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Modified Miniskirt Bentall with an Annular Pericardial Patch for Bentall's Endocarditis

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Abstract

Surgery for Bentall's endocarditis poses challenges because the infection spreads to the aortic valve annulus, leading to an annular abscess that necessitates reconstruction. We present a straightforward miniskirt Bentall procedure using an annular pericardial patch to treat Bentall's endocarditis with an annular abscess. After removing the former composite graft and debriding the aortic root and annulus, we created a miniskirt-composite graft using a mechanical or bioprosthetic valve, a straight or Valsalva graft, and an annular bovine pericardial patch with a valve prosthetic sizer. The miniskirt-composite graft, along with the underlying annular pericardial patch, was implanted using a double-layered suture technique.

Keywords

- annular pericardial patch
- Bentall's endocarditis
- destroyed aortic valve annulus
- miniskirt technique

Introduction

Surgery for endocarditis following the Bentall procedure poses challenges due to the spread of infection to the aortic valve annulus and subvalvular tissue resulting in an annular abscess. This situation necessitates the reconstruction of the aortic valve annulus and the addressing of aortoventricular discontinuity.[1,2] Reconstruction techniques for the aortic valve annulus, including pericardial reconstruction, tube grafts, and pericardial skirt techniques, have reported favorable outcomes.[2–4] Here, we introduce a novel modified miniskirt Bentall technique that utilizes an annular pericardial patch for managing Bentall's endocarditis.

Technique Description

Our approach involves a simple annulus reconstruction technique using an annular pericardial patch within the modified miniskirt Bentall technique for treating Bentall's endocarditis.

The step-by-step surgical technique is as follows:

1. After reopening the sternum, a cardiopulmonary bypass is established, and adhesions around the mediastinum and cardia are dissected. Following cardiac arrest induced by clamping the ascending aorta, the vascular graft is opened, and the aortic root is dissected. The former composite graft, including felt strips and pledgets, is completely removed. Careful debridement of the aortic root and annulus is performed using a massive povidone-iodine lavage, resulting in a circumferential defect in the aortic valve annulus that necessitates reconstruction. Pyoktanine blue is applied to the destroyed aortic annulus, followed by a thorough saline lavage.
2. A composite graft, consisting of a mechanical or bioprosthetic valve and a straight or Valsalva vascular graft, is prepared using a 5–0 polypropylene suture, incorporating a 5-mm skirt (►**Fig. 1A**).
3. A 1-cm-wide annular bovine pericardial patch is created using an aortic valve prosthetic sizer (ring type) of the same size as the mechanical or bioprosthetic valve (►**Fig. 1B, C**).
4. A noneverting mattress suture is performed using 2–0 polyester sutures with pledgets, anchoring the suture from the tissue of the left outflow tract to the aortic annulus. The suture is then passed through the created

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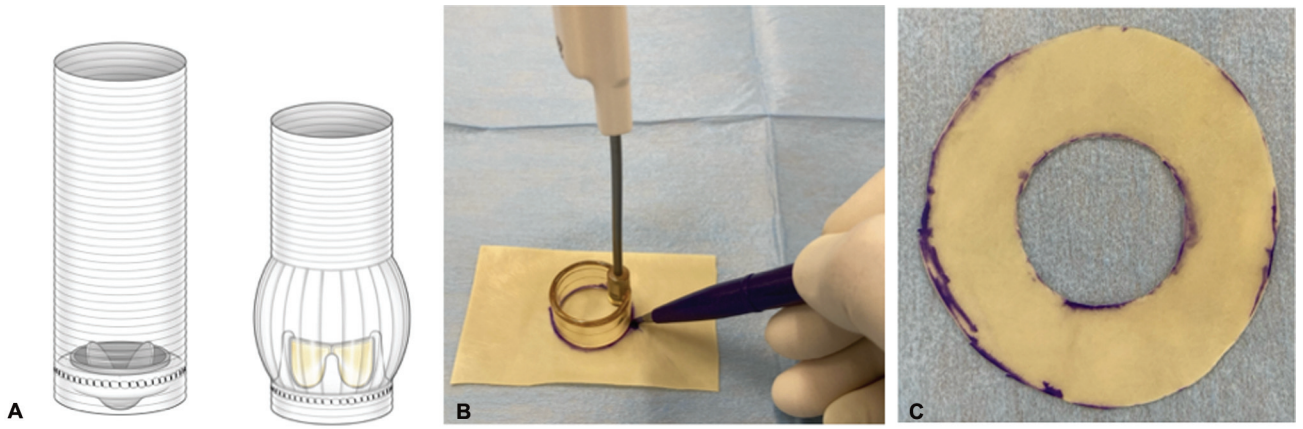

