

Case Reports

Stent Deployment in Old Saphenous Vein Grafts with the Use of a Protection Device

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We present two cases of patients with coronary artery disease who had undergone coronary artery bypass surgery and had developed significant disease in the saphenous vein grafts. Coronary angiography revealed complicated lesions in both cases as a result of the age of the grafts, which created a high risk for distal embolization during the interventional procedure. We decided to treat these lesions using an umbrella-type filter protection device (Angioguard) during the angioplasty procedure, in order to capture embolic material and thrombi from the degenerative lesions of these old vein grafts and avoid peripheral obstruction in the microcirculation with all the subsequent consequences. In one of the cases the emboli that were captured were visually detected but in the other no macroscopic emboli were detected. However, both patients were successfully treated without any evidence of distal embolization. The importance of coronary microvasculature protection and the use of such devices that can make coronary interventions safer is discussed in brief.

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A significant number of patients with coronary artery disease proceed to coronary artery bypass surgery for the treatment of their disease. Despite the increased use of arterial grafts (internal mammary, radial and gastroepiploic artery) as coronary artery bypass conduits, saphenous vein grafts are still widely used. However, saphenous bypass grafts with severe atherosclerotic lesions or occlusions are frequently found a short period after surgery. This adverse outcome in combination with the increased mortality and morbidity of re-operation¹, have created the need for the treatment of the diseased saphenous vein grafts by percutaneous interventional techniques.

Percutaneous balloon angioplasty in old saphenous vein grafts has some unique features related to the fact that the atheromatous substrate in the developed lesions is friable, easily detached and embolized during balloon inflation. This

frequently prevents the successful outcome of the procedure. Indeed, this risk is higher as the age of the saphenous vein graft increases (>3 years)³.

However, new techniques have been developed in an attempt to reduce complications during percutaneous interventions in old saphenous vein grafts. Specially designed protection devices have been introduced into clinical practice to protect coronary circulation from micro-infarcts and no-reflow phenomenon.

We describe the use of one of the available protection devices (Angioguard) in two patients with old saphenous vein grafts.

First case report

A fifty two year old patient with a history of coronary by-pass surgery, diabetes mellitus (on oral hypoglycemic agents) and hyperlipidemia was admitted to our de-



Figure 1. 1st case: Angiography of the saphenous vein graft with the stenosis in its mid portion. Ectatic segments are present after the lesion.



Figure 2. 1st case: Imaging of the Angioguard with its membrane fully expanded as can be concluded from the unfolded radiopaque dots (arrow).

partment with unstable angina. He underwent coronary percutaneous intervention in a saphenous vein graft anastomosed to the distal right coronary artery.

The patient had a coronary angiography 5 years ago which revealed significant proximal coronary artery disease in the left anterior descending coronary artery as well as in the right coronary artery, for both of which he underwent coronary artery by-pass surgery with a left internal mammary artery to the left anterior descending coronary artery and a saphenous vein graft to the right coronary artery.

During this admission his electrocardiogram manifested inverted T waves in leads II, III, aVF and his coronary angiography showed a patent left internal mammary artery and a long lesion with 90% stenosis in the vein graft to right coronary artery. (Figure 1). His left ventricular ejection fraction was 45% with inferior wall hypokinesia.

We decide to treat the patient with percutaneous intervention in the graft to the right coronary artery with the use of the protection device Angioguard (a filter device which entraps emboli). The device is positioned distally to the lesion in order to prevent debris embolization from the friable atherosclerotic plaque of an old degenerative vein graft to the distal native coronary artery.

The patient was receiving standard medical therapy for the treatment of unstable angina (aspirin, clopidogrel, b-blockers, heparin, calcium channel blockers) as well as a statin.

After the administration of heparin with a target ACT of >300 sec, a 7F graft right guiding catheter was inserted into the ostium of the saphenous vein

graft and the Angioguard device (5F size) was advanced into the body of the vein graft. The device with the self expandable filter has a flexible radiopaque guide wire at its distal end and thus the filter covered with the deployment sheath was easily positioned after the lesion. Subsequently, the deployment sheath was withdrawn and the umbrella-type porous membrane filter was fully expanded. Successful expansion was observed during fluoroscopy by noticing the opening of the radiopaque dots of the filter (Figure 2).

The filter is an umbrella-type membrane comprised of duralin and has 100 pores (100 μ m) which allow blood flow at the distal portion of the native coronary artery but entrap micro-emboli which cause no-reflow.

