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Surgical ablation of atrial fibrillation using radiofrequency

Ablação operatória da fibrilação atrial por radiofreqüência

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Abstract

Objective: **To evaluate the effectiveness of intraoperative atrial fibrillation ablation using radiofrequency during mitral valve procedure. This report describes the early and midterms results.**

Methods: **Between September 2003 and September 2005, 15 patients with mitral disease were operated. All patients were in cronic atrial fibrillation and with congestive symptoms despite full medication. The patients were analysed according to clinical criteria, electrical and echocardiographic findings.**

Results: **There were no hospital mortality or complications related to radiofrequency ablation. The mean follow-up period was 12.16 ± 10.29 months. All patients left operating room in sinus rhythm, however, before hospital discharge, only nine (60%) were in regular cardiac rhythm. During follow-up, two patients presented atrial fibrillation recurrence and currently seven (46.7%) keep sinus rhythm.**

Conclusion: **Despite low morbimortality related to the procedure, initial results in this report showed a less effectiveness of this technique when compared with other papers.**

Descriptors: **Catheter ablation. Atrial fibrillation/therapy. Cardiac surgical procedures. Mitral valve, surgery.**

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Resumo

Objetivo: **Avaliar, prospectivamente, a efetividade da ablação operatória da fibrilação atrial (FA) pelo uso da radiofreqüência, para reversão ao ritmo sinusal e sua manutenção a curto e médio prazo, nos pacientes submetidos a intervenção operatória sobre a valva mitral.**

Métodos: **Entre setembro de 2003 e setembro de 2005, 15 pacientes com indicação de operação da valva mitral associada ao diagnóstico de FA crônica foram operados com aplicação de radiofreqüência intra-operatória apenas no endocárdio do átrio esquerdo. A idade variou de 28 a 59 anos (46,33 ± 9,54 anos), sendo 10 (66,7%) pacientes do sexo feminino. O diâmetro do átrio esquerdo pelo ecocardiograma variou de 48 a 71 mm (56,66 ± 6,77mm).**

Resultados: **Não ocorreu nenhum óbito hospitalar ou complicações relacionadas à utilização de radiofreqüência. O tempo médio de acompanhamento foi 12,16 ± 10,29 meses. Todos os pacientes deixaram a sala de operação em ritmo sinusal, porém, antes da alta hospitalar, somente nove (60%) estavam em ritmo cardíaco regular, apesar da utilização de drogas antiarrítmicas e/ou cardioversão elétrica, na tentativa de reversão e manutenção do ritmo sinusal. Durante o seguimento, outros dois pacientes retornaram para FA e atualmente sete (46,7%) encontram-se em ritmo sinusal.**

Conclusões: **Apesar da baixa morbimortalidade operatória da ablação de FA por radiofreqüência, os resultados iniciais obtidos neste trabalho sugerem menor efetividade no tratamento da arritmia (FA), quando comparado a outros trabalhos da literatura que utilizaram a mesma técnica proposta.**

Descritores: **Ablação por cateter. Fibrilação atrial/terapia. Procedimentos cirúrgicos cardíacos. Valva mitral, cirurgia.**

INTRODUCTION

The patients referred for heart surgery may present preoperative atrial fibrillation (AF). This tachyarrhythmia, when untreated, may decrease chances of survival and increase the risk of neurological events [1,2].

The operative treatment that was effective in restoring the sinus rhythm was described by Cox et al. in 1991, in an operation called "Cox-Maze (labyrinth)" [3]. This operation consists of the performance of multiple atrial incisions and sutures aiming to block the reentry circuits involved in AF.

Despite the efficiency of this technique, its use was not widespread, due to the increased length of cardiopulmonary bypass and the higher risk of bleeding due to multiple incisions and sutures performed. Because of this, changes were developed in the operative treatment of AF, including the use of less invasive techniques, a reduction in the number of incisions and atrial sutures and, most importantly, the application of energy sources in the atrial endocardium. The aim of these applications is to produce transmural lesions that are able to block the poor conduction of electrical stimuli [4].

