Case report
Coronary ostial stenosis after aortic valvuloplasty
(comprehensive aortic root and valve repair)
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Abstract

Comprehensive aortic root and valve repair (CARVAR) surgery using specially designed aortic rings was introduced as a new surgical technique for aortic valve disease. We present five consecutive cases of iatrogenic coronary ostial stenosis after CARVAR surgery in patients with aortic stenosis. The preoperative coronary angiography confirmed that all the patients had normal coronary arteries. They underwent aortic valvuloplasty by aortic leaflet extension and insertion of specially designed inner and outer rings at the level of the sinotubular junction. Within 6 months after surgery, all the patients complained of resting chest pain and dyspnea with changes of electrocardiography. Repeated coronary angiography demonstrated right coronary artery (RCA) ostial stenosis in one patient and left main (LM) ostial stenosis in the other four patients. Intravascular ultrasonography demonstrated severe ostial stenosis and extensive echogenic tissue in the extravascular area. Four patients with LM ostial disease successfully underwent coronary bypass graft surgery, and percutaneous coronary intervention with stenting was performed in one case of RCA ostial stenosis. Because the mechanism of this complication is not fully confirmed, more clinical study is required to confirm the safety issues of CARVAR surgery.

Keywords: Aortic valve repair; Coronary stenosis; Coronary artery bypass

1. Introduction

It has been reported that coronary ostial stenosis can occur after aortic valve replacement, but the mechanism is not completely understood [1—3]. Comprehensive aortic root and valve repair (CARVAR) surgery with a specially designed aortic ring was recently introduced as a new surgical technique for treating aortic regurgitation and stenosis [4,5]. We present our recent experience of five cases of coronary ostial stenosis after performing CARVAR surgery in patients with aortic stenosis and suggest the mechanism for this complication.

2. Case report

A 62-year-old woman was admitted with the complaint of dyspnea. Echocardiography showed that the aortic valve was narrowed with thickened leaflets and calcification. The area of the aortic valve was 0.82 cm² measured by echocardiography. The CT angiography revealed normal coronary arteries without any stenosis. She underwent CARVAR surgery with aortic leaflet extension and insertion of a specially designed outer ring at the level of the sinotubular junction (STJ) and annulus. Myocardial protection was achieved by antegrade direct cannulation of both coronary ostia using a balloon-tipped cannula (coronary perfusion cannula, Polystan). After the CARVAR surgery, the patient was discharged without immediate complication. Two months later, the patient visited the emergency department due to severe resting chest pain. On admission, the electrocardiography showed diffuse T wave inversion in the precordial leads and lead III, aVF. The cardiac enzymes were normal. The coronary angiography revealed severe focal stenosis in the ostium of the right coronary artery (RCA). Intravascular ultrasound (IVUS) demonstrated very severe ostial stenosis of the RCA, but the proximal RCA was completely normal without any development of atherosclerosis (Fig. 1). Interestingly, extensive echogenic tissue was observed in the extravascular area surrounding the ostium. From proximal to the RCA ostium, there was a gradual decrease of the intra-luminal area without any proliferation of the intima. According to the findings of IVUS, there was a high suspicion that there might be a large amount of fibrosis in the extravascular area. The right coronary artery was compressed by the surrounding extravascular fibrotic tissue, and this was considered to be the main cause of the severe ostial coronary stenosis. Percutaneous coronary intervention was performed using...
coronary stenting (ENDEAVOR, 3.0 mm × 15 mm, Medtronics, USA). After the successful intervention, the patient was discharged without any complication and she has remained asymptomatic for 4 months.

There were another four cases of ostial coronary stenosis after CARVAR surgery (Table 1). All the patients had severe aortic stenosis and the techniques of CARVAR surgery were similar to that of the first case. Myocardial protection was achieved by antegrade direct cannulation of both coronary ostia in all patients. Within 6 months after surgery, the patients complained of resting chest pain and dyspnea with the change of electrocardiography. Because the coronary stenosis was not treated with other treatment modalities, PCI or CABG, we performed PCI or CABG for all patients.

Table 1
Clinical and surgical characteristics of the five patients with ostial coronary stenosis after comprehensive aortic root and valve repair surgery.

