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Valve-Sparing Repair of Aortic Root Aneurysms: An Update on the Florida Sleeve

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ABSTRACT

Aortic valve-sparing reimplantation remains an effective technique for repair of aortic root aneurysms. Studies indicate that the Florida Sleeve procedure is dimensionally stable and durable in the early postoperative period; however, our technique has evolved. We describe a 10-year institutional experience and the technical update of the Florida Sleeve repair for root aneurysms.

INTRODUCTION

Aortic root replacement with valve salvage is a widely accepted approach for correction of root aneurysms of a tricuspid aortic valve. David pioneered the reimplantation technique used worldwide. Long-term studies have shown favorable results [David 1992; David 2006; Svensson 2010]. We previously described a simplified technique for aortic valve salvage, the Florida Sleeve, and later reported early outcomes [Hess 2005; Hess 2009]. Our experience with the Florida Sleeve procedure has surpassed 10 years and the technique has evolved. We describe in detail the changes in our operative methods and provide the cardiothoracic surgery community with an update of the Florida Sleeve procedure.

TECHNIQUE

Prior to cardiopulmonary bypass, transesophageal echocardiography (TEE) is used to evaluate leaflets and annular and sinotubular junction (STJ) dimensions. After arrest, the ascending aorta is transected above the STJ, and then the root and the proximal coronary arteries are mobilized. This allows for appropriate visualization of the coronaries during dissection. With annular dilation (>26 mm), we perform a 1- to 3-mm reduction of the annulus to ensure proper function and coaptation. This is performed by placement of subannular pledgeted sutures. Approximately a 1- to 1.5-mm reduction is accomplished with each subannular stitch. Enough subannular stitches are placed for appropriate sizing of the annulus for coaptation. A maximum final diameter of 26 mm is allowed, with a minimum of 21 mm. Initially our choice in graft size was dependent on the extent of the sinus of Valsalva dilation measured with TEE. In order to narrow the annulus and STJ yet allow enough sinus expansion, the annulus-to-sinotubular junction ratio approximated 1.20 to 1 [Kunzelman 1994].

Originally, a straight tube graft was used, incorporating the same size utilized for both the annulus-to-STJ and STJ-to-arch sections. A graft size of 32 or 34 mm was used for moderately dilated sinuses. For mildly dilated or normal-sized sinuses, a 26- to 32-mm size graft was used. Since 2008, the Valsalva graft (Terumo Inc., Ann Arbor, MI, USA) has been the choice for root reimplantation, whereas a straight tube graft remains our selection for STJ-to-aortic arch replacement. Currently our Valsalva graft size is based on the diameter of the aortic sinuses as determined by preoperative computed tomography and intraoperative TEE. We use a Valsalva graft size of 30 mm for sinuses with diameters of <4.5 cm, a graft size of 34 mm for sinuses with diameters >7 cm, and a graft size of 32 mm for all sinus diameters between 4.5 cm and 7 cm. No longer is a single graft size used for each section; instead, we employ a smaller (28-30 mm) straight graft for the STJ-to-arch anastomosis.

In our initial report, multiple (10 to 12) 2-0 braided polyester annular sutures were placed in a horizontal mattress fashion 2 to 3mm below the center of each leaflet in a circle at the lowest point of the annulus. Our technique was modified to utilize only 3 to 4 subannular sutures, one just beneath the annulus at each commissure, with the fourth in the midportion of the noncoronary cusp. Care must be taken when placing the stitches beneath the commissure of the junction of the noncoronary cusp and the right coronary cusp, because this is the area of the membranous septum and and could lead to postoperative conduction abnormalities. The Valsalva graft is then positioned as a sleeve over the aortic root while the coronary ostia locations are marked on the graft at their anatomic locations. A distance of approximately 1 cm from the aortoventricular junction to the coronaries is estimated and marked for later suture placement, and the graft is removed.

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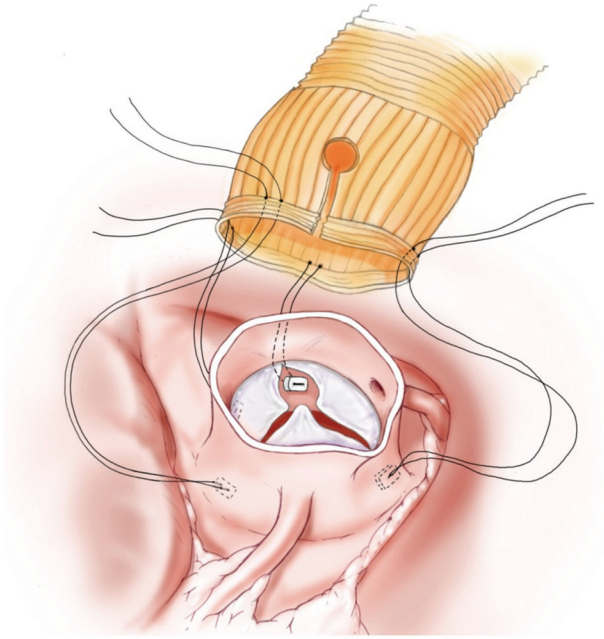

Figure 1. Four horizontal mattress sutures are placed below the aortic annulus to seat the graft.

