



**RESPIRATORY ECMO: BENEFITS BEYOND GAS EXCHANGE**

**Deepa Gopalan<sup>1</sup> and Kamen Valchanov<sup>2\*</sup>**

<sup>1</sup>Department of Radiology, Papworth Hospital, Cambridge CB23 3RE, UK.

<sup>2</sup>Department of Anaesthesia and Intensive Care, Papworth Hospital, Cambridge CB23 3RE, UK.

Corresponding Author: **Kamen Valchanov**

**E-mail:** [kamen.valchanov@nhs.net](mailto:kamen.valchanov@nhs.net)

<p><b>Article Info</b>  <i>Received 15/02/2015</i>  <i>Revised 27/03/2015</i>  <i>Accepted 12/04/2015</i></p> <p><b>Key words:</b>                  Tuberculosis                  Respiratory Failure                  ECMO                  Extracorporeal                  Membrane                  Oxygenation                  Tamponade                  Haemothorax                  Avalon</p>	<p><b>ABSTRACT</b>                  A 32 years old male patient was suffering from a severe form of tuberculosis necessitating respiratory support with peripheral veno-venous ECMO through a dual lumen Avalon Elite cannula inserted through the right internal jugular vein into the SVC and IVC. Left pleural effusion was treated with intercostal drain. Over the following 24 hours the patient became profoundly hypotensive, with reduced ECMO flow, and reduced haemoglobin level. Chest radiograph showed complete white out of both lungs with a left chest drain and a deviated right Avalon Elite ECMO cannula. Multidetector computed tomography demonstrated a large left haemothorax adjacent to the chest drain, causing mediastinal shift to the right. The right ventricle was compressed against the chest wall and there was collapse of both lungs. The compression of the right ventricle against right anterior chest wall explained the clinical presentation of extrapericardial tamponade. We stipulate that the presence of the long large bore relatively rigid Avalon Elite ECMO cannula precluded the mediastinum from further displacement and imminent cardiac arrest. The haemothorax was surgically evacuated and after two months ECMO was weaned off.</p>
--	---

**INTRODUCTION**

A 32 years old male patient was suffering from a severe form of tuberculosis necessitating respiratory support with peripheral veno-venous extracorporeal membrane oxygenation (ECMO) through a dual lumen Avalon Elite cannula inserted through the right internal jugular vein into the SVC and IVC. Left pleural effusion was treated with intercostal drain. Over the following 24 hours the patient became profoundly hypotensive, with reduced ECMO flow, and reduced haemoglobin level.

Chest radiograph (Figure 1a) showed complete white out of both lungs with a left chest drain (thin arrow) and a deviated right Avalon Elite ECMO cannula (block arrow). Multidetector computed tomography (Figure 1b and Figure 1c) demonstrated a large left haemothorax (white star) adjacent to the chest drain, causing mediastinal shift to the right. Note the close proximity of the right ventricle to the chest wall (notched arrow) and collapse of both lungs (black star).

**Pathophysiology**

The haematoma in this case displaced the mediastinum into the right hemithorax and the right ventricle was compressed against the anterior chest wall, clinically resulting in extrapericardial tamponade.

We stipulate that the presence of the long large bore relatively rigid Avalon Elite ECMO cannula precluded the mediastinum from further displacement and imminent cardiac arrest.

We conclude that in this case the ECMO cannula not only facilitated gas exchange, but also acted as a stabilizing tool for intrathoracic structures.

**Outcome**

The haemothorax was surgically evacuated and after two months ECMO was weaned off.

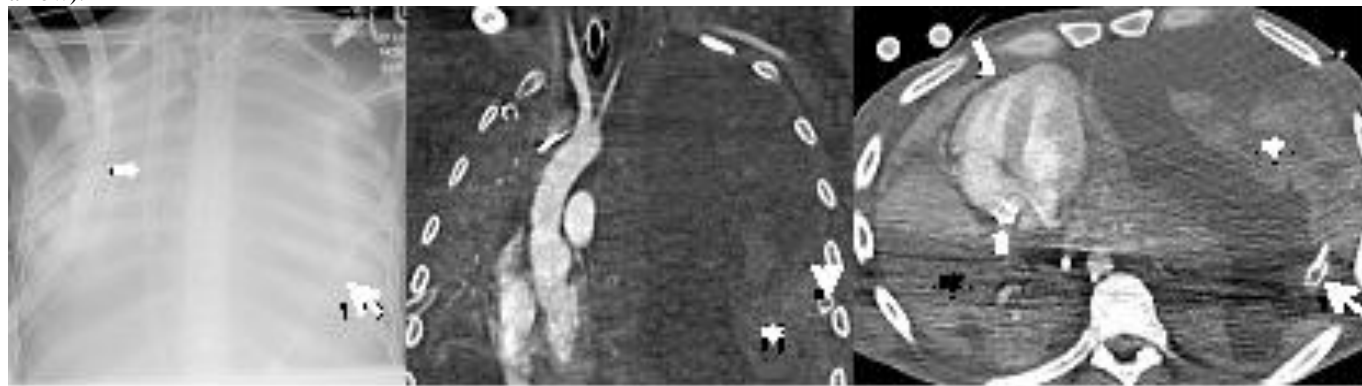


**Figure 1 a-c.**

1a: Complete white out of both lungs with a left chest drain (thin arrow) and deviated right Avalon Elite ECMO cannula (block arrow)

