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Waleed El-Awady
National Heart Institute, waleedawady@yahoo.com

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Original Article

A comparison between monopolar radiofrequency ablation and electrocautery (Diathermy) ablations in left modified MAZE (short-term results)

Waleed El-Awady
Department of Cardiac Surgery, National Heart Institute, Cairo, Egypt

Abstract

Introduction
Atrial fibrillation is the most common cardiac arrhythmia and is associated with significant morbidity and mortality. The classic cut-and-sew maze procedure is successful in 85–95% of patients. However, it is technically challenging and requires prolonged cardiopulmonary bypass. The left modified maze procedure is successful in 65–85% of patients. The aim of this study was to compare the success of two different ablation sources in the left modified MAZE.

Patients and methods
Between June 2010 and December 2016, 40 patients underwent left modified MAZE (Cox III) procedure: 20 patients were done with monopolar radiofrequency ablation (group A) and the other 20 patients were done with diathermy as electrocautery ablation (group B). All patients had left maze plus a concomitant operation.

Results
The patients' mean age was 38.2 ± 12.7 years; there was no mortality or stroke or any thromboembolic events in both groups. There were 14 (35%) males and 26 (65%) females. The mean left atrial size ranged from 62.6 to 27.4 mm. The mean cardiopulmonary bypass (CPB) time was 115.1 ± 84.9 min. The mean cross-clamp time was 86 ± 64 min. The incidence of freedom from atrial fibrillation was 45% at the end of the operation (40% of patients with normal sinus rhythm with group A and 50% with group B), and after 1-year follow-up, this incidence increased to 67.5%, with 70% in group A and 65% in group B; only one patient required permanent pacemaker.

Conclusion
Although monopolar radiofrequency ablation is slightly superior to electrocautery, diathermy is definitely a cheaper option and can be used with satisfactory considerable short-term results in left modified Maze procedure in case of absence of standard devices of ablation.

Keywords: Atrial fibrillation, diathermy ablation, left modified maze, radiofrequency ablation

Introduction

Atrial fibrillation (AF) is a common arrhythmia seen in clinical practice and is often secondary to mitral valvular disease (80%) [1]. Patients experience a reduced quality of life, even after successful valve surgery, owing to continuing AF and its associated morbidity [2,3]. Therefore, combination valve surgery and AF treatment in a single operation becomes an attractive goal for surgeons [4].

AF affects 6% of the population older than 65 years [5]. It is estimated that 1.4 million outpatient US hospital visits and 227 000 hospitalizations occur annually for the treatment of AF [6]. Anticoagulation, rate control, antiarrhythmic drugs, cardioversion, and catheter ablation therapy all play a role in the treatment of this arrhythmia, but all of these strategies have had limited success.

AF is associated with increased morbidity and mortality [7–11]. Its medical treatment often yields unsatisfactory results [12,13].

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Correspondence to: Waleed El-Awady, MD,
Department of Cardiac Surgery, National Heart Institute, Cairo, Egypt,
Tel: +20 100 258 2564.
E-mail: waleedawady@yahoo.com

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However, the Cox-Maze III procedure (CMP) has gained widespread clinical application owing to its perceived complexity [14].

Cox introduced the maze operation, a 'cut-and-suture' technique, in 1987. The procedure interrupts all possible macro re-entrant circuits responsible for AF by multiple surgical suture lines placed after surgery [15]. Results after a surgical maze procedure are encouraging, with sinus rhythm (SR) in 74–90% of patients at 2–3 years after surgery and operative mortality as low as 1% [16].

The Cox maze was achieved by creating a conduction block with transmural surgical incisions. Since its introduction, the operation has undergone two modifications. The CMP is the most recent version and has had an impressive success rate of more than 95% at 10 years [17]. However, implementation has been slowed by its perceived invasiveness and difficulty. The traditional 'cut-and-sew' technique requires cardiopulmonary bypass and can be time consuming. This has resulted in a hesitation by many surgeons to combine this procedure with valve repair or replacement. Furthermore, significant morbidity has been reported, including pacemaker requirement and left atrial dysfunction [18,19].

Although Cox demonstrated the feasibility of treating AF surgically by interrupting the atrial pathways for multiple reentry circuits, which are necessary for the maintenance of AF [17,20], new surgical techniques have focused on the development of potentially less invasive procedures by simplifying the pattern of atrial lesions and evaluating alternative energy sources that can create them quickly, without a cut-and-sew technique [3,14,21–24].

