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Combined radiofrequency modified maze and mitral valve procedure through a port access approach: early and mid-term results

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Abstract

Objective: The aim of this study was to assess the feasibility and effectiveness of irrigated radiofrequency (RF) modified Maze procedure through a port access approach during mitral valve surgery and evaluate early and mid-term results. **Material and method:** During a 16 months time period, 67 patients with chronic atrial fibrillation (AF) eligible for port access mitral valve surgery were randomly assigned to either Group A, in which they underwent a combined procedure ($N = 33$) or Group B, in which a valve procedure alone was performed ($N = 34$). Both groups were similar in terms of age, sex, valve pathology, duration of AF left atrial diameter and left ventricle function ($P > 0.05$). Four had undergone previous operations. **Results:** Median follow-up was 10 months for both groups, 95% CI (9.18–10.8). One patient in each group died early postoperatively (3 and 2.9%). Two patients required reoperation for bleeding, one in each group (3 and 2.9%). There were two conversions to right thoracotomy. In Group A, freedom from AF was 100% at the end of the operation (76% sinus, 24% pacemaker) Six and twelve months freedom from AF was 87.2 and 93.6%, respectively. In Group B, freedom from AF at the end of operation was 41%. At the end of 6 and 12 months, freedom from AF was 9.4% ($P = 0.0001$). One patient in Group A required a permanent pacemaker (3%). During follow-up, one patient in Group A died of non-cardiac causes (3%). In Group B, there were two late deaths: one cardiac (2.9%) and one neurologic (2.9%). There were no thromboembolic events detected in Group A during follow-up, whereas two patients in Group B suffered this complication (6%, $P = 0.081$). At 12 months, functional capacity had improved for patients in both groups ($P < 0.0001$). **Conclusion:** The combination of mitral valve surgery and irrigated RF Maze procedure was safe and efficient through a port access approach. There were no procedure related complications like esophageal or coronary artery injury. Early and mid-term results were favourable with 93.6% of patients free of AF at 1 year in comparison to the 9.4% of the control group. The data is not sufficient to reach any conclusions in terms of thromboembolic rates, despite favourable results for the RF Maze group. Nevertheless, in terms of feasibility, sinus rhythm restoration and overall outcome, early results are encouraging and we advocate the use of the combined procedure through a port access approach.

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Keywords: Port access; Radiofrequency ablation; Maze

1. Introduction

The surgical treatment of atrial fibrillation (AF) accompanying mitral valve disease has entered a new era with the development of new tools and advanced endoscopic techniques. Reports from different institutions have demon-

strated the efficacy and safety of port access mitral valve surgery [1,2]. Similarly, new energy sources have been adopted for treating AF in an effort to reduce the invasiveness and technical concerns with the original Maze procedure. Radiofrequency (RF) energy is commonly utilised for this purpose and has been shown to be effective for curing AF [3,4]. Since significant mitral valve disease is often associated with AF, combining these two less invasive procedures during a single operation becomes more appealing.

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The aim of this study was to assess the feasibility and efficacy of an irrigated RF system during port access mitral valve surgery and to evaluate early and mid-term results in terms of sinus rhythm restoration and outcome.

2. Materials and methods

The ethical commission of the hospital approved the study protocol. An informed consent was obtained from each patient, both for the surgical procedure and their cooperation during the follow-up. During a 16 months time period, data were prospectively collected on patients undergoing port access valve surgery with AF to receive the procedure. Inclusion criterion was a history of persistent AF for more than 6 months in patients undergoing minimally invasive mitral valve surgery. Patients with severe chest wall deformities (pectus excavatum), significant coronary artery disease, aortic valve insufficiency, lung adhesions and patients with iliac artery disease were excluded. In addition to routine angiography and echocardiography, each patient underwent a detailed evaluation preoperatively including a computerised axial tomography (CAT) and/or magnetic resonance imaging (MRI) and transesophageal echocardiography (TEE) for identification of such risk factors and proper patient selection. Following this process, patients were randomly assigned to either Group A ($N = 33$), in which they underwent port access surgery combined with the irrigated radiofrequency modified Maze procedure (RF Maze) or Group B ($N = 34$) as the control group in which they underwent port access valve surgery alone.

