The impact of surgical ablation in patients with low ejection fraction, heart failure, and atrial fibrillation

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Abstract

Objective: Surgical ablation procedures that use the Cox-Maze procedure lesion set were shown to be very effective. However, many surgeons are reluctant to perform the procedure, especially in high-risk patients such as those with reduced left ventricular (LV) function. This study explored the potential impact of the Cox-Maze III/IV procedure on patients with low ejection fraction (EF < 40%) and symptoms of heart failure experiencing atrial fibrillation (AF) who present for cardiac surgery. Methods: A prospective study whereby patients with persistent or long-standing persistent AF who had surgical ablation were followed. Echocardiograms (echo) were obtained; patients with preoperative EF < 40% were included. Health-related quality of life (HRQL-SF-12) and AF symptom severity were obtained at baseline and follow-up. Rhythm was captured by electrocardiogram (EKG) and 24-h Holter. Results: In the past 5 years, 482 patients had surgical ablation (424 full Cox-Maze) of whom 44 patients met the inclusion criteria; however, two patients did not have an available follow-up echo, leaving 42 patients for analysis. Mean age was 61.1 ± 12.9 years, and additive European System for Cardiac Operative Risk Evaluation (EuroSCORE) of 7.5 ± 3.1. There was one operative death, there were no strokes or transient ischemic attacks (TIAs) at follow-up, and EF improved from 30 ± 5.0% to 45 ± 13.0% at a mean of 1.5 ± 11.3 months, postoperatively. The return to NSR at time of follow-up echo was 86% (35/40). The physical functioning HRQL scores improved (37.0 ± 12.3 to 46.8 ± 9.1, p = 0.02) at 12 months (population norm = 38.1 ± 9.9) with a significant improvement in symptom severity. Kaplan–Meier event-free survival at 24 months was 87% (confidence interval (CI): 80.4–91.6) (events considered were redo valve replacement, ventricular assist device or death). Conclusions: This is a unique study assessing a high-risk group of patients. Surgical ablation in patients with low EF can be performed in a safe and effective way without added operative risk. Given the potential long-term clinical advantages of a successful surgical ablation in patients with low EF and heart failure, we believe that surgical ablation should be considered in such patients when they present to surgery.

Keywords: Atrial fibrillation; Surgical ablation; Heart failure; Quality of life

1. Introduction

Current statistics indicate that the incident rates for both heart failure and atrial fibrillation (AF) are on the rise. It is estimated over 2.3 million people suffer from AF in the United States alone, and this number is expected to increase to 5.6 million people by 2050 [1]. In addition, patient demographics in cardiac surgery programs is shifting toward a more aging population. As a result, the average age of patients operated on and the number of significant comorbidities that include patients with AF and heart failure is more common. The negative effects of AF are well known; however, a recent study determined that tachycardia-induced cardiomyopathy can be improved either by successful ablation and conversion to sinus rhythm or by achieving a rate-controlled ventricular response [2]. However, nothing has been written on the effects of surgical ablation in patients with poorly functioning ventricles.

The current clinical scenario together with the potential long-term clinical advantages of successful surgical ablation of AF, especially in a subgroup of high-risk patients with low ejection fraction and heart failure, led us to evaluate our clinical experience with such patients. Therefore, the objectives of our study were to investigate:

1. if surgical ablation to include the Cox-Maze III procedure in patients with left ventricular ejection fraction less than 40% can be performed safely and successfully; and
2. whether the restoration of sinus rhythm or a decrease in AF burden conveyed a clinical improvement in ejection fraction, increased functional capacity, achieved a better quality of life and perhaps led to better survival.

2. Methods

This study was approved by our institutional review board (IRB) and waiver of consent was granted.
This was a prospective study whereby all patients who presented for and underwent surgical ablation for AF were captured within our Surgical Ablation Registry. The registry was established prior to the beginning of our prospective study. The data collection sheets to include the preoperative and follow-up variables were developed and approved by our IRB before the start of the study. However, several amendments have been filed with our IRB to address continual clinical concerns, which included rhythm verification methods such as 1-week Holter monitoring and echocardiogram (echo) data collection. The database has been managed and overseen by a full-time database administrator; the data have also been collected by a full-time clinician. The registry data were merged through a data management platform with our local Society of Thoracic Surgeons’ (STS) database to create a longitudinal record.