More recently, simpler, less time-consuming 'partial Maze' procedures have been developed that have focused on creating surgical lesions in the left atrium predominantly [14]. A variety of patterns and devices with different energy sources have been introduced to perform a maze-like procedure more rapidly and safely [25].

Radiofrequency (RF) energy, which creates a blockage in lines of conduction by thermal damage and subsequent scar formation, is a relatively new energy modality being used for surgical ablation and treatment of AF and is highly effective [2,3].

Introduction of cryoablation and radiofrequency endocardial ablation (RFA) has reduced the morbidity and mortality due to a surgical maze procedure [26]. RF microbipolar coagulation was used by Patwardhan *et al*. [27] to perform the CMP with the restoration of SR in 80% of patients. Mapping studies have shown that re-entrant circuits or ectopic foci exist in the posterior left atrial wall, especially around the pulmonary veins [28].

The cardioblate of the RFA system uses RF energy to create spot or linear lesions in cardiac tissue to block the electrical activity causing AF. It uses a saline-irrigated hand-held electrode, which provides low impedance, and the constant trickle of saline cools the surface of the atrial tissue, which minimizes charring and deep lesions. The tip of the electrode is moved back and forth on the atrial tissue until it becomes white, which confirms that the lesion is effective [29].

RF energy has frequently been used in the ablation of cardiac tissue. It is capable of producing myocardial necrosis when applied to either the endocardium or epicardium [30–32].

The utilization of diathermy (electrocautery) as an energy source in the treatment of chronic AF has generated positive early clinical results; although this technology is available and affordable, it has not been well studied for this indication [33,34].

Patients and methods

Patients

A total of 40 patients underwent left modified MAZE as a surgical treatment for AF related to acquired heart disease between June 2010 and December 2016. Patients were invited to participate in the study after providing written informed consent besides approval for the release of information that was received from each patient.

Data collection

A total of 40 patients with AF and mitral disease or double valve disease, including mitral valve, had left modified MAZE (Cox III). Twenty patients had RFA (group A), and the other twenty had electrocautery (diathermy) ablation (group B), beside mitral valve repair, mitral valve replacement, or double valve replacement.

Inclusion criteria

Patients with a history of continuous AF for more than 6 months (chronic), age more than 18 years, and left atrial diameter more than 45 mm were included.

Exclusion criteria

Patients with a large left atrium (>70 mm), enlarged cardiothoracic ratio, longer duration of AF preoperatively (>20 years), multiple previous heart operations, pregnancy, active infective endocarditis, advanced age (>70 years), coronary artery disease, emergency surgery, and incapacity or refusal to participate in the study were excluded.

A 12-lead ECG was done on the day of the operation and repeated on fifth and seventh postoperative days. Echocardiography was done on the fifth postoperative day to assess the function of the valve repaired or the mechanical prosthetic valves replaced and left ventricle. Patients were followed up with ECG in the third and sixth months until 1-year follow-up after surgery.

The cardiac rhythm at the follow-up was based on ECG, and the rhythm was scored as a SR, AF/atrial flutter, nodal, or a pacemaker rhythm (heart block). Our maze procedures were considered successful in the case of restoration of SR as a result with or without pharmacological treatment.

Surgical procedure

Standard cardiopulmonary bypass was established, median sternotomy was performed mostly via bicaval cannulation, and cardiac arrest was obtained under aortic cross-clamping and repeated with antegrade cold blood-enriched crystalloid cardioplegia with moderate hypothermia. All the 40 surgical ablation procedures were performed concomitantly with mitral valve surgery. The left atrium was approached either through a standard left atriotomy, which was performed below the interatrial groove and extended inferiorly around the right inferior pulmonary vein, or trans-septal approach.

During the study period, the modified maze procedures were performed at the left atrium only using a variety of two types of devices with different energy sources, including RF and electrocautery (Diathermy).

Procedure specific to group A (radiofrequency ablation) All patients in group A had a left atrial maze procedure using RFA as an energy source. The procedure was performed on the endocardial surface of the heart before the actual mitral valve surgery. Monopolar saline-irrigated cooled tip RF ablation (SICTRA) was performed using the Medtronic Radiofrequency Generator Model 68 000 (710 Medtronic Parkway Minneapolis, Minnesota 55432-5604 USA) as an energy source (Fig. 1).

