stent in the proximal segment of the right coronary artery. The 0.014" high torque floppy is positioned distally in the right coronary artery; the second guidewire (Schneider) has just crossed the stent but could not be positioned distally in the right coronary artery.

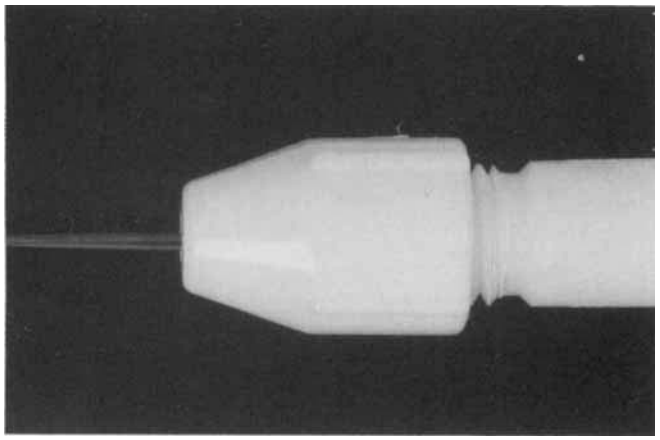

Fig. 4. Torquer device with both wires inserted.

made devices [19]. Development of intracoronary stents for the prevention of restenosis and treatment of acute closure after angioplasty is a valuable tool but has added one more item on the list of foreign bodies that can be retained inside the coronary artery. Failed delivery and unsuccessful deployment has been reported. Failed delivery rarely resulted in clinical sequelae for the patient—most stents were withdrawn—but some emobolized systemically during attempted withdrawal into the femoral sheath [1]. No reports describe details on treatment of undeployed, retained stents in the coronary artery.

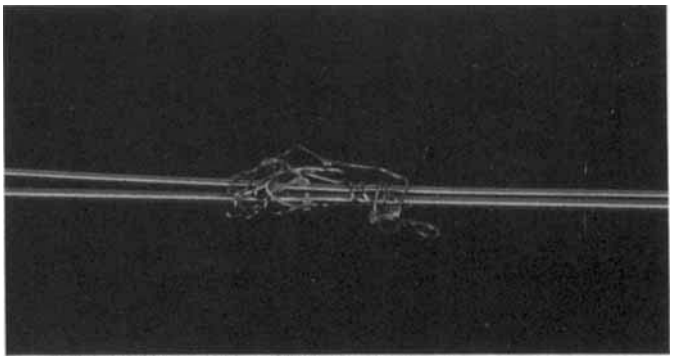

Fig. 5. Wiktor stent after removal from the proximal right coronary artery.

Pan et al. [20] recently reported on peripheral stent recovery after failed intracoronary delivery, but they restricted their report to stents lost from the balloon outside the coronary artery. The undeployed stents in our two patients however were retained inside the coronary artery and could not be retrieved by just withdrawing the balloon, wire, and guiding catheter assembly. The technique of stent retrieval is relatively easy. In our experience a relatively stiff wire (high torque standard 0.014 and 0.018") was required to recross the undeployed stent. In order to snare a stent with two wires it is essential that the second wire not follow the central lumen of the stent but crosses one of its filaments. In practice this will be the case because traversing the central lumen with the second wire is exceptional. This is an advantage in those cases in which the stent is difficult to see on fluoroscopy, such as for instance the Palmaz-Schatz stent.

The amount of tension resulting from pulling the wires is difficult to quantify. In our second patient a brief forceful pull was sufficient to retrieve the stent from the coronary artery. We advise trying this first; if it fails sustained gentle traction for a short period of time should be applied followed by one or more short forceful pulls if necessary.

Losing the stents in our patients was unpredictable from the anatomical appearance of the proximal vessel segment that had to be stented. There were no excessive bends, nor visible calcification (Fig. 2). The use of a delivery system [21] probably will prevent loss of stents, but these systems are not manufactured for all commercially available stents.

The technique described is applicable to stents lost in proximal vessels without tortuosity. Retrieval of stents lost in proximal tortuous vessels or in distal locations should be attempted with extreme care. Pulling the wires under these conditions will stretch the proximal vessel segment with potential damage. Even if retrieval of an

undeployed stent in a coronary artery is not considered, snaring it with two wires may be helpful in removing the stent during the subsequent surgical procedure.

