defects in 30% of patients [1]. A link between CAP and aortic connective tissue disorders is not established, but two previous studies have reported that association [7, 8]. In addition, several cases of aortic dissections have been described in these patients. The current patient had a family history of aortic dissection at a young age, and progressive dilatation of the aortic root had occurred during a 12-year period. Histologic findings were similar to those in patients with connective tissue disorder.

Medial necrosis is the histologic hallmark of patients with Marfan syndrome. It is also commonly seen in other groups who present with aortic dissections or aneurysms [6]. Non-Marfan patients with medial necrosis are at high risk of late adverse aortic events and should be aggressively monitored and treated to avoid acute aortic syndromes in other territories [8]. This patient did not meet the Gent criteria for the diagnosis of Marfan syndrome [9], but his family history, presentation, and histologic assessment were highly suggestive of Marfan syndrome or another aortic connective tissue disorder. Lifetime surveillance is recommended for aortic dilatation.

In conclusion, the aortic root anatomy in patients with CAP is preserved. Therefore, aortic root replacement can be safely performed without the need for technical modifications. Surgeons should be aware of the abnormal anterior location of the left phrenic nerve. CAP may be associated with abnormalities of the aortic wall that predispose patients to aortic aneurysm or dissection. Patients with CAP should be screened for root and ascending aorta aneurysms. Additional studies are necessary to further define this association.

References

Left Ventricular Assist Device and Heart Transplantation in Hemophilia A Patient

Mohammed Quader, MD, Zane Rusina, MD, Neil P. Lewis, MD, Lisa Martin, RN, and Gundars Katlaps, MD

Departments of Surgery and Cardiology, McGuire Veterans Medical Center, Richmond, Virginia

We report here a hemophilia patient who was bridged with a left ventricle assist device and later received heart transplantation. Preparation for surgery with factor VIII supplementation, intraoperative conduct of surgery, and challenges of postoperative course are described with a brief literature review.


Hemophilia is a rare X-linked autosomal recessive disorder. Type A, the more common form, is characterized by decrease in levels of clotting factor VIII. Severity of bleeding disorder is based on circulating factor VIII levels. Levels of greater than 5%, 1% to 5%, and less than 1% are termed mild, moderate, and severe disease, respectively [1]. Patients with mild or moderate disease often go undiagnosed or are diagnosed after significant unexpected bleeding from surgery [2]. Of the estimated 400,000 patients with hemophilia worldwide, only a third will get diagnosis in their lifetime. Recombinant factor VIII has significantly improved survival of patients with hemophilia. Diabetes and hypertension, the major risk factors for cardiac disease, are twice as common in patients with hemophilia [3]. Due to improved survival, more patients with hemophilia are expected to present with cardiovascular illnesses including advanced heart failure.

We report a case of a patient hemophilia A, who presented with advanced heart failure requiring placement of left ventricular assist device (LVAD; HeartMate II, Thoratec Corp, Pleasanton, CA), aortic valve replacement and coronary artery bypass surgery as a “bridge” to heart transplantation. Institution Review Board gave authorization to report this case.

A 63-year-old man with advanced ischemic cardiomyopathy was evaluated for heart transplantation. Echo-cardiogram showed severe biventricular failure, moderate aortic valve regurgitation, and severe mitral and moderate tricuspid valve regurgitation. Heart catheterization documented multivessel coronary artery disease, elevated pulmonary artery pressures, and
cardiogenic shock. He was deemed a suitable candidate for transplantation and listed.

Past surgical history was significant for a motor vehicle accident 20 years previously requiring repair of the left temporal artery associated with excessive bleeding. There was no history of spontaneous bleeding. His brother died of exsanguination during treatment of acute coronary syndrome. This prompted assessment of coagulation that demonstrated mild hemophilia type A, factor VIII levels 19% of predicted normal. After interdisciplinary discussion a factor VIII replacement plan was developed (Table 1).

While awaiting heart transplantation his condition deteriorated with multisystem organ dysfunction. A decision was made to offer LVAD as a bridge to transplantation. Moderate aortic insufficiency and concomitant right coronary artery disease in the face of poor right ventricular function made the surgical procedure more complex.

