Robotically-Assisted Left Atrial Fibrillation Ablation and Mitral Valve Repair Through a Right Mini-Thoracotomy

Gil Bolotin, MD, PhD, Alan P. Kypson, MD,
L. Wiley Nifong, MD, and
W. Randolph Chitwood, Jr, MD

Division of Cardiothoracic Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina

A combined robotic-assisted left atrial ablation and mitral valve repair was done through a 5-cm right anterior mini-thoracotomy. The patient was a 54-year-old man with severe mitral regurgitation and a 10-month history of persistent atrial fibrillation. The patient underwent off-pump, beating heart epicardial peripulmonary vein microwave ablation using the FLEX 10 catheter (AFx Inc, Fremont, CA), followed by supplemental on-pump endocardial lesions. The procedure was done using the da Vinci surgical robot (Intuitive Surgical Inc, Sunnyvale, CA). The mitral valve repair consisted of a No. 38 Cosgrove annuloplasty band implantation (Edwards Life Sciences, LLC, Irvine, CA). The postoperative recovery was uneventful, and the patient maintained normal sinus rhythm.

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Atrial fibrillation, the most common of all sustained cardiac arrhythmias, is present in 0.4% to 2.0% of the general population, and is found in approximately 9.0% of people older than 80 years of age [1]. An estimated 2.3 million adults in the United States currently have atrial fibrillation, and by the year 2050 this is expected to increase to more than 5.6 million [1]. Atrial fibrillation is associated with an increased risk of stroke from 1.5% at age 50 to 59 years to 23.5% by age 80 to 89 years, and this doubles the risk of mortality in both sexes [2]. Atrial fibrillation occurs in approximately 50% of patients undergoing surgery for mitral valve disease [3]. Because optimal medical therapy and catheter-based ablation frequently fail to control atrial fibrillation, several surgical ablative techniques have been developed [4]. Traditional ablative operations such as the Cox MAZE III operation have required a median sternotomy. However, with the development of minimally invasive cardiac surgery, the possibility of less-invasive surgical treatment for atrial fibrillation now exists [5]. Herein, we present a combined robotically-assisted left atrial fibrillation ablation procedure and minimally invasive mitral valve repair.

The patient was a 54-year-old active man with severe mitral regurgitation, reduced left-ventricular function, and a 10-month history of atrial fibrillation. The patient was intubated with a double-lumen endotracheal tube for single lung ventilation and was positioned with the right side of the chest elevated 45 degrees and the pelvis nearly flat. Cardiopulmonary bypass was established at 26°C using femoral arterial inflow (17 French, Medtronic [Bio-Medicus, Eden Prairie, MN]), venous drainage, femoral vein to right atrial cannulas (22 French CardioVations [Ethicon, Somerville, NJ]), and right internal jugular vein cannulas (17 French, Medtronic [Bio-Medicus]) to the superior vena cava (Fig 1A). The femoral arterial and venous cannulations were done under transesophageal echocardiographic control. Assisted-suction venous drainage with a vortex-pump was used. A 5-cm, submammary, right-anterior incision was performed and then extended under the pectoralis muscle into the fourth intercostal space (Fig 1B). The epicardial ablation procedure was done first, starting with the dissection of the transverse and oblique sinuses. The insertion of the FLEX 10 (AFx Inc) was done through the transverse sinus on-pump beating heart. Once the distal part of the ablation catheter was retrieved from the oblique sinus, the proper positioning of the catheter in relation to the left atrial appendage was seen with a 5-mm endoscope placed through the right anterior mini-thoracotomy. This part of the procedure was not done with the robotic arms. The ablation was done thereafter off pump. For the endocardial part, a transthoracic aortic cross clamp (Scanlan International, Inc, Minneapolis, MN) was used, and intermittent antegrade aortic root cold blood cardioplegia maintained cardiac arrest and myocardial protection. The mitral valve was exposed using a transthoracic atrial retractor (CardioVations, Ethicon) placed through a small left atriotomy. A left atrial sump sucker maintained a dry operative field, and intrathoracic carbon dioxide was insufflated continuously to displace intracardiac air. The robotic arms and camera were then inserted as previously described [6]. The ablation toward the mitral valve annulus and around the left atrial appendage was done with the FLEX 10 catheter manipulated intraatrially by the robotic arms, as was the left atrial appendage closure (Figs 2, 3). The mitral valve assessment. The robotic mitral valve repair was done using a No. 38 Cosgrove annuloplasty band (Edwards Life Sciences) that was inserted with interrupted 2-0 braided suture material. The saline test showed a good surgical result with no regurgitation. The cross-clamp time was 119 minutes, and the perfusion time was 149 minutes. The patient was weaned off cardiopulmonary bypass without difficulty in sinus rhythm. Postoperative transesophageal echocardiography showed no mitral insufficiency. The postoperative recovery was uneventful, with the patient discharged on postoperative day 5. At the 3-month follow-up, the patient was back to full activity, had not had any complications, and had maintained normal sinus rhythm.

