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Aortic Root Reconstruction in Two Patients with Chronic Aortic Dissection by Aortic Valve-Sparing Procedures Using a New Aortic Root Conduit with The Sinuses of Valsalva (De Paulis Valsalva graft)

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The durability of the aortic valve after aortic root reconstruction by an aortic valve-sparing procedure is of particular concern because of the absence of the sinuses of Valsalva in the David type-I reimplantation method. Various improvements have been made to the David-I method. In particular, a new aortic root conduit with the sinuses of Valsalva was developed recently and is expected to improve the long-term follow-up results of the aortic valve-sparing procedures. We used a Valsalva graft in two patients with aortic root dilation accompanied by aortic regurgitation and obtained good short-term results.

Key words: aortic regurgitation, aortic valve-sparing operation, aortic root surgery, aortic dissection

INTRODUCTION

Aortic root reconstruction by an aortic valve-sparing procedure has been vigorously discussed since publication of the remodeling procedure by Sarsam *et al*. [1] in 1992 and the reimplantation procedure by David *et al*. [2] in 1993. However, the indication and choice of operative procedures to be used remain highly controversial. The reimplantation procedure seems preferable in cases accompanied by dilation of the aortic annulus due to the preventability of dilation. With the David-I procedure where the sinuses of Valsalva are not incorporated, the durability in the long-term follow-up results was of concern because the valve leaflets were vulnerable to stress due to their lack of hemodynamic characteristics, resulting various improvements [3-7]. Recently, a graft, Gelweave Valsalva (Sulzer Vascutek, Renfrewshire, Scotland) (Fig. 1), was developed by De Paulis [8], which is easy to suture and expected to improve the long-term follow-up results of the reimplantation procedure. In our department, two patients with chronic type A aortic dissection accompanied by aortic root dilation underwent the reimplantation procedure using the Valsalva graft. Here, we report our experience.

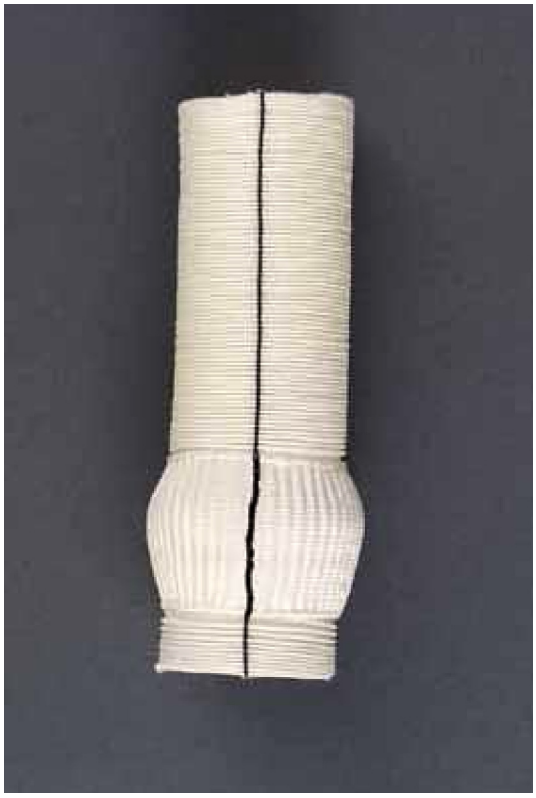

Fig. 1 Gelweave Vaislva graft.

