Coronary artery aneurysm after stent implantation: acute and long-term results after percutaneous treatment with a stent graft

Paolo Rubartelli, Giacomo Terzi, Lorenzo Borgo, Corinna Giachero

Division of Cardiology, San Martino Hospital, Genoa, Italy

Key words:
Aneurysm;
Coronary angioplasty;
Intravascular ultrasound;
Stent.

A patient with unstable angina was treated with elective Palmaz-Schatz stent implantation on a focal stenosis of the left circumflex artery. One year later, a large (13 mm in diameter) coronary artery aneurysm was diagnosed at angiography in the stented site. Intravascular ultrasound examination confirmed the presence of a true aneurysm located at the proximal end of the stent. The aneurysm was successfully treated with a Jostent Graft (Jomed Implantate) consisting of two slotted tube stainless steel stents supporting a polytetrafluoroethylene tube. The stent graft was implanted under intravascular ultrasound guidance. The 18-month angiographic follow-up showed good patency of the stent graft and complete exclusion of the aneurysm.

(Ital Heart J 2002; 3 (3): 202-205)

Received January 30, 2002; revision received February 20, 2002; accepted March 7, 2002.

Address:

Dr. Paolo Rubartelli

Divisione di Cardiologia
Ospedale San Martino
Largo Rosanna Benzi, 10
16132 Genova
E-mail:
prubartelli@smartino.ge.it

The development of a coronary artery aneurysm (CAA) after coronary stent implantation is a rare event. The natural history, as well as the best treatment of this pathological condition has not yet been well defined. Only one case of percutaneous repair of post-stent CAA has been reported[1]. This report refers to a case of a large CAA developing late after stent implantation in a patient who was hence submitted, under intravascular ultrasound (IVUS) guidance, to percutaneous implantation of a stent graft. The patient's long-term angiographic follow-up is also described.

Case report

A 57-year-old man with a history including a previous bypass operation and unstable angina was submitted to elective Palmaz-Schatz stent implantation on a focal stenosis of the left circumflex artery. The final dilation was achieved with a 15 mm long 4.0 mm balloon inflated at 12 atm. The angiographic result was optimal (a residual stenosis of 7% as evaluated at quantitative coronary angiography) (Fig. 1). No sign of dissection or perforation was apparent at any time during the procedure.

Although the patient remained asymptomatic, a routine coronary angiography performed 1 year later showed a large (13.2 mm in diameter at quantitative coronary angiography) aneurysm at the site of stent implantation without significant restenosis (Fig. 2). IVUS examination was performed using a 2.5-3.5F rapid-exchange catheter with a 20 MHz electronic transducer (Vision F/X, Endosonic, Rijwijck, The Netherlands). IVUS demonstrated symmetric stent expansion (minimal luminal area 12.1 mm^2) and the presence of a proximally located true aneurysm with a maximum diameter exceeding 12 mm, which is the width of the field of the Endosonic system (Fig. 2).

After obtaining written informed consent, a 7F Amplatz Left III guiding catheter was positioned at the left coronary ostium and a 0.014" extra support guide wire was advanced into the distal left circumflex artery. A 19 mm long Jostent Graft (Jomed Implantate, Rangendingen, Germany), consisting of two slotted tube stainless steel stents supporting a polytetrafluoroethylene (PTFE) tube in a sandwich technique, was hand-crimped on a 30 mm long 3.5 mm balloon and deployed to exclude the aneurysm. Attention was paid not to cover the origin of the small side branch just proximal to the CAA. The stent graft was post-dilated with a 4.5 mm non-compliant balloon (NC Viva, Boston Scientific Inc., Natick, MA, USA) inflated at 20 atm with complete exclusion of the aneurysmal sac and no residual stenosis (minimal luminal area 11.3 mm^2) (Fig. 3). The size of the balloon was chosen on the basis of the IVUS media-to-media diameter of the vessel

