Tricuspid valve reconstruction with the extracellular matrix tube technique: A word of caution

Yoshiya Toyoda, MD, Mohammed A. Kashem, MD, Kazuhiro Hisamoto, MD, and Akira Shiose, MD, Philadelphia, Pa

We report a case in which a recently described surgical technique was used to reconstruct the entire tricuspid valve with a CorMatrix extracellular matrix (ECM) tube (CorMatrix Cardiovascular Inc, Roswell, Ga).^{1,2} The repair showed initial success but ultimately failed.

CLINICAL SUMMARY

A 34-year-old woman, a current user of intravenous drugs, had development of tricuspid valve endocarditis with vegetations and severe regurgitation, along with multiple abscesses in her lungs. The patient underwent tricuspid valve surgery through a median sternotomy with standard bicaval cardiopulmonary bypass. At surgery, almost the entire tricuspid valve and the subvalvular apparatus were seen to have been destroyed and replaced with vegetations. The tricuspid annulus was measured at 50 mm. Two edges of a 10-cm CorMatrix ECM biomaterial patch were sewn together with 5-0 Prolene suture (Ethicon Inc, Somerville, NJ) in running fashion to create a tube 30 mm in diameter. Under aortic crossclamping, the entire

tricuspid valve including all leaflets and the infected subvalvular apparatus were resected. With CorMatrix ECM used to form pledgets, a buttress stitch of 5-0 Prolene suture was placed on each of 3 papillary muscles and through the edge of the CorMatrix tube at 120° intervals and tied down. The other end of the tube was sewn to the tricuspid annulus of the anterior and posterior leaflet insertions with 5-0 Prolene suture in running fashion. The patch attached to the tube was trimmed to cover the triangle of Koch and was sewn to the right atrial tissue from the commissure between the posterior and septal leaflets towards the inside of the coronary sinus, along the tendon of Todaro, to the commissure between the anterior and septal leaflets to avoid damaging the conduction system (Figure 1, A). The leak test with saline injection revealed a competent newly created tricuspid valve (Figure 1, B). The aortic crossclamp time was 62 minutes. The cardiopulmonary bypass time was 104 minutes. The patient's postoperative recovery was uneventful, with a hospital stay of 7 days.

Transthoracic echocardiography before discharge showed a well-functioning ECM tube as the new tricuspid valve without stenosis or regurgitation (Figure 2); however, the patient was readmitted in a few months. Echocardiography showed tricuspid valve regurgitation, with the entire CorMatrix tube prolapsing into the right atrium (Figure 3). The CorMatrix tube was removed, and a tricuspid valve replacement was performed with a porcine valve. The CorMatrix tube was torn and had degenerative changes (Figure 4). The pathology report showed tissue with necrosis, fibrinopurulent debris, gram-positive

From the Division of Cardiovascular Surgery, Temple University School of Medicine, Philadelphia, Pa.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication Feb 6, 2014; revisions received April 3, 2014; accepted for publication April 8, 2014; available ahead of print May 17, 2014.

Address for reprints: Yoshiya Toyoda, MD, Division of Cardiovascular Surgery, Temple University School of Medicine, 3401 N Broad St, Suite 301, Zone C, Philadelphia, PA 19140 (E-mail: Yoshiya.Toyoda@tuhs.temple.edu).

J Thorac Cardiovasc Surg 2014;148:e141-3

0022-5223/\$36.00

Copyright © 2014 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2014.04.015>

FIGURE 1. A, Drawing of the surgical technique. B, Intraoperative photograph of the newly reconstructed tricuspid valve with a CorMatrix extracellular matrix tube.

FIGURE 2. Postoperative transthoracic echocardiography after tricuspid valve reconstruction with CorMatrix extracellular matrix. A, Systole without color. B, Systole with color. C, Diastole without color. D, Diastole with color.

bacterial colonies, and granulation tissue formation. The patient's recovery was uneventful, with a hospital stay of 10 days.

FIGURE 3. Transesophageal echocardiography showing prolapse of the entire CorMatrix extracellular matrix tube.