In addition to the variables captured through our local STS database, and the clinical variables collected through our Surgical Ablation Registry as noted above, transthoracic echocards were obtained at baseline and at follow-up, as determined by their respective cardiologists. The baseline and follow-up echocards were performed at various clinical sites by the patients’ respective cardiologists. Patients, who had an ejection fraction less than 40%, were included in this study.

Health-related quality of life (HRQL) (SF-12v2TM) and AF symptom severity patient reports were obtained at baseline and at 6 months. HRQL was also obtained at 12, and 24 months and, then, yearly thereafter. The Short-Form 12 (SF-12) has long been considered a reliable and validated instrument for use to obtain patients’ perceptions of their HRQL, and has been used across many disease populations, including the cardiac surgery population. It is also easy to administer being particularly adept for use in self-report situations. This instrument measures eight concepts and two summary measures: physical component summary (PCS) and mental component summary (MCS), which result in two summary scores. Scores range from 0 to 100. For patients living with heart disease, the physical functioning summary scores are standardized to a mean of 39.2 ± 10.6, the mental health summary scores are standardized to a mean of 47.0 ± 10.5 and patients’ perception of their general health is standardized to a mean of 39.7 ± 10.5 (Ware J: Quality Metrics). A higher score means a better HRQL.

The Atrial Fibrillation Symptom Checklist: Frequency and Severity (V.3) was used to capture patients’ perceptions of their AF symptoms and their corresponding severity. There are 16 symptom items. The maximum frequency score is 64 and the maximum severity score is 48. Higher scores indicate more symptoms and a higher degree of severity when experiencing the symptoms (Bubien and Jay revised by Jenkins, Atrial Fibrillation Symptom Checklist: Frequency and Severity (V.3)).

The STS definitions were used for the major adverse cardiac events (MACEs), which included in-hospital mortality, stroke, re-operation for bleeding, prolonged ventilation, renal failure with and without dialysis, and re-admission within 30 days (Data analysis of the Society of Thoracic Surgeons National Adult Cardiac Surgery Database obtained at http://www.sts.org/doc/8242). Any subsequent interventions including cardioversions, antiarrhythmic drug changes or ablations were captured through our clinical follow-up program [3].

Rhythm status for patients, who underwent a surgical ablation procedure, was verified by electrocardiogram (EKG) and/or 24-h Holter monitor at the respective time points of 6, 12, and 24 months and, then, yearly thereafter. The 24-h Holter were recommended; however, due to cardiologist discretion and insurance issues, EKGs were obtained more often. The Heart Rhythm Society definition of success (all documented atrial arrhythmias >30 s is considered a failure) was used to determine the return to sinus rhythm rate at 6 and 12 months (Heart Rhythm Society Consensus Statement: http://www.hrsonline.org/policy/clinicalguidelines/upload/hr-and-euro-copy-for-print.pdf). The Social Security Death Index was searched for any follow-up deaths.

3. Data analysis

Descriptive statistics were used to describe the sample. Chi-square tests, unpaired t-tests and paired t-tests were used to identify any differences between time points. Kaplan—Meier survival analysis was used in determining event-free survival. Events considered were redo valve surgery, ventricular assist device placement or death. All data management and statistical analysis was completed in SAS/STAT™ software, version 9.1.3 of the SAS System for Windows (Cary, NC, USA).