A voltage of 25–30 W was adjusted according to the effectiveness of ablation. Oscillatory and to-and-fro motions were employed on the atrial endocardium using the cardioblate pen (Fig. 2) until proper blanching or whitening was achieved. Prolonged or repeated application was done when necessary to achieve a full-thickness scar.

Procedure specific to group B (electrocautery ablation)

All patients in group B had a left atrial maze procedure using electrocautery ablation as an energy source. The procedure was performed on the endocardial surface of the heart before the actual mitral valve surgery. The initial cautery lesions are placed using the 'spray mode' of an ordinary cautery pencil connected to a diathermy machine (COVIDIEN Force FX Electrosurgical Generator, 710 MEDTRONIC PARKWAY MINNEAPOLIS, MN 55432-5604 USA) set at 30 W and using the coagulation – spray setting (Fig. 3). Lesions are created by a slow progression of the pencil such that the tissue is blanched when the cautery arc is moved against the tissue. As the spark mode arc is employed in an empty heart, alteration in conductivity (due to blood and charring) is typically avoided, and the rate of progression of the cautery is primarily determined by blanching. This is approximately at the rate of around 1–3 s/cm. The cautery is never kept stationary as it has to be moved as soon as the tissue blanches.

Inspection of the left atrium and left atrial appendage for thrombus was done, and a 3-0 polypropylene purse string suture was used to close the left atrial appendage from inside. TEE was removed from behind the left atrium during pulmonary veins and posterior left atrium ablations to avoid esophageal injury. The endocardial ablation lines were done around both right pulmonary veins (superior and inferior) with 1-cm distance to avoid pulmonary vein stenosis later on and then both left pulmonary veins (superior and inferior) were encircled at the same fashion, and then connected together by one or two ablation lines (in case of large left atrium), and another connecting endocardial ablation line to the encircled closed left atrial appendage.

A connecting endocardial ablation line to the mitral valve annulus crosses over the circumflex coronary artery. To avoid any collateral damage to the circumflex coronary artery while performing the ablation line toward the mitral annulus, we targeted the P2–P3 segment of the mitral valve annulus in mitral valve repair or 5 o'clock position in mitral valve replacement while we give antegrade cold cardioplegic solution during the ablation in both groups. Lastly, a blind-ended line was drawn perpendicular to the line running from the left pulmonary vein island toward the mitral annulus. It ran across the isthmus and toward the area of the inferior vena cava (IVC) and stopping just short of the atriotomy incision (Fig. 4).

The operative field was kept dry during endocardium cauterization by two aspirators. Careful washing of the atrial chamber was performed with slightly wet gauzes before its closure to remove the carbonization products to avoid an

Figure 1: Medtronic radiofrequency generator model 68000.

Figure 2: Monopolar SICTRA Medtronic probe (Cardioblate pen).

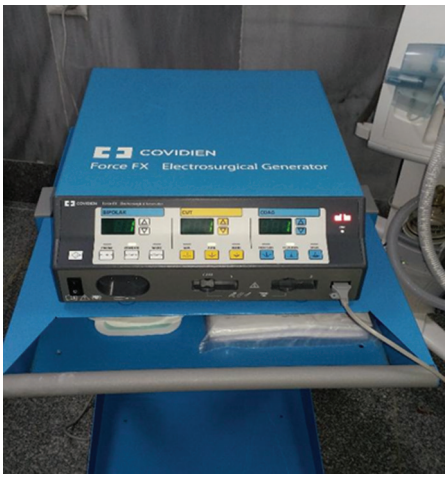

Figure 3: COVIDIEN force FX electrosurgical generator monopolar diathermy.

occasional systemic embolism. The left atriotomy is then closed after finishing the mitral valve. The heart is de-aired, and the patient is weaned off CPB in a routine manner. Atrial and ventricular wires are placed. Care is taken to place the atrial wires.

Perioperative AF was treated with either intravenous or oral amiodarone. If the drug was not tolerated, patients were managed with rate control medication and elective cardioversion at 2–6 weeks.