DISCUSSION

Recently, a novel surgical technique was reported for reconstruction of the entire tricuspid valve with a CorMatrix ECM tube.^{1,2} The long-term outcome, however, remains unclear. We achieved an initial success with this technique, but the repair failed in a few months. This indicates that the tube technique works, but the material in creating the tube is not good enough to provide durable outcomes. CorMatrix ECM is produced from porcine small intestinal submucosa. An acellular biomaterial that contains primarily collagen, it has been used for intracardiac repair.³ There are several benefits of using this tube technique. First, complete resection of infected tissue is possible, because any defect can be filled with the ECM patch. Second, this technique eliminates need for an annuloplasty ring, because the ECM tube itself acts as in that capacity. Third, with our modified technique, the conduction system can be avoided because the patch can be trimmed as needed to keep the suture line away from the conduction system. Finally, with this technique, the tricuspid annulopapillary muscle

FIGURE 4. Intraoperative photographs of the CorMatrix extracellular matrix tube at removal. A, Prolapsing CorMatrix tube. B, Resected CorMatrix tube showing infection and degenerative changes.

continuity is preserved.⁴ The failure that we observed in this case may have been due to the weak antiinfective property of CorMatrix or to its fragile nature when it is in the body for certain duration. CorMatrix ECM's resistance to infection depends on angiogenesis and thus on the patient's own defense mechanisms. This may not be adequate.

In conclusion, reconstruction of the entire tricuspid valve with the ECM tube technique is efficacious in achieving excellent valve function. The CorMatrix ECM, however, may not be the ideal material to provide long-term durable outcomes.

References

1. Fallon AM, Goodchild TT, Cox JL, Matheny RG. In vivo remodeling potential of a novel bioprosthetic tricuspid valve in an ovine model. *J Thorac Cardiovasc Surg.* December 19, 2013 [Epub ahead of print].
2. Mumtaz S, Pretorius V, Madani M, Jamieson SW. CorMatrix fashioned tricuspid valve as alternative to valve resection for acute infective endocarditis. Presented at: The 93rd Annual Meeting of the American Association for Thoracic Surgery; May 4-8, 2013; Minneapolis, MN.
3. Sündermann SH, Rodriguez Cetina Bieffer H, Emmert MY, Falk V. Use of extracellular matrix materials in patients with endocarditis. *Thorac Cardiovasc Surg.* 2014;62:76-9.
4. Okita Y, Miki S, Kusuha K, Ueda Y, Tahata T, Yamanaka K, Higa T. Analysis of left ventricular motion after mitral valve replacement with a technique of preservation of all chordae tendineae. Comparison with conventional mitral valve replacement or mitral valve repair. *J Thorac Cardiovasc Surg.* 1992;104:786-95.

Retroesophageal total anomalous pulmonary venous connection in a neonate

Lindsay A. Caldarone,^a Christopher A. Caldarone, MD,^b and Luca A. Vricella, MD,^a Baltimore, Md, and Toronto, Ontario, Canada

From the Division of Cardiac Surgery,^a Johns Hopkins University School of Medicine, Baltimore, Md; and The Hospital for Sick Children,^b University of Toronto, Toronto, Ontario, Canada.

Disclosures: Authors have nothing to disclose with regard to commercial support. Received for publication April 8, 2014; accepted for publication April 11, 2014; available ahead of print June 13, 2014.

Address for reprints: Luca A. Vricella, MD, Director, Pediatric Cardiac Surgery and Heart Transplantation, Johns Hopkins University, 1800 Orleans St, Zayed 7107G, Baltimore, MD 21287 (E-mail: lvricella@jhmi.edu).

J Thorac Cardiovasc Surg 2014;148:e143-5

0022-5223/\$36.00

Copyright © 2014 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2014.04.022>

In 1957, Darling and colleagues¹ proposed a classification scheme for total anomalous pulmonary venous connection (TAPVC). According to this scheme, only 5% of patients have “unusual” morphology, including mixed (type IV) or nonconfluent veins. We present to our knowledge the first reported case of retroesophageal pulmonary venous confluence.

CASE REPORT

A 2-month-old, 4.3-kg term infant with no previous cardiac diagnosis was found cyanotic and listless and was