Performing the Left Atrial Maze Ablation Pattern Without Atriotomy

Timo Weimar, MD, Sydney L. Gaynor, MD, Daniela Y. Seubert, MD, Ralph J. Damiano, Jr, MD, and Nicolas Doll, MD

Sana Cardiac Surgery Stuttgart GmbH, Stuttgart, Germany; AtriCure, Inc, Cincinnati, Ohio; and Washington University School of Medicine, St. Louis, Missouri

The need to perform an additional atriotomy is a major concern that keeps many surgeons from performing an extended left atrial lesion set in patients with atrial fibrillation during procedures such as aortic valve replacement. This does result either in a suboptimal lesion set or even in ignoring the rhythm disorder, leaving the patient exposed to an increased risk of stroke and possible hemodynamic compromises. This report describes a technique how pulmonary vein isolation, an isolation of the posterior left atrial wall and an anterior mitral annular line, which substitutes for the mitral isthmus line in order to prevent perimitral atrial flutter, can be performed during aortic valve replacement without the need for an atriotomy. This technique allows for an optimal time management by minimizing additional cardiopulmonary bypass–time and cross-clamp-time; however, its equivalent efficacy in successfully treating atrial fibrillation compared to the left atrial Maze IV ablation pattern needs to be revealed in future trials.

(Ann Thorac Surg 2016;101:777–9)

The Cox-maze procedure reflects the gold standard in the surgical treatment of atrial fibrillation (AF) and has become less invasive with the introduction of alternative energy sources such as radiofrequency and cryoenergy. Despite these developments, there still exists a lack of adaptation. Concern about adding complexity by the need for an atriotomy has made the decision-making process difficult for many surgeons, especially in patients receiving procedures that would not require an atriotomy. We report the case of a concomitant AF ablation adhering to the principles of a complete left atrial maze pattern without performance of an atriotomy.

Technique

The procedure was performed by T.W. in a 69-year-old man with severe aortic valve stenosis and drug-refractory symptomatic paroxysmal AF through a median sternotomy at Sana Cardiac Surgery Stuttgart. Intraoperative transesophageal echocardiography ruled out a thrombus in the left atrial appendage (LAA). The patient underwent electrical cardioversion into sinus rhythm, and pacing thresholds were determined for the pulmonary veins (PV), which then were isolated in pairs by placement of a bipolar radiofrequency clamp (AtriCure Synergy Series, AtriCure, Inc., Cincinnati, OH) on the surrounding cuff of atrial tissue (Fig 1). Electrical isolation was confirmed by the demonstration of bidirectional conduction block (pacing stimulus strength 20 mA). The time needed to perform the pulmonary vein isolation (PVI) was 9 minutes of a total cardiopulmonary bypass time of 77 minutes.

After the aorta was cross-clamped and cardioplegic arrest was induced, a complete aortotomy was performed 1 cm above the commissures. The calcified aortic valve was excised. Then the transverse sinus was developed by blunt dissection. A small stab incision was made at the tip of the LAA, and the clamp was inserted, one jaw epicardially and the other endocardially, with the tip placed well into the orifice of the upper left PV to ensure crossing the line of the PVI (Fig 2A, B).

The clamp was then placed from the LAA incision through the transverse sinus into the orifice of the upper right PV, thus creating the superior aspect of the box lesion (dome lesion, Fig 2C). The LAA was excluded by placement of an AtriClip device (AtriCure, Inc., Cincinnati, OH) at its base. After development to the oblique sinus, the pursestring site of the left ventricular vent at the right inferior PV was used to insert the clamp to create the floor lesion between the right and left inferior PV to complete the box and isolate the posterior atrial wall. The tip of the clamp crossed the orifice of the left inferior PV (Fig 2D).

The anterior mitral annular line was performed by use of a cryoprobe (CryoIce, AtriCure, Inc., Cincinnati, OH) to connect the dome lesion anterior to Bachman's bundle to the aortic annulus in the region of the left coronary/noncoronary commissure (Fig 3). The

Accepted for publication May 15, 2015.

Address correspondence to Dr Weimar, Herdweg 2, 70174 Stuttgart, Germany; email: timo.weimar@yahoo.de.

Drs Weimar, Gaynor, Damiano, and Doll disclose a financial relationship with Atricure.