Comment

The high prevalence of atrial fibrillation in mitral surgery patients has led to surgical attempts to treat the two problems in one surgery [7]. The combination of the traditional Cox MAZE procedure and mitral valve surgery has decreased the incidence of stroke at 5-years postoperatively, but it has not affected the survival rate [7]. However, the complex nature of such an approach limits general application by most surgeons. The development of minimally invasive cardiac surgery has opened the opportunity for combining a minimally invasive ablation and mitral valve surgery [8]. The superb visualization and dexterity offered by the new surgical robotic devices, combined with the flexibility of the ablation probe, have led to a safe and reproducible procedure. Efficient surgical ablation through the minimally invasive right anterior tho-

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Address reprint requests to Dr Bolotin, Department of Surgery, Brody School of Medicine, East Carolina University, 600 Moye Blvd, Greenville, NC 27858; e-mail: bolotin@tasmc.health.gov.il.

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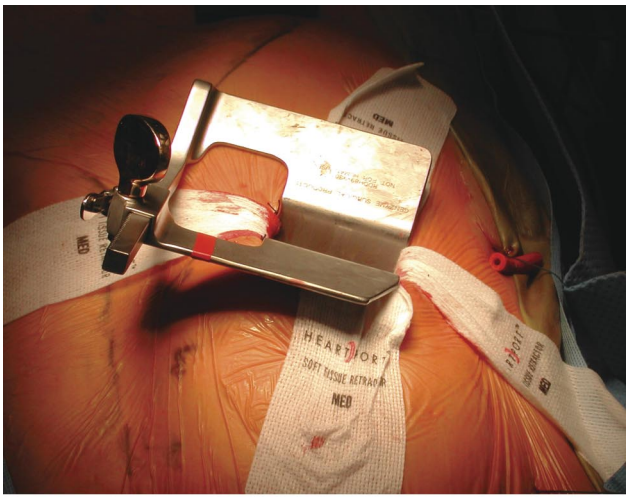

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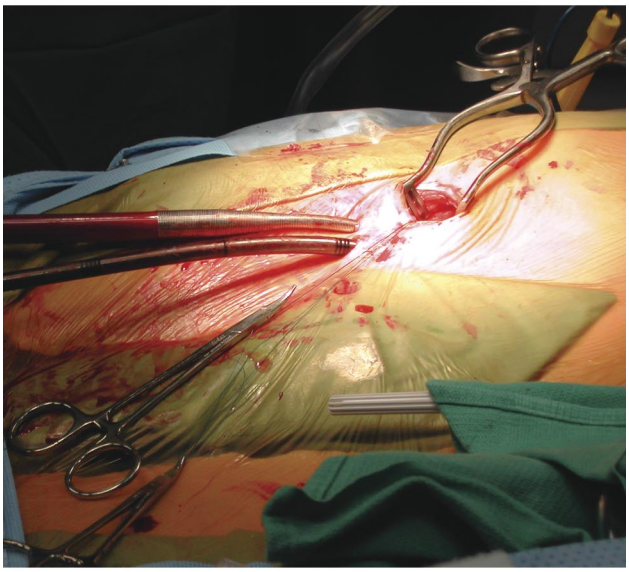

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Fig 1. (A) The surgical approach, 5-cm right anterior thoracotomy using a specially designed retractor, and (B) the femoral venous and arterial cannulation through the right groin.

racotomy approach may enable this procedure to be used more widely for the surgical treatment of atrial fibrillation with or without concomitant mitral valve surgery. Future work should focus on the possibility of a reproducible totally robotic approach for this combined procedure.

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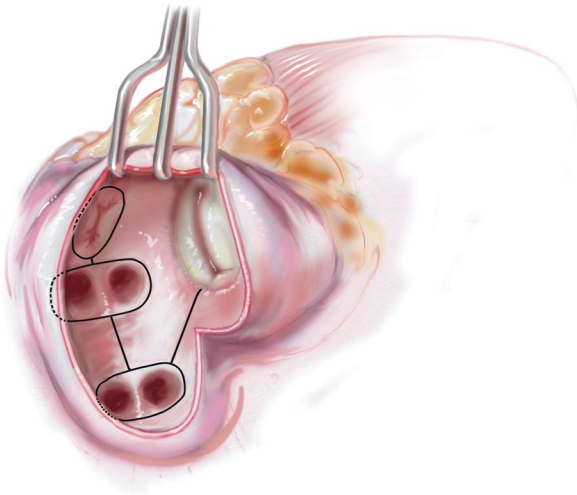

Fig 2. Schematic drawing of the ablation procedure in the left atrium.

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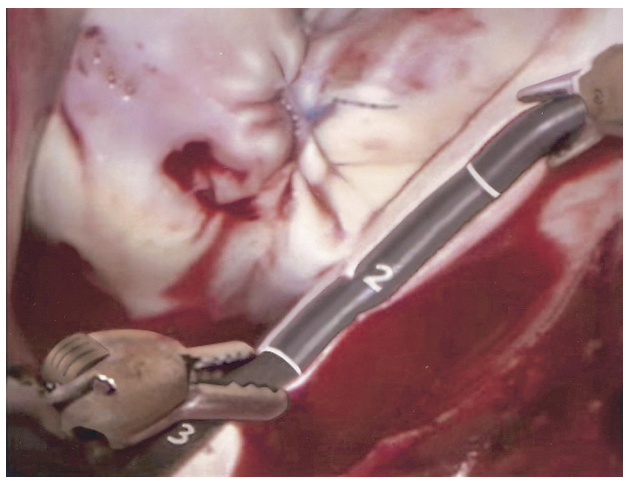

Fig 3. The FLEX 10 (AFx Inc, Fremont, CA) is held in position by the robotic arms.

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