Among the alternatives for the operative treatment of AF, radiofrequency ablation is often used. It is an alternating electric current with a frequency equal to that of radio waves. Its application is associated with continuous irrigation of saline solution from the tip of the electrode to have cooler contact with the atrial tissue and to reduce the possibility of an iatrogenic lesion on the closest organs or tissues [5].

The aim of this study is to evaluate the effectiveness of surgical ablation of AF with the use of radiofrequency applied only in the left atrial endocardium for the maintenance of short- and long-term sinus rhythm.

METHODS

Between September 2003 and September 2005, 15 patients with mitral valve disease ssociated with chronic AF who were indicated for surgery underwent intraoperative ablation of arrhythmia using radiofrequency, in addition to mitral valve plasty or replacement. The criterion for performing the radiofrequency ablation was the diagnosis of chronic permanent AF, with at least a twelve-month duration. We excluded the patients with infectious active mitral valve disease, patients with indication for emergency heart surgery and/or in the cases without available radiofrequency devices.

The group was composed of 10 (66.7%) female patients with ages ranging from 28 to 59 years (with a mean of 46.33 ± 9.54 years). In the case of mitral valve disease, 12 (80%) cases were of rheumatic etiology, and three (20%), degenerative. The left atrium diameter obtained by transthoracic echocardiogram ranged from 48 to 71 mm (56.66 ± 6.77 mm).

All patients presented congestive signs and symptoms, despite optimal clinical treatment, in that in the immediate preoperative, 58% were in Functional Class (FC) II and 42% in FC III, by the classification of the New York Heart Association (NYHA). The mean time of follow-up after the surgery was 12.16 ± 10.89 months.

The patients agreeded to participate in the study by signing a written consent form.

Operative technique

The operation began with hemodynamic monitoring: measuring the mean arterial pressure, central venous pressure and urine output, in addition to respiratory monitoring using pulse oximetry.

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The standard operation was performed; the surgical approach was median sternotomy with aortic cannulation of the superior and inferior vena cava through the right atrium after systemic heparinization (4 mg / kg), with moderate hypothermia to 32 °C.

As a method of myocardial protection, the hypothermic antegrade blood cardioplegia (approximately 18°C) was used with the addition of potassium (15 mEq/L) during induction. In subsequent doses, at intervals of 15 minutes, the perfusate blood was administered at 32°C, without adding any other substance.

The mitral valve approach was performed using left transseptal longitudinal atriotomy relative to the diameter of the left atrium, with mitral valve plasty or replacement.

The radiofrequency application was then performed in the endocardium of the left atrium with pulmonary veins isolation, in addition to three additional incisions: one initiated in the left atrial appendage and moving toward the superior left pulmonary vein orifice; another line between orifices of the superior pulmonary veins and, finally, an ablation line from the edge of the mitral ring to the orifice of the left inferior pulmonary vein. The equipment used for ablation is currently produced by Medtronic, Inc. (Cardioblate ® Surgical Ablation System). The system was composed of an energy generator and a unipolar pen irrigated on the distal portion with continuous infusion of saline solution to cool the electrode tip. The energy generator operated between 20 and 30 volts, with impedance up to 500 ohm.

At the end of surgery, the patients (in normothermia) were sent to the Postoperative Unit, where they were continuously monitored.

All patients received follow-up exams during hospital stays and in outpatient programs by a single member of the surgical team, meeting protocol for comparison of pre- and postoperative data.

RESULTS

There was no hospital mortality in this group, nor were there any complications related to the use of radiofrequency. All patients left the operating room in sinus rhythm; however, during the period of hospital stay, six (40%) patients presented again AF rhythm. From these, five received intravenous administration of amiodarone in the loading dose of 5-7 mg/kg and maintenance dose of 900 mg/day during their stay in the intensive care unit, followed by oral administration at doses of 200-600 mg/day over 3 months. One patient received electrical cardioversion of arrhythmia after hemodynamic instability, with application of two shocks of 100 and 200 Joules, respectively, followed by administration of amiodarone at the aforementioned doses. Despite attempts at reversion and maintenance of sinus rhythm, these patients were discharged from the hospital with AF rhythm and were maintained in an oral anticoagulation scheme with the use of dicumarinics, with doses adjusted according to the coagulogram.

