

High intensity focused ultrasound atrial fibrillation ablation during concomitant open heart surgery: is it time to offer this procedure to any patient undergoing cardiac surgery?

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Osmar Antonio Centurión,^{1,2} Karina E Scavenius,² Luis M Miño,² Orlando R Sequeira²¹Department of Health Sciences's Investigation, Sanatorio Metropolitano, Fernando de la Mora, Paraguay²Division of Cardiovascular Medicine, Clinic Hospital, Asunción National University, San Lorenzo, Paraguay**Correspondence:** Osmar Antonio Centurión, Professor of Medicine, Asunción National University, Department of Health Sciences's Investigation, Sanatorio Metropolitano, Teniente Ettiene 215 c/ Ruta Mariscal Estigarribia, Fernando de la Mora, Paraguay, Email osmarcenturion@hotmail.com**Received:** July 27, 2017 | **Published:** August 24, 2017

Editorial

Atrial fibrillation (AF) is known to be an important risk factor for morbidity and mortality in open heart surgery.¹ A 24% reduction in long-term survival has been described in patients undergoing coronary bypass surgery without conversion of atrial fibrillation into sinus rhythm.² Not treated preoperative atrial fibrillation was also associated with increased late cardiac morbidity and mortality, and poor long-term survival.³⁻⁵ Surgical conventional atrial lesions are generally created under cardiopulmonary bypass after opening the left atrium with the utilization of different energy sources.⁶⁻¹⁰ The surgically performed ablation lines done with radiofrequency, microwave, or laser energy sources were designed to closely replicate the original lesion set described by James L. Cox for a successful treatment of AF, but without the operative time and morbid cost of the classic cut and sew Maze procedure.¹¹ Indeed, due to the complexity of the Cox maze procedure, several different modifications have been introduced in an effort to simplify and shorten the operation. In addition, a left atriotomy performed in patients undergoing open heart surgery will increase cardiopulmonary bypass and cardiac exclusion times, as well as, morbidity and mortality. Therefore, any ablation technique that can be done before the initiation of cardiopulmonary bypass and without the necessity to perform a left atriotomy is a valid surgical alternative.¹² Indeed, a less-invasive epicardial AF ablation applied on the beating heart is definitely an attractive approach.¹³

In this issue of the Journal of Cardiology and Current Research, Romero-Ferrer B et al.,¹⁴ evaluated the effectiveness and safety of pulmonary veins epicardial ablation in AF patients during open heart surgery. They divided their patients into two groups, one with 20 patients with paroxysmal AF and another with 39 chronic AF. The primary endpoint was the presence of sinus rhythm at one year of follow-up. The effectiveness of the procedure to maintain sinus rhythm was 67.8% at the end of surgery, 54.4% at discharge, 54.7 at one month, 62% at six months and 65.3% at one year. No significant differences were found according to the underlying disease or the type of AF, although the results were better when AF was paroxysmal. There were no technique-related serious complications.¹⁴ The authors concluded that epicardial surgical ablation of the pulmonary veins with high-intensity focused ultrasounds is safe and shows good results, especially in patients with paroxysmal AF, regardless of their underlying heart disease, and it should be offered when there is a surgical indication for their cardiac illness.¹⁴

Several clinical studies analyzed the success rates of maintaining sinus rhythm of this procedure utilizing devices using high-intensity focused ultrasounds. The detected success rates ranged from 65% to 90% using this energy source.¹² In their study, Romero-Ferrer B et al.,¹⁴ observed that 65.3% of their patients were in sinus rhythm

