Case report

Radiofrequency ablation of atrial flutter combined with closure of atrial septal defect

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Abstract

Radiofrequency ablation of atrial flutter combined with patch closure of an atrial septal defect is described. Radiofrequency energy was delivered in the cavo-tricuspid isthmus and from the inferior margin of the atriotomy down to the septal defect using a temperature-controlled multipolar radiofrequency catheter. In addition, cryolesions were applied to the junction of the ablation scar with the tricuspid annulus and with the ostium of the inferior vena cava. Sinus rhythm was restored and an electrophysiologic study conducted 2 months later confirmed the bidirectional conduction block of the cavo-tricuspid isthmus. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Surgical closure of atrial septal defects significantly improves survival rate as demonstrated by Konstantidines et al. in a comparative study [1]. However, the incidence of new atrial arrhythmias or of cerebrovascular insults was not significantly different between the surgical and the medical groups. Indeed, up to 26% of the patients in their surgical group presented with atrial fibrillation or flutter. These patients were all operated on before 1991 and no additional antiarrhythmic treatment was applied. It is likely that the incidence of postoperative cerebrovascular accidents would improve by performing simultaneous correction of the atrial fibrillation or flutter.

The Cox maze procedure (or the right-side part of it) was combined successfully with atrial septal defect (ASD) closure in patients having atrial fibrillation or atrial flutter [2]. We report as an alternative in the presence of common atrial flutter a simple surgical method using intraoperative ablation.

2. Case report

A 64-year-old woman was admitted with chronic atrial flutter and an ASD diagnosed during a cardiac evaluation realized in view of a hip replacement. There was no episode of atrial fibrillation documented but she had noticed accelerated pulse rate for several years. This patient complained of grade 3 dyspnea and the recent onset of mild ankle edema. The electrocardiogram showed a common atrial flutter with a ventricular response of 124/min. Echocardiography showed a secundum ASD with a bidirectional shunt and 2/4 mitral regurgitation. The atria were markedly enlarged: the left atrium reached 84 ml and the right atrium 150 ml. At angiography, the systolic pulmonary pressure was 70 mmHg and the mean pulmonary pressure was 44 mmHg with a pulmonary to systemic blood flow ratio of 2.0:1.

Cardiac surgery was performed with bicaval cannulation and aortic cross-clamping, 28 °C hypothermia and antegrade cold blood cardioplegia. A longitudinal incision extending from the superior to the inferior vena cava was placed just lateral to the crista terminalis, avoiding the sinus node region. The incision was then obliquely prolonged towards the atrioventricular annulus. The diameter of the septal defect was 3 cm.

To create linear contiguous electrical blocks we used radiofrequency energy delivered by the EPT-1000XP Cardiac ablation controller connected to a malleable shaft including seven ablation electrodes (Thermaline, Boston Scientific, Mastricht, The Netherlands). Radiofrequency energy was delivered in the cavo-tricuspid isthmus and from the inferior margin of the atriotomy down to the septal defect, across the anterior limbus (70 °C; three electrodes simultaneously activated, 2...
min). The maximal energy that could be delivered was set at 100 W. A cryoprobe 5 mm in diameter (CCS-200; Frigitronics, Shelton, CT) was used to create cryolesions that were applied to the junction of the ablation scar with the tricuspid annulus and with the ostium of the inferior vena cava (−60 °C, 2 min). The time necessary to complete radiofrequency ablation and cryoablation was 8 min. Two more minutes were used for probe positioning. The procedure is illustrated in Figs. 1 and 2. Finally, the ASD was closed with an autologous pericardial patch. Aortic cross-clamping lasted 63 min and pump time was 79 min.

After weaning from cardiopulmonary bypass, spontaneous sinus rhythm was restored. Postoperative electrocardiogram showed sinus rhythm with complete right bundle branch block. On postoperative day 6, the patient developed an atrial tachycardia with 1/3 variable block followed by sinus rhythm after oral administration of amiodarone. She was discharged home on postoperative day 12 with the following treatment: amiodarone with a loading dose of 800 mg daily, amlodipine 5 mg daily, and acetylsalicylic acid 160 mg daily.

An electrophysiologic study was conducted 2 months later. It confirmed the bidirectional conduction block of the cavo-tricuspid isthmus and of the ablation line conducted across the anterior limbus. Holter monitoring showed sinus rhythm with rare episodes of accelerated junctional rhythm averaging 100 bpm.