Mean age was 53 ± 0 in Group A and 50 ± 8 in Group B ($P = 0.90$). Rheumatic disease was dominant in both groups with a prevalence of 55 and 59% in Groups A and B, respectively ($P = 0.90$). Patient characteristics are shown in Table 1.

2.1. Statistical analyses

The statistical analyses were performed using NCSS 2000 Davson Edition, (329 North 1000 East, Kaysville,

Table 1
Patients' characteristics

	Group A	Group B	<i>P</i> value
Sex			
Male	13	9	
Female	20	25	0.240
Age (years)	53 ± 10	50 ± 8	0.930
LVEF (%)	55.19 ± 6.34	55.03 ± 8.12	0.930
LAD (mm)	62.45 ± 10.45	66.66 ± 9.03	0.092
Duration of AF (month)	19.87 ± 10.59	21.97 ± 13.90	0.50
NYHA (class)	2.81 ± 0.60	3.19 ± 0.69	0.023*

LVEF, left ventricle ejection fraction; LAD, left atrial diameter; *, significant.

Utah, 84037) package program. Comparison between groups were performed using paired and unpaired *t* tests for numerical values. Chi-square test and Fisher's exact test were used for comparing categorical values. Changes in rhythm status in time within the same group were evaluated using Mc Nemar test. Continuous variables are expressed as mean \pm SD. 95% confidence limits were calculated.

2.2. Surgical procedure

After standard induction of anesthesia, patients underwent double lumen intubation for single lung ventilation. Following the administration of 2 mg/kg of heparin, a 17 F arterial cannula (DLP, Inc, Grand Rapids, MI) was introduced through the right internal jugular vein percutaneously to assist venous drainage during cardiopulmonary bypass (CPB). TEE monitoring was used routinely to evaluate the results of valve repair and detect evacuation of air. Patients were positioned supine with the right shoulder elevated and external defibrillation pads were placed. A right lateral minithoracotomy (4–6 cm) in the fourth intercostal space was performed. A soft tissue retractor (Heartport Inc, Redwood City, USA) was used for the exposure of the surgical field, avoiding the division or traction of any rib. A 5 mm camera port (Storz, Karl Storz GmbH and Co, Tuttingen-Ger) was introduced through the fourth intercostal space front axillary line. A second port was introduced through the sixth intercostal space mid axillary line for left atrial venting and carbon dioxide insufflation, which began immediately after collapsing the right lung. Simultaneously, the right femoral artery and vein were prepared by means of a 2 cm oblique incision in the groin. CPB was established by femoro-femoral cannulation. A 18–20 F arterial cannula (DLP, Inc, Grand Rapids, MI) was used for arterial cannulation. Venous drainage was obtained by a 24–29 F femoral cannula (DLP, Inc, Grand Rapids, MI) and the 17–19 F arterial cannula previously inserted in the right internal jugular vein, thus allowing adequate venous drainage. The pericardium was opened 2 cm above and parallel to the phrenic nerve. Exposure was optimised with several pericardial stay sutures. Patients were cooled down to 28°C. Both vena cavae were encircled with tapes for a dryer operative field. A transthoracic clamp (Chitwood, Scanlan, Saint Paul, MN, USA) was introduced from the second intercostal space, front axillary line percutaneously. After cross-clamping of the aorta, blood cardioplegia was administered through a custom made (DLP) antegrade cardioplegia cannula inserted in the ascending aorta. The left atrium was opened parallel to the interatrial groove. The Heart Port atrial retractor system (Heart Port Inc, Redwood City, CA) was used for the exposure of the atrium.

2.3. Radiofrequency ablation

The Cardioblate (Medtronic Inc, MN, USA) RF ablation

system consists of a power generator and a pen. This is a hand held unipolar RF ablation device. The electrode tip is irrigated with saline that cools the tissue and provides a low impedance path. The irrigation of the saline through the nine tip openings conducts RF current away from the tip creating a virtual electrode. During the procedure, the pen is slowly oscillated over the tissue. The power generator can produce a power output ranging from 20 to 30 watts/5 cc irrigation/min. The exact duration for each lesion varies according to tissue thickness, power setting and irrigation rate. Based on our personal experience and device guidelines, we most frequently used 25 watts with an irrigation rate of 5 cc/min. Experimental and clinical studies have suggested that these settings would allow to reach a tissue depth of 3–4 mm (average thickness of the left atrial tissue) in 15 s. The pen shaped probe allowed sufficient endothoracic movement and enabled the surgeon to perform precise ablation lines through a limited incision (Fig. 1). The videoscopic vision allowed excellent view for the left atrium during the Maze procedure (Fig. 2).

