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DECELLULARIZED HOMOGRAFT FOR AORTIC VALVE REPLACEMENT TWO YEARS AFTER LUNG TRANSPLANTATION

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Cardiac valvular surgery in patients after lung transplantation is a challenging procedure, reports are scarce. We report a 29-year-old patient who underwent concomitant mitral valve reconstruction and implantation of a decellularized aortic homograft two years after bilateral lung transplantation.

Keywords: decellularized homograft, cardiac surgery after lung transplantation.

INTRODUCTION

If lung transplanted patients develop heart valve disease, young age and the need for immunosuppression, regular transbronchial biopsies, and redo transplantation may influence operative strategy. While valvular reconstruction should be pursued whenever possible, the balance between the risk of bleeding in case of a mechanical substitute and future structural valve deterioration (SVD) in case of biological prostheses, should guide valvular prosthetic choice in case of replacement [1]. Recently, decellularized homografts have showed promising hemodynamics and durability and may represent an alternative to conventional biologic prosthesis [2].

We report the implantation of a decellularized aortic root allograft in a lung-transplanted patient who underwent concomitant mitral valve repair.

CASE DESCRIPTION

A 29-year-old female with severe pulmonary hypertension due to capillary hemangiomatosis was put on the waiting list for lung transplantation in December, 2017. The pre-transplant transthoracic echocardiography (TTE) showed trivial aortic and mitral insufficiency without morphological disturbances of the valve apparatus, severe impaired right ventricular function, mild tricuspid regurgitation and severe pulmonary hypertension.

In May, 2018 she developed right heart failure, was put on ECMO and transplanted 8 days later with ECMO removed by the end of surgery. The patient was discharged two months later.

In January, 2020 she was admitted at our institution due to new-onset dyspnea (NYHA III). Acute cellular and humoral rejection as well as infection were excluded. However, the TTE (Fig. 1, a and c) showed severe mitral regurgitation due to fibrosis without annulus dilatation (Carpentier IIIa), moderate-to-severe aortic regurgitation, a slightly decreased left ventricular ejection fraction (LVEF, 50%) with a left ventricular end diastolic diameter (LVEDD) of 55 mm. The tricuspid aortic valve showed fibrotic changes and central regurgitation due to failing leaflet coaptation, with low mean pressure gradient of 3 mmHg. The aortic annulus measured 22 mm. The left heart catheterization showed normal coronary arteries, and the right heart catheterization showed a normal pulmonary artery pressure (27/14/18 mmHg), a wedge pressure of 18 mmHg, a pulmonary vascular resistance of 22 Dynes, and a cardiac index of 2.24 (l/min)/BSA.

After median sternotomy, cannulation of the proximal aortic arch and both venae cavae was performed. The mitral valve morphology included isolated fibrotic restriction, more pronounced in the anterior leaflet (Fig. 1, b). Trans-septal mitral valve repair with anterior leaflet augmentation using untreated autologous pericardium, and an annuloplasty with a 26 mm ring was performed. The aortic valve leaflets appeared retracted (Fig. 1, d), showed restricted movement, and thus were not amenable to repair. The decellularized homograft with an annulus diameter of 21 mm was implanted orthotopically with a running suture [2]. Operation, bypass and cross clamp time amounted to 312 min, 225 min and 162 min, respectively. We used cold blood cardioplegia and mild hypothermia (32 °C). Intraoperative volume balance amounted to 3800 ml. Postoperatively the patient was extubated 5.5 hours after arrival at the intensive care unit and was transferred to the normal ward the next day requiring only 1 L oxygen supply over the nasal catheter.

Immunosuppressive therapy was replaced by a continuous intravenous infusion of 200 mg hydrocortisone

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24 hours before operation. On the first postoperative day, the immunosuppressive therapy with prednisolone (10 mg), tacrolimus (target level 8–10 ng/dL) and mycophenolate mofetil (750 mg twice a day) was reinitiated. Antibiotic therapy included meropenem and flucloxacillin for 7 days.