REFERENCES

1. Schatz RA, Baim DS, Leon M, Ellis SG, Goldberg S, Hirshfeld JW, Cleman MW, Cabin HS, Walker C, Stagg J, Buchbinder M, Teirstein PS, Topol EJ, Savage M, Perez JA, Curry RC, Whitworth H, Sousa JE, Tio F, Almagor Y, Ponder R, Penn IM, Leonard B, Levine SL, Fish RD, Palmaz JC: Clinical experience with the Palmaz-Schatz coronary stent; initial results of a multicenter study. Circulation 83:148–161, 1991.
2. Colombo A, Hall P, Thomas J, Almagor Y, Finci L: Initial experience with the disarticulated (one-half) Palmaz-Schatz stent: a technical report. Cathet Cardiovasc Diagn 25:304–308, 1992.
3. Steele PM, Holmes DR, Mankin H, Schaff HT: Intravascular retrieval of broken guidewire from the ascending aorta after percutaneous transluminal coronary angioplasty. Cathet Cardiovasc Diagn 11:623–628, 1985.
4. Khonsari S, Livermore J, Mahrer P, Magnusson P: Fracture and dislodgement of floppy guidewire during percutaneous transluminal coronary angioplasty. Am J Cardiol 58:855–856, 1986.
5. Keltai M, Bartek I, Biro V: Guidewire snap causing left main coronary occlusion during coronary angioplasty. Cathet Cardiovasc Diagn 12:324–326, 1986.
6. Krone R: Successful percutaneous removal of retained broken coronary angioplasty guidewire. Cathet Cardiovasc Diagn 12: 409–410, 1986.
7. Hartzler GO, Rutherford BD, McConahay DR: Retained percutaneous transluminal coronary angioplasty equipment components and their management. Am J Cardiol 60:1260–1264, 1987.
8. Watson LE: Snare loop technique for removal of broken steerable PTCA wire. Cathet Cardiovasc Diagn 13:44–49, 1987.
9. Lotan C, Hasin Y, Stone D, Meyers S, Applebaum A, Gotsman M: Guidewire entrapment during PTCA: a potential dangerous complication. Cathet Cardiovasc Diagn 13:309–312, 1987.
10. Stellin G, Ramondo A, Bortolotti U: Guidewire fracture: an unusual complication of percutaneous transluminal coronary angioplasty. Int J Cardiol 17:339–342, 1987.
11. Rizzo T, Werres R, Ciccone J, Karanam R, Shah S: Entrapment of an angioplasty balloon catheter: a case report. Cathet Cardiovasc Diagn 14:255–257, 1988.
12. Mikolich JR, Hanson MW: Transcatheter retrieval of intracoronary detached angioplasty guidewire segment. Cathet Cardiovasc Diagn 15:44–46, 1988.
13. Proctor MS, Loch LV: Surgical removal of guidewire fragment following transluminal coronary angioplasty. Ann Thorac Surg 45:678–679, 1988.
14. Sethi G, Ferguson TB, Miller G, Scott SM: Entrapment of broken guidewire in left main coronary artery during percutaneous transluminal coronary angioplasty. Ann Thorac Surg 47:455–457, 1989.
15. Serota H, Deligonul U, Lew B, Kern M, Vandormael M: Improved method for transcatheter retrieval of intracoronary detached angioplasty guidewire segments. Cathet Cardiovasc Diagn 17:248–251, 1989.
16. Van den Brand M, de Feyter P, Serruys PW, Zijlstra F, Bos E: Fracture of a balloon on a wire device during coronary angioplasty. Cathet Cardiovasc Diagn 16:253–257, 1989.
17. Doorey AJ, Stillabower M: Fractured and retained guidewire fragment during coronary angioplasty—unforeseen late sequelae. Cathet Cardiovasc Diagn 20:238–240, 1990.
18. Mintz GS, Bemis CE, Unwala AA, Hadjimiltiades S, Kimbiris D: An alternative method for transcatheter retrieval of intracoronary angioplasty equipment fragments. Cathet Cardiovasc Diagn 20: 247–250, 1990.
19. Savas V, Schreiber T, O'Neill W: Percutaneous extraction of fractured guidewire from distal right coronary artery. Cathet Cardiovasc Diagn 22:124–126, 1991.
20. Pan M, Medina A, Romero M, Suárez de Lezo J, Hernández E, Pavlovic D, Melián F, Marrero J, Cabrera JA: Peripheral stent recovery after failed intracoronary delivery. Cathet Cardiovasc Diagn 27:230–233, 1992.
21. Baim DS, Bailey S, Curry C, Walker C, Schatz RA: Improved success and safety of Palmaz-Schatz coronary stenting with a new delivery system. Circulation 82(Suppl III):III–657, 1990.