CASE 1

A 55-year-old man with acute type A aortic dissection underwent replacement of the ascending aorta with a graft in December, 1995. He began to develop atrial fibrillation in around 1998 and so treatment started. Thoracic aortic aneurysm was indicated in November, 2005. According to thoracic computer tomography (CT), the dissection cavity dilated to 80 mm in diameter was found only in the aortic arch. The root of the implanted ascending aorta at the proximal side also dilated to 55 mm. Ultrasound cardiography (UCG) showed grade II aortic regurgitation from the center (Fig. 2). He was diagnosed with remnant peripheral dissection cavity dilation after replacement procedures of type A ascending aortic dissection and grade II aortic regurgitation (AR) associated with aortic root dilation. He underwent aortic root reconstruction by the valve-sparing procedure, total aortic arch replacement

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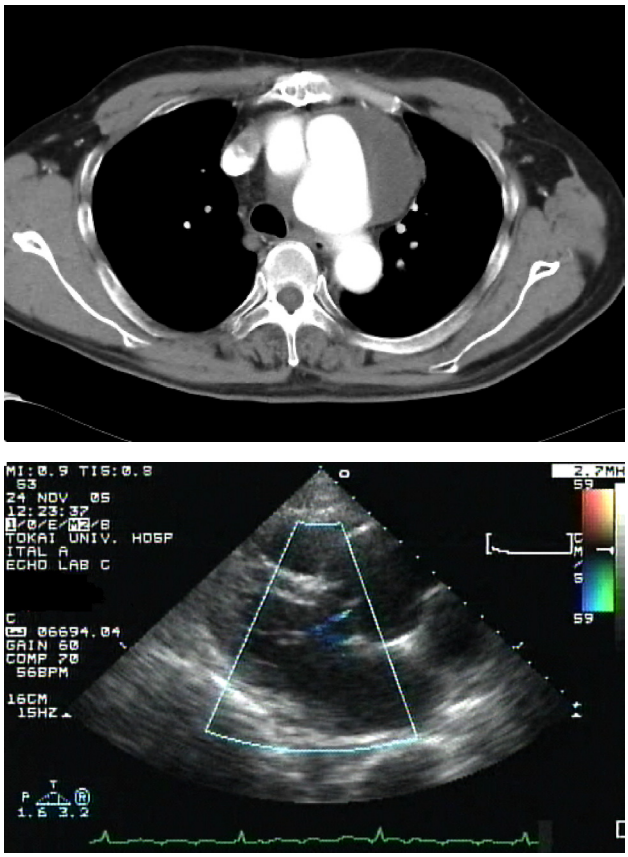

Fig. 2 Preoperative computer tomography (CT) and ultrasound cardiography (UCG) of Case 1. CT shows a remnant dissecting cavity in the aortic arch and the aortic arch dilated to 80 mm. UCG shows dilation of the aortic root and grade II aortic regurgitation from the center.

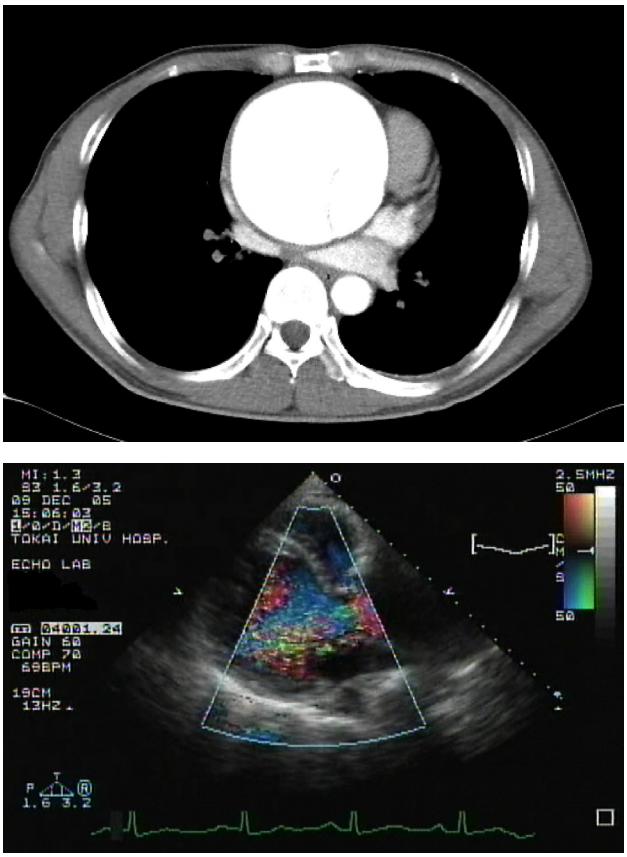

Fig. 3 Preoperative thoracic computer tomography (CT) and ultrasound cardiography (UCG) of Case 2. CT shows the presence of a dissecting cavity in the ascending aorta, which dilates to 95 mm. UCG shows dilation of the aortic root and grade III aortic regurgitation.