2.4. Surgical procedure

2.4.1. Left sided RF Maze

In Group A, the RF ablation commenced prior to any valvular procedure. Patients underwent either a left [24] or biatrial [9] Maze procedure. The left sided RF Maze procedure started with left atrial appendage (LAA) isolation through a circumferential RF lesion created around its base. This was followed by bilateral pulmonary vein isolation in a circular fashion. An ablation line from the LAA to the left superior pulmonary vein was created, followed by a connecting lesion between both islands of pulmonary veins drawn as near to the left atrial roof as possible to avoid injury to the esophagus. Additionally, an ablation line connecting the left pulmonary veins to the P2–P3 segment of the posterior mitral annulus was performed. Finally, an

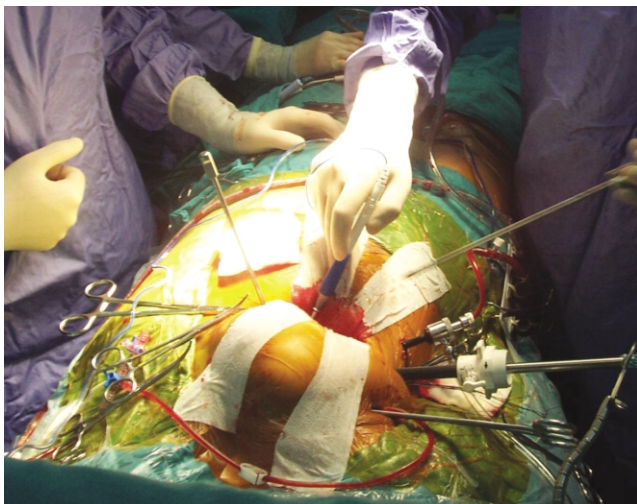


Fig. 1. The pen shaped probe allows sufficient endothoracic movement from a port access approach.

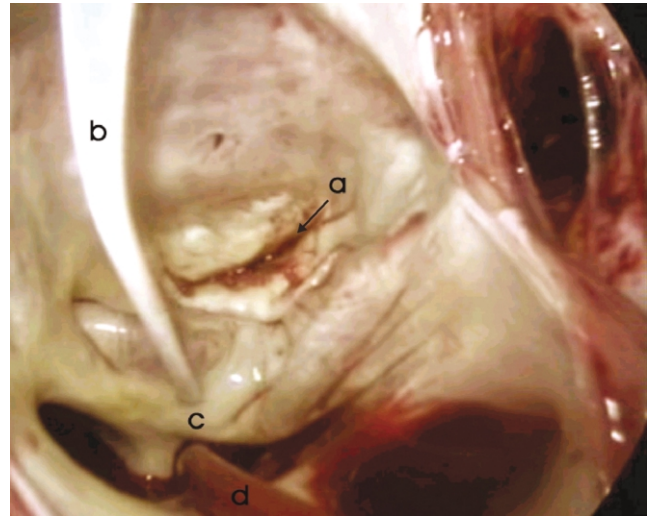


Fig. 2. The thoracoscopic view of the left atrium during ablation is shown. Note the whitish color changes around the pulmonary veins. (a) Anterior mitral valve leaflet. (b) Cardioblade pen is shown. (c) Ablation line. (d) Suction line.

ablation line from the middle of this line towards the base of the atria was performed to prevent re-entry pathways moving between the atria via the coronary sinus (Fig. 3). The LAA was oversewn from inside the LA and afterwards the mitral valve procedure was performed. The left sided Maze procedure added 7–9 min to the operation.