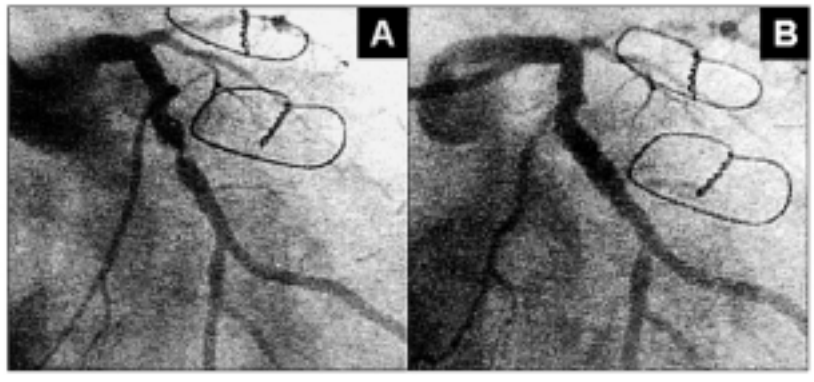

Figure 1. *Left coronary angiogram before* (A) *and after* (B) *elective Palmaz-Schatz stent implantation on a 70% stenosis of the left circumflex coronary artery.*

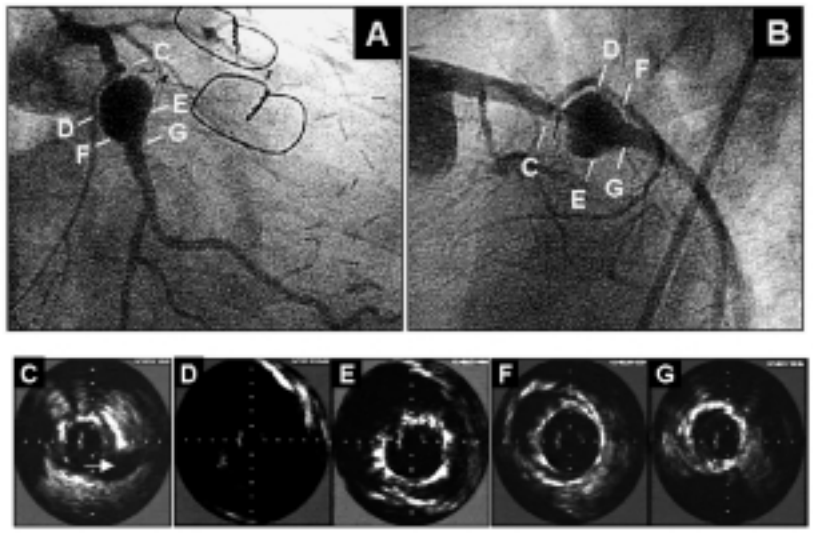

Figure 2. *Angiography* (A, B) *and intravascular ultrasound imaging (C-G) show the presence of a true aneurysm beginning a few mm proximal to the stent and extending to the middle of the stent.* A: *right anterior oblique caudal view.* B: *left anterior oblique cranial view.* C: *vessel proximal to the aneurysm. The origin of a small atrial branch can be appreciated* (arrow). D: *aneurysm with a maximum diameter exceeding 12 mm, which is the size of the field of the intravascular ultrasound system.* E, F: *proximal half of the Palmaz-Schatz stent surrounded by the aneurysm. In* F, *there is no contact between the stent struts and the aneurysmal wall over the entire circumference.* G: *distal half of the stent fully attached to the vessel wall. The minimal area of the stent is 12.1 mm*^{2}.

proximal and distal to the CAA, while the 20 atm final inflation was performed to overcome the stiffness of the Jostent Graft due to its three-layered structure. The patient was discharged after 2 days, with a prescription for ticlopidine for 3 months and aspirin indefinitely.

He remained asymptomatic for 18 months, after which he was readmitted to the hospital because of an episode of heart failure. At that time, coronary angiography (Fig. 4) revealed a 30% stenosis in the proximal part of the stent graft while the CAA was no longer visible.

Discussion

A CAA is usually defined as a localized coronary artery dilation which exceeds the diameter of the adjacent normal segment by 1.5 times[2]. According to this definition, the incidence of CAA has been reported to vary from 1.4% in an autopsy study[3] to 4.9% in the Coronary Artery Surgery Study[2], where the CAA was detected at angiography. In adults, spontaneous CAAs are generally caused by atherosclerosis[3].

CAAs have been also reported to occur after balloon angioplasty[4-9], directional atherectomy[10-12], laser angioplasty[13], and stent implantation[8,14-16]. IVUS examination enables us to distinguish true aneurysms from false aneurysms. In the former, the aneurysmal wall contains the medial tissue that shows continuity with the media of the adjacent normal coronary segment. In the latter, the aneurysm is delimited only by adventitial tissue or even just by the visceral pericardium[17]. False aneurysms are often[18-20] but not always[17,21,22] a consequence of coronary perforation.

