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Scalloped Freehand Pulmonary Homograft for Prosthetic Tricuspid Valve Replacement

Giovanni Battista Luciani, MD, Nunzio Davide de Manna, MD, Antonio Segreto, MD, Laura Lanzoni, MD, and Giuseppe Faggian, MD

Division of Cardiac Surgery, Department of Surgery, Dentistry, Pediatrics, and Gynecology, University of Verona, Verona, Italy; and IRCCS Ospedale Sacro Cuore Don Calabria, Verona, Italy

Tricuspid valve replacement is commonly performed using biologic or mechanical prostheses. Partial or complete valve replacement using mitral homograft tissue has also been described. Anecdotal reports exist of valve replacement using a pulmonary homograft within a cylinder. This report describes a technique for native or prosthetic valve replacement using a freehand scalloped pulmonary homograft. Late follow-up confirmed the efficacy of this surgical strategy.

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Tricuspid valve replacement (TVR) is rarely performed, and, when indicated, it is usually carried out using mitral bioprostheses or mechanical valves.[1] Although late outcomes are reportedly similar, biologic prostheses are increasingly being implanted because of the high thrombogenicity and increased risk of prosthetic dysfunction when using mechanical devices, in addition to the progress made with transcatheter valve therapies.[2] In the presence of infective endocarditis, either native, on irreparable valves, or prosthetic, alternative techniques, such as complete[3] or partial[4] mitral homograft replacement have been reported with some success. Limitations to these procedures include the availability of homograft tissue and the greater complexity of surgery, thus making the outcomes less predictable. Another potential shortcoming of mitral homograft TVR is the need for an adequate-size valve annulus. Therefore, alternative strategies must be envisioned in cases of a severely scarred or diminutive tricuspid annulus, often associated with a small right ventricular cavity, such as in congenital heart disease. Here we describe a technique for TVR using a scalloped free-hand pulmonary homograft.

TECHNIQUE

A 27-year-old woman with a long history of intravenous drug abuse, decompensated HCV-related liver cirrhosis, peripheral edema, and fever was admitted to our unit (Division of Cardiac Surgery, University of Verona, Verona, Italy) for relapse of prosthetic tricuspid valve endocarditis. Her past surgical history at another hospital included tricuspid valve repair 1 year before for methicillin-resistant *Staphylococcus aureus* endocarditis, followed by TVR 2 months later with a 25-mm mitral bioprosthesis, for relapse of *S aureus* and *Candida albicans* endocarditis. Six months before admission to our unit, she also had a mediastinal abscess requiring sternal revision. Echocardiography showed severe prosthetic dysfunction with multiple vegetations causing severe stenosis (mean transprosthetic gradient, 8 mm Hg) (Figure 1). Given her young age, history, and body size (weight, 47 kg; body surface area, 1.48 m^2), associated with a small and scarred valve annulus and the concomitant necessity to free the patient from prosthetic tissue, TVR using a pulmonary homograft rather than a mitral homograft valve was indicated (Figure 2). Furthermore, considering the patient's small right ventricular cavity, the implantation technique was modified from the inverted cylinder method, previously described,[5,6] to avoid outflow obstruction. Accordingly, the homograft was scalloped, tailoring flanges of vascular tissue to allow grafting onto papillary muscle tissue (Figure 2A). Through repeat median sternotomy and using normothermic cardiopulmonary bypass, the tricuspid bioprosthesis was explanted during a period of cardioplegic cardiac arrest. The prosthesis contained vegetations, but also signs of premature degeneration (Figure 3A). The tailored pulmonary homograft itself (Figure 3B) was anchored by suturing the 3 pillar flanges

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Address correspondence to Dr Luciani, Division of Cardiac Surgery, Department of Surgery, Dentistry, Pediatrics, and Gynecology, University of Verona, Piazzale Aristide Stefani 1, Verona 371286, Italy; email: giovanni.luciani@univr.it.