4. Results

4.1. Overall preoperative characteristics

In the past 5 years, 482 patients have undergone surgical ablation at our facility with 424 patients having undergone the full Cox-Maze III/IV procedure to include all the lesions that were described by Dr James L. Cox for the Cox-Maze III and by Dr Ralph Damiano for the Cox-Maze IV. All the lesions were performed by using either an argon-based cryothermal device as the only energy source (Cox-Maze III) or a combination between argon-based cryothermolgia and bipolar radiofrequency for the Cox-Maze IV [4–8]. The first patient recruited for the study was in January 2005 and the last patient was recruited in March 2010 with our last follow-up date noted as of August 2010. Forty-four (10%) of our patients were found to have an ejection fraction <40% on their preoperative echo; however, two patients did not have an available follow-up echo, leaving 42 patients for analysis. The mean age was 61.6 ± 12.9 years (range 21—84 years). The mean additive European System for Cardiac Operative Risk Evaluation (EuroSCORE) was 7.5 ± 3.1 (range 3.0—14.0). The mean preoperative ejection fraction was 30% ± 5.0 (range 15—37%). Twenty (48%) of the patients were found to be in the New York Heart Association (NYHA) class III or IV at the time of their surgery (Table 1). The majority of the patients also presented with long-standing persistent AF with an average duration of 64.8 ± 82.7 months. In addition, eight patients (19%) had undergone a preoperative catheter ablation, 16 patients (38%) had undergone at least one preoperative cardioversion and 37 (88%) were on antiarrhythmic medication prior to surgery.
Thirty-eight patients underwent a full Cox-Maze procedure and four patients underwent a left-sided-only ablation. Thirty-four of the patients presented for concomitant surgery, while eight patients underwent a stand-alone Cox-Maze III/IV procedure for lone AF. Tachycardia-induced cardiomyopathy was evident in five of the eight patients, one of the eight patients was found to have non-ischemic cardiomyopathy and the other two patients were found to be experiencing left ventricular dysfunction and/or hypokinesis of the left ventricle.

There was 1/42 (2%) operative death and no perioperative strokes or transient ischemic attacks (TIAs). The operative death occurred in a patient, who had a pulmonary vein isolation procedure concomitant to a coronary artery bypass procedure. The cause of death was cardiac. There were 4/42 re-operations for bleeding. The mean length of stay was 10.9 ± 9.5 days. Two patients (2/42; 5%) experienced renal failure marked by elevated creatinine (Table 2).

### 4.2. Long-term follow-up

All patients included in the analysis had at least one echo completed, but for those who had several, the most recent echo was used in this analysis. Overall, at a median of 6.1 months (range 0.2—42.9 months) postoperative, the ejection fraction was found to have improved by an average of 15% to a mean of 45 ± 13.0% (range 15—65%). The rate of return to NSR at time of follow-up echo as determined by EKG/24-h Holter was 86% (30/35). Interestingly, three patients out of the five, who were found not to be in sinus rhythm at the time of their echo, had a noted improvement in their ejection fraction, while one of them showed a significantly lower AF burden of less than 1 h per 24 h.

For those who did not have an improvement in their ejection fraction (n = 6), two patients were found to be experiencing AF on a continuous basis. In addition, half of these patients (n = 3) were older than 75 years. Their average left atrium size was 6.1 ± 2.9 cm²; however, this was not significantly different from those who had an improved ejection fraction (p = 0.42). Half the patients (n = 3) had long-standing persistent AF on average 83.2 ± 130.2 months prior to surgery; again, though, this was not significantly different from those who had an improved ejection fraction (p = 0.46). All these patients had undergone a full Cox-Maze procedure.

Overall, patients with long-standing persistent AF at the time of surgery (n = 19) showed a significant improvement in their ejection fraction (median = 50%; range 15—60%; p = 0.0004; Fig. 1). Patients with persistent AF at the time of surgery (n = 20) also showed a significant improvement in the ejection fraction at follow-up (median = 50%; range 25—65%; p = 0.0001; Fig. 1).

