

# A modified surgical ablation line for atrial fibrillation. The Bachmann line

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## Abstract

Surgical treatment of atrial fibrillation generally consists in the isolation of the pulmonary veins (“box-lesion”). Bachmann's bundle is a cardiac structure that may play an important role in the genesis of the atrial fibrillation. Surgical isolation of such bundle has not been reported before. We aim to describe how to perform minimally invasive epicardial pulmonary vein isolation along with the isolation of the Bachmann's bundle. Adding the surgical ablation line of Bachmann's bundle is a feasible, fast, and easy procedure that may contribute to the reduction of atrial fibrillation relapses.

## KEYWORDS

atrial fibrillation, hybrid treatment, long-standing atrial fibrillation, minimally invasive ablation

## 1 | INTRODUCTION

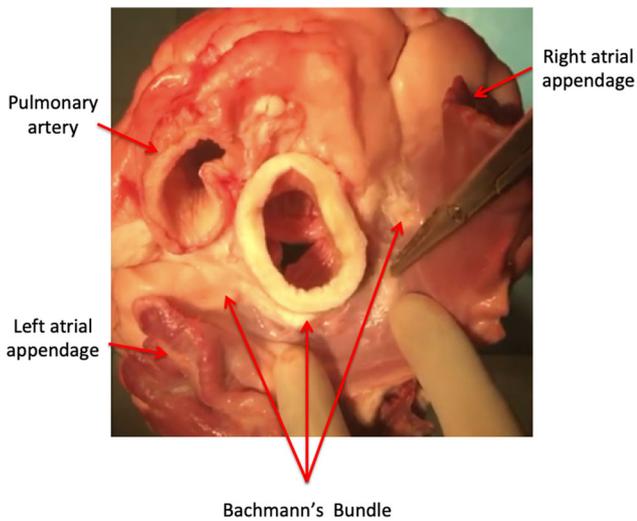
Patients presenting with persistent and long-standing atrial fibrillation (AF) represent a major challenge for cardiologist and surgeons.<sup>1</sup> Catheter-based procedures despite continuous improvement have no negligible recurrence rate and high need for repeated intervention.<sup>2</sup> Surgical minimally invasive and thoracoscopic approach has been emerging as alternative treatment, with promising results.<sup>3</sup> There is also a rationale to believe that the synergy of the surgical epicardial and transcatheter ablation may provide improved outcome.<sup>4</sup> The conventional epicardial box-lesion consists in the isolation of the pulmonary veins (PVI) and represents the “gold standard ablation line.” Nevertheless there are other cardiac structures that may play a pivotal role in the genesis of AF. Bachmann's bundle (BB) is a muscular structure comprising of parallel-aligned myocardial strands connecting the right and left atrial wall<sup>5</sup> (Figure 1) and is the main pathway of interatrial conduction.<sup>5</sup> Surgical isolation of the BB does not require additional blunt dissection since is easily accessible from the epicardium, beneath the ascending aorta.<sup>5</sup> We hypothesized that the surgical BB ablation would be safe, easy to perform and may result in less AF recurrence. Here we describe how to perform epicardial minimally invasive surgical PVI in conjunction with the

BB ablation. We also briefly report perioperative results of our series as safety outcome and 1 year follow up.

## 2 | TECHNIQUE

Patients underwent minimally invasive AF ablation with BB on the basis of the following criteria: (a) persisting isolated AF refractory to the maximal tolerated doses of class IC or III antiarrhythmic agents, alone or in combination, and (b) at least 1 failed electrical or pharmacologic cardio-version attempt during the 6 months preceding the surgical evaluation, (c) symptomatic recurrent long-standing persistent AF as defined by the HRS/EHRA/ECAS Expert Consensus Statement on catheter and surgical ablation of AF.<sup>6</sup> Left atrial dimension indexed to body surface area exceeding 35 mm/m<sup>2</sup> was considered an exclusion criterion but no duration of the AF.

The operation starts by performing the “conventional box-lesion” as we have described before<sup>3</sup> (Video 1). A 3 to 4 cm right mini-thoracotomy is performed at the level of the third intercostal space, and a soft-tissue retractor applied. A thoracoscopic camera is used in all the cases, and the pericardium is opened above the right phrenic nerve. The oblique sinus is entered by blunt dissection. The Estech



**FIGURE 1** Bachmann's Bundle. Surgical and anatomical view (Bovine heart)

COBRA Fusion 150 Surgical Ablation System (Estech, San Ramon, Calif) is used in all patients.

The introducer with the magnetic tip is pushed into the transverse sinus but beneath the superior vena cava until the left atrial appendage is passed. The second introducer is advanced into the oblique sinus until its tip hinges the first introducer. The ablation probe is funneled into position, so that pulmonary veins are encircled. The device used suction to stabilize the contact with the epicardium and achieve uniform energy delivery. A circular box lesion is created with bipolar radiofrequency energy. Ablation was performed by two energy applications lasting 150 seconds each followed by a double monopolar energy applications of 60 seconds. These were followed by a 60-second application after the probe was moved circumferentially, to achieve complete closure of the box lesion.

