

## Atraumatic Lung Hernia: A Rare Complication Of Minimally Invasive Surgical Atrial Fibrillation Ablation

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### Abstract

Lung herniation after minimally invasive thoracoscopic pulmonary vein ablation has never been described before so far. We report for the first time, of its incidence in a 62-year-old patient, 6 weeks after a minimally invasive cardiac surgery (MICS) for atrial fibrillation ablation. We suggest that even after MICS, a high resolution computerized tomography scan should be performed in patients presenting with breathing difficulty and chest pain to rule out this condition too, other than pulmonary vein stenosis.

### Introduction

Pulmonary vein (PV) isolation is considered key to atrial fibrillation (AF) ablation.<sup>1</sup> Due to limitations of medical therapy in achieving sinus rhythm, there has been recent upsurge in surgical and catheter-based technologies to achieve this goal.<sup>2-4</sup> Recently, a new concept of bringing the advantages together of a cardiac surgeon and an electrophysiologist in order to overcome the drawbacks and suboptimal results of both catheter ablation and surgical AF treatment is successful with promising results.<sup>5,6</sup> Atraumatic lung hernia is a rare entity secondary to minimally invasive cardiac surgery (MICS).<sup>7,8</sup> To the best of our knowledge, it has never been described secondary to any lateral approach thoracoscopic MICS. With increasing number of surgical arrhythmia procedures in future, cardiac surgeons and physicians must keep a watchful eye for such complication.

We report herein a case of lung herniation after MICS for AF ablation.

### Case Report

A 62-year-old woman with a 3-year history of symptomatic paroxysmal AF was refractory to anti arrhythmic drugs including

amiodarone, in spite of undergoing endocardial PV isolation by radiofrequency (RF) catheter a year ago. Echocardiography showed a structurally and functionally normal heart with mildly dilated left atrium.

### Hybrid Procedure

The details of the procedure have been described elsewhere.<sup>9</sup> To summarize, after inducing general anaesthesia, a 12 mm videoport in 5th intercostal space and 2 working ports of 5 mm and 12 mm were inserted along anterior axillary line in 3rd and 6th or 7th intercostal spaces respectively. The pericardium was opened posterior to phrenic nerve and it was extended upto the diaphragm and superior vena cava on opposite sides. A bipolar RF clamp (Atricure, West Chester, OH, USA) was placed at the antrum of the PVs. Four to 6 applications of about 15 seconds with a median output of 10 to 15 Watt were performed. Both roofline and an inferior line were made epicardially using a bipolar RF pen device (Coolrail, Atricure). At the end of procedure, incision for a left working port (12 mm) was extended to 3 cms to facilitate positioning the epicardial left atrial appendage (LAA) clip (AtriClip, Atricure Inc.). Using the Gillinov-Cosgrove™ Selection Guide (Atricure Inc.) a 35 mm LAA clip was selected. Avoiding the pulmonary and circumflex arteries, the clip was placed at the base of the appendage. The clip can be repositioned before deployment, if the clip's position is not satisfactory. After the clip was in optimal location, it was closed and released from the deployment tool manually. The Clip did not migrate intraoperatively.

After endocardial placement of His and coronary sinus catheters, a transeptal puncture was done using long 8-F sheath (SL0, St. Jude Medical) into the left atrium guided by fluoroscopy and transesophageal echocardiography. PVs and linear lesions were checked for electrical isolation. AF inducibility was attempted using endocardial burst pacing and adenosine administration. No endocardial touchup

### Key Words:

Thoracoscopic Surgical Ablation, Atrial Fibrillation, Minimally Invasive, Complication, Atraumatic Lung Hernia, LAA Clip

### Disclosures:

Mark La Meir and Laurent Pison are also consultant to Atricure.

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was needed due to intact surgical ablation lines and no evidence of dormant PV reconnection. The pericardium was approximated with a stitch, and a chest tube was placed in both pleural cavities. There was no drain left in the pericardial space. The insertion sites for working ports were closed using surgical skin staplers. The exclusion of appendage was successful as assessed by postoperative transesophageal echocardiography.