2.4.2. Right sided RF Maze

A circumferential, epicardial ablation line was performed around the base of the right atrial appendage, followed by a 4 cm anterior epicardial ablation line toward the inferior vena cava. The right atrium was entered through a posterior longitudinal and lateral incision at the dorso-lateral aspect, extending to the AV groove reaching the interatrial septum. The epicardial ablation continued towards the superior and inferior vena cavae meeting with

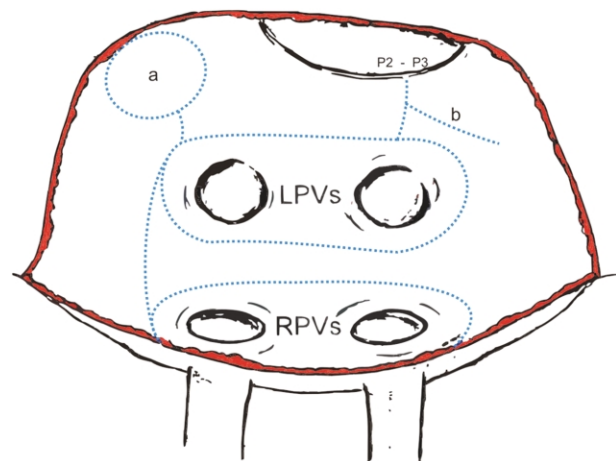


Fig. 3. The left atrial ablation lines are shown. (a) Isolation of the left atrial appendage. (b) The ablation line towards the reflection of the coronary sinus. LPVs, left pulmonary veins; RPVs, right pulmonary veins; P2–P3, posterior second and third segment of the mitral valve.

the surgical incision in the middle (Fig. 4a). The rest of the ablation lines were performed endocardially in the right atrium and can be seen in Fig. 4b. The right sided Maze added 4–6 min to the original procedure.

Patients in Group B underwent a standard valvular procedure: a repair or replacement without ablation. The concomittant procedures performed in both groups are shown in Table 2.

Twenty-five patients underwent mitral valve repair. There were four commissurotomies, five ring insertions for annular dilatation, five quadrangular resections of the posterior leaflet, nine Reed-type annuloplasty, one Alfieri type repairs and one triangular resection of the anterior leaflet. Mean operation time was 192.5 ± 20.4 min in Group A and 185.4 ± 25.5 min in Group B. Duration of CPB was 140.5 ± 34.3 min in Group A and 128.3 ± 28.3 min in Group B. Mean cross-clamp time was 88.5 ± 13.4 min in Group A and 78.9 ± 9.4 min in Group B ($P = 0.90$). Concomittant procedures are shown in Table 2.

2.5. Technical details

The ablation preceded any other procedure, in order to avoid any damage to the suture lines due to heat produced

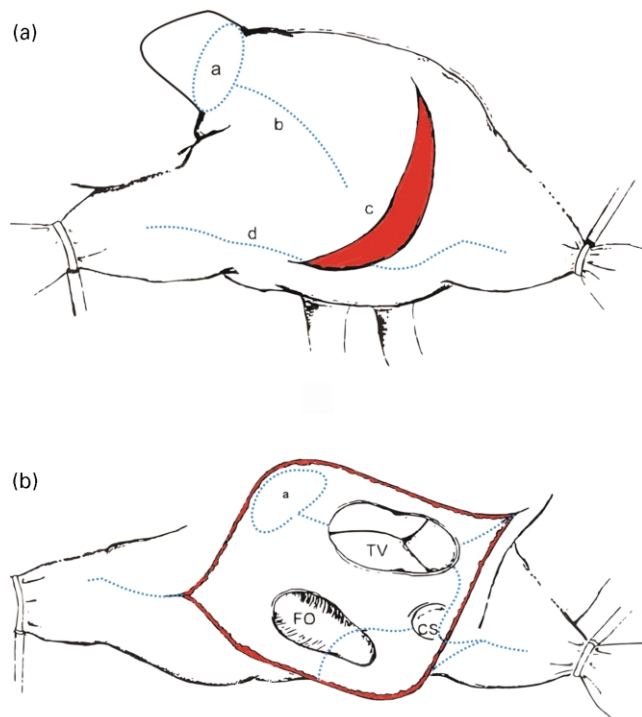


Fig. 4. (a) Ablation lines performed in the right atrium are shown. (a) Isolation of the right atrial appendage. (b) Epicardial ablation towards the inferior vena. (c) Posterocaudal incision to enter the right atrium. (d) Ablation of the interatrial septum between the two vena cavae. (b) Ablation lines performed in the right atrium are shown. (a) Isolation of the right atrial appendage. (b) Ablation line passing from the fossa ovalis and moving towards the isthmus area. CS, coronary sinus; FO, fossa ovalis; TV, tricuspid valve.

