

Alternative Approach for Use of a Left Ventricular Assist Device With a Thrombosed Prosthetic Valve

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Implantation of a left ventricular assist device is problematic in patients with prosthetic heart valves, due to an increased risk of thrombosis with embolization. This report describes the use of a bovine pericardial patch to close the aortic outflow tract in a patient with a mechanical aortic valve and end-stage cardiomyopathy who required urgent left ventricular assist support. A successful outcome suggests that this technique may be of value in treating similar patients. *J Heart Lung Transplant* 2002;21:402–404.

The incidence of prosthetic valve thrombosis has been reported at 0.1% to 0.5%.¹ When this potentially fatal complication occurs, treatment options are mostly limited to thrombolytic therapy, surgical debridement or selective valve replacement.² Mortality with surgical valve replacement ranges from 2% to 4% in low-risk groups to 25% to 40% in high-risk groups.^{2,3} Thrombolytic therapy has been successful in low-risk patients with preserved ventricular function and New York Heart Association (NYHA) Class I or II failure. However, in patients with NYHA Class IV failure, the success rate is only 65%, with a mortality of 13% and a major complication rate of 30%.⁴ With such dismal success for patients with prosthetic valve thrombosis and severe congestive heart failure, cardiac transplantation is a viable option in some patients. Unfortunately, some of these patients will be unable to wait for heart transplant and will require left ventricular assist device (LVAD) support as a bridge to transplantation. In patients with prosthetic aortic valves, use of these devices has been associated with thrombotic

complications.⁵ This concern has been noted by the assist device manufacturers, who consider the presence of a mechanical aortic valve as an exclusion criterion for LVAD placement,⁶ or as a significant risk factor.⁷ This concern has arisen due to lack of blood flow across the aortic valve in a left ventricle fully supported by an assist device, with most of the cardiac output being device-generated—thrombosis of the valve may occur, leading to peripheral embolization. Although a recent report failed to identify any thromboembolic events in 8 patients treated with the Thoratec LVAD (Thoratec Laboratories, Pleasanton, CA),⁸ ongoing concern about this risk led us to adopt an alternative surgical approach. This report describes the use of a bovine pericardial patch to oversee the aortic orifice in a patient with a thrombosed prosthetic aortic valve and congestive heart failure, requiring urgent Thoratec LVAD as a bridge to transplantation.

CLINICAL SUMMARY

A 39-year-old woman with a history of rheumatic heart disease, Type II diabetes mellitus and hypertension was admitted with end-stage dilated cardiomyopathy. At the age of 24 years, she had undergone aortic valve replacement for aortic stenosis with a St Jude mechanical prosthesis (St Jude Medical, Inc, St Paul, MN). Prior to admission, she had noted increasing dyspnea on exertion, with the development of orthopnea and paroxysmal nocturnal dyspnea. Upon admission, she was found to be in cardiogenic shock, with orthopnea, dyspnea at rest, pulmonary edema, refractory hyponatremia and

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early renal failure. She was managed with aggressive diuresis and afterload reduction, while being properly anti-coagulated for her mechanical valve. Echocardiography performed 6 months previously had shown a left ventricular ejection fraction (LVEF) of 20%, with moderate-to-severe mitral regurgitation. Repeat echocardiography at this admission revealed central aortic insufficiency, LVEF of 15% and severe mitral regurgitation. Cine-fluoroscopy demonstrated complete immobility of one aortic valve leaflet, confirming the suspicion of prosthetic valve thrombosis. Usual treatment options were felt to present prohibitive risks. Thrombolysis was contraindicated due to severe coagulopathy and heavy menorrhagia with an INR of 5.5, resulting from congestive hepatic dysfunction. Surgical replacement was considered inappropriate in the setting of severe left ventricular dysfunction and the requirement for two prosthetic valves. She was accepted as a suitable candidate for cardiac transplantation. Despite inotropic support with dobutamine and dopamine, her clinical status continued to deteriorate, with worsening end-organ dysfunction, renal failure, refractory hyponatremia, decreased mental status and respiratory decompensation. Left ventricular support became imperative.