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2015.05.137

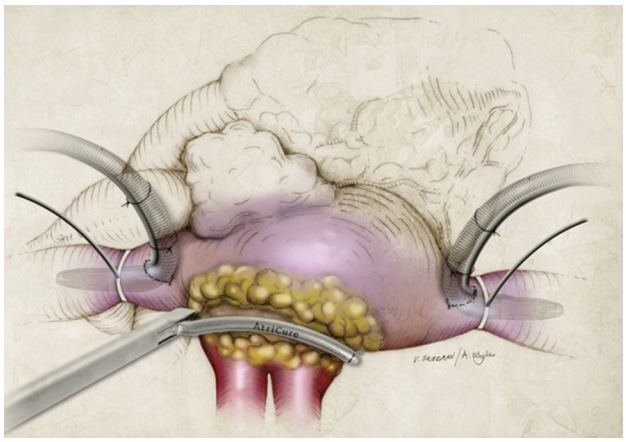

Fig 1. Pulmonary vein isolation in pairs.

cryoprobe was first placed inside the aortic root to intersect with the midpoint of the anterior mitral annulus, which is a short distance below. Next, the cryoprobe was placed epicardially to create an ablation line, which connected the anterior mitral annular lesion to the dome lesion. Each cryoablation was performed for 2 minutes. These steps took 12 minutes. Forty minutes were required to implant a stented porcine aortic prosthesis, adding to a total cross-clamp time of 52 minutes. The patient's stay in the intensive care unit was 17 hours; the total hospital stay was 7 days. The patient did not experience any postoperative adverse event or AF recurrence and was discharged home in sinus rhythm, not using type I or III antiarrhythmic drugs.

Indication

We select the treatment strategy according to the underlying pathology and in alignment with recent guideline recommendations. In general, triggers are believed to be the primary source of initiation of paroxysmal AF; thus, PVI is often appropriate to eliminate those AF episodes [1]. In persistent and longstanding AF, sustaining macroreentry circuits are believed to be the underlying pathology; thus, a more extensive lesion set is required [2]. However, there is some indication that in patients with paroxysmal AF and coronary heart disease or aortic valve stenosis, triggers outside of the vicinity of the pulmonary veins seem to be more frequently the cause of AF than in patients with stand-alone AF. On the basis of these observations, it is our experience that success rates of PVI may decrease below the expected 90%, which has been confirmed by recent reports [3]. We therefore might consider an extended lesion set in terms of the left atrial ablation pattern of the Cox-maze procedure in this patient subgroup to obtain the best possible results.

Lesion Set Rationale

The described lesions can be performed under direct vision and conform to the left atrial lesion pattern of a Cox-maze IV procedure. The most challenging line to be performed without atriotomy is the isthmus line to

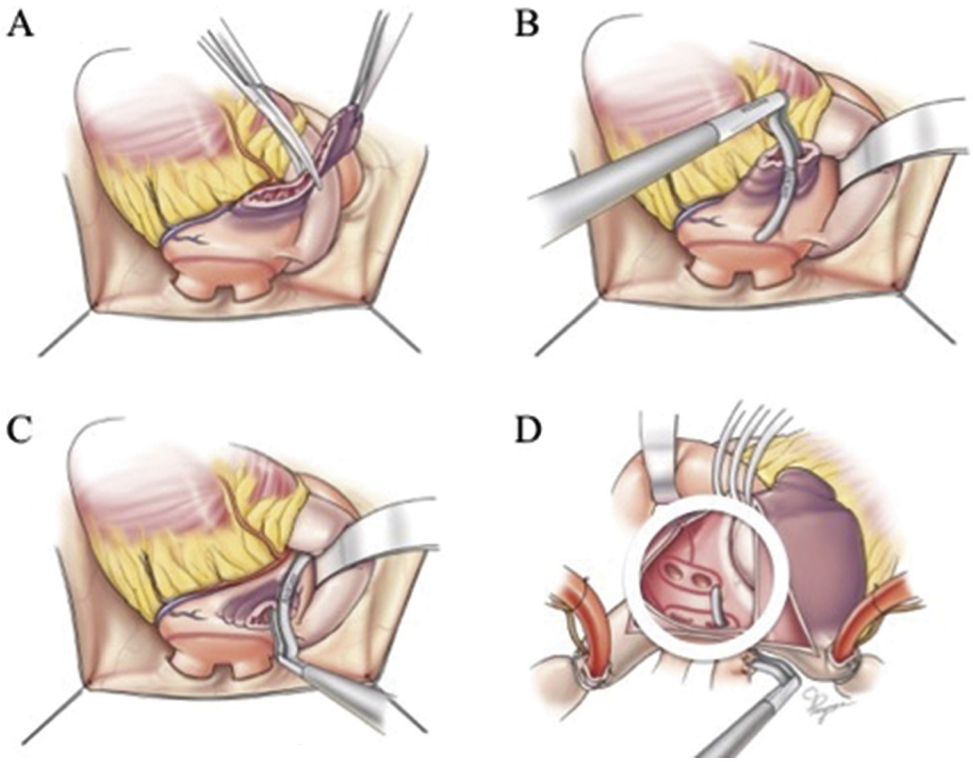

Fig 2. (A) Stab incision at the left atrial appendage (LAA). (B) Lesion from the LAA incision into the upper left pulmonary vein (PV). (C) Dome lesion from the resection line through the transverse sinus in the upper right PV. (D) Cross-section: floor lesion through the lower right PV through the oblique sinus in the lower left PV.