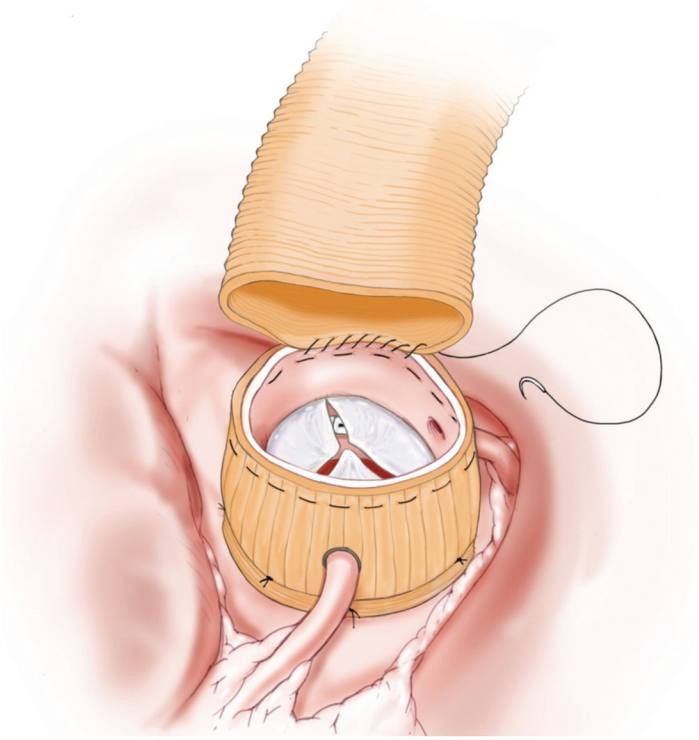

Figure 2. A running mattress suture with an inner felt strip connects the 2 grafts.

Vertical slits made by eye cautery along the markings create "coronary keyholes." All but 3 mm of the lower portion of the Valsalva graft is cut off. This is performed prior to creation of the coronary keyholes. Next, a 3.0 permanent monofilament suture is passed in a horizontal mattress fashion at the base of each keyhole slit. The use of a right angle can facilitate the passing of the suture below the coronary vessels. The sutures are then passed through the other end of the slit and tagged. The subannular sutures are then passed through the graft base, and the graft is positioned as a sleeve over the root while the coronary keyholes are aligned (Figure 1). A Hegar dilator (Jarit Instruments, Hawthorne, NY, USA), which is placed through the aortic annulus, is sized according to the formula described by Svensson to avoid reduction at the STJ and annulus in smaller aortic roots [Svensson 2003]. First, the 3.0 monofilament sutures under the coronary vessels are tied. Then the annuloplasty is accomplished by tying of the subannular sutures, and the Hegar dilator is removed, ensuring that the graft is seated properly at the base of the aortoventricular junction. For large STJ diameters, the redundant aortic wall may be pleated within the sleeve.

The sleeve is then cut at the level of the sinotubular junction. In our previous series the sleeve and aortic wall were sutured with a running baseball stitch. Currently our grafts are approximated with a running mattress suture circumferentially with an inner felt strip at the proximal STJ and then sutured to the ascending graft with a running baseball stitch (Figure 2). This suture line expectedly narrows the diameter of the STJ, leading to recent adaptation of Hegar dilator use for smaller aortas to ensure an annular-to-STJ ratio of approximately 1.20 to 1. In patients with marked STJ dilation, further reduction is accomplished by appropriate straight graft sizing for replacement of the ascending aorta.

COMMENTS

The Florida Sleeve is an effective surgical technique to repair aortic root aneurysms. Prior reports have described its stability and durability at early to midterm follow-up [Hess 2009]. With the Florida Sleeve repair, the aortic root is encased in a Dacron sleeve to prevent expansion and aortic insufficiency. This obviates the need for sinus resection and coronary artery reimplantation. Our experience with the Florida Sleeve has shown an ability to repair aortic roots up to 8 cm with native leaflets.

After 10 years of experience, the Florida Sleeve procedure has undergone technical changes and adaptations. In our early series several patients developed heart block thought to be due to the numerous subannular sutures in the septal area [Hess 2009]. To decrease the likelihood of heart block, we have modified this method to include only 3 or 4 anchoring subannular sutures located inferior to each commissure and at the midportion of the noncoronary cusp (Figure 1). In the earlier years, subannular sutures may have caused annulus constriction, but the technique has been improved with reductions in the anchoring sutures. Additionally, a Hegar dilator is now placed through the distal suture line to avoid narrowing the STJ.

Originally a straight graft was used for reimplantation. Studies have shown that cylindrical grafts cause strain on the native aortic valve, which may potentiate leaflet buckling and damage [Grande-Allen 2000]. Vibratory effects of valve leaflets is a great concern, and we hypothesize this may cause calcification of the leaflets as well. As such, we now use 2 different grafts, a Valsalva graft (Terumo Inc, Ann Arbor, MI, USA) sleeve to allow for proper sinus expansion with decreased stress and a smaller straight graft from the STJ to the aortic arch. Currently, the Valsalva graft size is based on the diameter of the aortic sinuses. It is important to remember that the sizing of the grafts is a measure of the rigid portion of the graft and not actually the sinus portion. In most of our patients a 32-mm Valsalva graft is appropriate, with a 30-mm graft for sinus diameters <4.5cm and a 34-mm graft for diameters >7 cm. We tend to use a graft slightly larger than those described by Svensson et al [Svensson 2003].

We have also modified our sleeve-to-aortic wall suture. Previously a running baseball suture of 4-0 polypropylene was used. Some patients, especially those with connective tissue disorder, experienced bleeding at this suture line. To prevent the inner suture from tearing through the aorta, we now use a circumferential felt strip underneath the running mattress suture to buttress against tears during the graft-to-graft anastomosis (Figure 2).

In conclusion, we report several technical modifications to the Florida Sleeve operation that we have incorporated into this procedure since our most recent publications on this technique. We continue to find this technique reproducible and effective after more than a decade of experience.

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