Postoperative care

Patients who are in SR were put on an infusion of amiodarone (10 mg/kg/24 h) and then an oral amiodarone 200 mg/day for 3 months. In patients who had nodal rhythm, temporary atrioventricular pacing was instituted. Amiodarone was given primarily to ensure decreased atrial automaticity to offset the increased atrial tissue conduction speed that can cause transient AF despite adequate maze lesions. This is done to ensure the maintenance of SR postoperatively at all times to ease hemodynamic management in sick left ventricles; the addition of amiodarone, even though only 3 months, ensures the maintenance of SR and early return of atrial function. Multinodal attack of AF (maze + amiodarone + optional atrial pacing) ensures a controlled SR throughout the immediate postoperative period and makes it smoother. Coumadin was given for patients with valve replacement, and aspirin was given to patients with the repair for life.

Results

The mean age was 32.9 ± 18.1 years, with 38.3 ± 12.7 and 27.7 ± 22.3 years for groups A and B, respectively; there was no mortality in both groups. There were 14 (35%) males, with eight and six males in groups A and B, respectively, and there were 26 (65%) females, with 12 and 14 females in groups A and B, respectively. There were 14 (35%) patients with paroxysmal AF; 10 of them were in group A, and the other four were in group B. There were 26 (65%) patients with persistent AF; 10 of them were in group A and the other 16 were in group B. We had two patients were done as redo cases, and all of them were in group B. The mean left atrial size ranged from 62.6 ± 27.4 mm, with 59.9 ± 30.1 min group A and 68 ± 22 mm in group B. The left atrial approach during the procedure was 32 (80%), with 12 and 20 patients in groups A and B, respectively; all patients in group B were done through the left atrial approach. The transseptal approach was done in eight (20%) patients, and all of them were in group A. Patient demographics characteristics, and concomitant procedures are shown in Table 1. The mean CPB time was 115.1 ± 84.9 min, with 113.6 ± 16.4 min and 117.5 ± 82.5 min in groups A and B, respectively. The mean cross-clamp time was 86 ± 64 min, with 83.1 ± 11.9 and 90.8 ± 59.2 min in groups A and B, respectively. There were no reoperations for failed valve repairs, but we had one patient in group B with prolonged cross-clamp time (150 min) and prolonged CPB time (200 min) due to mitral valve repair, with a flexible ring had to be revised with a rigid ring along with a ring in the tricuspid valve in a beating heart. We had two (5%) patients with bleeding, and all of them were in group A. Sixteen (40%) patients needed inotropic support postoperatively; four of them were in group A and 12 were in group B. Six (15%) patients had low cardiac output postoperatively, with two in group A and four in group B. The incidence of freedom from AF was 45% at the end of the operation (40% of patients with normal SR with group A and 50% with group B); after 1-year follow-up, this incidence increased to 67.5%, with 70% in

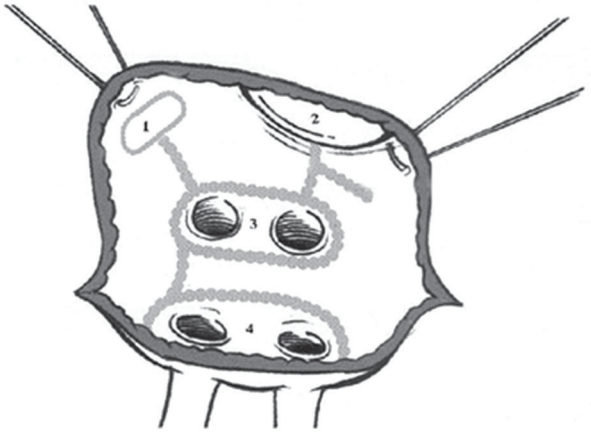

Figure 4: Diagram of the maze lines performed in the left atrium. It included pulmonary vein isolation where both left pulmonary veins and both right pulmonary veins were isolated separately. A roofing line between the two superior pulmonary veins was done as well as two lines extending from the left pulmonary vein island, one going toward the base of the left atrial appendage and the other toward the annulus of the mitral valve at a point corresponding to the middle of the posterior mitral leaflet. Another blind-ended line was drawn perpendicular to the line running from the left pulmonary vein island toward the mitral annulus. It ran across the isthmus and toward the area of the IVC and stopping just short of the atriotomy incision. (1) Closed LAA, (2) mitral valve, (3) isolated left pulmonary veins island, (4) isolated right pulmonary veins island.