Fig. 1 Composite graft with miniskirt and annular pericardial patch. (**A**) The straight tube or Valsalva graft is everted with a 5-mm skirt, and a mechanical or bioprosthetic valve is sewn to the end of the everted graft using 5–0 polypropylene continuous sutures. (**B**) The bovine pericardium is marked using a prosthetic valve sizer (ring type). (**C**) Annular pericardial patch with a width of 1 cm.

annular pericardium to reconstruct the aortic root (►**Fig. 2A–C**). Subsequently, the composite graft is implanted by passing a 2–0 polyester suture through the prosthetic valve cuff and the skirt (►**Fig. 2B, D**).

5. After tying the noneverting mattress sutures (first-layer sutures), a second-layer continuous suture with 4–0 polypropylene is applied between the skirt and the root tissues, including the annular pericardium, to reinforce the root and prevent bleeding (►**Fig. 2E**; double-layered suture).
6. The coronary arteries are reconstructed using the button technique with 6–0 polypropylene sutures (►**Fig. 2F**).

Case Presentation

A 49-year-old woman developed endocarditis following a modified Bentall procedure. At 39 years of age, the patient

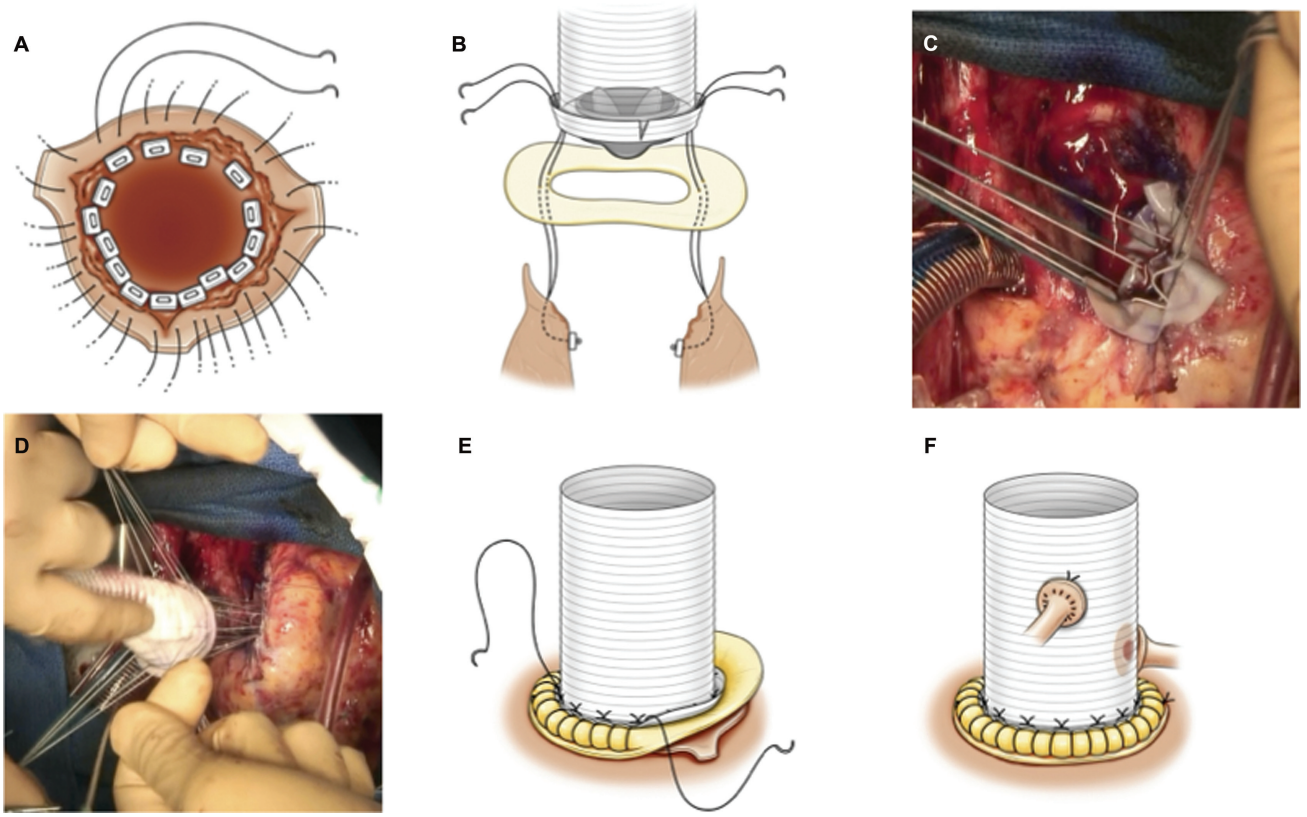

Fig. 2 Intraoperative images. (**A**) Noneverting mattress suture with 2–0 polyester sutures applied to the destroyed aortic annulus after radical debridement. (**B–D**) The 2–0 polyester suture needle is passed through the annular pericardial patch, the cuff of the composite graft, and the miniskirt. The annular patch is placed on the destroyed aortic annulus, followed by tying the noneverting mattress suture after the composite graft is positioned on the annular pericardial patch. (**E, F**) A second-layer continuous suture with 4–0 polypropylene is placed between the miniskirt and the root tissues, including the annular pericardium.

Fig. 3 Postoperative three-dimensional computed tomography angiography image.

underwent a modified Bentall procedure involving the implantation of a 23-mm Epic valve (Abbott Laboratories, Chicago, IL, United States) for a Valsalva sinus aneurysm with aortic valve regurgitation. Subsequently, we performed a remodified Bentall procedure using the miniskirt technique with a 23-mm SJM Regent (Abbott Laboratories) and a 26-mm Triplex straight vascular graft (Terumo Aortic Vascutek Ltd, Renfrewshire, Scotland, UK), along with reinforcement of the aortic valve annulus using an annular pericardium. Postoperative computed tomography angiography confirmed good patency of the reconstructed coronary ostium without any vascular issues (►**Fig. 3**). The patient was discharged without complications and remained free from vascular events or recurrent infections for over a year postoperatively, without requiring additional antibacterial therapy.

Discussion