The natural history of spontaneous CAA is not well defined, although anecdotal cases of thrombosis, embolization and rupture have been reported[23,24]. The

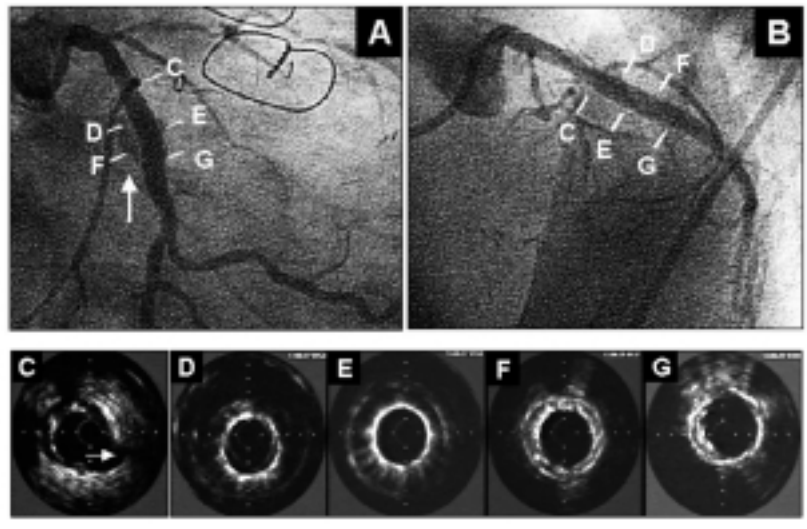

Figure 3. *Angiography* (A, B) *and intravascular ultrasound imaging (C-G) after exclusion of the aneurysm with a Jostent Graft.* A: *right anterior oblique caudal view. A faint residual staining of the aneurysmal sac due to the remaining contrast material* (arrow) *is apparent.* B: *left anterior oblique cranial view.* C: *vessel proximal to the aneurysm. The origin of the small atrial branch is not covered by the stent graft* (arrow). D, E: *expanded Jostent Graft with a minimal luminal area of 11.3 mm*^{2}. G: *Palmaz-Schatz stent distal to the Jostent Graft.*

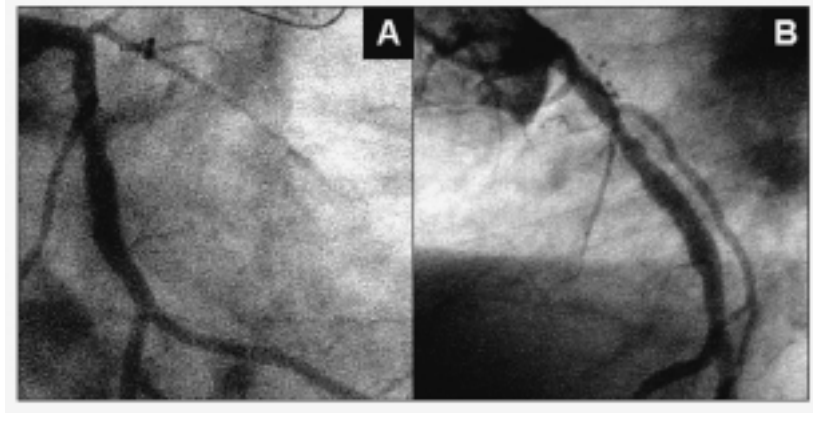

Figure 4. *Left coronary angiogram 18 months following the implantation of the Jostent Graft.* A: *right anterior oblique caudal view.* B: *left anterior oblique cranial view. A 30% stenosis can be seen in the proximal part of the stent graft, while the aneurysm is no longer visible.*

long-term outcome of post-intervention CAA is unknown. However, all but one[7] post-intervention true CAAs reported in the literature are small in diameter, varying from 4.1 to 7.3 mm[1,6,9-11,14-16,25], while the CAA reported herein is relatively large (13 mm). Theoretically, the risk of rupture or thrombosis should increase with an increase in size. For this reason, we decided to offer to our patient the option of percutaneous treatment of the CAA with a Jostent Graft.

Only a few cases of either spontaneous or post-intervention CAA, as well as post-intervention false aneurysms, treated with autologous vein[17,18,25-27] or PTFE covered stents[1,18,22,28-33] have been reported. In addition, the Jostent Graft has been used in coronary perforations and saphenous vein graft lesions. In the largest published experience[34], including 109 cases of vein graft lesions, only one case of subacute thrombosis and a restenosis rate of only 17% were reported.