The wire which forms the framework of the catheter and remains after the withdrawal of the deployment sheath was used as a guide wire for direct stenting (4.0 mm/18 mm) at 10 atm (Figure 3). The Angioguard catheter was removed with the filter capture sheath. There was no residual stenosis angiographically and TIMI flow was grade 3 (Figure 4).

Several white-yellowish atheromatous emboli were detected by visual observation of the filter. (Figure 5). The patient was asymptomatic after the procedure, had no hemodynamic compromise and CK, CK-MB and Troponin T at 8 and 16 hours showed no increase compared to baseline values. The patient was complication-free during his hospitalization and was discharged after 24 hours with the usual post-stent medical regimen. The patient remains asymptomatic 6 months later.



Figure 3. 1st case: Stent deployed in the lesion (two arrows) and the membrane fully expanded distally as determined by the radiopaque dots (one arrow).



Figure 4. 1st case: Angiography of the graft after stent deployment.

Second case report

A 74 year old patient with a history of hypertension, hyperlipidemia and an old anterior myocardial infarction (1983), who had undergone coronary artery by-pass surgery for three vessel disease (1989), was admitted to our hospital because of worsening angina on exertion over the last 7 days despite medical therapy. In 1989 he had received a left internal mammary artery to the left anterior descending coronary artery and two saphenous vein grafts to the obtuse marginal and right coronary artery accordingly. His recent coronary angiography during his last admission showed two sequential lesions of 95% and 60% in the mid portion of the graft to the right coronary artery, patent left internal mammary and occluded graft to the obtuse marginal which had a 60% stenosis in its proximal portion (Figure 6).

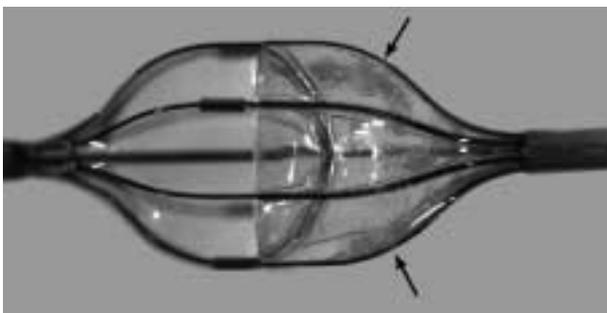


Figure 5. 1st case: Angioguard with captured emboli (arrows).

In 1995, the patient had undergone a balloon angioplasty procedure in the native right coronary artery after the distal anastomosis with the by-pass graft, which was disease-free at that time. The proximal circumflex had a 50% stenosis, the left internal mammary artery was patent and the vein graft to the obtuse marginal was occluded at that time too.

The result of the previous angioplasty was still maintained in the recent coronary angiography. Left ventricular ejection fraction was 30% with diffuse hypokinesia of the left ventricle.

Nitrates, b-blockers, statin, aspirin, low molecular weight heparin for one week and clopidogrel were administered prior to the procedure.

His electrocardiogram showed a normal axis with right bundle branch block and inverted T waves in leads II, III, aVF.

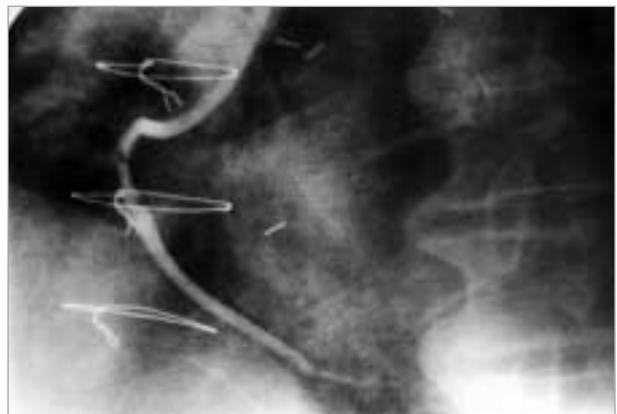


Figure 6. 2nd case: Angiography of the graft with two lesions in the mid portion.



Figure 7. 2nd case: Stent deployment in the proximal lesion with Angioguard fully expanded distally, as determined by its radiopaque dots (one arrow).