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### Table 1. Patient demographics (n = 42).

| Mean age (SD) | 61.6 (12.9) years |
| Gender number | Male = 31 (74%) |
| Preoperative ejection fraction (mean ± SD) | 29.9 (5.0) |
| Preoperative NYHA classification | I — 9 (21%) |
| | II — 13 (31%) |
| | III — 16 (38%) |
| | IV — 4 (10%) |
| History of preoperative hypertension | 52% |
| Mean CHADS Score | 1.7 (1.2) |
| Type of atrial fibrillation prior to surgery | Paroxysmal 3 (7%) |
| | Persistent 20 (48%) |
| | Long standing persistent 19 (45%) |
| | Additive EuroSCORE (mean ± SD) 7.5 (3.1) |
| Type of surgeries | Stand alone Cox-Maze procedure 8 (19%) |
| | CABG 8 (19%) |
| | Valve (MVR and or AVR) 19 (45%) |
| | CABG/valve 7 (17%) |
| | Left atrial size > 5.5 12 (29%) |
| | Ejection fraction < 35% 29 (69%) |
| | Preoperative pacemaker 6 (14%) |
| | Preoperative myocardial infarction 7 (17%) |

**Table 2. Postoperative and follow up complications.**

| Prolonged ventilation (>24 h) | 5 (12%) |
| Stroke/TIAs | 0 |
| Renal failure non dialysis | 2 (5%) |
| Mediastinitis | 0 |
| Operative death | 1 (2%) |
| 30 day mortality | 0 |
| LOS (mean ± SD) | 10.9 (9.5) days |
| Readmissions within 30 days (reasons for readmissions) | 1 (pericardial effusion/tamponade) |
| Average time of follow up | 31.3 (18.9) months |
| Readmissions over time: | 15 patients had 34 readmissions |
| CHF readmissions | 10 |
| Embolic stroke | 0 |
| Stroke other | 1 a |
| Atrial flutter/atrial fibrillation | 4 |
| Ventricular fibrillation | 1 |
| Other | 18 |

*Pt was recently diagnosed with multiple myeloma, admitted with pancytopenia in sinus rhythm.*

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**Fig. 1.** Change in mean ejection fraction between baseline and time of echocardiogram overall and by rhythm and type of preoperative atrial fibrillation.
Thirty-eight of the patients underwent a full Cox-Maze procedure and four patients underwent a left-sided ablation only. At the time of the echo, 27/31 (87%) of the full Cox-Maze patients had a return to sinus rhythm with 23 of the 27 patients in sinus rhythm off antiarrhythmic medications. Of the left-sided ablation, three of four had returned to sinus rhythm with one of three off antiarrhythmic medications.

Overall, patients’ NYHA classification improved significantly \((p = 0.007)\) at the time of their echo, with 100% of the known patients \((n = 11)\) in NYHA class III or IV moving to either class I or II, postoperatively (Fig. 2). There were no embolic strokes in a mean follow-up of 31.3 ± 18.9 months, with 13 of the 16 eligible patients off coumadin by 6 months. Four patients experienced a major bleeding event (defined as requiring hospitalization for the bleeding and/or blood transfusion for blood loss). Two patients were on coumadin therapy and two patients were on aspirin therapy at the time of their bleeds.

During follow-up, we found that eight patients required a cardioversion for recurrence of AF, which reestablished sinus rhythm. Three patients required an implantable cardioverter—defibrillator (ICD) placement in accordance with the American Heart Association and the American College of Cardiology guidelines for ICD placement (AHA guidelines for ICD placement: http://circ.ahajournals.org/cgi/content/full/117/21/2820).

### 4.3. Re-admissions

There was one re-admission within 30 days of surgery for pericardial effusion/tamponade. In a mean follow-up time of 31.3 ± 18.9 months, 15 patients experienced 34 re-admissions (<1% re-admission rate per patient). The majority of re-admissions \((n = 18)\) were for non-cardiac-related events. Re-admissions related to congestive heart failure accounted for 10 out of 34 (29%) of the re-admissions and rhythm disturbances accounted for 5 out of 34 (15%) (Table 2).