Table 2
Concomittant surgical procedures

Procedure	Group A	Group B
MVR	17	17
MVP	7	9
MVR + TP	4	3
MVP + TP	5	4
MVR + ASD	–	1
Reoperation	2	2

MVR, mitral valve replacement; MVP, mitral valve repair; TP, tricuspid valve repair; ASD, atrial septal defect.

by the RF energy. The TEE probe was always removed during the ablation to prevent any damage by the transmission of heat waves to the esophagus and cause injury.

To avoid any collateral damage to the circumflex coronary artery while performing the ablation line towards the mitral annulus, the P2–P3 segment was targeted.

The biatrial Maze procedure was applied in cases in which the right atrium had to be opened for a tricuspid valve inspection or an atrial septal defect or if the patient formerly had a history of atrial flutter. Otherwise the procedure was limited to the left side.

2.6. Postoperative management

All patients received temporary atrial and ventricular pacemaker wires at the end of the operation, for pacing or overdriving the atrium when necessary.

Since rhythm problems are common during the early postoperative period, patients in both groups received prophylactic amiodarone. An initial dose of 150 mg were given at the end of the operation intravenously followed by 0.5 mcg/kg/min for 24 h followed by 200 mg daily. The authors do not favour early cardioversion for patients in postoperative AF and reserve this for patients who are still in AF after 3 months. Antiarrhythmic medication was administered for 3 months in Group A and gradually discontinued afterwards. Patients in Group B received cordarone for 12 months. After 12 months, only patients who were in sinus rhythm continued to receive cordarone.

All patients underwent 72 h of Holter monitoring during their hospitalization. Left atrial transport function was evaluated 12 months after the operation by transthoracic echocardiography with Doppler analysis of mitral flow.

The anticoagulation management protocol was the same as that applied for routine open heart surgery. Patients receiving mechanical valves continued Coumadin (Du Pont Pharmaceuticals, Wilmington, DE) treatment. At discharge, all patients received coumadin, due to the high incidence of arrhythmias during this period. INR value was kept between 2.5 and 3 in patients who were in sinus rhythm and between 3 and 3.5 for patients who remained in AF. Coumadin was discontinued after 6 months, if the patient was in sinus

rhythm and did not receive a mechanical valve. All other patients continued to receive coumadin.

3. Results

Median follow-up was 10 months 95% CI (9.18–10.8). There was no operative mortality in either group. One patient in Group A died 27 days after the operation due to multi organ failure after a long-lasting pulmonary infection (3%) and one patient in Group B was lost 5 days after the operation due to a gastrointestinal complication (2.9%). During the late follow-up, one patient in Group A (3.1%) and two patients in Group B died (6%). The death in Group A was non-cardiac (traffic accident). One death in Group B was accepted as sudden cardiac death and the second one was due to a cerebral thromboembolic event (autopsy finding). There were two conversions to thoracotomy. One patient in each group needed reoperation for bleeding. One patient in Group A (3%) and two in Group B (6%) were re-admitted with late pericardial tamponade and treated with pericardial drainage using endoscopic techniques. There were no reoperations for failing valve repairs. However, two patients, one in each group had minor paravalvular leaks, which did not need intervention, but these patients remained in close follow-up. This leak was due to severe calcification of the posterior annulus and not to technical limitations. Outcome and complications are shown in Table 3.

Follow-up was divided into three periods: 6, 12 and over 12 months (maximum 18 months). Each patient underwent a detailed physical examination and 12 lead electrocardiography during each examination.

In Group A, intraoperative freedom from AF was 100% (76% SR, 24% pacemaker). At discharge, 81% of patients were free of AF. During 6 months, 1 year and over 1 year follow-up, 87.2, 93.6 and 92% of patients were free of AF, respectively.