A Thoratec LVAD was inserted, with the procedure modified by closure of the aortic orifice. The proximal ascending aorta was opened in transverse fashion, exposing a chronically thrombosed aortic valve with pannus in-growth formation. To avoid systemic embolization and to minimize aortic regurgitation, a bovine pericardial patch (Baxter, Irvine, CA) was used to oversee the aortic orifice by sewing it to the sewing ring of the prosthetic valve with a running 4-0 prolene suture. Cardioplegic arrest time was 26 minutes. Post-operatively, anti-coagulation was maintained with clopidogrel, heparin and warfarin. No thromboembolic events were noted, and the patient recovered completely from renal failure, hepatic failure and pulmonary edema. On postoperative day 11, she underwent orthotopic heart transplantation and removal of the LVAD. Examination of the valve at this point revealed a significant amount of thrombus at the aortic valve level, along with a completely sealed aortic root (Figure 1). Her post-operative course was uneventful and she was discharged from the hospital 2 weeks after surgery.

DISCUSSION

Left ventricular assist devices have become an important treatment modality as a bridge to transplantation for patients with end-stage cardiomyopathy.



FIGURE Appearance of the pericardial patch in the aortic orifice. The heart was explanted during the heart transplantation procedure.

Recent experience with the Thoratec ventricular assist device demonstrated 68% transplantation survival in such a group of 84 patients, with a post-transplant survival of 88%.⁹ Another report demonstrated a 96% survival rate in 27 of 44 patients who underwent transplantation following device support.¹⁰ Their actuarial survival was 88% and 83% at 1 and 5 years after transplantation. These are encouraging results for individuals in such profound heart failure, supporting the use of these devices in appropriate settings. However, this patient population poses significant problems, with many risk factors that often contraindicate placement of a ventricular assist device. Among these, the presence of a prosthetic valve, especially in the aortic position, has been considered a relative contraindication to VAD support. This is due to blood flow diversion into the VAD, leading to stagnant flow near the valve, and is based on previous reports⁵ of thrombotic complications and of institution-mandated contraindications.^{6,7} Despite a recent report demonstrating few complications in a group of 8 patients with 12 mechanical intracardiac valves,⁸ concern about implanting a VAD in such patients is easily justified.

In this report, a bovine pericardial patch was used to oversee the aortic orifice of a patient with end-stage cardiomyopathy and a prosthetic aortic valve who could no longer wait for transplant and

required mechanical ventricular support. Bovine pericardium was chosen due to its pliability and relative non-thrombogenicity. Although this added 26 minutes of cardioplegic arrest time to the procedure, our patient was weaned from cardiopulmonary bypass easily with VAD support. Her recovery was excellent, with a return to normal of renal function, mental status and electrolytes. At the time of transplant, a significant amount of clot was found adherent to the aortic valve, on the undersurface of the pericardial patch. Fortunately, there was no clinical evidence of embolization. It is possible that the presence of a patch contributed to this amount of thrombosis, providing an area of low turbulent flow. However, with a properly functioning ventricular assist device, blood flow at the aortic orifice is usually low anyway, with most being diverted into the inflow cannula of the device.

Although this technique has been described previously,¹¹ the present case differs in several important ways and illustrates the feasibility of this approach in different situations. Most importantly, our patient already had a thrombosed aortic valve. In addition, she had a bileaflet valve, as opposed to ball-and-cage, and required a Thoratec LVAD, which necessitates aggressive anti-coagulation.

Potential downfalls of this technique include a remaining risk of thromboembolism, inherent to any VAD, and a need for cardioplegic arrest. Emboli could still potentially dislodge from the undersurface of the valve and enter the inflow cannula, leading to peripheral embolization via the LVAD. This risk may be compounded by the cul-de-sac of the closed orifice; however, with proper anti-coagulation necessitated by the VAD, this risk should be minimized. Cardioplegic arrest, albeit for a short period, could further damage the right ventricle, with the potential requirement for right ventricular assist device. Sudden VAD malfunction with a closed aortic orifice is particularly worrisome. However, with current devices, this seldomly occurs and

must be weighed against the risk of potential valve thrombosis and embolization.

Given the complexity of such patients, this technique of aortic orifice closure is relatively simple and, although not fully protective, may provide a safeguard against peripheral embolization. It should be considered in patients with a prosthetic aortic valve who require support with a left ventricular assist device.

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