1b: Multidetector computed tomography demonstrating a large left haemothorax with acute blood (white star) adjacent to the left chest drain

1c: Multidetector computed tomography demonstrating left intercostal drain (thin arrow), left haemothorax (white star), Avalon cannula through left atrium (short thick arrow), and right ventricle compressed against right anterior chest wall (long thick arrow).



**DISCUSSION AND CONCLUSION**

ECMO is a supportive measure for patients in severe cardiovascular or respiratory failure. While it is accepted as a mainstream treatment in the paediatric population [1], its use in adults has been less popular until the publication of CAESAR trial [2]. Following this respiratory ECMO has become a popular method of support for adult patients in extreme respiratory failure who are unlikely to survive with conventional mechanical ventilator support [3].

The results, as documented in the ELSO database [4], offer up to 70% survival rates. The use of modern dual lumen cannulae, like Avalon Elite, has become popular due to its simplicity, safety profile, and ease of mobilisation of patients needing long-term support [5]. This cannula offers not only adequate blood flow to allow oxygen flux and carbon dioxide clearance, but it also has the unique property of entering the inferior vena cava through the right atrium and superior vena cava [6]. Hence the cannula provides relative fixation of the mediastinal structures and

prevents them from extreme displacement. Large pleural collections are common in patients with severe respiratory failure resulting from tuberculosis [7]. In ECMO supported patients, who are anticoagulated, inserting intercostal drains can occasionally lead to large haemothorax [8]. These haemothoraxi can occasionally be so large and expand rapidly that they can cause extrapericardial tamponade [9]. A variety of protective mechanisms for such tamponades causing imminent death have been described [10].

In this case we report the haemothorax was so large that it displaced the mediastinum in the right haemothorax to a degree that the right ventricle was compressed against the right chest wall, thus producing signs of extrapericardial tamponade. We stipulate that if there was not relative splinting of the mediastinum by the ECMO Avalon Elite cannula the right ventricular compression would have lead to a rapid tamponade and cardiac arrest.

**REFERENCES**

1. Maslach-Hubbard A and Bratton SL. Extracorporeal membrane oxygenation for pediatric respiratory failure: History, development and current status. (2013). *World J Crit Care Med*, 4, 29-39.
2. Peek GJ, Mugford M, Tiruvoipati R, Wilson A, Allen E, Thalanany MM, Hibbert CL, Truesdale A, Clemens F, Cooper N, Firmin RK, Elbourne D; CESAR trial collaboration. (2009). Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial. *Lancet*, 17, 1351–1363.
3. Hung M, Vuylsteke A, Valchanov K. (2012). Extracorporeal membrane oxygenation: coming to an ICU near you. *J Int Care Soc*, 13, 2-9.
4. Paden ML, Conrad SA, Rycus PT, Thiagarajan RR. (2013). Extracorporeal Life Support Organization Registry Report 2012. *ASAIO J*, 59, 202-10.
5. Rubino A, Vuylsteke A, Jenkins D, Fowles JA, Hockings L, Valchanov K. (2014). Direct complications of the Avalon bicaval dual-lumen cannula in respiratory extracorporeal membrane oxygenation (ECMO): Single-center experience. *Int J Artif Organs*, 37, 741-7.



6. Kohler K, Valchanov K, Niams G, Vuylsteke A. (2013). ECMO Cannulation. *Perfusion*, 28,114-124.
7. Chinchkar NJ, Talwar D, Jain SK. (2015). A stepwise approach to the etiologic diagnosis of pleural effusion in respiratory intensive care unit and short-term evaluation of treatment. *Lung India*, 32, 107–115.
8. Joshi V, Harvey C, Nakas A, Waller DA, Peek GJ, Firmin R. (2013). The need for thoracic surgery in adult patients receiving extracorporeal membrane oxygenation: a 16-year experience. *Perfusion*, 28, 328-32.
9. Hajjar RJ, Rose GA, Madsen JC, Levine RA, DeSanctis RW. (1995). Extrapericardial cardiac tamponade after blunt chest trauma. *Am Heart J*, 130, 620-1.
10. Khan MU and Khouzam RN. (2015). Protective effect of pulmonary hypertension against right-sided tamponade in pericardial effusion. *South Med J*, 108, 46-8.