In Group B, 41% of patients were free of AF at the end of the operation (20.5% SR, 20.5% PM). Despite antiarrhythmic therapy, only 15.2% were free of AF at discharge. During follow-up, 9.4, 9.4 and 7.6% remained in sinus rhythm, respectively ($P = 0.0001$). The rhythm status of patients during follow-up are shown in Table 4. During follow-up between discharge and 12 months, no significant change was detected in AF rate for both groups ($P = 0.25$, $P = 0.98$). During Holter monitoring, early postoperatively, a subgroup analysis of Group A patients revealed no difference in terms of sinus rhythm restoration between patients who received a left or biatrial Maze procedure even though the small number of biatrial procedures did not allow to reach a statistically significant conclusion. However, none of the patients undergoing a biatrial Maze procedure had postoperative atrial flutter while right atrial flutter was detected in two patients with the left sided Maze procedure ($P = 0.005$). These patients were treated successfully with percutaneous techniques. Atrial transport function (LAT) was evaluated 12 months postoperatively using transthoracic echocardiography with Doppler analysis of mitral flow in 31 patients showing that 95% of patients had recovered LAT in Group A. Restoration and maintaining sinus rhythm was significantly lower in Group B at discharge and follow-up. One patient in Group A needed a permanent pacemaker implantation 1 month after the operation due to a third degree AV block (3%). At 12 months, the functional capacity of patients had improved in both groups ($P = 0.0001$). There were no thromboembolic events detected in Group A. In Group B, there were two thromboembolic events, one resulting with death (6%, $P = 0.081$) (Table 4).

4. Discussion

Different minimally invasive surgical approaches have recently been applied to treat mitral valve disease with or without AF, in an effort to minimize surgical trauma and improve cosmetic results. The Maze III procedure has long been accepted as the gold standard for the surgical treatment of AF [5]. While shown to be highly effective, this procedure has been criticised for being a difficult and lengthy operation. This has led to multiple attempts in creating a faster and simpler procedure using various energy sources to replace the incisions of the original cut and sew technique. These energy sources include RF, cryoablation, bipolar cautery and microwave [6–8]. Most of the literature has focused on the use of RF energy with various modifications and the efficacy of these systems have been well documented [8,9]. After the initial success with these various energy sources, efforts were aimed towards performing these procedures through less invasive approaches [10]. The feasibility of an epicardial approach has been demonstrated using RF or microwave energy during off-pump CABG. However, an epicardial approach

Table 3
Complications and outcome

	Group A	Group B	<i>P</i> value
Pacemaker	1 (3%)	0	>0.05
Reoperation for bleeding	1 (3%)	1 (2.9%)	>0.05
Infection (superficial wound)	0	1 (2.9%)	>0.05
Prolonged ventilation	1 (3%)	–	>0.05
Mortality (30 days)	1 (3%)	1 (2.9%)	>0.05
Mortality (late)			>0.05
Cardiac	0	1 (2.9%)	
Non-cardiac	1 (3%)	1 (2.9%)	
Endocarditis	0	0	>0.05
Paravalvular leak (minor)	1 (3%)	1 (2.9%)	>0.05
Late tamponade	1 (3%)	2 (6%)	>0.05
Thromboembolic event	0	2 (6%)	0.08
Improvement in NYHA	2.81 ± 0.60	3.19 ± 0.69	0.023
	↓	↓	
	1.10 ± 0.30	1.84 ± 0.51	<0.0001

Table 4
Rhythm status of patients during follow-up

Rhythm status	Group A	Group B	P value
Perioperative			
SR	25 (76%)	7 (20.5%)	$\chi^2 = 26.59$
PM	8 (24%)	7 (20.5%)	$P = 0.0001$
AF	0	20 (59%)	
Discharge			
SR	25 (78%)	15.2%	$\chi^2 = 26.96$
PM	1 (3%)	0	$P = 0.081$
AF	6 (19%)	28 (84.8%)	$P = 0.0001$ (Fisher's)
6 months			
SR	26 (84%)	3 (9.4%)	$\chi^2 = 38.17$
PM	1 (3.2%)	0	$P = 0.0001$
AF	4 (13%)	29 (90.6%)	$P = 0.0001$ (Fisher's)
12 months			
SR	28 (90.3%)	3 (9.4%)	$\chi^2 = 44.47$
PM	1 (3.3%)	0	$P = 0.0001$
AF	2 (6.4%)	29 (90.6%)	$P = 0.0001$ (Fisher's)
> 12 months (13–18 months)			
SR	10 (83.3%)	1 (7.6%)	
PM	1 (8.3%)	–	
AF	1 (8.3%)	12 (92.4%)	

P values were calculated using both Chi-square and Fisher's exact test. SR, sinus; PM, pacemaker; AF, atrial fibrillation.

alone during valvular procedures does not offer any clear advantage since eliminating CPB is not possible [11–13].

