

Case Report

Left Main Coronary Artery Stenosis after Aortic Valve Replacement

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We describe two cases with iatrogenic left main coronary artery stenosis where a symptomatology of unstable angina appeared within three months of aortic valve replacement surgery. One patient was treated with aortocoronary bypass and the other with angioplasty and stenting.

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Stenosis of the left main stem and the ostium of the right coronary artery after aortic valve replacement was first described by Roberts and Morrow in 1967.¹⁻⁵ This complication appears after less than 3% of aortic valve replacement procedures, in which catheters are used for selective cardioplegia infusion.⁶⁻⁸ The clinical symptomatology is often severe and may appear from one to thirty months after the procedure.³⁻²⁴ The usual treatment is aortocoronary bypass surgery, but cases treated by balloon angioplasty have been reported.¹⁷ Angioplasty with stenting has not so far been described in similar cases with early left main coronary ostial stenosis following aortic valve replacement.

Case presentations

First case

A woman aged 69 years with a severely stenosed aortic valve and mild aortic regurgitation, free of coronary vessel stenoses and with normal left ventricular contractility, underwent aortic valve replacement. Her aortic valve was tricuspid, thickened and extremely calcified. It was replaced with a mechanical valve, ATS 21 mm (Guidant). My-

ocardial protection was achieved by antegrade cold blood cardioplegia. The first dose was administered by infusion at the aortic root and subsequent ones via the coronary ostia (Figure 1). The postoperative course was uneventful.

Three months later the patient exhibited a severe degree of angina on effort and at rest, with transient ST-segment depression on the anterior and lateral ECG leads. Coronary angiographic examination showed a severe degree of stenosis in the left main coronary ostium (Figure 2).

The patient underwent aortocoronary bypass with two grafts to the anterior descending and circumflex branches, on a beating heart with no extracorporeal circulation. The procedure was free of complications.

Second case

This patient was a man, aged 72 years, with chronic atrial fibrillation and a severe degree of aortic valvular stenosis, but without regurgitation and with normal left ventricular function. The preoperative coronary angiogram showed 30% stenosis of the left main coronary ostium and 70% stenosis of the proximal segment of the anterior de-



Figure 1. Catheters for elective administration of cardioplegia to the left and right coronary arteries. The catheter has an automatically inflating balloon at its tip so as to be obstructive and “atraumatic”.

scending branch (inset in figure 3). The patient underwent aortic valve replacement with a biological valve, Edwards Magna 23 mm (Edwards Lifesciences), and a bypass was performed with the left mammary artery to the anterior descending branch. As in the previous case, myocardial protection was achieved by antegrade cold blood cardioplegia, with the first dose being delivered at the aortic root and subsequent ones via the coronary ostia (Figure 1).

Fifty days later the patient exhibited severe angina on minimal effort with prolonged anginal episodes

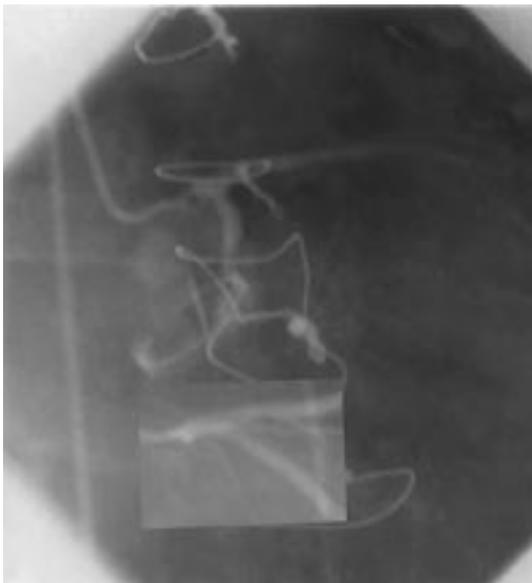


Figure 2. In right lateral projection, the left main coronary artery shows a severe degree of stenosis (angiogram three months after surgery). The inset shows the vessel without stenosis, before the aortic valve replacement surgery.



Figure 3. Left main coronary ostial stenosis in the left lateral projection, one and a half months after aortic valve replacement. The inset shows the vessel before the valve replacement, with only a small degree of stenosis. (The tip of the 6F diagnostic catheter is within the body of the main artery.) In this projection, with the more cranial inclination, the stenosis in the anterior descending branch can be seen.

accompanied by ST-segment depression on ECG leads V_3 - V_6 , I and aVL. Coronary angiography showed a severe degree of stenosis of the left main coronary ostium and occlusion of the anterior descending branch, with perfusion from the left internal mammary artery (Figure 3).