Table 1: The demographic characteristics of the study group

	Group A: RFA [20 (100)] [*n* (%)]	Group B: diathermy [20 (100)] [*n* (%)]	Total [40 (100)] [*n* (%)]
Mean age	38.3±12.7	27.7±22.3	32.9±18.1
Total	20 (100)	20 (100)	40 (100)
Mortality	0 (0)	0 (0)	0 (0)
Sex			
Male	8 (40)	6 (30)	14 (35)
Female	12 (60)	14 (70)	26 (65)
Type of atrial flutter			
Paroxysmal	10 (50)	4 (20)	14 (35)
Persistant	10 (50)	16 (80)	26 (65)
LA (mm)	59.9±30.1	68±22	62.6±27.4
Redo	0 (0)	2 (10)	2 (5)
Approach to LA			
Left atriotomy	12 (60)	20 (100)	32 (80)
Transseptal	8 (40)	0 (0)	8 (20)
Concomitant procedures			
Mitral valve repair	12 (60)	6 (30)	18 (45)
Mitral valve replacement	0 (0)	2 (10)	2 (5)
Double valve replacement	14 (70) 6 (30)	8 (40) 4 (20)	22 (55) 10 (25)
Double valve repair	0 (0)	4 (20)	4 (10)
Tricuspid valve repair	10 (50)	4 (20)	14 (35)
Other cardiac surgery	0 (0)	2 (10)	2 (5)
CPB time (min)	113.6±16.4	117.5±82.5	115.1±84.9
AOX time (min)	83.1±11.9	90.8±59.2	86±64
Complications			
Bleeding	2 (10)	0 (0)	2 (5)
Inotropic support	4 (20)	12 (60)	16 (40)
Low COP	2 (10)	4 (20)	6 (15)
Neurological	0 (0)	2 (10)	2 (5)
stroke	0 (0)	0 (0)	0 (0)
Postoperative rythym (immediate)			
Sinus rhythm	8 (40)	10 (50)	18 (45)
Atrial flutter	8 (40)	6 (30)	14 (35)
Nodal	2 (10)	4 (20)	6 (15)
Pacemaker rhythm (HB)	2 (10)	0 (0)	2 (5)
Postoperative rythym (1 year)			
Sinus rhythm	14 (70)	13 (65)	27 (67.5)
Atrial flutter	5 (25)	7 (35)	12 (30)
Pacemaker rhythm (HB)	1 (5)	0 (0)	1 (2.5)

RFA, radiofrequency ablation; AOX, aortic clamping; COP, Colloid Osmotic Pressure; LA, left atrium.

group A and 65% in group B. Two (5%) patients in group A required a temporary pacemaker implantation because of a third-degree atrioventricular block; after 1 year, one patient required permanent pacemaker. No mortality as long as nor stroke or any thromboembolic events were detected in any patient.

Discussion

The CMP was developed to restore normal SR, to allow for the discontinuation of anticoagulation and antiarrhythmic drugs, and to reduce stroke risk [35,36].

The incidence of AF in patients with mitral valve disease is ~40–60%. Jatene *et al*. [37] confirmed the benefits of the Maze operation in patients undergoing mitral valve repair. Only 5.3% of the patients undergoing Cox's technique developed AF after 37 months versus 76.5% of those who underwent valve repair alone.

Between January 1988 and January 2002, the freedom from recurrent AF at 14 years in Maze procedure was 93%. The excellent long-term results with this operation established it as the standard for the surgical treatment of AF. Despite these excellent results, the operation required a relatively long period of cardiopulmonary bypass and an arrested heart [25]. That is why modified maze procedure in patients with AF and undergoing MVR has given encouraging results [38,39].

The Framingham study [40] has shown that the incidence of stroke is five times higher in patients with AF. The effect in the quality of life decreased physical capacity, and consequently, decreased labor capacity, complications, and sequelae; increased mortality rate in patients with this disease and increased medical expenses show the importance of its diagnosis and adequate treatment. Some surgeons do not perform maze procedure in addition to MVR with mechanical valves because these patients receive systemic anticoagulation after surgery. Bando *et al*. [41] had 8 of 10 late strokes among patients receiving optimal anticoagulation which indicates that although anticoagulation is beneficial, it does not abolish the risk of stroke associated with AF. In our study, we had neither stroke (0%) nor mortality (0%), but there were morbidities.

