Robot Assisted CryoMaze: Atrial Fibrillation Correction Surgery in Patients with Failed Catheter Ablation

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Dr Bethencourt has a special interest in robotic surgery and atrial fibrillation procedures.

Introduction

The Cox Maze-III procedure is considered the gold standard in the treatment of atrial fibrillation.[1] While the original procedure as described by James L. Cox, M.D. had a high degree of efficacy, it was not widely adopted due to the invasiveness of the procedure. With advances in minimally invasive techniques and a device to recreate the lesion set, the maze procedure is adoptable by cardiac surgeons desiring to treat patients with atrial fibrillation.

In this report, we describe a closed-chest, robotic cryo maze procedure for failed catheter ablation.

Technique

A 65-year old male with a history of symptomatic paroxysmal atrial fibrillation refractory to amiodarone and flecainide was referred to us from Electrophysiology for previously failed catheter ablation five months prior. The patient was extremely symptomatic and there was a concern for esophageal fistula[2] because the position of the esophagus near the left atrial posterior wall precluded additional attempts at catheter ablation.

Right-sided robotic port access.

The patient was prepared for a right-sided robot assisted procedure. General anesthesia was induced with preparation and draping. Ports were introduced with two in the fourth intercostal space, one in the third, one in the fifth, and one anteriorly in the sixth.

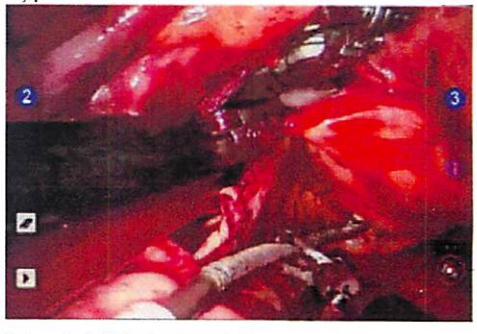
The da Vinci™ Surgical System was docked and the absence of adhesions was confirmed. The pericardium was opened and suspended with external Gore-Tex® stay sutures.

Inferior Vena Cava (IVC) and arterial cannulation were performed in standard fashion by gaining access through femoral approach. Superior Vena Cava (SVC) access was gained via the jugular. Cannulation position was confirmed by transesophageal echocardiogram (TEE), and the patient was placed on bypass.

Following pericardial access, caval tapes were placed but initially not snared until the plane behind the oblique sinus was developed to expose the Coronary Sinus (CS). The entire procedure was performed under continuous perfusion pressure of 60 mm hg. CO_2 was insufflated at 5 liters/min. Intra-thoracic and left atrial pressures were atmospheric, with the working port open at all times.

Left Sided Lesions

The left atrium was opened via Waterston's groove. An epicardial CS cryolesion was performed using the ATS CryoMaze™ 7cm probe for two minutes. Lesion transmurality was visualized on the endocardial left atrial surface. A separate endocardial lesion from the right inferior pulmonary vein to P3 of the mitral annulus was performed. This lesion is superimposed over the previous CS lesion to ensure transmurality and reduce the risk of atypical left atrial flutter.[3]



Epicardial CS lesion creation.

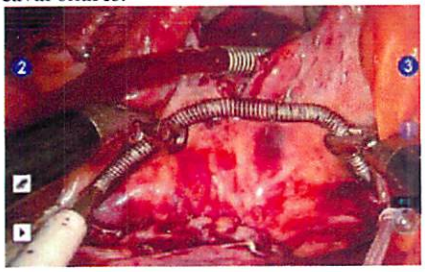
Additional lesions were placed to encircle the pulmonary veins as a "box", and a lesion connected the box to the left atrial appendage. All lesions were applied for two minutes in accordance with the ATS Medical Cox CryoMaze procedure guide.[4]

The excellent visualization provided by the da Vinci Surgical System helped ensure that the lesions to the left atrial appendage and the mitral valve annulus connected to the box lesion without gaps that may lead to a failed procedure.

The left atrial appendage was oversewn in two layers as a linear closure with continuous 4-0 Gore-Tex suture. Left atrial reduction was deemed unnecessary as the left atrium was 4.5 cm in diameter.[5] The left atrium was closed and CO_2 evacuated during closure by allowing the left atrium to fill passively. No residual bubbles were seen on TEE at the end of the procedure. Re-warming began after the left atrial closure.

Right Sided Lesions

An incision was made in the right atrium obliquely from the Crista Terminalis and anteriorly toward the 2 o'clock position of the tricuspid annulus (the T-incision). An intercaval cryolesion was placed from the SVC to the IVC along the Crista Terminalis, connecting the T-lesion on the lateral free wall of the right atrium, with care taken to extend the lesion to the vena caval snares.



Intercaval lesion creation.

A cryolesion was placed connecting the anterior margin of the T-incision to the 2 o'clock position on the tricuspid annulus to prevent the possibility of right atrial flutter. The final cryolesion was placed from the 10 o'clock position of the tricuspid valve annulus to the dome of the right atrial appendage. The right atrium was then closed with two layers of continuous 4-0 Gore-Tex suture. The caval tapes were removed and the patient weaned from bypass.

Excellent cardiac function was observed by TEE, with note of functional left atrial contraction and sinus rhythm. All surgical sites were treated with FloSeal®. The groin was closed with 3-0 Vicryl™ subcutaneous and 4-0 Monocryl™ subcuticular sutures. The patient was returned to the CCU in stable condition, extubated, awake and alert. Total procedure time was two hours and 56 minutes. Cardiopulmonary bypass time was 148 minutes. Total ablation procedure time was 24 minutes.

The patient remained in sinus rhythm throughout his post-operative stay and was discharged from the hospital on post-op day four on amiodarone and Coumadin®. At three-month follow up, the patient was observed in sinus rhythm on both ECG and Holter monitor. Amiodarone was discontinued and cardiac rhythm will be evaluated again at the 6-month follow up.

Discussion

The goal of minimally invasive cardiac surgery is to perform the operation with reduced surgical trauma, reduced pain, fewer complications, better cosmeses, shorter length of stay and an earlier return to activities of normal daily life.[6,7,8] While the Cox Maze-III procedure has proven to be highly effective and durable,[1,9] it has not been widely adopted because of long operative times and surgical trauma. The da Vinci System provides superior visualization and exposure with the most minimally invasive approach possible. Improved dexterity during delicate procedures is also enhanced by robotic instrument control. These advantages have resulted in the added benefit of reduced healthcare consumption. In this regard, our goal has been to incorporate robotic application to both our cardiac valve procedures as well as the surgical correction of atrial fibrillation.

Advantages with new technologies combining robotic application with a malleable ablation device capable of creating a fully transmural lesion using hypothermic energy, the ATS CryoMaze® System, accomplishes the goal of being minimally invasive while replicating the original Cox Maze-III lesion pattern. The combination of these two technologies can provide a "best of both worlds" outcome in the field of robotic surgery and the treatment of atrial fibrillation.

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