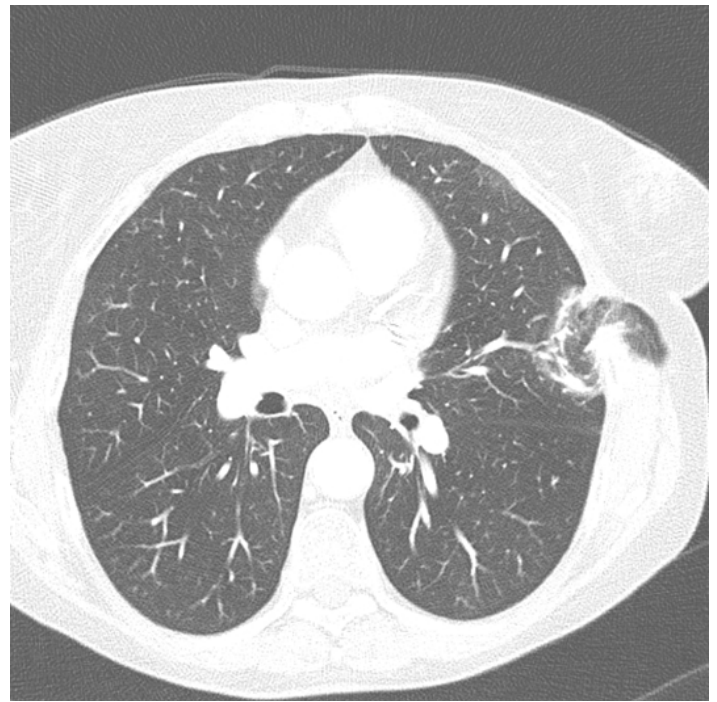
#### Post Procedure Events

Post-procedure recovery was uneventful. Six weeks later, she presented at our hospital's clinic with complaints of pain in left thorax region associated with dyspnea (NYHA class 2). Pain used to increase on inspiration, was dull aching and non-radiating type. General physical examination was otherwise normal. Transthoracic echocardiography showed no pericardial effusion, no valvular (aortic or mitral) dysfunction and normal left ventricular function.

Her chest radiograph was within normal limits and subsequently advised medical management with painkillers. After 3 days, she returned with similar complaints. Due to history of MICS and strong clinical suspicion to rule out any complication, high resolution computerized tomographic (HRCT) scan was ordered. The scan showed (figure 1 and 2) a lung herniation in left chest wall through two intercostal levels that was caused by ports placement (and extra widening) in the chest wall. Finally, she underwent surgical release of the entrapped lung tissue through hernial sac, freed from adhesions, and reduced back into the thoracic cavity. Now after 12 weeks follow up, she is asymptomatic.

#### Discussion

MICS for AF ablation is a novel tool. It has evolved over time, to reduce the complications and cosmetic disadvantages of conventional cardiac surgery incision leading to a shorter hospital stay.<sup>10</sup> Herniation of pulmonary tissue was described earliest in 1499 by Roland.<sup>11,12</sup> Later in 1946, Maurer and Blades established the definition of lung



**Figure 2:** High-resolution computerized tomography scans (axial view) of lung hernia.

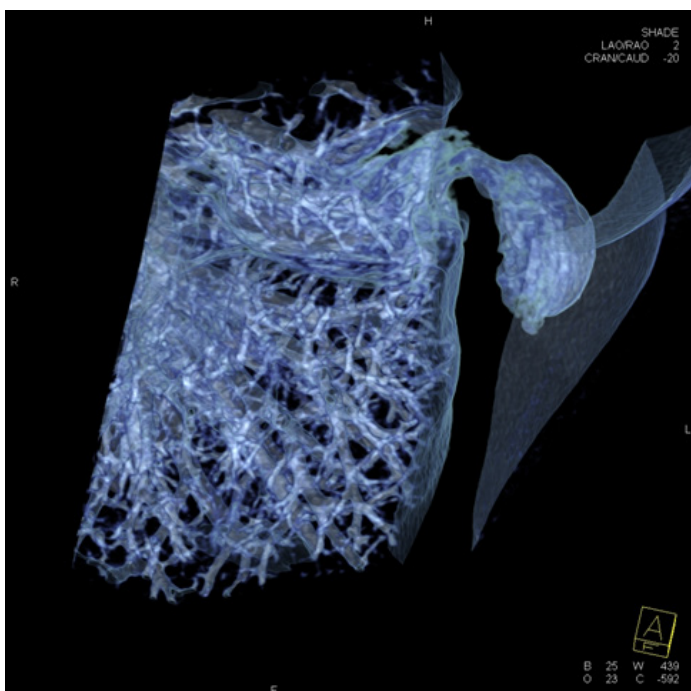
herniation as “a protrusion of the pleural-covered lung beyond its normal boundaries through an abnormal opening in the thoracic enclosure.”<sup>13</sup> They are also classified according to their etiology as spontaneous, traumatic or post-thoracotomy and according to their location as cervical, thoracic, abdominal, or thoraco-abdominal.<sup>14</sup>