at one year of follow-up. Their results are in accord with previous studies. Schopka S et al.,¹⁵ reports 62% maintenance of sinus rhythm at 6 and 12 months of follow-up. They studied 110 patients with AF and concomitant open heart surgery. Main underlying heart diseases were aortic valve disease (50%), ischemic heart disease (48%), and mitral valve disease (18%). AF was paroxysmal in 29%, persistent in 31%, and long standing persistent in 40% of patients. All patients had successful application of the system on the beating heart prior to initiation of extracorporeal circulation. No device-related deaths occurred, and postoperative pacemaker insertion was necessary in 4 patients. Groh MA et al.,¹⁶ studied 98 consecutive patients with a primary diagnosis of ischemic heart disease who underwent surgical therapy of atrial fibrillation concomitant to coronary bypass grafting using also epicardial ultrasound technology. Coronary artery bypass grafting was isolated or associated with various combinations of aortic, mitral, tricuspid, and left ventricular restoration surgery. At 12 months of follow-up, there were 1 early death and 4 extracardiac late deaths. A pacemaker was implanted in 4 patients. Freedom from atrial fibrillation at the 6-month visit was 84% for the entire population, 76% in patients with permanent AF, and 91% in patients with paroxysmal AF. At 1-year visit, 85% were free from atrial fibrillation. Camm CF et al.,¹⁷ published a review of the most important articles in the literature with a sinus rhythm maintenance ranging from 60 to 82% after surgery and ablation procedure. Ninet J et al.,¹² reported sinus rhythm maintenance of 85% of patients at 6 months follow-up, and 100% when AF was paroxysmal. No complications or deaths were device or procedure related. There were 4 (3.8%) early deaths and 2 late extracardiac deaths. A pacemaker was implanted in 8 patients.

Similar results were achieved by different studies with this surgical AF ablation procedure. The goal of these technique is to create lines of intra-atrial conduction block that will preclude the development of reentrant rhythms in the atria, as well as, to isolate the triggers for AF development near the pulmonary veins to resume and maintain sinus rhythm. Structural and electrophysiological changes take place over time within the left atrial myocardium in patients with structural heart disease associated with AF. Over the years the atrial wall undergoes changes due to pressure and volume overload. The structural changes are due to dilatation of the atrium, to some degree of hypertrophy, fibrosis, and overstretching of the myocardial fibers.¹⁸ These changes produce an anatomical substrate with electrophysiological alterations which increases the likelihood of developing AF by causing heterogeneity in intraatrial and interatrial conduction.^{19,20} This non-uniform anisotropic properties cause an irregular and fractionated propagation of the depolarization wave.^{21–23} Structural inhomogeneity or local differences in electrophysiological or ultra-structural properties are considered to play a major role in the initiation of reentrant circuits and atrial arrhythmias due to the increased likelihood of unidirectional block of the premature impulse and conduction delay.^{24–26} Therefore, the mere isolation of triggers around the pulmonary veins will not be sufficient to suppress all causes and effects of AF, since the arrhythmogenic foci known to trigger AF are more likely to reside in the left atrial myocardium than in the pulmonary veins in certain cases.²⁰

Patients with paroxysmal AF showed a significantly higher success rate than those with persistent or long standing persistent AF. These patients with paroxysmal AF usually suffer from less pathologic alterations of the atrial myocardium including myocyte size, wall thickness, fibrotic changes and left atrial size. Nevertheless, there is a possibility that these good outcomes may have been a result of inadequate diagnostic measures to detect short periods of AF during follow-up, since some studies did not perform Holter ECG assessment, or implantation of event loop recorders in patients who underwent epicardial AF ablation. Romero-Ferrer B et al.,¹⁴ also followed the heart rhythm of their ablated patients with conventional surface electrocardiograms only. Therefore, it is possible that the incidence of patients in sinus rhythm may have been overestimated.¹⁴

Conclusion

In conclusion, AF epicardial ablation concomitant to cardiac surgery appears to be an efficient procedure to improve outcome. Epicardial surgical ablation of the pulmonary veins with high intensity focused ultrasound is safe and demonstrated good results at one year of follow-up. It may be offered to patients with surgical indication for their underlying cardiac condition in association with paroxysmal AF. Despite these good results, it is not time yet to offer this procedure to any AF patient undergoing open heart surgery unless this efficacy is unequivocally proven in large randomized clinical trials.

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Conflicts of interest

Author declares there no conflicts of interest.

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