Angioplasty of the left main ostium was performed using a JL4 7F guiding catheter (Medtronic) and a BMW guidewire (Guidant) in the circumflex branch, and predilatation with a 3.5 x 10 mm cutting balloon (Boston Scientific). Full balloon expansion was achieved at 8 Atm and the immediate result was good, with no apparent dissection. A 3.5 x 12 mm Taxus drug-eluting stent (Boston Scientific) was expanded at 20 Atm and a further dilatation was performed using a 4 x 10 mm Runner low compliance balloon (Bolton Medical) up to 18 Atm. The stent was placed so as to cover the ostium of the left main artery without covering the bifurcation of the vessel (Figure 4).

Discussion

Iatrogenic coronary ostial stenosis after aortic valve replacement is a potentially life-threatening complication and prompt diagnosis and treatment are essential for the patient's survival.



Figure 4. After the stent has been placed in the left main coronary ostium there is no stenosis (left lateral projection). The anterior descending branch is filled mainly from the internal mammary artery.

The usual clinical picture includes severe angina, ventricular arrhythmias, congestive heart failure and sudden death. It usually appears within the first six months but may occur up to thirty months after the procedure.³⁻²⁴ The incidence of this complication has been estimated to be less than 3%,⁶⁻⁸ but the real incidence is not known, considering that cases of undiagnosed sudden death following aortic valve replacement could be attributed to iatrogenic main coronary stenosis.

It is believed that the occurrence of ostial stenosis is the result of a strong hyperplastic reaction of the vessel wall, in response to micro-injuries from the catheters used for cardioplegia administration. The micro-injuries are related to the infusion pressure of the cardioplegic fluid and overdistension of the vessel by the catheter tip.² The same phenomenon has also been described following left coronary angioplasty, but at a more peripheral site close to the bifurcation, probably because the site of the injury from the guiding catheter was also more peripheral.^{10,21} However, left main ostial stenosis has been described after aortic valve replacement, without selective administration of cardioplegia via the coronary ostia, as the result of extension of fibrosis from the aortic annulus.⁹ It seems likely that certain individuals may have a predisposition to a strong hyperplastic reaction following injuries. It has been noted that the presence of apolipoprotein-E genotype $\epsilon 4$ is much more common

in patients who have left main ostial stenosis following aortic valve replacement.⁶

Although the problem of left main ostial stenosis after aortic valve replacement was described in the 60s and 70s, it remains a problem even today, in spite of the developments in the manufacture of catheters for selective cardioplegia solution infusion and in techniques for myocardial preservation. Cardioplegia administration by other means, such as via the coronary sinus, reduces the need for manipulation of the coronary ostia and could perhaps provide a solution.^{25,26}

In view of the location of the new stenosis in the left main coronary artery, the rapid progression of the hyperplastic lumen encroachment during the first months following surgery and the existence of hypertrophic myocardium with increased oxygen demand, treatment of this entity requires immediate reperfusion. Aortocoronary bypass is not without problems, considering the temporal proximity to the first operation and the difficulty of protecting the myocardium adequately, and it may result in a high incidence of perioperative infarction.⁷ In our first patient the beating heart aortocoronary bypass procedure was successful and without complications. Beating heart aortocoronary bypass surgery seems to offer some survival benefit to patients who have undergone previous cardiac surgery,²⁷ but it is not certain whether it is superior to aortocoronary bypass surgery under extracorporeal circulation with an arrested heart in patients with left main coronary artery stenosis.²⁸

In our second patient angioplasty was chosen as treatment, mainly because of the protection provided by the internal mammary artery to the anterior descending branch. Balloon angioplasty, without stenting, has been reported in only three patients with left main coronary artery stenosis following aortic valve replacement,¹⁷ while there is no report of stenting in such cases. Because the site of the stenosis is usually at the ostium of the left main artery, central to the bifurcation to the anterior descending and circumflex branches, angioplasty and stenting are technically easier.²⁹ In addition, as our case shows, the stenosis is easily dilatable using a cutting balloon, without the creation of dissections or appearance of immediate elastic recoil. Predilatation allows sufficient opening of the stenosis, especially if there is a strong fibrous reaction, and allows for the precise placement of the stent without the time limits imposed by ischaemia from obstruction of the stenotic lumen by the guiding catheter. Implantation of a drug-eluting stent has the advantage of a very low restenosis rate.³⁰

In conclusion, iatrogenic left main coronary ostial stenosis following aortic valve replacement should be avoided by limiting the manipulation of the ostia of coronary vessels as much as possible during the surgical procedure. This complication should be diagnosed and treated immediately, with either aortocoronary bypass or angioplasty. In view of the high incidence of complications associated with aortocoronary bypass under extracorporeal circulation with an arrested heart, beating heart surgery or angioplasty with stenting should be considered as possible alternatives.

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