### 4.4. Health-related quality of life

Patients reported significantly improved physical functioning HRQL scores at 12 months post surgery \((37.0 ± 12.3\) to \(46.8 ± 9.1, \ p = 0.01\); population norm = 38.1 ± 9.9). Patients’ perceptions of their general health had also significantly improved at 12 months \((40.6 ± 14.2\) to 50.6 ± 9.0, \(p = 0.03\); population norm = 39.7 ± 10.5). In addition, patients’ reported physical functioning scores had also significantly improved at the time of their respective echos \((37.0 ± 12.3\) to \(44.2 ± 9.5, \ p = 0.02\). Patients’ perception of their general health had also significantly improved at the time of their echos \((40.6 ± 14.2\) to \(47.1 ± 11.5, \ p = 0.03\). Patients’ mental health scores increased slightly at these respective time points; however, the results were not significant (Fig. 3).

In addition, when the HRQL scores were analyzed by whether patients had returned to sinus rhythm at the time of their echo, a significant increase in scores were noted for those in sinus rhythm. Those who were found not to be in sinus rhythm at the time of their echo still experienced a significant increase in their HRQL scores (Figs. 4 and 5).

### 4.5. Symptom severity and frequency

There was a significant improvement in patients’ reported severity of symptoms and frequency of symptoms by 6 months. Patients’ mean reported severity scores prior to surgery were 19.8 ± 8.2, which had significantly decreased by 6 months to 13.0 ± 4.2 \((p = 0.005)\). Their mean reported frequency scores prior to surgery were 25.2 ± 9.1, which had also significantly decreased by 6 months to 14.0 ± 5.6 \((p = 0.0004)\).

![NYHA Pre and Post Operative](image)

**Fig. 2.** Change in mean NYHA classifications between baseline and time of echocardiogram.

![Overall SF12 NBS Scores During Follow-up](image)

**Fig. 3.** Change in health related quality of life scores over time.

![Non SR at Time of EF SF12 NBS Scores During Follow-up](image)

**Fig. 4.** Health related quality of life scores for those not in SR at time of echo.
4.6. Survival

Kaplan—Meier survival analysis determined that survival at 36 months was 87%, with 70% confidence limits of 80.4—91.6 (Fig. 6).

5. Discussion

This study is one of the first to look at a unique group of patients, who presented to surgery with low ejection fraction (<40%) and significant AF. It is well established that the incidence of AF is high in patients with higher NYHA [9]. The arrhythmia has been implicated as a predictor for mortality and cardiovascular co-morbidity. There is an ongoing debate regarding what is the best approach — rate or rhythm control [10,11]. However, the results of these studies must be kept in the context of the patient population studied. It is clear that, in a specific subgroup of patients with low ejection fraction and heart failure, the impact of restoration of sinus rhythm may be the greatest; however, there is yet no clear evidence to support this assumption.

We found that surgical ablation in patients with low ejection fraction can be performed safely and with a relatively high success rate. It appears that restoration of sinus rhythm or a reduction in AF burden may contribute not only to the improvement in a patient’s ejection fraction but also to their quality of life as well as the symptoms associated with AF. Theoretically, restoration of sinus rhythm in this subgroup of patients may potentially improve long-term outcome to include survival and reduce risk of stroke without increasing operative risk.

Guglin and colleagues found that restoration of sinus rhythm in patients with heart failure led to fewer heart failure symptoms than those in the rate control arm, and that stable sinus rhythm conveyed the best functional status. They conclude that if current treatments fail to result in a stable sinus rhythm, then other treatment options including ablation should be considered [12]. We, too, found that patients who had a restoration of sinus rhythm had a significant improvement not only in their ejection fraction but also in their HRQL scores, especially their physical functioning and general health. Furthermore, they reported a marked decrease in their AF symptoms and in the severity of their symptoms.

This is not the first report that suggests that surgical restoration of sinus rhythm may be related to improved ejection fraction. Stulak et al. from the Mayo Clinic reported a significant improvement in ejection fraction and NYHA class in patients following the classic cut-and-sew Cox-Maze procedure [13]. As in our series, they also attributed the improvement in patient functional status not only to the restoration of AV synchrony but also to the excellent rate control following the Cox-Maze procedure. Based on these studies, we may suggest a more careful look at the original results of the Atrial Fibrillation Follow Up Investigation of Rhythm Management (AFFIRM) study [10,11]. We believe our results may be in line with these more recent findings.