Bachmann bundle is then ablated by introducing the magnetic tip below the ascending aorta and above the roof of the left atrium until the left atrial appendage is passed. No further dissection is required.

The second introducer is advanced into the oblique sinus until its tip hinges the first introducer. The ideal Bachmann ablation line goes from the left to the right atrial appendage behind the non coronary aortic sinus. Ablation was performed as described above (Figure 2A,B). All our cases were performed off-pump. After the probe is withdrawn, efficacy assessment is done by measurement of conduction across the lesion. Conduction block is evaluated with pacing from the pulmonary veins (exit block).

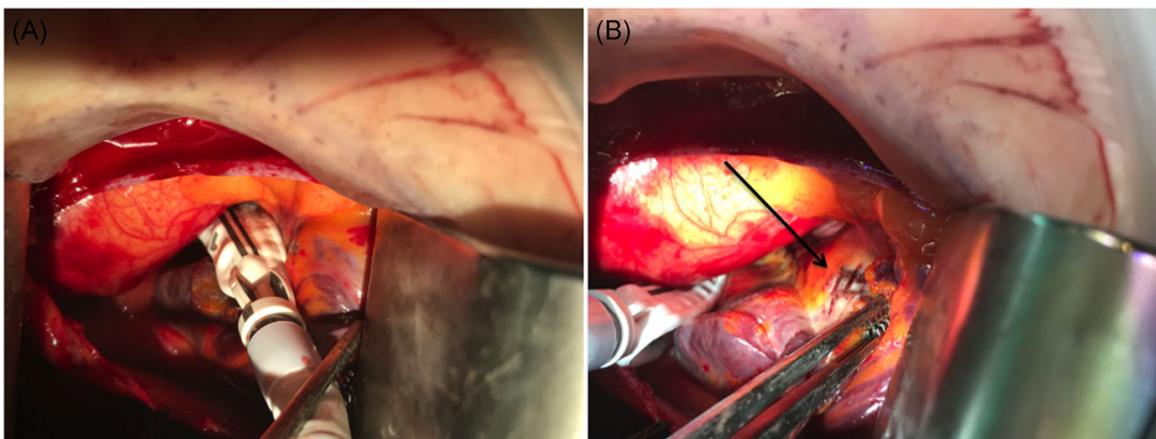
We have performed this technique in 30 consecutive patients. There has been no bleeding and no conversion to sternotomy. No patient died. One patient (3.3%) had delirium day 1 after surgery with negative CT brain. Temporary pacing was required in one patient for reversible atrioventricular block (3.3%) that reversed on the third postoperative day. Eight patients (26.6%) underwent electrical cardioversion before hospital discharge because of persisting AF or supraventricular tachycardia. All patients were discharged home in medical therapy; four patients were in AF at the time of discharge (13.3%). At 1 year follow up 26 patients (87%) were free from atrial fibrillation based on ECG Holter monitoring,

### 3 | COMMENTS

The addition of the BB ablation line at the level of the roof of the left atrium, between the right and left atrial appendages, was easy to perform, did not require further blunt dissection and was not associated any adverse events in our series.

Pulmonary vein isolation alone provides excellent results for paroxysmal AF, yet success rate for persistent AF remain unsatisfactory.<sup>7</sup> To implement the likelihood of sinus rhythm restoration in patients with persistent AF, various additional percutaneous ablation strategies have been developed.<sup>7</sup> These techniques incorporate additional ablation lines targeting non-pulmonary vein triggers,<sup>8</sup> ligament of Marshall ablation and autonomic denervation.<sup>7</sup>

We believe that BB isolation may significantly contribute in reducing the AF relapse in patients with long-standing persistent AF,



**FIGURE 2** A, The probe is retrieved and (B) result of the Bachmann's bundle ablation is showed (black arrow)

since different triggers of chronic AF may lie outside the pulmonary veins box.<sup>7</sup> Structural changes of BB may cause longitudinal dissociation in conduction of adjacent muscle fibers, thereby facilitating re-entry and hence development of AF<sup>5</sup>; BB travels subepicardially across the interatrial groove; its rightward and leftward extensions bifurcate to pass to either side of the right and left atrial appendages.<sup>5</sup> Reentrant circuits may potentially occur in the epicardial layers. Given the anatomical position of the BB, surgical ablation may be more effective than endocardial catheter-based ablation.

In conclusion, in patients with long persistent AF, minimally invasive surgical ablation with BB, was safe and may contribute to reduce AF relapse. One year follow up demonstrated good maintenance of sinus rhythm but long term longitudinal follow up is needed to validate this strategy.

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#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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