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Case report - Valves

Vacuum-assisted venous drainage in tricuspid valve re-replacement

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Abstract

The number of reoperations for prosthetic valve replacement has increased in recent years due to the steady increase in life expectancy. However, reoperations are complex and require experience and skills. We report the case of a 69-year-old female with severe right heart failure who underwent tricuspid valve re-replacement 28 years after the initial tricuspid valve replacement. Cardiopulmonary bypass with vacuum-assisted venous drainage (VAVD) was used to achieve better perfusion flow and heart decompression with smaller venous cannulae. The operation was successful. The VAVD system is effective in patients who have a persistent elevation of central venous pressure.

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1. Introduction

Owing to an improvement in prosthetic valve durability and a steady increase in life expectancy, reoperations for degenerated bioprosthesis have recently become frequent. As the time since implantation increases, more cases will come to reoperation [1]. Patients are sometimes reluctant to undergo reimplantation of a prosthetic valve and they do not seek immediate medical help even though their condition is deteriorating. As a consequence, cardiovascular surgeons have to manage more severe cases in a second operation. Reoperations have more difficult and more complicated problems, so ingenuity is necessary for a successful operation. We report a case of tricuspid valve re-replacement in a patient with severe congestive heart failure caused by calcified tissue valve failure. The reoperation was successful using a vacuum-assisted venous drainage (VAVD) system.

2. Case report

A 69-year-old female was admitted to our hospital for dyspnea on exertion and bilateral edema of her lower extremities. She had a history of rheumatic valve disease, and had undergone combined mitral valve replacement with a 29-mm Björk-Shiley valve (Shiley Inc., Irvine, CA, USA), and tricuspid valve replacement using a 31-mm Carpentier–Edwards pericardial valve (Edwards Lifesciences, Irvine, CA, USA) 28 years previously. On auscultation, a grade 4/6 diastolic rumble was heard on the xyphoid process. Physical examination revealed dilated cervical veins and right upper quadrant tenderness in the abdomen. The liver was palpable 8 cm below the right costal margin, and a caput medusae was seen around the umbilicus. Edema, varices and pigmentation of the lower extremities bilaterally were present.

A chest X-ray revealed a dilated heart with a cardiothoracic ratio of 78%. Echocardiography showed enlargement of both the right atrium (RA) and the inferior vena cava (IVC). The tricuspid valve area measured 0.57 cm². The mitral valve displayed good hemodynamic function despite an enlarged left atrium with calcification. Laboratory data showed a platelet count of 93×10^3/µl, glutamic-oxaloacetic transaminase (GOT) of 25 U/l, glutamic pyruvic transaminase (GPT) of 10 U/l, lactate dehydrogenase of 301 U/l, total bilirubin of 1.4 mg/dl, and gamma-glutamyl transpeptidase (γ-GTP) of 59 U/l, suggesting liver dysfunction. A diagnosis of tricuspid prosthetic valve stenosis was made.

The patient underwent replacement of the tricuspid prosthesis. Because the preoperative computed tomography (CT)-scan revealed right atrial and ventricular dilation and its adhesion to the sternum (Fig. 1), cardiopulmonary bypass (CPB) with VAVD was instituted prior to sternal reentry by cannulation of the femoral artery, and direct cannulation of the right internal jugular vein with a 18-F cannula, and the femoral vein with a 24-F long cannula. The position of these cannulae was confirmed by transesophageal echocardiography.

The patient was cooled to 25 °C, and re-sternotomy was performed under ventricular fibrillation. Adhesion of the right atrium and ventricle made the dissection around the superior vena cava and IVC difficult, and snaring was not possible. Atriotomy was performed after reducing the flow and clamping the superior vena cava. After applying a purse-string suture around the IVC orifice, an 18-F Foley...
balloon catheter was inserted and inflated into the dilated IVC, and fixed by snaring the purse string. Although there was some space between the balloon and the IVC wall, a bloodless operative field was obtained (Fig. 2). Venous drainage was stable during the procedure.