To decrease the future risk of thromboembolism, a LAA exclusion or excision surgery is recommended in patients undergoing surgical treatment for AF or mitral valve.<sup>15</sup> LAA clip occlusion epicardially may not only provide stroke prevention but also reduce the recurrence of AF by causing acute electrical isolation of the LAA.<sup>16</sup> The Clip used in this procedure is pre-loaded on a disposable Clip applicator and used for open occlusion of the heart's LAA. No device-related perioperative complication has been observed and follow up with CT imaging has shown stable clip placement.<sup>17,18</sup>

Most of the previous cases of lung hernia happened with minimal-access thoracotomy in anterior wall of thorax, however particular for our patient has been their lateral and posterior location. We concluded main culprit being the extra operative trauma due to widening of the mini incisions of 12 mm (initially) to 3 cm to accommodate an epicardial LAA clip. If epicardial Clip was not indicated for a patient, the size of working port lesion would not be widened. The other possible reasons are inadequate closure of lesions (for insertion of videoports and interports), inherent weakness of intercostal muscles and intensive cauterization of the intercostal muscles. However, we did not observe any unexpected bleeding from sites of working ports insertion during the procedure. The patient's activity during the period of chest-wall healing should be limited regardless of the size of the skin incision.<sup>12</sup>

#### Important Findings

The classical triad of patient's history and the clinical symptoms and physical examination brings the physician closer to the diagnosis. However, it may sometimes not bring close enough as in this case.



**Figure 1:** Three-dimensional reconstruction of high-resolution computerized tomography scans of the lung hernia.

CT scan helped to fill the necessary void by delineating the size and location of the defect and dimensions of the hernia and leading to correct diagnosis.<sup>19</sup> The patient may present with a well-demarcated bulge increasing in size by expiration and vice-versa and more evident during coughing or Valsalva maneuver. Hernia may not pose a serious threat unless associated with incarceration and strangulation of the pulmonary tissue. The diagnosis of lung hernia should be confirmed after ruling out bronchopleural fistula, subcutaneous emphysema, lipoma and a gas-forming infection which require different treatment strategy.<sup>12, 20</sup>

### Conclusions:

Lung hernia may occur after MICS for AF ablation, as a rare complication. Thus, it seems important to recommend CT scan in similarly symptomatic patients during their routine follow up.