<table>
<thead>
<tr>
<th>No.</th>
<th>Sex/age</th>
<th>Aortic valve</th>
<th>Aortic aneurysm</th>
<th>Number of aortic rings</th>
<th>Time duration for event</th>
<th>Coronary lesion</th>
<th>Clinical presentation</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F/62</td>
<td>AS, severe</td>
<td>None</td>
<td>2</td>
<td>2 months</td>
<td>RCA ostium</td>
<td>UA</td>
<td>PCI (stent)</td>
</tr>
<tr>
<td>2</td>
<td>M/61</td>
<td>AS, severe</td>
<td>None</td>
<td>4</td>
<td>3 months</td>
<td>LM ostium</td>
<td>UA, CHF, AF</td>
<td>CABG (LIMA-LAD)</td>
</tr>
<tr>
<td>3</td>
<td>M/59</td>
<td>AS, severe (Bicuspid)</td>
<td>None</td>
<td>4</td>
<td>2 months</td>
<td>LM ostium</td>
<td>NSTEMI, CHF, AR, severe Endocarditis</td>
<td>CABG (LIMA-LAD)</td>
</tr>
<tr>
<td>4</td>
<td>M/70</td>
<td>AS, severe (Bicuspid)</td>
<td>None</td>
<td>4</td>
<td>5 months</td>
<td>LM ostium</td>
<td>UA</td>
<td>CABG (LIMA-LAD, RA-OM)</td>
</tr>
<tr>
<td>5</td>
<td>M/64</td>
<td>AS, severe</td>
<td>None</td>
<td>4</td>
<td>6 months</td>
<td>LM ostium</td>
<td>STEMI, CHF, AR, severe Endocarditis</td>
<td>CABG (LIMA-LAD)</td>
</tr>
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</table>

angiography showed very severe ostial stenosis in left main coronary artery, they successfully underwent coronary bypass graft. At the same time, there were three cases of severe aortic regurgitation among these patients. Additionally, infective endocarditis was combined in case 3. Two patients successfully underwent aortic valve replacement (case 3, 5), and one patient underwent aortic valve repair again (case 2). After discharge, they were asymptomatic during follow-up.

3. Discussion

Since 1967, there have been some reports of coronary ostial stenosis after aortic valve replacement [1–3]. In most cases, the perfusion catheter used for cardioplegia was suggested as the potential cause of coronary ostial stenosis because of the direct intima injury of the coronary artery by the high-pressure inflated ballooning during the infusion of cardioplegia [6]. However, the mechanism is not certain because it is possible that some coronary ostial stenosis had developed without the use of a perfusion catheter for cardioplegia [7]. In addition, the histopathologic findings showed that the intima injury after aortic valve replacement was different from conventional atherosclerosis [8]. The specimen taken by directional coronary atherectomy (DCA) had intima hypertrophy, mucinous degeneration, and hyaline degeneration, but no evidence of atherosclerosis. Some investigators suggested that an immunological reaction could be another mechanism, rather than atherosclerotic changes induced by a coronary perfusion catheter [3]. Aortic valvuloplasty employing aortic rings (CARVAR) is a unique surgical technique, but the clinical data for the safety and efficacy of this procedure is limited [4,5]. The procedure consists of three main components such as correction of the leaflets, the sinotubular junction and the aortic annulus. For correcting the sinotubular junction and aortic annulus, specially designed aortic rings are inserted into the inner and outer sides of the aorta. Anatomically, the ostium of the coronary artery is located between two aortic rings and it may be possible that the ostium of the coronary artery could be influenced by an immunological reaction of extensive fibrosis. Because four aorta rings were usually used in the inner and outer ascending aorta, the amount of prosthetic material in CARVAR surgery is larger than that in the bioprosthetic or mechanical valve. In our cases, the IVUS finding showed massive fibrosis and its extrinsic compression around the ostium of the coronary artery. This finding is comparable to those of the previous reports and it supports the hypothesis of immunological reaction of the aortic ring, which is composed of bioprosthetic material. However, even if our cases support the possible mechanism of immunologic reaction, this does not fully explain the whole process of iatrogenic coronary stenosis.

In our cases, four were managed by CABG surgery and one case was treated by coronary artery stenting. Because we do not know the exact pathophysiological mechanism of this kind of stenosis, percutaneous coronary intervention (PCI) should only be performed with a high degree of caution and be regarded as an alternative choice for the patient who has a clinically poor medical condition [9,10]. It is generally recommended that CABG is a treatment of choice for ostial stenosis after aortic valve replacement.

In conclusion, iatrogenic coronary ostial stenosis can occur after CARVAR surgery and it could be caused by immunological fibrosis of aortic rings. It is clearly evident that more clinical study is required to confirm the safety issues of CARVAR surgery.

References