Significant mitral valve disease is often associated with chronic AF and approximately 60% of mitral valve cases referred for surgery are reported to have AF [14,15]. This fact has stimulated surgeons to approach these two problems during a combined minimally invasive approach. Mohr and associates have shown the feasibility of creating ablation lines using RF energy during minimally invasive valve procedures in a large series. They reported a 6 months and 1 year sinus rhythm restoration rate of 78 and 69%, respectively, in a group of 133 patients. This was a subset of 234 patients operated during a 3 years period showing the feasibility of RF ablation through a port access approach [16].

Dr Sie and Dr Khargi were among the first to use the irrigated RF device for the surgical treatment of AF [8,9]. Dr Sie reported a freedom from AF of 98 and 86%, at 1 and 2 years [17]. A recent review of the literature shows that 1 year sinus rhythm restoration varies between 62 and 98% among series using RF energy [4,11,12,18]. These differences can be attributed to variations in patient selection, ablation patterns and technical equipment used. The choice of lesion pattern during the ablation procedure differs among groups, thus having an impact over the success of the procedure [19]. A recent study has shown that a lesion pattern comprising of electrically isolating the pulmonary veins, left atrial appendage and left atrial connecting lesions was 100% effective in terminating AF in an animal model in comparison to other models which consist of pulmonary vein isolation alone [20]. This is similar to the ablation

pattern the authors have been using. On the other hand, series based on simple pulmonary vein isolation seem to have a slightly lower SR restoration rate suggesting that simplifying the procedure comes at a cost of lower SR restoration rates [12,16,21]. One advantage of the left sided limited procedure is that it obviates the need for some incisions. However, if a patient develops atrial flutter after the operation, this usually needs to be managed by catheter ablation techniques [16,21]. Two patients in our series had to undergo such a procedure. These series report post-operative incidences of atrial flutter reaching 10–15% [16–22]. Although catheter based techniques can be applied in these patients, a second procedure will increase the cost considerably and this option may not be available in all centers. Our current policy is to apply a biatrial approach in patients with a history of atrial flutter or where the right atrium has to be opened. Otherwise, the procedure is limited to the left side. A combination of epicardial and endocardial ablation was applied during the right-sided Maze procedure. This is a modification of our previous method in order to avoid the amputation of the right atrial appendage and to reduce the number of surgical incisions [18]. However, the right sided procedure, especially ablation around the isthmus area slightly increases the risk of AV block, which happened in one patient in our series (3%).

Esophagus injury and coronary artery damage (circumflex artery) are two serious complications that have been reported during RF ablation [16,23]. Esophageal injury reported in most series is attributed to the heat waves transmitted by the TEE probe. Therefore, the removal of the probe before beginning the ablation is advised. In addition,

the type of RF device, amount of energy delivered and the ablation pattern are other points that need to be mentioned in order to bring such complications to a minimum. The pulmonary vein is a thin structure which is in close relation to the esophagus and ablation inside the pulmonary veins may increase the chance of esophagus injury [16,21,23]. The authors lesion pattern largely replicates the Maze III procedure, with the ablation lines being located outside the pulmonary veins and never entering the vein, thus minimizing the chance of esophageal damage. The saline irrigation has some theoretical advantages over dry RF systems. It cools the surface temperature so that direct heating is transmitted below the surface resulting in a lesion of greater depth and higher chance of creating a transmural lesion. Irrigation obviates the need of firm contact and pressure. This also avoids the use of excessive energy levels that can cause collateral damage which has been reported in some series [16,23]. Probes designed to stamp at the tissue at a certain pressure with constant high energy levels bring the tissue, being ablated in closer relation to underlying structures, which can be a potential cause of collateral damage. The importance of probe design becomes even more crucial during minimally invasive procedures. The pen shaped probe used during this study enabled the surgeon to perform ablation lines through a limited incision allowing sufficient endothoracic movement without any pressure to the atrial tissue. However, in patients with a deep chest and giant atrium, it can be difficult to reach the LAA directly with the probe pen and a longer pen can be appreciated in such cases.