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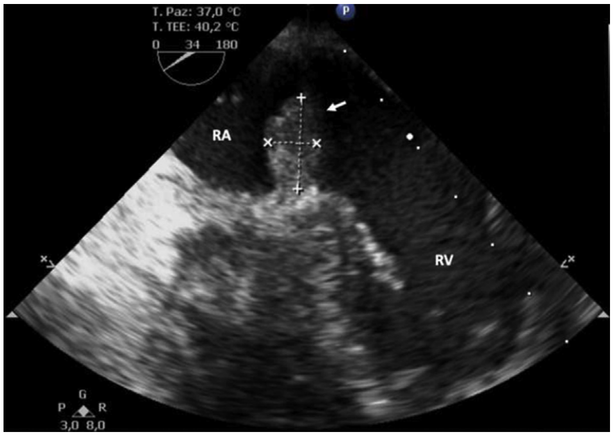

FIGURE 1 Transesophageal echocardiography in the deep transgastric view shows oscillating multiple hyperechogenic vegetations attached to the tricuspid bioprosthesis, the largest measuring 15 × 8 mm (arrow). (RA, right atrium; RV, right ventricle.)

on the papillary muscle remnants. Finally, the pulmonary homograft conal muscle was implanted using 3 monofilament sutures on the native tricuspid annulus (Figure 3). Postoperative transesophageal echocardiography showed no tricuspid regurgitation, trivial stenosis (mean gradient, 2 to 3 mm Hg), and no right outflow obstruction. Results of intraoperative cultures of the vegetations were negative. The postoperative course was characterized by the need for 2 reoperations for bleeding complications secondary to a known platelet function disorder, followed by discharge on the eighth postoperative recovery day. At 18-month follow-up, the patient is thriving, free from relapse of infection, and with a satisfactory functional result on echocardiography (preserved biventricular function, no tricuspid valve regurgitation, and mild stenosis, with 4 mm Hg mean transhomograft pressure gradient) (Supplemental Figure 1).

COMMENT

TVR using mechanical or biologic prostheses is an established treatment for irreparable tricuspid valve disease.[1] Although the use of bioprostheses is increasing, driven also by progress in catheter-based interventions on the tricuspid valve,[2] premature structural valve degeneration and prosthetic valve endocarditis, particularly in young patients, pose unique challenges. Valve replacement, whether partial or complete, using mitral homografts has since been reported.[3,4] Although anecdotal reports of long-term satisfactory function exist, most evidence, on the basis of case series with midterm follow-up, shows limited durability. Furthermore, technical issues with mitral homograft leaflet implantation make this technique less predictable. TVR using an inverted cryopreserved pulmonary homograft has rarely been described, and notably, no follow-up, even short-term follow-up, has thus far been reported. In children with congenital heart disease, TVR using pulmonary

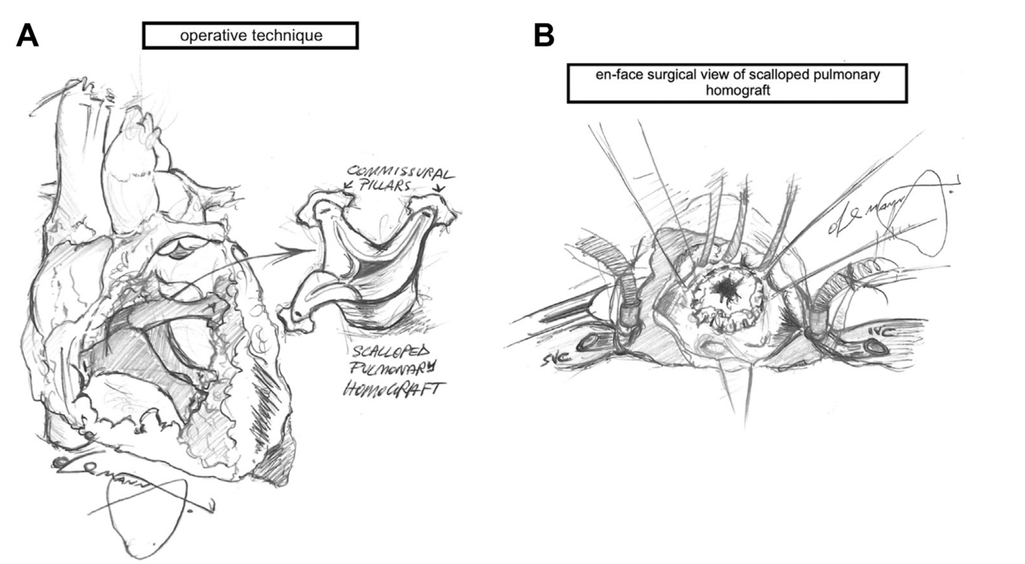

FIGURE 2 Operative technique. (A) A 27-mm cryopreserved pulmonary homograft was trimmed in 3 scalloped commissural pillars anchored to the papillary muscle remnants with 4-0 polypropylene (Prolene, Ethicon, Somerville, NJ) stiches. (B) En face surgical view of the tailored pulmonary homograft in the tricuspid position. The proximal portion of the pulmonary homograft was attached to the annulus with 3 4-0 Prolene continuous sutures. (IVC, inferior vena cava.)