On the 11th postoperative day, she was discharged to the rehabilitation clinic after uncomplicated postope-

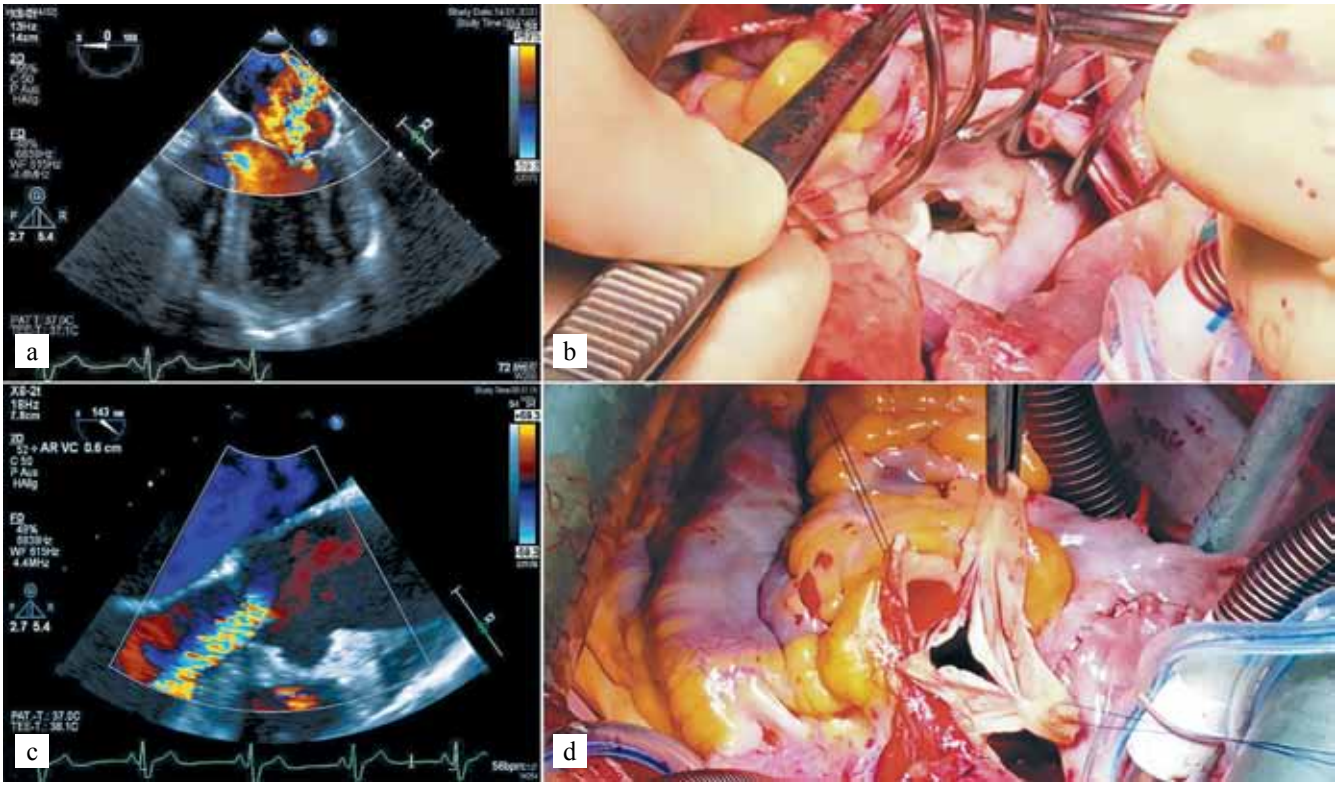

Fig. 1. Transesophageal echocardiography and intraoperative findings of the mitral (a, b) and aortic (c, d) valves