It has been postulated that many patients undergoing mitral valve surgery convert to sinus rhythm irrespective of ablation and that ablation may not be necessary in this group of patients. It has also been suggested that routine prophylactic use of antiarrhythmics might have a major role in the high conversion rates to sinus. However, these ideas do not seem to be justified by the data coming from this study since only 9% of patients who did not receive ablation were in sinus rhythm at 1 year despite antiarrhythmic therapy ($P = 0.0001$). Several studies have shown similar results [9,24]. Whatever technique is used, even with the original Maze procedure, an early AF rate of 35% is reported [25]. This early AF is explained by the late healing process of atrial lesions and by the inflammatory process associated with the procedure. In addition, early atrial arrhythmias and AF after the operation can be caused by small macro re-entries which respond well to antiarrhythmic therapy [25]. We believe that these data provide a solid basis for such a therapy after the operation even though the prophylactic use of antiarrhythmics is still a controversial issue.

A major criticism for port access surgery has been the prolonged CPB and ischemic times. Our series is no exception. Even though CPB and cross-clamp time improved during the learning curve, they still exceeded the conventional method. Although the ischemic time was

slightly longer in the RF Maze group, this did not have any adverse effect on outcome. However, both the port access technique and complex mitral valve repair require a learning curve and it is the authors feeling that complex mitral valve repair should be avoided in the beginning of one's experience during port access surgery.

Outcome after mitral valve surgery can be influenced by many factors. Studies have shown that persisting chronic AF has a negative impact, and these patients experience a reduced quality of life due to impaired hemodynamic function and increased risk of thromboembolism. Although the follow-up was short, none of the patients who received RF ablation had any thromboembolic event while two patients in Group B suffered from this complication ($P = 0.08$). Longer term follow-up with larger series and other parameters are needed to reach any conclusion concerning the quality of life or the rate of thromboembolism between two groups. However, a recent study has shown that patients undergoing the Cox-Maze procedure enjoyed less thromboembolic complications at the end of 5 years, supporting the early data coming from our study [24].

Our series did not include any patient with lone AF. However, the avoidance of a sternotomy may largely increase patient acceptance of surgical treatment for isolated AF and can become a major reason for increased patient referral for antiarrhythmic surgical treatment. As for AF with structural valve disease, achieving both goals through a port access approach becomes even more important since many of the isolated mitral valve cases are operated through a minimally invasive approach today.

In conclusion, the port access approach provided a good access for both valve surgery and the RF Maze procedure. The combination of direct and videoscopic vision allowed adequate view of both the valve and left atrium, leading to a safe and efficient combined procedure. There were no procedure related complications such as esophagus or coronary artery injury. Short and intermediate term follow-up was favourable, with 93.6% of patients receiving the combined procedure being free of AF at 12 months in comparison to 9% in the control group. No thromboembolic event was observed in the RF Maze group. Whether these favourable results will continue during the long-term remains to be seen; nevertheless, early results are encouraging.

5. Limitations of the study

This is an interim report on the subset ($N = 33$) of the total of 95 patients who underwent the irrigated radio-frequency Maze procedure. There are several limitations of this study. The authors were strict in patient selection in this study leading to a highly selective group of patients in terms of left ventricle function, left atrial diameter and duration of AF. Patients with low LVEF, or a giant left atrium were excluded from the study. Mean duration of AF was

relatively short. These factors could have contributed to the favourable results in this study. The lack of routine 24 h Holter monitoring at 12 months control is another limitation of this study. We could perform a limited number of Holter studies at 6 and 12 months. For this reason, we did not include them in the study. The numbers of biatrial procedures were limited and this did not allow for a comparison of a left or biatrial procedure in terms of sinus rhythm restoration. However, the authors have previously published their data on this subject [18].

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