### References:

- Haissaguerre M, Jais P, Shah DC, Takahashi A, Hocini M, Quiniou G, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. *The New England journal of medicine* 1998; 339: 659-666.
- Galperin J, Elizari MV, Chiale PA, Molina RT, Ledesma R, Scapin AO, et al. Efficacy of amiodarone for the termination of chronic atrial fibrillation and maintenance of normal sinus rhythm: a prospective, multicenter, randomized, controlled, double blind trial. *Journal of cardiovascular pharmacology and therapeutics* 2001; 6: 341-350.
- Wyse DG, Waldo AL, DiMarco JP, Domanski MJ, Rosenberg Y, Schron EB, et al. A comparison of rate control and rhythm control in patients with atrial fibrillation. *The New England journal of medicine* 2002; 347: 1825-1833.
- Cox JL, Schuessler RB, Cain ME, Corr PB, Stone CM, D'Agostino HJ, Jr., et al. Surgery for atrial fibrillation. *Seminars in thoracic and cardiovascular surgery* 1989; 1: 67-73.
- Stamou SC, Khabbaz KR, Mahmood F, Zimetbaum P, Hagberg RC. A multidisciplinary approach to the minimally invasive pulmonary vein isolation for treatment of atrial fibrillation. *The Annals of thoracic surgery* 2010; 89: 648-650.
- Pison L, La Meir M, van Opstal J, Blaauw Y, Maessen J, Crijns HJ. Hybrid thoracoscopic surgical and transvenous catheter ablation of atrial fibrillation. *Journal of the American College of Cardiology* 2012; 60: 54-61.
- Ross RT, Burnett CM. Atraumatic lung hernia. *The Annals of thoracic surgery* 1999; 67: 1496-1497.
- Athanassiadi K, Bagaev E, Simon A, Haverich A. Lung herniation: a rare complication in minimally invasive cardiothoracic surgery. *European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery* 2008; 33: 774-776.
- La Meir M, Gelsomino S, Luca F, Lorusso R, Gensini GF, Pison L, et al. Minimally invasive thoracoscopic hybrid treatment of lone atrial fibrillation: early results of monopolar versus bipolar radiofrequency source. *Interactive cardiovascular and thoracic surgery* 2012; 14: 445-450.
- Ng PC, Chua AN, Swanson MS, Koutlas TC, Chitwood WR, Jr., Elbeery JR. Anterior thoracotomy wound complications in minimally invasive direct coronary artery bypass. *The Annals of thoracic surgery* 2000; 69: 1338-1340; discussion 1340-1331.
- Roland. De pulmonibus sanaripot. In: Chavliac G, editor. *Cyurgia. Liber III* (cap); p 144.
- Gouda H, Multz AS, Khan A, Rossoff LJ, Green LM, Graver D. Lung hernia as a sequela to limited-access mitral valve surgery. *Texas Heart Institute journal / from the Texas Heart Institute of St Luke's Episcopal Hospital, Texas Children's Hospital* 2002; 29: 203-205.
- Maurer E, Blades B. Hernia of the lung. *The Journal of thoracic surgery* 1946; 15: 77-98.
- Sulaiman A, Cottin V, De Souza Neto EP, Orsini A, Cordier JF, Gamondes JP, et al. Cough-induced intercostal lung herniation requiring surgery: Report of a case. *Surgery today* 2006; 36: 978-980.
- Calkins H, Kuck KH, Cappato R, Brugada J, Camm AJ, Chen SA, et al. 2012 HRS/EHRA/ECAS Expert Consensus Statement on Catheter and Surgical Ablation of Atrial Fibrillation: recommendations for patient selection, procedural techniques, patient management and follow-up, definitions, endpoints, and research trial design. *Europace : European pacing, arrhythmias, and cardiac electrophysiology : journal of the working groups on cardiac pacing, arrhythmias, and cardiac cellular electrophysiology of the European Society of Cardiology* 2012; 14: 528-606.
- Starck CT, Steffel J, Emmert MY, Plass A, Mahapatra S, Falk V, et al. Epicardial left atrial appendage clip occlusion also provides the electrical isolation of the left atrial appendage. *Interactive cardiovascular and thoracic surgery* 2012; 15: 416-418.
- Salzberg SP, Gillinov AM, Anyanwu A, Castillo J, Filsoufi F, Adams DH. Surgical left atrial appendage occlusion: evaluation of a novel device with magnetic resonance imaging. *European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery* 2008; 34: 766-770.
- Salzberg SP, Plass A, Emmert MY, Desbiolles L, Alkadhi H, Grunenfelder J, et al. Left atrial appendage clip occlusion: early clinical results. *The Journal of thoracic and cardiovascular surgery* 2010; 139: 1269-1274.
- Bhalla M, Leitman BS, Forcade C, Stern E, Naidich DP, McCauley DI. Lung hernia: radiographic features. *AJR American journal of roentgenology* 1990; 154: 51-53.
- Eisa N, Alraiyes AH, Shaheen K, Alraiyes MC. Lung hernia. *BMJ case reports* 2013; 2013.