An Effective Modification to Simplify the Right Atrial Lesion Set of the Cox-Cryomaze

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Reluctance to perform biatrial Cox-cryomaze is primarily to avoid the vexation of creating a right-atrial-lesion (RAL) set of Cox-Maze-III. An alternative pattern of RAL set includes (i) a horizontal atriotomy, continued medially as a linear cryolesion across the posterior tricuspid annulus, (ii) a cavocaval lesion, and (iii) a lateral cryolesion from the midportion of the atriotomy to the tip of the right atrial appendage (RAA). This latter lesion is a substitute for a cryolesion that, in past, was directed medially by a stab wound in the tip of the RAA to the anterior tricuspid annulus. Use of the simplified RAL set, therefore, allows for more deftly achieving a complete biatrial Cox-cryomaze.

The pathophysiologic basis of long-standing persistent atrial fibrillation (AF) often includes a substantial proportion of reentrant circuits that reside within the right atrium. This provides the rationale for performing surgical ablation by use of a biatrial lesion set during the maze procedure [1]. However, there is a reluctance to perform biatrial lesion sets because of the technical complexity of the procedure. Cavai inflow control, additional atriotomy, and prolonged cardiopulmonary bypass time increase the time and complexity associated with the biatrial approach. In particular, the lesion from the right atrial appendage (RAA) to the anterior tricuspid annulus can be technically challenging. From an ergonomic perspective, adding a standard right atrial lesion (RAL) set of the Cox-maze IV [2] with a cryoprobe becomes particularly challenging with a robotic endoscopic approach. Therefore, we demonstrate an effective alternative to this lesion to simplify the biatrial Cox-cryomaze.

Technique

A 69-year-old man with mitral regurgitation and long-standing persistent AF presented with New York Heart Association class II symptoms. The transesophageal echocardiogram revealed moderately severe mitral regurgitation with a large central jet and an ejection fraction of 35% to 40% with global hypokinesia. A totally endoscopic robotic assisted mitral valvuloplasty with a 28-mm Physio II ring (Edwards Lifesciences) with the assistance of a semiautomated suture device (COR-KNOT, LSI Solutions, Victor, NY) was performed. The Aortic cross-clamp time was 101 minutes, and the cardiopulmonary bypass time was 185 minutes. The postoperative course was uneventful, and the patient was discharged on postoperative day 4 in normal sinus rhythm with no mitral regurgitation as shown by predischarge echocardiogram. At the last follow-up visit at 6 months, he was not taking any anticoagulants.
antiarrhythmics or anticoagulants, and he was found to have no AF burden according to a continuous monitoring loop recorder (Reveal-XT, Medtronic Inc, Minneapolis, MN) that had been implanted just before discharge.

Our cumulative experience, thus far, is composed of 45 patients with the RAL modification. Of 45 patients undergoing the RAL modification, there are 42 long-term survivors. Of these, 39 of 42 patients have no AF burden, for an overall success rate of 93%. The outcomes reported in this initial cohort are similar to the excellent results reported in several other large series of patients undergoing cryomaze [4, 5]. A detailed analysis of our results is beyond the scope of this article as it is focused on the description of our surgical technique. More results from an ongoing study, summarizing the entire experience, will be forthcoming in the near future.

Comment

The reluctance to carry out biatrial Cox-cryomaze for the surgical treatment of AF is primarily to avoid the vexation of creating the RAL set of the Cox-Maze III [1]. The most difficult lesion to make on the right side is the linear cryolesion from the tip of the RAA to the anterior tricuspid annulus. The rationale to include this lesion in the Cox-Maze III is to prevent reentrant circuits from circling around the base of the RAA [1]. With the original RAL set, one starts with a horizontal atriotomy in the mid-free wall of the RA. The medial continuation is a linear cryolesion across the posterior tricuspid annulus. Posteriorly, the atriotomy ends at the interatrial septum. A cryolesion is made from the superior vena cava down to the inferior vena cava. Finally, through a stab wound in the tip of the RAA, a linear cryolesion is made from the RAA to the anterior tricuspid annulus. This latter lesion can be quite technically challenging to make, particularly through a minimally invasive approach. Robotically, it entails making a shepherd’s crook of the probe and placing the crook in the tip of the RAA so that the tip of the probe extends across the anterior tricuspid annulus. This often poses an ergonomic challenge. In addition, inadvertent minor torquing of the still frozen probe can result in endothelial disruption and produce troublesome bleeding between the RAA and the atrioventricular (AV) groove. In our experience, this is particularly likely to occur in elderly women with extremely thin atria.

Therefore, to avoid this potential risk and to simplify the procedure, we have modified this particular lesion by displacing it laterally. The modification, therefore, substitutes the medial linear cryolesion from the tip of the RAA to the anterior annulus with a linear cryolesion that starts laterally in the midportion of the atriotomy and is directed toward the the tip of the RAA, making this lesion much easier to construct than the original lesion. Bleeding in this area is much more readily controlled. It also takes substantially less time than the usual 2-minute freeze to achieve transmurality. Additionally, because this lesion is lateral, rather than medial to the tip of the RAA, it may in fact reduce the likelihood of freezing the sinoatrial (SA) node artery. Conceivably, this could lessen the likelihood that a postablation permanent pacemaker will be required, although it is imperative that many of these procedures are carried out before this hypothesis is proven.

To preserve the contractility of the entire right atrium, an important concept in the RAL set is preserving a corridor, roughly 2 cm in width, of neurologically intact right atrial tissue from the SA node to the free wall of the
right atrium. The modification simply transposes the corridor from lateral to medial in relation to the RAA so that it runs medially between the tip of the RAA and the AV groove. Overall, use of the simplified RAL set allows for more easy achievement of a complete biatrial Cox-cryomaze.

**Conclusion**

Technically deft, the lateral lesion not only avoids potential damage to the AV groove but also is as effective as the medial one in preventing reentrant circuit formation around the base of the RAA. Although this modification of the RAL set initially appears to be a trivial and minor substitution of cryolesions, it achieves the same two-fold purpose of disrupting the macroreentrant circuit around the RAA while also retaining the right atrial corridor. Thus, it should theoretically be as effective as the previous RAL set in eliminating AF as well as preserving right atrial function. Furthermore, not only is the lateral RAA lesion technically easier to create, but also it avoids potential damage to the AV groove or the SA node artery. Hearts that are particularly fragile, occasionally prone to troublesome bleeding from the medial lesion that results from minor torquing of the still frozen probe, may particularly benefit from this modification. Being technically simpler, faster, and possibly safer, this modified RAL set allows for more easy achievement of a complete biatrial Cox-cryomaze. Although our preliminary clinical experience supports this modification to be highly effective, long-term follow-up and a large patient cohort will determine whether this hypothesis is valid.

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