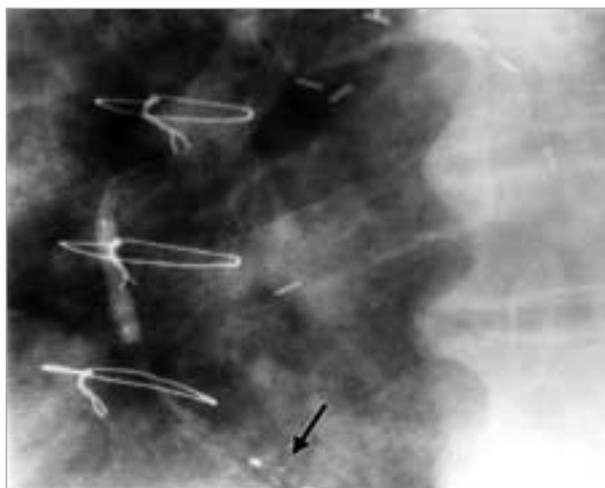


Figure 8. 2nd case: Stent deployment in the second lesion with the membrane of Angioguard fully expanded, as determined by its radiopaque dots (one arrow).

The ostium of the graft was cannulated with a 7F AL-2 and subsequently the Angioguard device with its guiding wire on its tip was inserted distally.

Two stents (3.5/18 mm και 3.5/13 mm) were directly deployed sequentially, at 12 atm at the two lesions (Figure 7, 8). The Angioguard catheter was removed with the filter capture sheath and angiography of the graft after the procedure showed no residual stenosis and a coronary flow of TIMI grade 3 (Figure 9).

Despite the age of the vein graft, the membrane of the filter revealed no emboli.

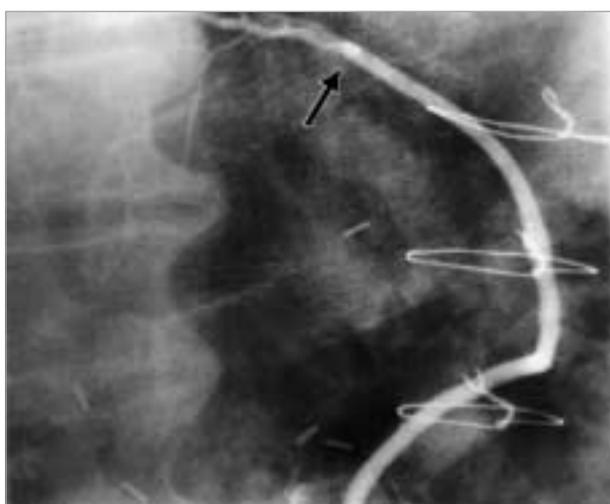


Figure 9. 2nd case: Angiography of the graft after two stents have been deployed. Arrow indicates the good distal flow.

The patient remained asymptomatic through out the procedure and there were no changes in Troponin levels at 8 and 16 hours compared to baseline levels.

The patient's condition was good during his hospitalization and he was discharged after 24 hours with the usual post-stent medical regimen. The patient remains asymptomatic after 3 months.

Discussion

Coronary artery by-pass grafting surgery is substantial beneficial in patients with coronary artery disease, offers symptomatic relief and prolongs survival in some subgroups of patients³. Each year in 5-10% of the treated patients symptoms of angina will reoccur and 40-50% of the vein grafts will occlude in the first decade^{4,5}. Saphenous vein graft disease during the first post-operative year is constituted by intimal layer hyperplasia, while in older grafts it is characterized by marked atheromatosis with frequent thrombus formation. Treatment of vein graft with percutaneous interventional techniques besides the overall technical difficulties has more frequent and substantially greater periprocedural complications and has limited long-term success when compared with angioplasty in native coronary arteries.

In the current article, we report the successful treatment of significant stenoses in old saphenous vein grafts using coronary stents and a protection device (Angioguard). There was no evidence of post-procedural distal embolization in coronary

microvasculature, as determined by myocardial enzymes and the absence of no reflow phenomenon. No reflow phenomenon –a reduction in coronary flow during contrast injection that is not due to local thrombosis, angiospasm or vessel dissection but rather to limited blood flow in the level of coronary microcirculation– has been reported with a frequency that varies between 2.5-8%^{6,7} but in percutaneous coronary interventions in saphenous vein grafts has been reported up to 20%⁸. Among the various pathophysiologic mechanisms that are related to the development of no reflow phenomenon, are the peripheral embolization in microvasculature of atherosclerotic debris with consequent mechanical obstruction and angioconstriction by the release of vasoactive substances from platelet rich thrombotic material. The conventional approach, if this complication occurs, consists of the administration of nitrates, calcium channel blockers (specifically verapamil)⁹, bolus administration of adenosine¹⁰ or the interventional - mechanical approach with intraaortic balloon pump¹¹. The majority of these approaches had poor results in the management of no reflow, with frequent complications such as myocardial ischemia, infarction and arrhythmias. The deployment of certain other medical approaches in order to prevent periprocedural complications during saphenous vein grafts interventions like thrombolytic drug^{12,13} or IIb/IIIa platelet receptor inhibitors did not result in substantial decrease of embolic events¹⁴. Specifically, EPIC study reported a decrease in embolic events in a patient subgroup that underwent angioplasty procedure in venous grafts by administration of IIb/IIIa inhibitors but the meta-analysis of EPIC and EPILOG studies¹⁴ showed no benefit regarding the early post procedural complications.