The effect of return to sinus rhythm on mortality remains controversial. Several large studies including the AFFIRM and Rate Control versus Electrical cardioversion (RACE) trials conveyed no improvement in survival [10,11,14]. However, our findings may be more in line with the results from the Danish Investigations of Arrhythmia and Mortality on Dofetilide trial (DIAMOND), which showed that restoration of sinus rhythm was associated with improved survival [15]. We noted that our survival over time in this patient population remained high, despite their burden of illness.

In our group of patients, the left atrial appendage was surgically excised in all patients, which may contribute to the improved survival due to the lower risk of thrombo-embolic events [16]. Interestingly, a significant number of our patients remained on coumadin, despite being in sinus rhythm due to other indications. We found that 13 of the 16 eligible patients were off coumadin by 6 months and, at 2 years, 9 of the eligible 15 patients were off the drug. We believe that this may have a positive impact on reduced morbidity and mortality during follow-up.

Quality of life and severity of symptoms related to AF were also assessed in this study. The outcome is very promising. Patients do report a significant improvement during follow-up, and there is a clear correlation with the improvement in NYHA class. These results are of significance, as the treatment being offered to patients with heart failure is also focused on improved quality of life and not only long-term survival.

As noted, some of the patients in this group were operated using limited left atrial ablation lesion set only. The decision
to perform the ablation procedure was left to the attending cardiac surgeon. The rest of the procedures were all Cox-Maze III/IV that are considered by us to be the same procedure with regard to ablation pattern. It seems that, in this subgroup of patients, a limited lesion set results in a lower success rate; however, the number of patients is too small to draw any conclusions.

5.1. Limitations

This study has several limitations. It was performed at a single center with a surgical ablation program run by very experienced surgeons; thus, these results may not be reproducible at low-volume centers. In addition, the follow-up echos were obtained from multiple centers, and were carried out by multiple board-certified cardiologists, which may have introduced some variability in the actual echo reading.

Although these patients were followed up for almost 3 years, our results may change with a longer period of follow-up. The improvement of the return to sinus rhythm on mortality will need to be further investigated, as some of the improvement may be due to the repair of a dysfunctional valve or improved blood flow to an ischemic area. Although these findings are encouraging and should be seriously considered, this is a small series of patients; hence, a prospective randomized study should be developed to verify our results.

6. Conclusions

This is a unique study looking into our surgical results with a very challenging group of patients. One of the key clinical points that this study demonstrates is that patients with low ejection fraction and heart failure can be offered surgical ablation using the Cox-Maze III/IV pattern or its modifications with no added operative risk. We also determined that the restoration of sinus rhythm conveyed an improvement in patients’ reported HRQL and ejection fraction, which may have introduced some variability in the actual HRQL.

Although these findings are encouraging and should be seriously considered, this is a small series of patients; hence, a prospective randomized study should be developed to verify our results.

References


Appendix A. Conference discussion

Dr S. Salzberg (Zurich, Switzerland): You have operated about 400—500 patients now, with concomitant maze, of which about 10% were in low ejection fraction. I think you also highlighted a very important point, that AF is under-treated. The Cox-Maze procedure is a difficult procedure which not every cardiac surgeon feels comfortable in doing. Therefore, I think it’s very important that we once again highlight that we have guidelines to treat these patients.

My question for you is in regard to the lesion and the choice of lesions which were done. You said in the paper that it was left up to the surgeon’s discretion if he wanted to do left-sided lesions only or a full lesion set. I would like you to comment on that. That’s the first question.

The second question is in regard to your failures. And I think A-Fib is probably one of the areas in cardiac surgery where we have to focus on the failures because that’s where we can learn. In the paper you had 4 patients who developed recurrent AF and/or flutter. I wasn’t quite clear what that was, so I’d appreciate a comment on that and if that was in patients who had a full Cox-Maze procedure or only left-sided lesions.

And then the last thing. All these patients showed significantly improved ejection fraction, therefore improved survival, and I think that’s the most important message we can learn from your excellent presentation.