FEATURE ARTICLES

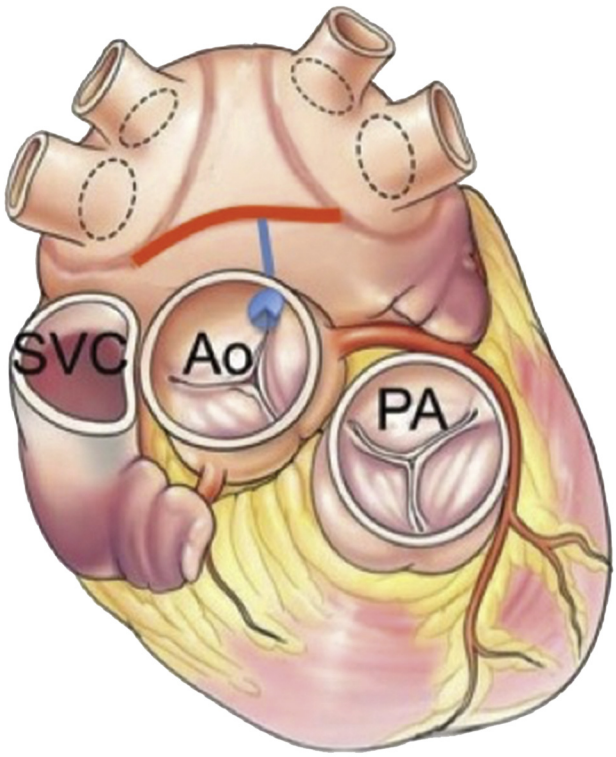

Fig 3. Mitral annular lesion (blue): cryoenergy is applied inside the aortic root and epicardially from the dome lesion (red) to the aortic root at the left coronary / noncoronary commissure. (Ao = aorta; PA = pulmonary artery; SVC = superior vena cava.)

the mitral annulus. If the bipolar radiofrequency clamp is used to create this lesion, there is a tendency for the clamp to either slip off the annulus because of the thick fat layer in the atrioventricular groove or potentially damage the valve tissue if inserted too far. The use of cryoenergy preserves the collagen matrix and thus the valve tissue. However, if the cryoprobe is used endocardially without atriotomy, one would not be able to accurately determine the position of the distal tip of the probe at the mitral annulus. Because of the fibrous connection between the aortic and mitral valves, a line from the dome lesion to the aortic annulus and hence to the anterior mitral annulus should have the potential to stop the perimitral macroreentries known as the atypical flutter waves. Thus, the commissure between the noncoronary and left coronary aortic cusp can be used as a landmark for an alternative mitral annular lesion. At this position the left fibrous trigone connects to the epicardial surface. The positioning of this lesion is therefore slightly different from that described by Edgerton and colleagues [4]. This ablation line should be placed to the left and anterior to Bachman's bundle to reduce the chance of left atrioventricular asynchrony resulting from a block of the fast right-to-left conduction pathway through Bachman's bundle.

Comment

Although a complete maze IV lesion set through a pursestring approach with use of a cryoprobe has been described before by Ad [5], this technique requires a lot of experience because the mitral isthmus line is not done under direct vision [5]. Our reported technique allows for direct visualization of the device, thus ensuring that the ablation lines overlap and do not damage adjacent tissue. In our opinion, this technique is also less time consuming, allowing for better time management. However, in patients in whom a bilateral ablation seems to be appropriate, Ad's technique for the right atrium can be used to complete the full maze IV ablation pattern.

Creating the dome lesion as described requires some amount of dexterity and familiarity with the retrocardiac space. We recognize that this is a new concept and may not be the solution for every surgeon, particularly if faced with financial constraints in terms of using more then one ablation device. Most important, equivalent efficacy compared with the maze IV lesion set needs to be confirmed.

It is important that the introduction of any new technique should first be evaluated for its safety and efficacy before being introduced clinically, and we believe that this iteration of the left atrial maze pattern potentially meets those standards.

References

1. Haissaguerre M, Jais P, Shah DC, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. N Engl J Med 1998;339:659–66.
2. Weimar T, Schena S, Bailey MS, et al. The Cox-maze procedure for lone atrial fibrillation: a single-center experience over 2 decades. Circ Arrhythm Electrophysiol 2012;5:8–14.
3. Kainuma S, Mitsuno M, Toda K, et al. Dilated left atrium as a predictor of late outcome after pulmonary vein isolation concomitant with aortic valve replacement and/or coronary artery bypass grafting. Eur J Cardiothorac Surg 2015 Jan 21; [Epub ahead of print].
4. Edgerton JR, Edgerton ZJ, Weaver T, et al. Minimally invasive pulmonary vein isolation and partial autonomic denervation for surgical treatment of atrial fibrillation. Ann Thorac Surg 2008;86:35–9.
5. Ad N. A multi-purse string maze procedure: a new technique to perform the full maze procedure without atriotomies. J Thorac Cardiovasc Surg 2007;134:717–32.