Two leaflets of the tricuspid prosthetic valve were heavily calcified. The prosthesis was carefully retrieved by cutting the annular cloth between the metal ring and the sewing cuff, preserving the annulus, and replacing the defective valve was with a new 31 mm Carpentier–Edwards pericardial valve. The duration of CPB was 204 minutes, and the ventricular fibrillation time was 72 minutes. Hemolysis due to vacuum pressure drainage was null. Weaning from the extracorporeal circulation was easy, and postoperative hemodynamics were stable. Postoperative bleeding was minimal. Edema of both legs and liver congestion improved after the operation.

3. Discussion

Repeat valve surgery carries a high morbidity and mortality [1, 2], and the surgical approach for reoperation of a tricuspid prosthetic failure is difficult. A dilated RA adhering to the sternum may be injured during mediastinal reentry, and inappropriate myocardial protection may result in postoperative low-output syndrome.

Snaring of the bicaval veins are mandatory to obtain a bloodless surgical field, but this is not easy. Caval drainage tubes with balloons are possible alternatives, but this often fails due to a size mismatch between the balloons and the severely dilated caval veins. The VAVD system was introduced to obtain satisfactory drainage through a small-caliber cannula in minimally invasive heart surgery. It is also useful in the tricuspid reoperation because venous blood is effectively aspirated from the veins even when the veins are open to the air [3]. In our case, CPB with VAVD established before median sternotomy facilitated surgery by decompressing the heart, and allowed safe re-entry to the mediastinum.

Chronic tricuspid prosthetic valve dysfunction is frequently accompanied by liver dysfunction, including portal hypertension, thrombocytopenia and coagulopathy. Therefore, we limited the dissecting area to the RA and a part of the right ventricle, which minimized bleeding. VAVD achieved a bloodless operative field and was not blocked by the incoming air, due to the venous drainage being continuously pressure-regulated. Blockade of the IVC using a balloon catheter was also useful.

The most recognised complications of VAVD are hemolysis and entrainment of air producing gaseous microemboli [4]. Misplacement of venous cannula from the RA into the azygos vein or the hepatic vein may induce failure of drainage and elevation of venous pressure. Antegrade cannula insertion from the internal jugular vein and the femoral vein, and confirmation of cannula tip by transesophageal echocardiography, can avoid these complications.

The choice of prosthetic material for tricuspid valve replacement (TVR) is controversial. We used a bioprosthesis because the use of a mechanical valve in the right heart has a higher rate of valve thrombosis compared with left
heart implants. If endocarditis or valve thrombosis occurs with the mechanical valve, emergency surgery is required, and this leads to an even higher mortality [5].

In conclusion, tricuspid reoperation was successful using the VAVD system. Although the valvular reoperation is complex, a re-do operation can be carried out smoothly with a fully worked-out plan.

References


eComment: Tricuspid valve replacement with vacuum-assisted venous drainage

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We read with interest the article by Fukuda et al. [1] regarding redo tricuspid replacement using vacuum assisted venous drainage (VAVD).

This has been a routine method for us and I would like to add that with properly instituted VAVD there is no need to snare or occlude the superior vena cava (SVC) or inferior vena cava (IVC) in redo cases. In fact when doing it on a beating heart supported by cardiopulmonary bypass (CPB) we routinely desnare the IVC tape (if put) in primary cases (and we do not encircle or snare it in redos) and this allows the coronary sinus effluent to be captured by the IVC cannula (be it trans femoral or trans right atrial) by vacuum assisted drainage and this allows us to operate on such cases with minimal dissection. This gives a sufficiently dry field for us to operate and ensures that the CPB systemic venous pressure is truly zero as any venous hold up can decrease transhepatic perfusion pressure and cause hepato-renal dysfunction. There has been no excessive hemolysis with this method [2].

References