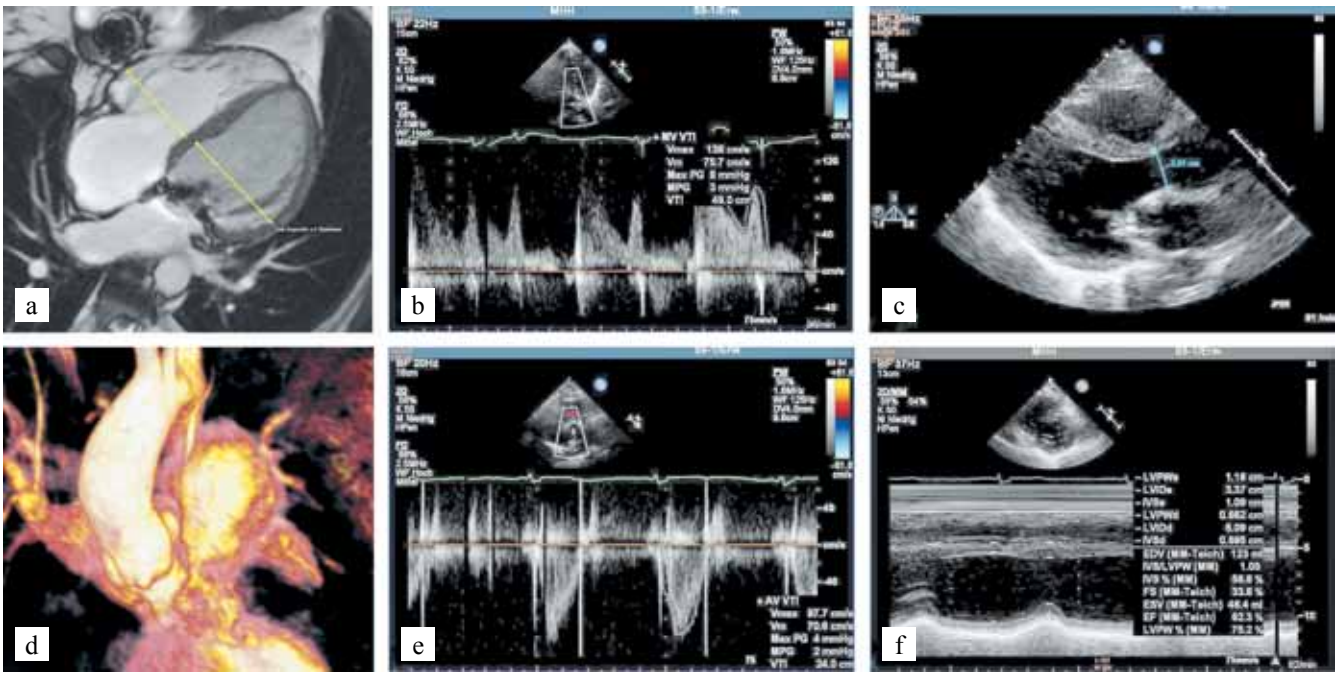

Fig. 2. Postoperative findings: a – four chamber view showing normal heart dimensions; b – pw-Doppler signal in reconstructed mitral valve; c – B-mode systolic longitudinal axis showing wide LVOT and good mitral coaptation; d – contrast enhanced MRI-angiography of LVOT; e – pw-Doppler signal in aortic annulus; f – M-Mode dimensions of the LV

rative course. TTE performed at discharge did not show any mitral or aortic valvular regurgitation. Moreover, the left ventricular function amounted to 60% with LVEDD of 43 mm, the aortic valve area to 2 cm^2, the mean pressure gradient across the mitral valve to 3 mmHg by an opening area of 3 cm^2. The lung function tests showed FEV_1 of 1.23 L (41% predicted), VC_{max} of 1.81 (52% predicted), FEV_1/VC_{max} of 68% (81%).

At 3 months follow up the TTE showed excellent aortic valve function, mild mitral insufficiency and the mean pressure gradient across the mitral valve was 3 mmHg. The MRI revealed normal heart dimensions, the aortic valve had a maximum gradient of 6 mmHg by a maximal flow speed of 122 cm/s and a mild regurgitation (Fig. 2).

COMMENT

Experience in lung-transplanted patients undergoing cardiac valve surgery is scarce [3–5]. According to our recently published experience, concomitant lung transplant and cardiac valvular surgery yielded poor results [6]. Contrarily, cardiac surgery after lung transplantation showed better early and long-term results. In the present case report, we had to face several challenges off, and we discussed several strategies for planning the operation. TAVI for aortic valve replacement was not possible, because the aortic valve was not stenotic. Singular mitral valve clipping may have temporarily reduced the symptoms, but may not have provided acceptable long-term durability [7]. Therefore, we planned reconstruction of both valves. The mitral valve morphology allowed a safe repair with augmentation of the anterior leaflet using autologous pericardium, achieving sufficient coaptation length, and an annuloplasty using a 26 mm ring. The preoperative echocardiography showed fibrosis and restricted movement of the aortic leaflets, as well as a small aortic annulus (22 mm). According to the current guidelines for aortic valve surgery [1], our 29-year old patient should have received a mechanical prosthesis. However, we considered the need for lung biopsies and the concrete risk of developing chronic lung allograft dysfunction and requiring re-transplantation in the future an important contraindication for implanting a mechanical prosthesis. However, conventional biologic prostheses undergo rapid SVD in young patients [1]. Furthermore, the small aortic annulus of our patient would only have allowed the implantation of a relatively small prosthesis, either mechanical or biologic. Instead, we have recently reported that decellularized homografts, showed significant reduction in the re-operation rate in comparison to conventional biologic prosthesis in children and young adults [8]. Moreover, aortic valve replacement with a homograft is best suited for patients with a small aortic annulus to provide a better effective orifice area and lower gradients after surgery.

Axel Haverich holds shares in corlife oHG. Igor Tudorache is medical consultant for corlife oHG. The other authors of this manuscript have no conflicts of interests.

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