The Jostent Graft has several advantages over autologous vein covered stents. Incision and harvesting of the vein are not required, thus avoiding inconvenience for the patient and reducing the duration of the procedure. The Jostent Graft profile, although higher than that of a regular stent, is much lower than that of the autologous vein covered stent, allowing the use of a 6 or 7F guiding catheter. This device, as well as other covered stents, cannot be used to treat a CAA located on a side branch. In this case, not only would the implantation of a covered stent occlude the side branch and cause ischemia, but the side branch could also refurnish the CAA with blood via a collateral circulation.

IVUS imaging is particularly useful during the percutaneous treatment of a CAA. Before the procedure, IVUS allows us to distinguish between true and false aneurysms, provides detailed information about the size and wall morphology of the target vessel, and clarifies the relationship between the CAA and the previ-

ously implanted stent. After treatment, IVUS can confirm the adequacy of the position of the stent graft proximal and distal to the CAA such that the operator is sure of the complete exclusion of the aneurysmal sac. The expansion of the device may also be assessed.

In conclusion, the implantation of a stent graft on a CAA occurring after stent implantation was found to be feasible and effective. The long-term outcome was satisfactory.

References

1. Heuser RR, Woodfield S, Lopez A. Obliteration of a coronary artery aneurysm with a PTFE-covered stent: endoluminal graft for coronary disease revisited. Catheter Cardiovasc Interv 1999; 46: 113-6.
2. Swaye PS, Fisher LD, Litwin P, et al. Aneurysmal coronary artery disease. Circulation 1983; 67: 134-8.
3. Daoud AS, Pamkin D, Tulgan H, Florentin RA. Aneurysm of the coronary artery: report of ten cases and review of the literature. Am J Cardiol 1963; 11: 228-37.
4. Vassanelli C, Turri M, Morando G, Menegatti G, Zardini P. Coronary arterial aneurysms after percutaneous transluminal coronary angioplasty - a not uncommon finding at elective follow-up angiography. Int J Cardiol 1989; 22: 151-6.
5. Bal ET, Thijs Plokker HW, van den Berg EM, et al. Predictability and prognosis of PTCA-induced coronary artery aneurysms. Cathet Cardiovasc Diagn 1991; 22: 85-8.
6. Desai PK, Ro JH, Pucillo A, Weiss MB, Herman MV. Left main coronary artery aneurysm following percutaneous transluminal angioplasty: a report of a case and review of the literature. Cathet Cardiovasc Diagn 1992; 27: 113-6.
7. Tamura A, Mikuriya Y, Kadota M, Nasu M. Serial arteriographic findings in a patient with development of an unusually large coronary aneurysm after angioplasty. Am Heart J 1994; 127: 1650-2.
8. Slota PA, Fischman DL, Savage MP, Rake R, Goldberg S. Frequency and outcome of development of coronary artery aneurysm after intracoronary stent placement and angioplasty. STRESS Trial Investigators. Am J Cardiol 1997; 79: 1104-6.
9. Di Mario C, Inglese L, Colombo A. Treatment of a coronary aneurysm with a new polytetrafluoethylene-coated stent: a case report. Catheter Cardiovasc Interv 1999; 46: 463-5.
10. Krolick MA, Bugni WJ, Walsh JW. Coronary artery aneurysm formation following directional coronary atherectomy. Cathet Cardiovasc Diagn 1992; 27: 117-21.
11. Prewitt KC, Laird JR, Cambier PA, Wortham DC. Late coronary aneurysm formation after directional atherectomy. Am Heart J 1993; 125: 249-51.
12. Imai Y, Hara K, Yamasaki M, et al. Mid-term follow-up of coronary artery aneurysm after directional coronary atherectomy. J Cardiol 1999; 33: 201-8.
13. Preisack MB, Voelker W, Haase KK, Karsch KR. Case report: formation of vessel aneurysm after stand alone coronary excimer laser angioplasty. Cathet Cardiovasc Diagn 1992; 27: 122-4.
14. Voigtlander T, Rupprecht HJ, Stahr P, Nowak B, Kupferwasser I, Meyer J. Development of a coronary aneurysm 6 months after stent implantation assessed by intracoronary ultrasound. Am Heart J 1996; 131: 833-4.