Echocardiography realized 3 months postoperatively showed the absence of any residual shunt. The atrial volumes were considerably reduced: 51 ml for the left atrium and 38 ml for the right atrium. The patient underwent an uneventful total hip replacement. She is asymptomatic and in permanent sinus rhythm 22 months after her cardiac procedure. Her medication is unchanged, except for amiodarone that was reduced to 200 mg daily.

3. Discussion

Since the initial work of Klein [3], the isthmus between the tricuspid annulus and the eustachian ridge (TA-ER) has been recognized as a critical portion of the typical atrial flutter circuit. There is evidence that typical flutter circuits in humans depend on the crista terminalis and eustachian ridge as its posterior barrier, whereas the tricuspid annulus forms the lower anterior barrier. In addition, atypical flutter patterns can involve only the base of the right atrium: the TA-ER isthmus, the portions of the posterior right atrium, and across the lower segment of the crista terminalis [4]. Therefore, in the present case, a conduction block was created in the cavo-tricuspid isthmus between the hinge of the septal leaflet of the tricuspid valve and the eustachian ridge, at the mouth of the inferior caval vein.

The presence of an ASD and the creation of a surgical scar to close that defect could induce another type of atrial flutter. Indeed, the group of Haissaguerre described a specific type of figure-of-eight reentry circuit involving simultaneously the atriotomy scar and the tricuspid valve [5]. Radiofrequency delivery in the TA-ER isthmus transformed the tachycardia into a different morphology tachycardia, disclosing atrial activation by the periatriotomy loop. To
avoid that kind of recurrence, we performed a second conduction block joining the surgical atriotomy with the posterior margin of the ASD, across the crista terminalis towards the posterior limbus.

Finally, a simple modification of the atrial approach incision line can be very effective in interrupting and preventing a flutter: an atriotomy performed perpendicular to the terminal groove and extended towards the tricuspid annulus can cure the arrhythmia [6]. Therefore, the ASD was approached by a longitudinal incision extending from the superior to the inferior vena cava and then obliquely prolonged towards the atrio-ventricular annulus.

The Thermaline radiofrequency ablation probe is a temperature-controlled multipolar radiofrequency catheter that has to be applied onto a dry field. It was reported as a reliable tool to create transmural conduction blocks in the treatment of atrial fibrillation either by the endocardial or by the epicardial approach [7]. The radiofrequency ablation probe was preferred to create linear scars in the thin atrial wall since the technique is quick, allowing the creation of a complete scar within 2 min. By contrast, the cryoprobe was used in areas where the depth of the cryolesion is critical (tricuspid annulus, cavo-atrial junction) since the maximum depth of cryoinjury was determined accurately [8].

Series describing long-term outcome after surgical repair of isolated ASD [9] have shown that for patients who had ASD closure between the ages of 25 and 41 years, the incidence of late fibrillation or flutter was still 41%, even though only 6% had those arrhythmias preoperatively. The addition to the closure of ASD of a procedure limiting the advent of further supraventricular arrhythmias is a matter of debate. In our opinion, the technique reported herein is effective in patients candidates for ASD closure presenting with permanent or paroxysmal atrial flutter. However, the present technique has not demonstrated its efficacy in atrial fibrillation. Therefore, if prophylaxis is the issue, we should recommend a right-sided maze procedure which was effective in 18 patients having atrial fibrillation or flutter [2].

Thus, radiofrequency ablation of atrial flutter during atrial surgery can be combined with closure of an ASD to reduce long-term morbidity and possibly mortality.

References


Appendix A. ICVTS on-line discussion

**Authors:** Drs. Gino Gerosa and Tomaso Bottio, Dept. Cardiovascular Surgery, University of Padua, Via Giustiniani, 2, Padua, Italy

**Date:** 11-Aug-2002 10:02

**Message:** This report describes a 64-year-old woman with an ASD and chronic atrial flutter which required repair. Defects of the atrial septum are commonly seen in adult age and atrial arrhythmias prevalence, moreover atrial fibrillation, in this special setting, is similar (p = 0.69) when comparing pts surgically treated or nonsurgically treated [1]. Patients presenting this arrhythmia are likely to have severe changes in left ventricular systolic performance, being at higher risk for stroke or systemic thromboembolism. Due to the high incidence of atrial fibrillation (41%) in patients between the ages of 25 and 41 years who have had ASD closure, we would recommend adding to this right atrium approach an additional left atrium radiofrequency ablation procedure, more likely to restore sinus rhythm, through an extension of the existing atrial septal defect, as we routinely do.