How to do it

A simple closure method for a mechanical aortic valve in left ventricular assist device implantation

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Abstract

Because a mechanical aortic valve is a contraindication for the implantation of left ventricular assist device, complicated additional procedures such as a replacement with a bioprosthesis and a closure of the left ventricular outflow tract are required to implant the device. Among such procedures, a sandwich plug technique using vascular clips is one of the simple and feasible procedures. However, this technique requires an off-label use of vascular clips within the aorta that could be associated with a risk of dislodgement and embolization. Thus, we developed a modified sandwich technique without using vascular clips, where the valve leaflets were fixed in the closed position using felt patches and sutures instead of vascular clips. This modified technique is a simple and secure method to close the mechanical aortic valve with the minimum use of artificial materials.

Introduction

In the implantation of a left ventricular assist device (LVAD), patients with a mechanical aortic valve require additional complicated procedures, such as replacement of the valve with a bioprosthesis [1] or closure of the left ventricular outflow tract using a pericardial patch [2], to avoid the risk of thromboembolic complications [3]. Although Cohn and Frazier reported a rapid and easy technique, named sandwich plug technique, to close a mechanical aortic valve using felts, braided polyester sutures, and vascular clips [4], the use

of vascular clips in the aorta is off-label in Japan and could be associated with a risk of dislodgement and embolization. Thus, we developed a modified sandwich plug technique without using vascular clips.

Technique

The modified sandwich plug technique is a simple and feasible procedure characterized by the fixation of a mechanical aortic valve in a closed position only using patches and sutures (Figure 1). Two circular patches made of a 1.85-mm-thick polytetrafluoroethylene felt were used on the ventricular and aortic sides. The patch on the ventricular side, which was slightly larger than the diameter of the mechanical valve, was slid under the valve through a central orifice between the leaflets after two pairs of pledgeted 2-0 braided polyester sutures (Ethibond EXCEL; ETHICON, Johnson & Johnson, Tokyo, Japan) were passed through the center line of the patch. Close attention was paid to confirm the linear alignment of the four sutures and that the implantation of the patch fully covered the ventricular surface of the valve. Subsequently, the sutures were passed through the patch on the aortic side that was designed slightly larger than the ventricular one and tied, thus sandwiching the mechanical valve between the patches. Furthermore, to secure the valve in the closed position without using a vascular clip, two suture ends of four sutures were then placed opposing each other on the aortic wall at the same height as the edge of the

mechanical valve so that the two suture ends were tightened over and covered each valve leaflet.

We performed this procedure for the patient with a mechanical valve who was indicated for LVAD implantation because of a progression of heart failure dependent on inotropes and an intra-aortic balloon pump. He had a history of three cardiovascular surgeries including repeat aortic root replacement using prosthetic graft and coronary artery bypass grafting using the left internal thoracic artery and the saphenous vein. Therefore, before the LVAD implantation, he required redo replacement of the distal portion of the aortic prosthesis under hypothermic circulatory arrest to attach the outflow graft for LVAD. As a result, the cardiac arrest time and the cardiopulmonary bypass time were 67 and 218 minutes, respectively. The fixation of the mechanical valve took approximately 5 minutes. The leaflets were completely closed in postoperative fluoroscopy and no transvalvular blood flow was found on postoperative echocardiography. No thrombus or pannus formation between the Valsalva sinus wall and the rim of the mechanical valve was detected on the postoperative enhanced CT.

Comment

In the original “sandwich technique”, in addition to the aortic and ventricular patches, the rectangular piece of felt pinched with large titanium vascular clips was placed on the

patch on the aortic side. As these clips lie perpendicular to the rotation axis of the leaflets, the leaflets are fixed in the closed position. However, the placement of vascular clips in the blood stream is an off-label use in Japan and could be associated with the risk of dislodgement of the clip and embolization. Therefore, we fixed the leaflets using sutures tied on the patches by tightening them on the leaflets, perpendicular to the line of leaflet closure. In our case, the durable fixation of the valve using the sutures would be expected because these sutures were placed on the aortic prosthesis. In contrast, a reinforcement of the sutures, such as the use of felt pledgets, would be required in cases with the native aortic root. Another concern was possible thrombus formation on the naked polytetrafluoroethylene felt patch. Cohn and Frazier assessed explanted valves from heart transplantation and reported that there was no evidence of thrombus around the patches. Our modified sandwich plug technique is a simple and secure method to close the prosthetic aortic valve with the minimum use of artificial materials in the blood stream.

Legend for Figure

Fig. 1 Schematic images (a and b) and photos from the wetlab (c－d) of the modified sandwich plug technique without using vascular clips. (a) The aortic valve prosthesis is sandwiched between two circular patches of polytetrafluoroethylene felt, which are fixed with two pairs of pledgeted 2-0 braided polyester sutures. (b) The sutures are fixed on the

aortic wall at the same height as the edge of the mechanical valve (black arrow and circle) so that the tightened sutures cover the mechanical valve leaflets. (c) View from the aortic side. (d) Side view. (e) View from the left ventricle.