procedure and MAZE operation in December, 2005.

CASE 2

A 42-year-old man. Abnormal findings were obtained on a thoracic plain film in a health check at his company in October, 2005. UCG revealed dilation of the aortic root, grade III AR, and the left ventricle diastolic diameter was 73 mm. According to CT, the false lumen was found in the regions from the ascending aorta to the distal aortic arch. The diameter of the ascending aorta dilated to 95 mm (Fig. 3). He was diagnosed with chronic type A aortic dissection accompanied by grade III aortic regurgitation and underwent aortic root reconstruction by the valve-sparing procedure and total aortic arch replacement in December, 2005.

PROCEDURES

After a median sternotomy, the periaortic region of the aortic root was detached. The aorta was dissected just above the sinotubular junction (STJ) and the aortic valve was observed. Unless there was deformation of the aortic valve such as fenestration or prolapse, the valve-sparing procedure would be chosen. Both coronary arteries were cut out from the aortic wall in the shape of a cuff. The aortic wall was excised at the site 3 mm apart from the annulus of the aortic valve. A horizontal mattress was placed outward in each valve leaflets with 4 to 5 stitches from within just below the aortic valve. The distance of each commissure from the horizontal mattress was measured and the graft was cut off so that each commissure would fall on the new STJ of the graft. The excised graft was placed over the aortic valve. The horizontal mattress stitches in the lower part of the valve were passed outward through the proximal end of the graft from within outward and immobilized by ligation to prevent twisting. Then, if the native commissure located at a level lower than STJ of the graft, the level of STJ should be lowered by folding outward the edge of the graft so as to immobilize the commissure [9]. The valve was immobilized starting from the lowest part by a series of suturing with 4-0 polypropylene sutures. The Valsalva part of the graft had extensibility and was very easy to suture. Coaptation of the aortic valve was confirmed by filling the graft with water. The cuff of the coronary arteries was continuously sutured with 5-0 or 6-0 polypropylene sutures. If the wall was fragile, such as in patients with Marfan syndrome, it was reinforced with felt. Initially, the size of the graft was determined based on David's report [2] but we now decided the size of the graft on the basis of annulus diameter plus 1 to 2 mm or up to 30 mm in diameter.

