

# A lethal tension pneumothorax during minimally invasive coronary artery bypass surgery: Can transesophageal echocardiography pick it?

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## ABSTRACT

Minimally invasive cardiac surgery is establishing itself as the standard of care across the world. MICS CABG is currently performed in only a few centers. Hemodynamics disturbances are peculiar during MICS CABG due to space constraints. We report a 70-year-old man who underwent MICS CABG who developed tension pneumothorax during revascularization that was diagnosed in a novel way.

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**Key words:** Minimally invasive coronary artery bypass surgery; Tension pneumothorax; Transesophageal echocardiography

## INTRODUCTION

One-way communication between lung parenchyma and the pleural cavity leads to tension pneumothorax. Tension pneumothorax is not tolerated well, especially during positive pressure ventilation. Within minutes, the development of a tension pneumothorax during invasive positive-pressure ventilation will lead to cardiovascular collapse. Prompt diagnosis and treatment are must. In minimally invasive coronary artery bypass grafting (MICS CABG), revascularization is performed through the left mini-thoracotomy which requires the collapse of the left lung. The occurrence of tension pneumothorax during one-lung ventilation in MICS CABG obviously is more lethal. However, diagnosis during surgery can be difficult. We report a 70-year-old man who underwent MICS CABG, developed tension pneumothorax during surgery, which was diagnosed in a novel manner.

factors for coronary artery disease included diabetes mellitus (21 years) and a positive family history. Transthoracic echocardiogram revealed normal left ventricle function and hypokinetic mid and distal inferoseptal wall. Coronary angiogram revealed a significant three-vessel coronary artery disease. Carotid Doppler revealed 30–40% narrowing of the right carotid artery at the level of carotid bulb. Other biochemical and hematological parameters were within normal limits. His vital parameters were stable (sinus rhythm with heart rate of 81/min). He was taken up for minimally invasive coronary artery surgery.

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## CASE REPORT

A 70-year-old male patient presented with complaints of breathlessness and chest pain on exertion for the past 6 months. Risk

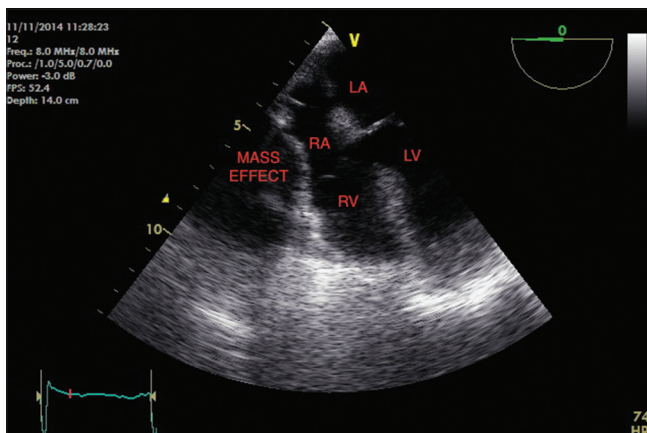
On the day before surgery injection, levosimendan 1 ml/h (12.5 mg in 50 ml normal saline) was started as per the protocol. Intraoperative monitoring apart from the American Society of Anesthesiologists standards included pulmonary arterial pressure and transesophageal echocardiography (TEE) (multi-plane 5 MHz transesophageal probe GE Vingmed Ultrasound, Horten, Norway). The patient was induced with fentanyl, propofol, and rocuronium. Postinduction, a Cook's bronchial blocker (7 Fr), was placed in the left main bronchus with the help of pediatric bronchoscope for lung isolation to facilitate surgery through left mini-thoracotomy. Maintenance included gas mixture (O<sub>2</sub>:air, 50:50 with sevoflurane 1%) with intermittent doses of vecuronium and propofol infusion. During one-lung ventilation, FiO<sub>2</sub> was increased to 100%. Immediate postinduction, TEE findings were consistent with preoperative echocardiogram [Video 1]. After the conduits were ready, patient was heparinized with 15000 units. Activated clotting time was used to monitor the adequacy of anticoagulation. The technique of minimally invasive coronary artery bypass involves opening the pericardium until its reflection off the aorta. A silk suture is then placed on the right half of the pericardium just above the superior venacava. The suture is brought out parasternally in the second or third space and functions as a retraction suture. Soon after this stitch was placed a mass effect on the right atrium was noticed [Figure 1 and Video 2]. At this moment, the patient was generating a tidal volume of 390 ml with pressure support of 16 cm of H<sub>2</sub>O. The patient was hemodynamically stable without any inotropes. Postheparin blood gas analysis was normal (PO<sub>2</sub> 115 and PCO<sub>2</sub> 34). Two proximal vein graft on aorta and left internal mammary artery to the left anterior descending (LAD) artery anastomosis were completed