The probability of an embolic event during coronary interventions can be reduced with the use of protection devices such as Angioguard. The Angioguard device system that was used in our patients consists of a protective umbrella-type filter which is placed distally to the lesion and traps the dislodged debris without restricting antegrade blood flow during the angioplasty. The pore size of the umbrella that permit blood flow is approximately 100 μm . Smaller particles can pass the filter device but this is without any clinical significance¹⁵. The embolized debris that was trapped on the filter in the first case was visually detectable while in the second case the absence of visible debris does not exclude

the microscopically presence of embolic material on the filter. The fact that myocardial enzymes did not increase from baseline strongly supports this perception. Macroscopically the dislodged debris consisted of fragments of the atherosclerotic plaque and thrombus. Under microscopic examination necrotic nucleus, cholesterol debris, lipid rich macrophages and fibrin are observed while smooth muscle cells are rarely detected⁷.

The device that we used in the procedure is a first generation device with a big crossing profile (5F), however with the appropriate size guiding catheters and sufficient back up we did not encounter any difficulties in positioning the device distally to the lesion.

Currently two different systems of protection devices have prevailed in clinical practice. The SAFER study, demonstrates a significant decrease in the incidence of no reflow as well as a 50-60% reduction in major cardiac events in patients undergoing angioplasty intervention using stent implantation with the PercuSurge protection device¹⁶. Percusurge device has also been used in carotid interventions. This device requires distal balloon occlusion (Percusurge) of the coronary blood flow, which will not be tolerated by a lot of patients since the mean occlusion time by the distal balloon is 4,7 minutes. Additionally, the suction may not be always completed permitting the passage of debris in microvasculature. Another significant disadvantage of this device is that due to the distal balloon inflation and obstruction of blood flow angiographic assessment of the vessel cannot be performed during the procedure.

It is worth noticing that due to the profile of the protection devices, it is important to choose the appropriate guiding catheter and careful manipulations in order to achieve stable catheter-graft engagement and subsequently sufficient catheter support (back up) for safer and easier passage of the protection device, specifically in elongated and high grade lesions. Limited manipulations are also required in order to decrease «trauma» in the friable venous graft lesions.

Under the category of percutaneous treatment modalities for saphenous vein grafts disease, some other interventional techniques or devices have been deployed in order to avoid the already reported complications and to ensure long term maintenance of interventional success.

Placement of stents in the friable atheromatic vein graft lesions, which can in theory trap with their

struts friable material and prohibit debris dislodgement and distal embolization have improved early angiographic results but have not decreased embolic events¹⁷.

The coated stents are a promising solution to this problem¹⁸. The direct stenting technique as well as the lower inflation pressures during stent deployment seems to avoid atheromatous plaque squeezing and protruding through the stent struts¹⁹.

Therefore, the unique features of the saphenous vein graft lesions with the increased risk of complication regardless of the intervention performed, created a need for the development of devices which will protect microcirculation.

With the availability of new imaging techniques and the ability to detect abnormalities in the microcirculation (contrast Echo, MRI)^{20,21} and our broader understanding of acute coronary syndromes, the need for protection of the microcirculation has been expanded to coronary interventions that are performed in native coronary vessels in patients with stable angina (iatrogenic plaque rupture) and in patients with unstable angina with «hot» atheromatous plaques in which thrombi are actively involved. Even with successful dilatation of the coronary lesions tissue perfusion abnormalities can be detected indicating abnormalities in the microcirculation. Currently we know that Troponins become elevated in a percentage of 30-40% after coronary interventions in native coronary arteries, a finding which is of greater clinical importance than previously appreciated. Recent studies indicate that even minor myocardial necrosis after percutaneous interventions affects morbidity and event free survival and should be taken as a significant prognostic factor for long term outcome²².

In conclusion it is clear that with the availability of the protection devices a new era is initiated in the protection of microcirculation during coronary interventions in acute coronary syndromes and in stable coronary lesions in native coronary vessels. Regarding the interventions in saphenous vein grafts, the need for protection devices during the procedure is becoming a prerequisite. However the design of larger trials is required to further clarify these issues.

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