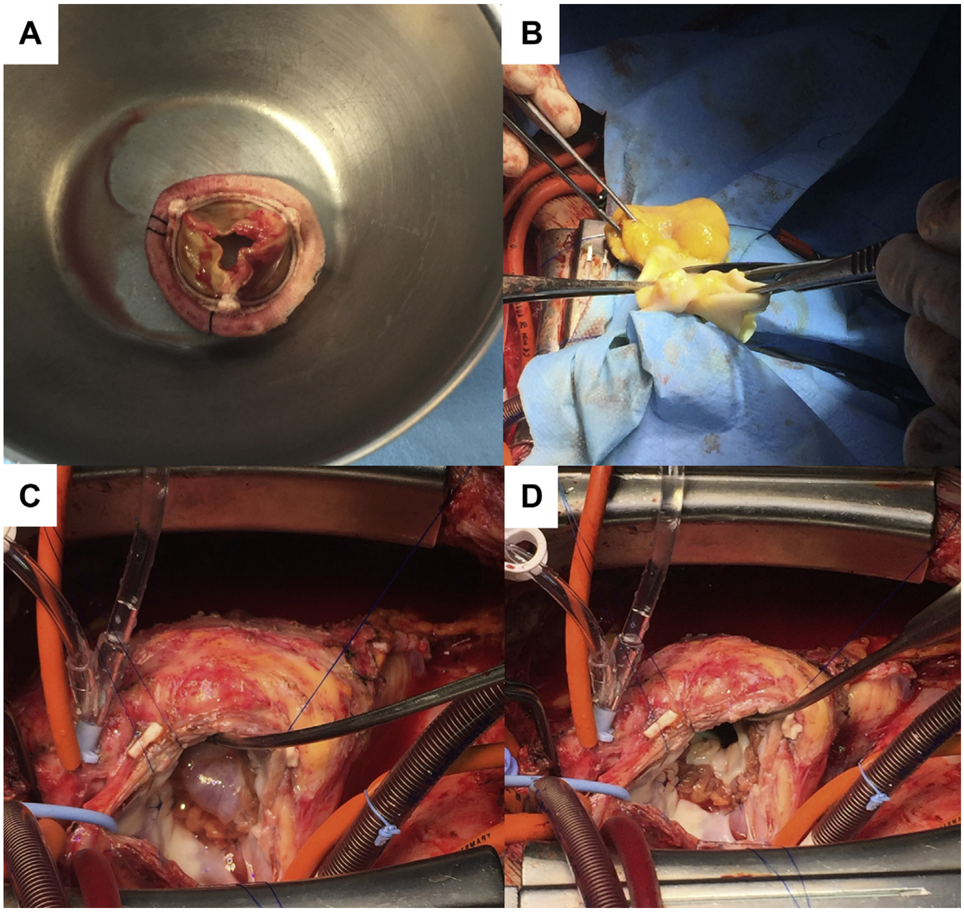

FIGURE 3 (A) The degenerated bioprosthetic tricuspid valve, ventricular view, with vegetations. (B) The tailoring phases of the pulmonary homograft on the back table. (C) Systolic and (D) diastolic views after intraoperative saline testing of the pulmonary homograft in the tricuspid position.

homograft valves encased in vascular prostheses and anchored onto the right atrium by using a skirt of pericardium has been proposed.[5] More recently, a similar, although simplified, strategy using an inverted pulmonary homograft cylinder has been applied in an adult with native tricuspid endocarditis.[6] Here we describe a technique for TVR using an inverted scalloped pulmonary homograft, which is particularly suited to patients with a diminutive valve annulus and a small right ventricle, such as the patient here reported. Fashioning scalloped geometry from the native sinuses of Valsalva, the homograft avoids any potential right ventricular outflow obstruction while at the same time allowing thorough exposure of the right ventricular cavity to define site of commissural pillar anchorage precisely. The present report documents late function of a pulmonary homograft in the tricuspid position, which appears satisfactory and stable. Whether degeneration with calcification will occur similar to that seen in mitral homografts is currently unknown. Nonetheless, a transcatheter valve-in-mitral homograft is potentially feasible even in patients with a diminutive tricuspid valve annulus.[7]

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