Simple replacement with a homograft or pulmonary autograft (Ross' procedure) provides good early and long-term outcomes for Bentall's endocarditis or prosthetic valve infection with a destructive aortic annulus. The pliable and flexible nature of the muscular cuff around the annulus fills the defective aortic root annulus and is firmly connected to prevent bleeding from the root.[1,5] However, obtaining a suitable homograft can be challenging in Japan, especially during emergencies. Moreover, pulmonary autograft replacement is a technically demanding and time-consuming procedure, particularly in reoperation cases. Therefore, composite graft replacement or xenograft replacement is still in demand due to the easily obtainable and familiar techniques. When patients have a shallow annular abscess, the Teflon-reinforced U-suturing with circumferential tourniquets technique can achieve a good result without tearing the annulus by reducing tension on pledgets.[6] However, an extensively destructed aortic annulus in composite graft or xenograft replacement requires alternative reconstruction techniques. Consequently, xenopericardial or autologous pericardial patch reconstruction may be preferred over homograft or pulmonary autograft replacement due to its ease of handling and appropriate fitting to the defective annulus, facilitated by the soft nature of pericardial tissue.[2]

Recently, Doi et al reported a simple method of root grafting using a bovine pericardial skirt technique for extensive endocarditis, although the aortic annulus is commonly reconstructed using a pericardial patch and running sutures.[4] They created a xenograft valved conduit by sewing a doughnut-shaped bovine pericardial sheet to the proximal end of the conduit and replaced the aortic root using a double-layered suture technique, yielding favorable outcomes. While our technique also employs a double-layered suture technique, it differs from the pericardial skirt technique by incorporating an annular pericardial patch that fills the defective annulus. This patch is placed beneath a composite graft on the destroyed aortic annulus by passing a needle through both the annular pericardial patch and the composite graft. Additionally, we apply a second-layer suture between the miniskirt and the annular pericardial patch, including the aortic root, which provides strong hemostasis. Furthermore, manually determining the inner annular size during the preparation of an annular pericardial patch can be challenging. Our technique addresses this issue by facilitating the creation of an annular pericardial patch using a prosthetic valve sizer of the same size as the replaced prosthetic valve, enabling appropriate annular reconstruction under the composite graft without interfering with the left ventricular outflow tract.

Our simple, modified miniskirt Bentall's procedure with annular pericardial patch reinforcement could serve as a useful and reproducible technique for addressing Bentall's endocarditis. However, further studies are needed to confirm the robustness of the proposed technique.

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Conflict of Interest
None declared.

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