15. Regar E, Klauss V, Henneke KH, Werner F, Theisen K, Mudra H. Coronary aneurysm after bailout stent implantation: diagnosis of a false lumen with intravascular ultrasound. Cathet Cardiovasc Diagn 1997; 41: 407-10.
16. Noguchi T, Itoh A, Miyazaki S, et al. Images in cardiovascular medicine. Intravascular ultrasound diagnosis of a coronary true aneurysm after Palmaz-Schatz stent implantation. Circulation 1999; 99: 162-3.
17. Nisanci Y, Coskun I, Oncul A, Umman S. Coronary artery aneurysm development after successful primary stent implantation. Cathet Cardiovasc Diagn 1997; 42: 420-2.
18. Kaplan BM, Stewart RE, Sakwa MP, O'Neill WW. Repair of a coronary pseudoaneurysm with percutaneous placement of a saphenous vein allograft attached to a biliary stent. Cathet Cardiovasc Diagn 1996; 37: 208-12.
19. Di Mario C, Caprari M, Santoli C, et al. Transcatheter repair of a large coronary pseudoaneurysm using ultrasound guidance and vein-covered stents. G Ital Cardiol 1997; 27: 701-5.
20. Schobel WA, Voelker W, Haase KK, Karsch KR. Occurrence of a saccular pseudoaneurysm formation two weeks after perforation of the left anterior descending coronary artery during balloon angioplasty in acute myocardial infarction. Catheter Cardiovasc Interv 1999; 47: 341-6.
21. Kitzis I, Kornowski R, Miller HI. Delayed development of a pseudoaneurysm in the left circumflex artery following angioplasty and stent placement, treated with intravascular ultrasound-guided stenting. Cathet Cardiovasc Diagn 1997; 42: 51-3.
22. Lell E, Wehr G, Sechtem U. Delayed development of a coronary artery pseudoaneurysm after angioplasty. Catheter Cardiovasc Interv 1999; 47: 186-90.
23. Befeler B, Aranda MJ, Embi A, Mullin FL, El-Sherif N, Lazzara R. Coronary artery aneurysms: study of the etiology, clinical course and effect on left ventricular function and prognosis. Am J Med 1977; 62: 597-607.
24. Rath S, Har-Zahav Y, Battler A, et al. Fate of nonobstructive aneurysmatic coronary artery disease: angiographic and clinical follow-up report. Am Heart J 1985; 109: 785-91.
25. Gruberg L, Roguin A, Beyar R. Percutaneous closure of a coronary aneurysm with a vein-coated stent. Cathet Cardiovasc Diagn 1998; 43: 308-10.
26. Wong SC, Kent KM, Mintz GS, et al. Percutaneous transcatheter repair of a coronary aneurysm using a composite autologous cephalic vein-coated Palmaz-Schatz biliary stent. Am J Cardiol 1995; 76: 990-1.
27. Perin EC. Autologous vein-coated stent for exclusion of a coronary artery aneurysm: case report with postimplantation intravascular ultrasound characteristics. Tex Heart Inst J 1999; 26: 223-5.
28. Heuser RR, Reynolds GT, Papazoglou C, Diethrich EB. Endoluminal grafting for percutaneous aneurysm exclusion in an aortocoronary saphenous vein graft: the first clinical experience. J Endovasc Surg 1995; 2: 81-8.
29. Poli A, Lucreziotti S, Bossi I, Bramucci E, Ardissino D, Angoli A. Lesione coronarica con aneurisma: correzione mediante angioplastica ed impianto di stent ricoperto. G Ital Cardiol 1998; 28: 797-9.
30. Antonellis IP, Patsilinakos SP, Pamboukas CA, et al. Sealing of coronary artery aneurysm by using a new stent graft. Catheter Cardiovasc Interv 1999; 48: 96-9.
31. Kolettis TM, Kyriakides ZS, Kremastinos DT. Treatment of a coronary artery aneurysm with a novel stent. Clin Cardiol 1999; 22: 759-61.
32. Leung AW, Wong P, Wu CW, Tsui PT, Mok NS, Lau ST. Left main coronary artery aneurysm: sealing by stent graft and long-term follow-up. Catheter Cardiovasc Interv 2000; 51: 205-9.
33. Clarke NR, Banning AP. Obliteration of a coronary artery aneurysm with a covered coronary stent. Heart 2001; 86: 198.
34. Baldus S, Koster R, Elsner M, et al. Treatment of aortocoronary vein graft lesions with membrane-covered stents: a multicenter surveillance trial. Circulation 2000; 102: 2024-7.