Bakker and associates stated that the probability of AF after the maze procedure varies with time, remaining quite low during the first postoperative months and increasing gradually after that. Decreased left ventricular function, increased age, and increased preoperative creatinine levels were associated with a decreased probability of sustained SR. Although the 30-day mortality was relatively high, it was explained by preoperative characteristics and by the complexity of the cardiac procedure [42].

Significant mitral valve disease is often associated with chronic AF, and ~60–80% of mitral valve cases referred for surgery are reported to have AF [1]. All the cases in our study had mitral valve disease as a fixed pathology, as we have a comparison between two variable ablation devices.

Elimination of the extensive cutting and sewing needed to make the atrial incisions of the CMP gives these new operations the potential to simplify the procedure and decrease the time of surgery. The hope is that this will reduce morbidity, encourage referrals, and speed the adoption of this operation by surgeons.

Many groups also have chosen to omit many of the incisions of the Cox maze procedure. This has made clinical interpretation results difficult because failure could be due either to inadequate ablation technology or to an inadequate lesion set. It was our goal to perform all the basic lesions of left-sided Maze but to replace all of the incisions with lines of ablation.

The average cross-clamp time to perform alone maze procedure (cut and suture) was 93 ± 34 min. After CMP, 15% of the patients required postoperative pacemakers [43]. These problems with the traditional CMP have authors and others to begin evaluating strategies to simplify the surgical treatment of AF [21,44]. In our study, the mean cross-clamp time of concomitant procedures was 86 ± 64 min, with 83.1 ± 11.9 for RFA and 90.8 ± 59.2 min for electrocautery. We had 2.5% of all patients who required a postoperative pacemaker, such a case had RFA and developed heart block.

Sie *et al*. [45] published a study with the use of RF for AF ablation, in which they followed the lines proposed by Cox's procedure in a biatrial approach, reaching 79% of the regular rhythm at 6 months of clinical follow-up. Abreu Filho *et al*. [46] published a study with similar characteristics to the aforementioned study, with a success rate of 72.7%, representing patients free of AF at 12-month follow-up. Another two studies by Sie and Khargi were among the first groups to use the irrigated RF device for the surgical treatment of AF [2,47]. Sie *et al*. [2] reported incidences of freedom from AF at 1 and 2 years of 98 and 86%, respectively. A recent review of the literature shows that the incidence of SR restoration at 1 year varies between 62 and 98% among series using RF energy [3,22]. These differences can be attributed to variations in patient selection, ablation patterns, and the technical equipment used. Patient selection probably remains the most important factor affecting the outcome of the procedure [48]. Patients with a large left atrium and patients with an enlarged cardiothoracic ratio seem to have a decreased rate of SR restoration [48]. In our study, the incidence of freedom of AF in monopolar RFA and diathermy group was 70 and 65%, respectively, at a 12-month follow-up.

Esophageal injury and coronary artery damage (the circumflex artery) are two serious complications that have been reported during RF ablation [49,50]. Esophageal injury attributed to heatwaves transmitted by the TEE probe. Therefore, the removal of the probe before beginning the ablation is mandatory. Moreover, the type of RF device, the amount of energy delivered, and the ablation pattern are other points that need to be considered to minimize such complications. The pulmonary vein is a thin structure that is close to the esophagus, and ablation inside the pulmonary veins may increase the chance of esophageal injury [49–51]. The saline irrigation has some theoretical advantages over dry RF systems. It lowers the surface temperature so that direct heating is transmitted below the surface, resulting in a lesion of greater depth and higher chances of creating a transmural lesion. Irrigation obviates firm contact and pressure. In our study, we had no incidence of esophageal or coronary artery injury, in either of the groups.

A common strategy has been to replace the surgical incisions with linear lines of ablation made using various energy sources, including RF, cryoablation, microwave, ultrasound, and laser energy [52,53].

Deneke *et al*. [54], in a randomized prospective trial using cooled-tip RFA, demonstrated that the modified maze procedure produced SR in about 80% of patients at a 1-year follow-up and also showed an improvement in the functional capacity of patients undergoing the maze procedure along with mitral valve replacement. The percentage of patients with chronic AF and mitral valve disease reverting to SR after a mitral valve surgery alone is between 8 and 27% [55]. In our study, we had nearly the same results in the RFA group at a 1-year follow-up (70%).

