Work in progress report - Arrhythmia

Beating-heart ablation of the cavo-tricuspid isthmus

Antonio di Virgilio, Francesco Onorati*, Pasquale Mastroroberto, Attilio Renzulli

Cardiac Surgery Unit, Magna Graecia University, Catanzaro, Italy

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Abstract

Atrial flutter onset following ‘mini-Maze’ procedures worsens patient recovery and prolongs hospital-stay. It has been demonstrated that atrial flutter recurrence following isolated left-sided ‘mini-Maze’ often originates from the right cavo-tricuspid isthmus. We report here a simple procedure to ablate the cavo-tricuspid isthmus, either on cardio-pulmonary bypass and/or off-pump. Two ablation lines were made with an irrigated bipolar radiofrequency clamp, starting from a purse-string suture in front of the coronary sinus toward the coronary sinus and the atrio-ventricular groove, respectively. Another ablation line is directed toward the right appendage. A purse-string suture on the right appendage is used to connect the inferior with the superior vena cava, thus ablating the terminal crest.

Keywords: Electrophysiology; Arrhythmias; Minimally invasive surgery

1. Introduction

The Maze III was introduced to treat atrial fibrillation (AF) in 1991 [1] and has since been proven to be effective [1–4]. Since Haissaguerre demonstrated the key-role of the pulmonary veins in AF [5], a number of simpler procedures were developed to overcome the complexity of the Maze III [2–4].

One of the most frequently used ‘left mini-Maze’ procedures is represented by radiofrequency ablation of the left atrium [3,4], the efficacy of which is still debated because of the reduced lesion set [6]. Recent studies have reported the appearance of atrial flutter (AFL) after ‘mini-Maze’ [6–8]. Most reports agree with a central role of the right isthmus in determining AFL, demonstrating that it could be prevented by cavo-tricuspid isthmus ablation [6–8]. Moreover, it has been demonstrated that bipolar radiofrequency ablation has significant advantages over monopolar ablation because of the transmurality of the lesions [6,8].

In order to reduce the incidence of AFL following radiofrequency left ‘mini-Maze’, a new method to easily ablate the right atrial isthmus is reported.

2. Surgical technique and results

A purse-string suture is stitched in front of the coronary sinus (CS) orifice, which can be also used to deliver retrograde cardioplegia in ‘on-pump’ procedures (Figs. 1A, 2). In order to ablate both the septal and the inferior isthmus of the right atrium, the irrigated radiofrequency clamp (Cardioblate BP Device, Medtronic Inc, Minneapolis, MN, USA) is introduced through the purse string, and firstly directed between the inferior vena cava (IVC) and the CS (Figs. 1A, 2 – ablation line 1). Then, directing the bipolar clamp towards the atrio-ventricular groove, between the CS and the tricuspid valve (Figs. 1B, 2 – ablation line 2). The bipolar clamp is rotated upward to create an endo-epicardial ablation line connecting the purse string to the right appendage (Fig. 1C). An additional purse string suture on the tip of the right atrial appendage (may be used ‘on-pump’ for venous drainage or ‘ad-hoc’ created in off-pump cases) allows connection of the superior vena cava with the IVC, and ablation of the terminal crest for a complete right atrial ablation (Fig. 1D). Off-pump ablation of the right appendage completes the procedure.

Between February and November 2005 this technique was applied in six patients: two off-pump coronary revascularization procedures; two after cardiopulmonary bypass discontinuation following aortic valve replacement, as in the case reported in Fig. 1; the last two on cardiopulmonary bypass, after left mini-Maze procedures – either ablating the left isthmus – following mitral valve replacement. Of these patients, five suffered from chronic AF, whereas one was referred because of severe aortic stenosis and paroxysmal atrial fibrillation, the last episode being responsible for acute pulmonary oedema. All patients underwent off-pump left ‘mini-Maze’ as described by Gaynor et al. [6], followed by the above-mentioned off-pump right atrial ablation.

All patients started i.v. amiodarone (15 mg/kg/day) for 24 h, followed by 400 mg/day oral amiodarone.

There were no intra-operative and postoperative complications. Stable sinus rhythm was obtained in all, and no cases of supraventricular arrhythmias, in particular AFL, were observed postoperatively. The patients were dis-
charged in sinus rhythm, and at a mean follow-up of 6.1 months (2–11 months) no AF or AFL were registered.

3. Discussion

AF is the most common arrhythmia encountered in the daily practice [1,2,5]. Multiple circuit reentry and multiple wandering wavelets have been the dominant conceptual model of AF for 50 years [5]. The Cox-Maze procedure was designed to interrupt such reentrant circuits [1]. However, the Cox-Maze is complex, and a number of ‘mini-Mazes’ have been recently proposed to reduce cross-clamp time [2,3,6–8]. More recently mini-invasive approaches and off-pump procedures were demonstrated to have acceptable efficacy and good mid-term durability, with the main limitation of recurrent supraventricular arrhythmias [6–8]. It is known that the most commonest type of AFL, so-called Type-I AFL, is the consequence of a counter-clockwise macro-reentry within a right atrial circuit, which uses the terminal crest for its descending limb, the triangle of Koch and the anterior margin of the oval fossa as the ascending component, and, irrespective of its upper margin, the so-called cavo-tricuspid isthmus, between the mouth of the inferior caval vein, and the hinge of the septal leaflet of the tricuspid valve (Fig. 2) [1,2,5,7]. Therefore, the importance of ablating the coronary sinus and the right atrial isthmus to prevent the recurrence of both typical and atypical AFL has been emphasized [1].

Our technique allows a simple isolation of the entire cavo-tricuspid region by applying two ablation lines from a purse-string suture – in front of the coronary sinus – to the coronary sinus and the atrio-ventricular groove, respectively. This purse-string suture can also be used to deliver retrograde cardioplegia in ‘on-pump’ surgery. Moreover, turning the forceps toward the right atrial appendage, and completing the procedure with the aid of a second purse-string suture on the appendage itself, a complete right atrial isolation is obtained.

We applied this technique to complete AF ablation procedures in 6 patients suffering from chronic (no.5) and paroxysmal (no.1) AF, always following a left-sided ‘mini-Maze’. The technique suggested is particularly useful to prevent postoperative type I AFL, originating from the cavo-tricuspid isthmus, when coupled with both ‘on-pump’ left-sided maximalist approach (i.e. pulmonary vein isolation, ablation of the left isthmus and the left appendage, and additional junction lines between the right and the left pulmonary veins, between the pulmonary veins and the left appendage, and between the pulmonary veins and the mitral annulus) or ‘on-pump’ and/or ‘off-pump’ left-sided minimalist approach (i.e. epicardial isolation of the pulmonary veins associated with a specific ablation of the left appendage).

Finally, it is known that the bipolar radiofrequency forceps allowed full-thickness ablation lines [6,8]. Compared to monopolar devices, the bipolar forceps used is quicker, easier and assures transmural lesions, further reducing the risk for AF and AFL. Moreover, our technique can avoid cardiopulmonary bypass, being particularly useful for closed heart procedures, in which right atrial ablation is often eliminated. Thus, a full ‘Maze’ can be performed off-pump, opening the way to complete bi-atrial isolation with mini-invasive approaches.

References