After administering 40 units/kg intravenous bolus of factor VIII through a median sternotomy, the patient was placed on cardiopulmonary bypass (CPB) pump; a standard dose of heparin achieved activated clotting time of greater than 450 sec. Cardiac arrest was obtained with cold blood cardioplegia. The aortic valve was replaced with a 23-mm Magna valve (Carpentier-Edwards; Edwards Lifesciences Corp, Irvine, CA) saphenous vein graft anastomosed to the posterior descending artery. The cross-clamp was released and sinus rhythm returned.

On a beating heart in flow and out flow, cannulae of LVAD were attached to the left ventricle apex and ascending aorta, respectively, connected to the LVAD and active removal of air was performed as the pump speed gradually increased to 8,400 rpm. The proximal end of the vein graft was anastomosed to the outflow graft. The patient was released from CPB support without any difficulty. Total CPB time was 150 minutes and cross-clamp time was 58 minutes. Estimated blood loss was 1,000 cc and he received 2 units of pack red blood cells (PRBC), 4 units of frozen plasma, and 2 units of platelets at the end of surgery. Protamine was given and activated clotting time returned to baseline value of 129 seconds. The chest was primarily closed after satisfactory hemostasis.

Patient had only 200 cc drainage in the chest tubes for the next 24 hours and maintained a stable hemoglobin level. Factor VIII was administered at 20 units/k intravenous bolus every 12 hours for the next 3 weeks (Fig 1). Once the chest tubes were removed the insertion site continued to bleed despite compression dressing and increasing the dose of factor VIII to 30 units/k. Purse-string skin stitches were needed to contain ongoing oozing. He received 1 unit of PRBC for a drop of hemoglobin.

On postoperative day 2, warfarin was started for LVAD thrombosis prophylaxis. His heart failure symptoms improved significantly and multisystem organ recovery was apparent. However, his remaining course was marred with multiple episodes of gastrointestinal (GI) bleeding, possible pump thrombosis, and transient ischemic attacks requiring systemic anticoagulation with heparin. There was never a steady time where he was well anticoagulated and was not manifesting GI bleeding (Fig 2). After 156 days of support on LVAD he received successful heart transplantation.

Once again, 40 u/kg intravenous bolus of factor VIII was administered preoperatively. Following standard

<table>
<thead>
<tr>
<th>Table 1. Factor VIII Dose and Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>1-2 hours before Surgery</td>
</tr>
<tr>
<td>During surgery</td>
</tr>
<tr>
<td>Postoperative period for 2-3 weeks</td>
</tr>
</tbody>
</table>

IV = intravenous; LVAD = left ventricle assist device.
bicaval technique, orthotopic heart transplantation was performed with excellent graft function; estimated blood loss, 700 cc. For generalized coagulopathy in addition to factor VIII dose, the patient received 3 units of PRBC, 6 units of frozen plasma, 2 units of platelets, 1 unit of cryoprecipitate, and a dose of recombinant factor VII 90 mcg/kg intravenous bolus. There was minimal drainage from mediastinal chest tubes postoperatively. He was released from hospital on postoperative day 22. At 4 months post transplantation he is enjoying good health.

Comment
Three heart transplantations have been performed successfully in pediatric patients with hemophilia A in the published literature [4–6], of which only 1 was supported with a biventricular device (Excor; Berlin-Heart AG, Berlin, Germany) for 178 days [6]. For heart surgery in patients with hemophilia, there are no standard guidelines for factor VIII supplementation. Common themes, as succinctly summarized by Rossi and colleagues [7], suggest keeping factor VIII level over 50% of normal prior to and during the immediate postoperative period. Using this approach, of the 36 summarized patients who had heart surgery only 4 (9%) had significant bleeding. In general, patients who have not bled during the first postoperative week seldom bleed later. In view of this, either continuous or bolus doses of factor VIII have been used for 7 to 10 postoperative days in most surgical cases. Our patient required 3 weeks of factor VIII supplementation at the first surgery due to onset of GI bleeding. With anticipated longer wait times for heart transplantation in our state and region we elected to bridge our patient with HeartMate II. Anticoagulation, which is required to prevent pump thrombosis, has been well tolerated in patients with hemophilia who had mechanical heart valves [8].

Patients with hemophilia are living longer and are expected to present with cardiovascular morbidities including advanced heart failure. Bridge to transplantation with a LVAD is increasingly necessary but is fraught with challenges related to pump thrombosis and GI bleeding. Major cardiac surgical procedures, as presented here, can be safely performed in patients with hemophilia with meticulous interdisciplinary planning.

The authors acknowledge the support of McGuire Veterans Medical Center and the heart failure team who provided care for our patient.

References