uneventfully. Following LAD anastomosis, there was a persistent hypotension with rise in pulmonary artery pressure. On TEE mass effect on the right atrium had increased significantly with reduction in tidal volume to 200 ml with same pressure support [Figure 2 and Video 3]. This was notified to surgeon immediately. A pneumothorax was suspected and following a nick in the pleura hemodynamics improved immediately with the disappearance of mass effect on the right atrium on TEE. The distal end of saphenous vein grafts to the obtuse marginal and posterior descending artery completed uneventfully. The patient was extubated after 4 h with stable hemodynamics. On 1<sup>st</sup> postoperative day, a small pneumothorax was observed on the right side postremoval of drains. This pneumothorax on the 2<sup>nd</sup> postoperative day required an intercostal drain to be inserted. This was removed on the subsequent day with no further issues. The patient did well from here on and was discharged in a hemodynamically stable condition on day 4.

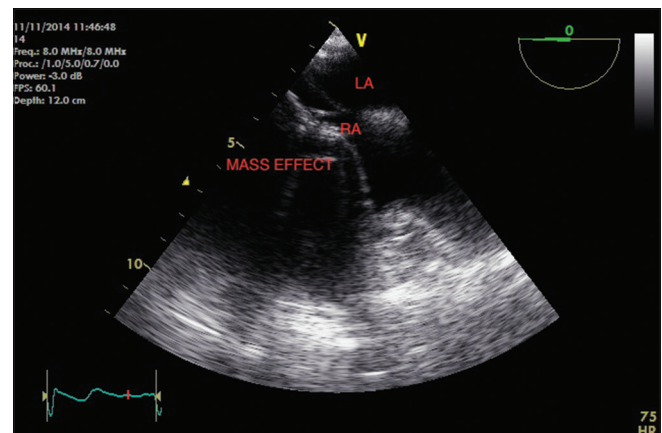
## DISCUSSION

Tension pneumothorax is one of the life-threatening conditions which needs a prompt diagnosis. Intraoperative pneumothorax can be due to regional blocks (40%), airway instrumentation (19%), barotrauma (16%), and central venous lines (7%). Tension pneumothorax has different presentations depending on spontaneous or positive pressure ventilation. The patient will succumb to cardiovascular collapse within minutes of developing tension pneumothorax when on positive pressure ventilation.<sup>[1,2]</sup>

MICS CABG is performed through 4–6 cm long left thoracotomy incision with one lung ventilation.<sup>[3]</sup>



**Figure 1:** Mid-esophageal 4 chamber view with clockwise rotation showing mass effect on the right atrium



**Figure 2:** Mid-esophageal 4 chamber view with clockwise rotation showing right atrium compression due to mass effect

The technique of MICS CABG involves opening the pericardium until its reflection off the aorta. A silk suture is then placed on the right half of the pericardium just above the superior venacava. The suture is brought out parasternally in the second or third space and functions as a retraction suture. This silk pericardial retraction suture has two purposes. First, it keeps the right lung away from the aorta while the proximal anastomosis is performed. Second, by lifting the suture, the aorta is turned toward the left making it more accessible for the side clamp to be applied before the proximal vein anastomosis. Following anastomoses of vein grafts proximally on the aorta, the distal anastomoses are performed. In this particular case, the pericardial retraction suture likely punctured the lung during placement. The gradual accumulation of air led to a tension pneumothorax which in turn led to compression of the right atrium causing features similar to cardiac tamponade.

TEE is considered as a Category I indication for any unexplained hemodynamics as well during minimally invasive cardiac surgery. TEE showed a mass effect on the right atrium which was immediately notified to operating surgeon.<sup>[4]</sup>

This mass effect on right atrium was the reason behind hemodynamic collapse. Following a nick in right-sided pleura, there was immediate improvement in hemodynamics with normal blood pressure and normal pulmonary artery pressure without any inotropic support. Improvement in hemodynamics immediately following needle decompression favors the diagnosis of tension pneumothorax.<sup>[1,2]</sup>

A mass effect seen on TEE should be most likely fluid; however, in the presence of open chest fluid cannot be confined to one place and cannot cause tamponade. It is

challenging to diagnose pneumothorax in MICS CABG, especially during surgery. In our case, a mass effect was seen immediately following a pericardial stitch before doing proximal. However, there were no hemodynamic disturbances, and pneumothorax was not suspected in lieu of normal ventilatory parameters.

We opine that the tension pneumothorax is a challenging diagnosis, especially in MICS CABG with open chest. TEE can help in such diagnosis, especially when it is compressing the one of the heart chamber like right atrium as in our case and producing a clinical picture of a cardiac tamponade.

As per our knowledge, this is the first case report of intraoperative tension pneumothorax in MICS CABG.

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#### Conflicts of interest

There are no conflicts of interest.

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