Negative results - Valves

Aortoventricular disruption after aortic valve replacement: a rare complication

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Abstract

Aortoventricular disruption after aortic valve replacement is extremely rare. A case of aortoventricular disruption following aortic valve replacement is described in detail, and related case reports are reviewed. A 76-year-old male underwent aortic valve replacement with a tissue valve using everting mattress sutures, repair of the ascending aortic aneurysm, and mitral valve repair. After cardiopulmonary bypass was terminated, pulsatile bleeding behind the aortic root was observed, which required cardiopulmonary bypass. The ventricular rupture was located just below the left coronary annulus, and appeared secondary to a tear through the ventricular myocardium by the valve sutures. The tear was internally repaired by pledgeted sutures and Dacron patch reinforcement. The patient recovered and was discharged without major complications. Although this serious complication is extremely rare, surgeons should be aware that deep everting stitches on the left coronary annulus potentially causes aortoventricular disruption. Overstretching the posterior aortoventricular junction may contribute to this type of injury.

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1. Introduction

Left ventricular rupture is well documented as a critical complication of valve surgery, exclusively so in mitral valve replacement [1, 2]. In contrast, aortoventricular disruption is extremely rare after valve surgery. We experienced a rare case of aortoventricular disruption after aortic valve replacement, which was successfully repaired by pledgeted sutures, and Dacron patch reinforcement, with re-implantation of the aortic prosthesis.

2. Case report

A 76-year-old male without cardiac history was referred to our clinic for congestive heart failure due to valvular disease. His symptoms were consistent with the New York Heart Association (NYHA) class III. Chest roentgenogram showed cardiomegaly, pulmonary congestion and mediastinal widening. Echocardiography demonstrated severe aortic and mitral regurgitation with left ventricular dysfunction. Left ventricular systolic and diastolic dimensions were 83 mm and 73 mm, respectively, and the ejection fraction was 25%. The posterior left ventricular wall thickness and the interventricular thickness were 6 mm and 7 mm, respectively. The estimated left ventricular mass index was 325 g/m². Computed tomographic scan demonstrated a 70-mm aneurysm in the ascending aorta. Coronary angiogram showed no coronary disease. After informed consent was obtained, the patient underwent ascending aortic replacement, aortic valve replacement and mitral valve annuloplasty. Using our usual cardiopulmonary bypass technique with standard aortic and bicaval cannulation, the heart was arrested with cold blood cardioplegia in an antegrade and retrograde fashion. The left atrium was opened and mitral annuloplasty was performed with a 26-mm Physio ring (Edwards Lifesciences, Irvine, CA, USA). At 25 °C, cardiopulmonary bypass was temporarily stopped and selective cerebral perfusion was performed. The ascending aorta was excised and a Dacron tube graft was sewn at the origin of the brachiocephalic artery. The graft was cannulated and cardiopulmonary bypass was resumed. The aortic valve was excised, and everting 2-0 polyester mattress sutures were placed on the aortic annulus in the usual fashion, where the pledgets were placed on the annulus and the sutures came out of the subannular ventricular wall. The aortic annulus was not calcified, and there was no need to debride the annulus. The aortic bioprosthesis was implanted into the intra-annular position without difficulty. After cardiopulmonary bypass was terminated, there was a small bleeding from the posterior suture line of the proximal anastomosis. Hemostasis was attempted with manual compression on the posterior side of the aorta. After a while, pulsatile bleeding was observed behind the aortic root, where manual control of the bleeding was not successful. Therefore, we resumed cardiopulmonary bypass and rearrested the heart. The aortic root...
was re-entered and the prosthesis was removed. There was a horizontal, 8-mm tear in the left ventricular outflow tract, which was located just below the left coronary annulus (Video 1). The tear penetrated through the ventricular wall and the aortoventricular junction toward the transverse sinus. It appeared that the valve sutures tore through the ventricular myocardium. It was repaired using three pairs of 4-0 polypropylene pledgeted mattress sutures, where needles passed through the ventricle and the left atrial wall and came back to the annulus. The left coronary annulus was reconstructed with a Dacron patch. Precaution was taken not to injure the left coronary artery (Video 2). The prosthesis was re-implanted and the aorta was closed. The patient came off the cardiopulmonary bypass without difficulty. Operation time, cardiopulmonary bypass time and aortic cross-clamp time are 14 h 20 m, 8 h 6 m and 5 h 10 m, respectively. The patient was discharged without major complications. A year after the surgery, the patient is in NYHA class I, and echocardiography showed improved left ventricular function, with an ejection fraction of 35% and left ventricular diastolic dimension of 59 mm. Histological analysis of the aneurysmal wall showed severe atherosclerotic alteration without typical findings of medial necrosis.

3. Discussion

There are few previous reports of aortoventricular disruption following aortic valve replacement [3, 4]. Iida and coworkers [3] reported that the rupture occurred 6 h after the operation, and the cause of the rupture was an inadvertent injury to the left ventricular wall just below the left coronary annulus. Mediratta and coworkers [4] described two cases of aortoventricular disruption after stentless bioprosthesis implantation. In these cases, the injury was attributed to extensive debridement of the calcified aortic valve. Although the mechanisms of the injuries are different, the location of these previous case reports is similar to ours, which is the posterior aortoventricular territory adjacent to the roof of the left atrium [3, 4]. Aortoventricular disruption is clearly distinguished from ‘left ventricular rupture’, which is classified into three types according to the location, i.e. type I (along the posterior aortoventricular groove), type II (at the base of the papillary muscle) and type III (anywhere between type I and type II) [1]. These types of rupture usually occur after mitral valve replacement [1, 2]. In our case, it is likely that the catastrophic bleeding was a consequence of a myocardial tear by pulling on everting valve sutures too much.

In this particular case, we are aware that some of the sutures on the left coronary annulus may have passed the posterior ventricular myocardium, which potentially caused a myocardial tear. Although the employed suture technique was most likely responsible for this complication, it may also be relevant that the left ventricle was extremely dilated and the wall thickness was thin (approx. 6 mm). Moreover, mechanical stretch on the aortoventricular continuity during manual hemostatic compression may have expanded the initial small tear in the endocardium, which finally perforated the whole thickness of the ventricular muscle. From the anatomical standpoint, the injured portion was the part of the parietal myocardium below the aortic valve, which separates the ventricular outflow tract and the transverse sinus [5]. Therefore, deep everting stitches in this area potentially cause the inadvertent myocardial penetration. Although we did not obtain a myocardial tissue sample in this case, it would have been interesting to examine any cardiomyopathic features by utilizing immunohistological staining.

Based on the experience described herein, we have changed our practice, and now we always use non-everting mattress sutures (pledgets on the subannular tissue and the ventricular wall) in aortic valve replacement. We also take extreme care to avoid overstretching the posterior aortic root during hemostasis. Should the rupture occur, we believe that this type of injury is not simply repaired by sealing, and suture repair with annular reconstruction is the best option as an emergent procedure. Needless to say, it is of utmost importance to avoid the left coronary artery during the repair.

References