From the nine (60%) patients who left the hospital in sinus rhythm, two presented relapse of AF rhythm during postoperative follow-up, with left atrium diameters of 65mm and 68mm, respectively. Currently, seven (46.7%) patients are in sinus rhythm in the mean period of follow-up of 12.16 ± 10.89 months.

The examinations performed during hospital and outpatient follow-up of these patients were the surface electrocardiogram, transthoracic echocardiography and 24-hour Holter monitoring.

DISCUSSION

AF presents an arrhythmia that may be accompanied by ischemic or valvar heart disease, presenting harmful and deleterious complications, such as the risk of thromboembolic phenomena [6]. The operation to stop AF is a compelling alternative procedure for patients who will undergo open heart surgery, and aims to relieve the symptoms by restoring sinus rhythm, by maintaining atrial contractility, and by reducing of risk of thromboembolic events [7].

This arrhythmia may be easily classified according to its persistence. Thus, AF may be intermittent or continuous, features which have different electrophysiological bases [8]. According to the classification of the American College of Cardiology/American Heart Association, intermittent fibrillation may be paroxysmal and persistent, while continuous fibrillation may be permanent [9].

The use of radiofrequency as an energy source for ablation of AF has been presented successfully in some studies. Sie et al. [10] observed a rate of reversal to sinusal rhythm of 79% in patients operated with radiofrequency application in a mean follow-up period of 40 months. Other studies have shown rates of reversal to sinusal rhythm between 70 and 90% [11,12], and in cases of mitral valve disease, the reversal to this rhythm can range between 81% and 91% [13,14]. Moreover, the restoration of sinus rhythm allows for a decrease in the use of antiarrhythmic drugs, as well as an interruption of oral anticoagulation, excluding the patients with metallic prostheses [7].

One of the relevant aspects for greater effectiveness in the use of radiofrequency is the transmurality of the lesion produced in atrial epicardium. A comparative experimental study between ultrasound and radiofrequency was

performed, which aimed to compare the time of application, continuity and depth of the epicardial lesions. This study has proven that this method is feasible and capable of producing accurate transmural lesions without perforations, especially when the source of energy is radiofrequency [15].

A possible complication of the use of this energy source is the esophageal perforation. In 2003, Doll et al. [16] showed incidence of 4% of this complication in 387 operated patients. They did not find preoperative factors capable of predicting the occurrence of this serious complication, despite the possibility suggested by other authors, who related it to extremely low body weight presented by some patients who had esophageal perforation [17].

In this study (although it is an initial experiment), the outcomes showed less effectiveness of the technique in intra-operative treatment of AF. Since then, several factors have been discussed in an attempt to improve the outcomes and in order to obtain and maintain sinus rhythm in these patients.

All patients selected for the operation presented chronic AF. No patient presented acute or paroxysmal episodes of arrhythmia, in which a greater possibility of success is suggested in terms of the reversal and maintenance of sinus rhythm. The left atrium diameter is another factor involved, mainly during recurrence of AF episodes. Thus, larger diameters increase the possibility of return to the arrhythmia during the postoperative [18]. Although advanced age may be a predictive factor for greater occurrence of AF, this was not observed in our study. It was likely not observed because of the small number of included cases and because of a lower mean age relative to other published studies [9,10].

In terms of the operative technique, there are different ways to perform pulmonary vein isolation [9,10]. However, facing the published outcomes in previous studies, we began to question the need for applying the radiofrequency lines in the epicardium of the right atrium. Raman et al. [19], examining 132 patients who underwent operation with ablation in both atria, obtained reversal to sinus rhythm in 84%, 90% and 100%, at 3, 6 and 12 months of follow-up, respectively. Also in terms of the technique, the mean time of radiofrequency application in atrial epicardium was 8 minutes, while some studies show the mean time of application between 15 and 17 minutes, or that is, such a drastically lower application time may have implications on the transmurality of the atrial lesions, resulting in a greater possibility of operative failure.

CONCLUSION

Despite the low operative morbidity of the AF ablation by radiofrequency, the initial results obtained in this study suggest less effectiveness in the treatment of this arrhythmia when compared with other studies in the literature that used the same proposed technique.

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