Dr Ad: I think we have evolved as a center. The left-sided lesions were done not by me, but by other surgeons. And it’s not a criticism; it was open to all of
us to try to enroll patients in the way we felt appropriate. And now that we have information and results of about, I think, 60 patients with left-sided ablation only, we pretty much restrict ourselves to left-sided lesions only in patients with true paroxysmal atrial fibrillation and left arterial size less than 4 cm.

The way we are asked to report failures is any event longer than 30 seconds, either atrial tachycardia or atrial flutter and atrial fibrillation. And I don’t know the answer off the top of my head about the type of atrial fibrillation, but I think we can easily add it to the manuscript as required. So we include under the definition, any event longer than 30 seconds for atrial tachycardia, atrial fibrillation and flutter. I know for sure that none of the patients having the full maze had left atrial flutter, but I don’t recall the rest of the arrhythmias.

Dr S. Benussi (Milan, Italy): I suppose the bottom line would be that today the coexistence of low ejection fraction in our open patients, rather than a contraindication to ablation, is a strengthening both of the indication to add concomitant ablation and the very indication to surgery. Because in our experience with open surgery in patients with low ejection fraction and functional mitral regurgitation, those who recover sinus rhythm after concomitant ablation actually double their ejection fraction while those with sinus rhythm before surgery, generally tend to recover, in the best case scenario, their preoperative left ventricular function after surgery. So the possibility of combining atrial fibrillation ablation surgery is today actually something encouraging us to give surgery to these borderline patients. I wanted to know if you share my opinion on this.

My main point is nevertheless on lone atrial fibrillation patients. I’ve happened to operate on patients with 10% or 20% ejection fraction that were actually candidates for heart transplantation, saw them recover normal heart function after ablation surgery. These patients in the hands of the electrophysiologist, have a precise flow chart or treatment because they have proven quite nicely that percutaneous left atrial ablation is much better than to ablate (the A-V node) and pace. But what about the tons of patients that were in the heart failure clinic that responded very well to surgery.

As for your first comment, you know I’m still going back and forth on how aggressive we should be with those patients. And I think like anything else in cardiac surgery, it comes with experience. Because there are patients that my gut feeling will say to me to just go out and don’t be too sophisticated, keep it simple, otherwise you’re going to be in trouble. When you ask me what are the indications I work according to, I don’t really know. But I think that the comment we can make based on this small series, and the very large series operated on, that our very good follow-up is indicating that we should never say no for the Cox-Maze procedure just because a patient has EF less than 40%.

Dr K. Khargi (The Hague, Netherlands): I fully agree to push the indications to the sicker patients, because the sicker the patient the higher the yield can be.

My question is about cardiac failure. Very often these patients have concomitant cardiac diseases like coronary artery sclerosis and/or mitral valve pathology. Did you do any additional procedures? And how do you exclude that these pathologies could be confounding factors in the results which you have presented?

Dr Ad: We have a list of concomitant procedures, there is CABG, mitrals, a couple of valves and so on and so forth. And that’s basically what we all do. So also with CABG we open the left atrium. I don’t suggest opening the left atrium and just doing what you need to do in order to achieve a reasonable lesion set. But again, if you do it many times, it takes you less time. So the way I approach these patients is a little bit different than someone who has done only 10 of them. So we all have to be aware of it and try to build our experience in patients, by staging it — in patients that you open the left atrium anyhow for mitral valve surgery, but with the CABGs maybe delay them for a later period of time. But don’t offer them just pulmonary vein isolation, do nothing.

Dr Khargi: I agree with that. But the point is that the improvement is not, for instance, being attributed to the CABG procedure or the concomitant mitral valve?

Dr Ad: I agree with that. No question about it. I said it during my presentation, we don’t think that the EF improved due to the restoration of sinus rhythm, it’s the other procedures we have done as well. However, it just makes sense that if the patient leaves the OR in sinus rhythm and maintains it down the road, their prognosis should be better.

Dr Khargi: I agree with that.