Compliance with ethical standards

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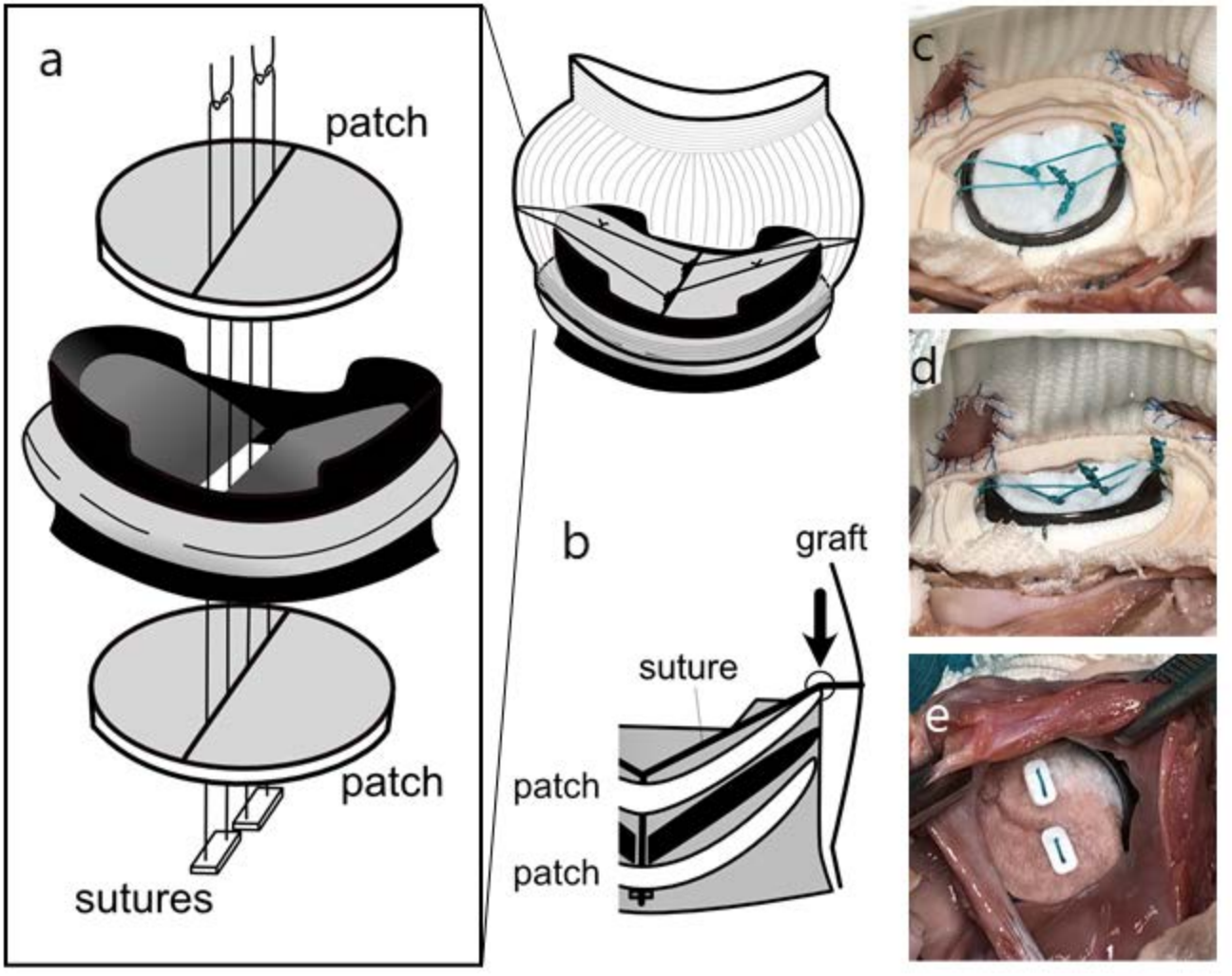
References

1. Dranishnikov N, Stepanenko A, Potapov EV, Dandel M, Siniawsli H, Mladenow A, et al. Simultaneous aortic valve replacement in left ventricular assist device recipients: single-center experience. Int Artif Organs 2012; 35: 489–94.

2. Pelletier MP, Chang CP, Vagelos R, Robbins RC. Alternative approach for use of a left ventricular assist device with a thrombosed prosthetic valve. J Heart Lung Transplant 2002; 21: 402–4.

3. Ahn H, Granfeldt H, Hubbert L, Peterzen B. Long-term left ventricular support in patients with a mechanical aortic valve. Scand Cardiovasc J. 2013; 47: 236–9.

4. Cohn WE, Frazier OH. The sandwich plug technique: simple, effective, and rapid closure of a mechanical aortic valve prosthesis at left ventricular assist device implantation. J Thorac Cardiovasc Surg. 2011; 142: 455-7.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