Although Güden *et al*. [4] had favorable short-term and intermediate-term follow-up results of unipolar RF, 92% of the patients received biatrial (n = 9) and left maze (n = 34), being free of AF at 12 months. In our study, we had 70% of patients who received left modified maze only, being free of AF at 12-month follow-up with monopolar RFA.

Kress *et al*.[23] have shown in an animal model that a lesion pattern consisting of electrically isolating the pulmonary veins and the left atrial appendage and the creation of left atrial connecting lesions was 100% effective in terminating AF, compared with other models consisting of pulmonary vein isolation alone.

Lam *et al*. [56] stated in a study of surgical treatment of AF with diathermy *in vitro* that the best results (high tissue coagulation necrosis, low risk of perforation) would come from spray mode with a power of setting between 30 and 35 W, along with contact times of 1–3 s/cm. He also stated that although they have not found diathermy capable of creating transmural lesions histologically, there were excellent clinical results from reported series, which certainly call into question the need for transmurality as a prerequisite for electrical isolation. In our study, we used the power of setting 30 W in our diathermy group, along with contact times 1–3 s/cm with the restoration of SR 65% after 1-year follow-up.

Simha *et al*. [33] presented their initial experience with 25 patients undergoing the Maze procedure by electrocautery. Lesions similar to those of the Cox-Maze procedure were reproduced using an electrocautery knife set on 'spray' mode, with the power output of 40 W and at a nonspecific contact time. There were no complications reported, and SR was restored in 96% of patients at a mean follow-up of 3.5 years. His study also showed that using electrocautery at that output to perform biatrial endocardial ablation, 36% of the patients required definitive pacemaker implantation. In our study, in which the approach was restricted only to the left atrium with a lower power output of 30 W, we had no patient with diathermy ablation group who required a pacemaker.

Similarly, Desaulniers *et al*. [34] presented their results using an electrocautery knife tip set on spray mode at a power of setting of 26 W to reproduce Maze lesions in the left atrium; 70% of their patients were in SR at short-term follow-up. In our study,

we had nearly the same results in diathermy ablation group; we used an electrocautery knife set on 'spray' mode, with the power output of 30 W with contact times 1–3 s/cm, and 65% of patients were in SR at short-term follow-up (1 year) in left maze only.

Inamdar *et al*. [57], in an approach only to the left using electrocautery, observed a high rate of AF recurrence in the first months postoperatively, possibly owing to inadequate ablation of atrial tissue, producing incomplete lines. Additionally, it was hypothesized that it would be necessary 3–6 months to complete the cicatrization of the ablation lines to achieve an efficient electrical stimulus block. Recidivation of AF in the first weeks after ablation is evident, not meaning procedure failure. In our study, 40% of RFA and 50% of diathermy patients were in SR immediately after the operation; this rate raised to 70% of RFA and 65% of diathermy after 1 year of follow-up. This fact can also be explained by the postoperative transient atrial inflammatory process and by the transoperative atrial ischemia [58,59]. Other studies have described ectopic focuses external to the pulmonary veins, or arising from other atrial structures, which would be related to the recidivation of postoperative AF [60,61].

Recurrence is influenced by the type and duration of AF, choice of lesion set in permanent AF, and left atrial size, so that early operation, careful choice of lesion set, and left atrial reduction might enhance results. To reduce recurrence, it has also been suggested that routine prophylactic use of antiarrhythmic drugs has a major role in the high rates of conversion to SR. However, these ideas do not seem to be justified by the data coming from recent studies [27,48,62]. We used antiarrhythmic drugs for 3 months after the procedure in both groups to maintain normal SR.

Conclusion

Although monopolar RFA is slightly superior to electrocautery, diathermy is definitely a cheap option and can be used with satisfactory considerable short-term results in left modified Maze procedure in case of absence of standard devices of ablation.

Limitations

The current study has several limitations that should be considered. This is a small prospective cohort, single-center study. These limitations as it represents our preliminary experience with a small number of patients and short-term results need to be confirmed by larger series with longer follow-up which can determine whether these procedures have effective long-term results or not. This study does not take into consideration the electrophysiological properties of diathermy on atrial tissue. The ECG is a 'snapshot' in time and has limited ability to detect transient atrial arrhythmias in patients during the follow-up period.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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