"Martin Mattress": Surgical Technique for Achieving Hemostasis in Redo Aortic Root Operations

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Abstract

A 71-year-old gentleman with prior bioprosthetic aortic valve replacement was admitted with aortic valve dehiscence and an aortic root abscess. He underwent reoperative sternotomy, aortic root, mitral valve, and hemiarch replacement. To augment hemostasis, we implanted the "Martin Mattress"—a pericardial patch sutured to the fibrous ridge within the innominate vein, superior vena cava, right atrium, right ventricular outflow tract, and pulmonary artery—which is preferred to modified Cabrol fistula techniques in infectious root pathology.

Keywords
- reoperation
- aorta
- endocarditis
- hemostasis

Introduction

Reoperative cardiac surgery is associated with significant intraoperative and postoperative coagulopathy. Mechanistically, surgical dissection and extensive lysis of adhesions cause diffuse capillary injury and tissue damage, which are compounded by activation of the fibrinolytic system during cardiopulmonary bypass.[1] The Cabrol fistula[2] and modified approaches[3–5] have been described to control bleeding in this setting; however, these approaches involve fistula creation between a surgically created perigraft compartment (patch wrap technique or pericardial recess coverage technique) and the right atrium or superior vena cava—which may be problematic in the setting of infectious root pathology. Avoiding fistula creation, we introduce the "Martin Mattress" technique to achieve hemostasis in patients undergoing reoperative cardiac surgery to limit blood product usage and procedural time, particularly in the setting of infectious root pathology.

Case Presentation

A 71-year-old man presented as a hospital-to-hospital transfer for definitive management of acute-onset severe congestive heart failure. Medical and surgical history were significant for Factor VIII deficiency, prior coronary artery bypass grafting, and bioprosthetic aortic valve and ascending aortic replacement. Seven weeks prior to admission, he had also developed complete heart block and underwent biventricular implantable cardioverter–defibrillator (ICD) placement.

On workup, transthoracic echocardiography (TTE) demonstrated an ejection fraction of 40 to 45%, a dilated left ventricle with a poorly seated, unstable aortic valve bioprosthesis with perivalvular leak causing severe aortic insufficiency, and moderate-to-severe mitral regurgitation.

On admission, he was asymptomatic and vitals included: blood pressure 115/43, heart rate 87, respiratory rate 21, and oxygen saturation 95% on 2-L nasal cannula. With a widened pulse pressure and TTE findings, it was clear that the aortic insufficiency and heart failure symptoms were due to dehiscence of his aortic valve bioprosthesis. Although he was afebrile (98.2°F [36.8°C]) with a normal, stable white blood cell count (7.0 thou/mm^3 on admission), vancomycin and cefepime were started empirically.

The patient was offered urgent intervention. Intraoperatively, two-thirds of the bioprosthetic valve was dehisced from the aortic annulus, affecting the aortomitral continuity.

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Inspection of the mitral valve revealed multiple drop vegetations rendering the anterior leaflet beyond repair. He underwent a reoperative sternotomy, aortic root replacement (27-mm Freestyle porcine root), mitral valve replacement (31-mm Mosaic valve), hemiarch replacement, modified Cabrol bypass grafts to the right and left main coronaries, biventricular ICD lead removal, and mediastinal antibiotic irrigation catheter placement. During the operation, he received 8 units of packed red blood cells, 1 unit of fresh-frozen plasma, 6 units of platelets, and 4 units of cryoprecipitate. Bleeding persisted following heparin reversal with protamine.

A "Martin Mattress" was implemented. In this technique, a pericardial patch is sewn to the fibrous ridges contained within the innominate vein, superior vena cava, right atrium, right ventricular outflow tract, and pulmonary artery to contain bleeding to ultimately obtain tamponade and subsequent hemostasis (►**Fig. 1**). The chest was closed with sternal wires with a plan for week-long mediastinal antibiotic irrigation.

At the end of the case, his hemoglobin was 8.8 g/dL. He did not require any blood products over the following week. As planned, the patient returned to the operating room for removal of the central portion of the patch, where we observed excellent hemostasis. Permanent biventricular epicardial leads were placed.

Postoperatively, he required hemodialysis for poor renal function. A peripherally inserted central catheter was placed for a 6-week course of intravenous antibiotics. The patient was discharged 29 days following the index operation.

During follow-up, he remains on life-long oral suppressive antibiotics, renal function is fully recovered, and he is off hemodialysis. The patient participates in regular physical activity and is alive and thriving at latest follow-up 1,126 days (>3 years) postoperatively.