According to postoperative UCG, the sinuses of

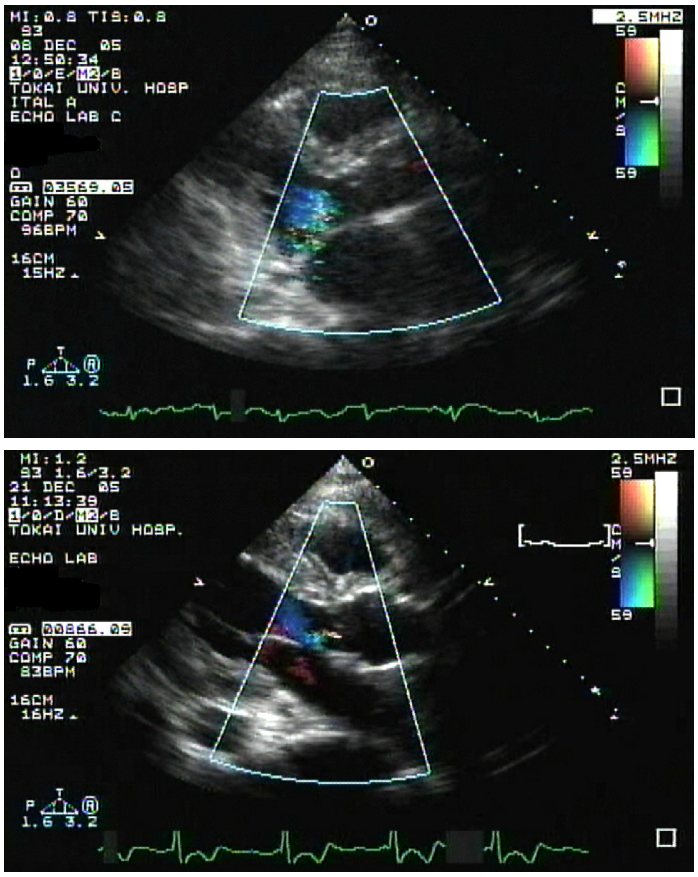

Fig. 4 Postoperative ultrasound cardiography of Case 1 (upper) and Case 2 (lower). Good reconstruction of the sinuses of Valsalva is seen in both cases. Trivial aortic regurgitation is observed in Case 2.

Valsalva were well reconstructed in both cases. Trivial aortic regurgitation was observed in Case 2.

DISCUSSION

The standard operation for aortic root lesion is the Bentall procedure [10], in which not only the coronary arteries are reconstructed but also a composite valve graft is substituted for the aortic root and valve. However, when the aortic valve is normal, a rational alternative is to reconstruct the aortic root while preserving the valve. The David method, one of the aortic root reconstruction methods by the valve-sparing procedure, has been modified with time to include types I to V [6, 11]. Types I, IV and V adopt the reimplantation procedure. In the early type of the David-I method, a straight tube graft without the sinuses of Valsalva was used for replacement. Kunzelman [7] reported that straight tube graft without the sinuses of Valsalva might cause irregular opening and closing of the aortic valve, and the valve leaflets might touch the graft during the valve opening and be damaged, possibly shortening the life of the valve. In addition, Bellhouse [12, 13] proved that STJ was important for generation of a swirling current within the sinuses of Valsalva at the early stage. This swirling current is formed already at the early stage of the systole to prevent the valve leaflet from touching the aortic wall. Then, the valve leaflets close almost completely at the end of the systole due to the swirling current inside the sinuses of Valsalva. Thubrikar [14] also proved that the curve of the sinuses of Valsalva was important for sharing the load with the valve leaflets. Thus, the important functions of the sinuses of Valsalva have been elucidated, which led to various modifications in the David I method in order to produce pseudosinuses aiming at improving the long-term durability of the aortic valve [3-6, 8]. However, these modifications were not widely applicable and more sophisticated technology was required.

The Valsalva graft introduced by De Paulis *et al.* [8] has a self-expanding region (skirt) which extends in the direction perpendicular to longitudinal ruga and reproduces the shape of the Valsalva sinus. The height of the skirt is the same as the diameter of the graft. This extends by 30% toward the horizontal direction. As the height of the skirt is predetermined, various measures have been published in case the commissures to be reconstructed are low [15].

The Valsalva graft seems to be useful not only for valve-sparing procedures but also for Bentall surgery using a mechanical heart valve in that the functions inherent to the Valsalva sinus as well as the easing of tension during coronary artery suturing make reconstruction easier. Good 10-year follow-up results were reported by de Oliveira [9] even with the David-I reimplantation procedure without the sinuses of Valsalva. Better long-term follow-up results are expected by introducing the Valsalva graft.

CONCLUSIONS

The durability of the valve leaflets after implementing the valve-sparing procedure was unfavorable in the David-I surgery without the sinuses of Valsalva, and various modifications were made. Recently, an artificial graft, Gelweave Valsalva graft, was introduced to overcome its disadvantages, and is expected to improve the long-term follow-up results of the valve-sparing procedure.

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