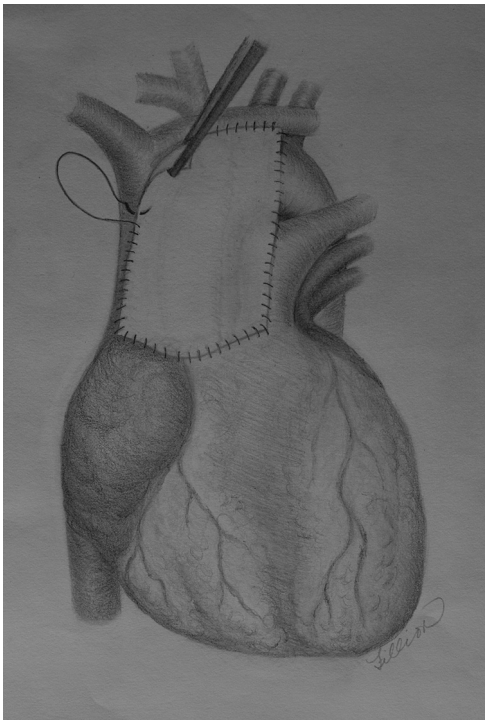

Fig. 1 "Martin Mattress" pericardial patch sewn to the fibrous ridges within the innominate vein, superior vena cava, right atrium, right ventricular outflow tract, and pulmonary artery.

Discussion

Patients undergoing reoperative cardiac operations are at high risk for bleeding, which may necessitate increased blood product usage, with its associated morbidity.[6] In these cases, the "Martin Mattress" can help decrease blood product utilization by creating biologic tamponade. A customized pericardial patch is sewn to contain the innominate vein, superior vena cava, right atrium, right ventricular outflow tract, and pulmonary artery (►**Fig. 1**). In cases of infectious diagnoses, we plan for reoperation 7 to 10 days after the index operation, during which the mediastinum is continuously irrigated with antibiotic solution. At the subsequent operation, we incise the central portion of the patch and evaluate for hemostasis. If this is not achieved, the patch is reclosed with a running prolene. If hemostasis has been achieved, we proceed with excision and removal of the patch and sternal closure. In the current patient undergoing reoperative aortic root intervention with additional increased risk of bleeding due to Factor VIII deficiency, this technique was associated with no postoperative blood product usage or hemostatic complications.

Bleeding in high-risk patients undergoing reoperative cardiac procedures can be due to medical coagulopathy and/or surgical bleeding. Medical coagulopathy is combatted via utilization of platelets, cryoprecipitate, fresh-frozen plasma, and concentrated factors including prothrombin complex concentrate and Factor VII. However, analyses of blood product usage in cardiac surgery and more specifically, aortic surgery, consistently demonstrate increased risk of morbidity and mortality among patients who receive perioperative blood products.[6–8] The Martin Mattress primarily targets medical coagulopathy by creating a biologic tamponade to limit bleeding until coagulopathy can be corrected.

In our experience, the decision to implement a Martin Mattress follows heparin reversal. If there continues to be significant bleeding, we ensure that the bleeding is not secondary to a mechanical surgical issue. If no mechanical causes are identified and bleeding persists, we suture the Martin Mattress pericardial patch to the surrounding fibrous ridges to contain bleeding. If necessary in a patient with endocarditis, it is important to place an antibiotic irrigation catheter and continuously irrigate the closed space to avoid secondary infection, since the patch could serve as a nidus. Nonetheless, in our experience, when implemented with caution, this technique has successfully contributed to hemostasis without adverse consequences.

Compared with the Cabrol fistula technique[2] and modified approaches,[3–5] the Martin Mattress technique avoids fistula creation, which is particularly important in the setting of infectious root pathology. Zhang et al[3] evaluated their modified Cabrol fistula technique in 76 acute type A aortic dissection patients. Their approach involved suture closure of the transverse pericardial sinus, pericardial patch coverage of the pericardial recess (between the superior vena cava

and pulmonary artery), and incision into the superior vena cava or right atrial roof. While they reported favorable outcomes, spontaneous fistula closure, and no thrombotic complications associated with their modified technique, Cabrol fistula approaches may not be acceptable in the setting of infectious root pathology, in which fistulization could lead to dissemination of infection. The Martin Mattress technique avoids fistulization and includes antibiotic irrigation catheter placement in infectious root pathology to achieve hemostasis without propagating infection.

The "Martin Mattress" pericardial patch technique is an effective method of achieving hemostasis in patients at high risk for bleeding during reoperative aortic root operations, particularly in the setting of infectious root pathology. In the present case, hemostasis was effectively achieved using this technique in a 71-year-old man with a history of Factor VIII deficiency undergoing reoperative sternotomy for endocarditis, explant of prior prostheses, aortic root, mitral valve, and hemiarch replacement. The patient did not require postoperative blood product transfusions and is alive and well 1,126 days (37 months) postoperatively.

Conflict of Interest
None declared.

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