

## Should ECPR be attempted following refractory cardiac arrest secondary to airway obstruction by a mediastinal mass?

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**Abstract** : Mediastinal masses may compress the heart, large blood vessels (particularly the superior vena cava), the trachea or major bronchi leading to abrupt collapse. Even patients who are relatively asymptomatic while awake can develop acute respiratory or hemodynamic collapse after induction of general anesthesia. We present a patient who developed total airway occlusion and cardiac arrest after induction of general anesthesia. Management included urgent deployment of peripheral veno-arterial (VA) extracorporeal membrane oxygenation for continued extracorporeal cardiopulmonary resuscitation (ECPR).

Deployment of peripheral VA extracorporeal support may have eventually restored hemodynamic stability in this patient but the pre-induction deployment of extracorporeal support would have provided much more effective brain perfusion. We should be cautious about attempting to deploy extracorporeal support after an acute collapse in a patient with a mediastinal mass and where conventional chest compressions and attempts at ventilation may not provide satisfactory brain perfusion or oxygenation.

**Key words** : ECPR ; ECMO ; mediastinal mass.

### INTRODUCTION

A large mediastinal mass can compress the heart, superior vena cava (SVC), trachea or major bronchi during a diagnostic or surgical procedure. Even patients who are relatively asymptomatic while awake can develop abrupt collapse during general anesthesia (1). We present a patient scheduled for surgical biopsy of a mediastinal mass who developed total airway occlusion and cardiac arrest after induction of general anesthesia. Management included urgent deployment of extracorporeal cardiopulmonary resuscitation (ECPR) for refractory cardiac arrest.

### CASE REPORT

A 17 year old previously healthy male patient presented for surgical biopsy of an anterior mediastinal mass. He had a two-week history of

edema with engorgement of superficial veins in the upper thorax and neck. He also reported some recent fatigue and weight loss but denied any dyspnea or orthopnea.

On examination, the patient was alert, in no respiratory distress and Pemberton's sign (congestion and cyanosis of the face with increased respiratory distress when both arms are elevated against the side of the head) was negative. There were no palpable lymph nodes in the neck or axillae.

Thoracic computed tomography (CT) revealed a large mediastinal mass causing partial obstruction to the SVC and narrowing of the distal trachea. A radiology guided percutaneous biopsy of the mass was considered too high-risk and the patient was referred to our cardio-thoracic surgeons for surgical opinion. A limited anterior thoracotomy rather than a mediastinoscopy was planned because of the soft tissue swelling in the neck.

Following a review of the CT images with the surgeon, it was decided that optimal tissue samples could be acquired through a small left sided anterior thoracotomy under general anesthesia. There was some urgency to proceed with the biopsy so that the most appropriate chemotherapy could be initiated without delay.

Routine monitors were applied and general anesthesia was induced with propofol and fentanyl. After establishing that spontaneous ventilation could be easily assisted by manual face mask positive pressure ventilation, atracurium was used to facilitate tracheal intubation.

It was immediately evident that manual ventilation of the lungs required high airway pressure associated with an upward sloping expiratory capnograph trace. There was progressive difficulty with manual ventilation of the lungs with no end-

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tidal carbon dioxide signal recorded. After a first endo-tracheal tube insertion and evidence of no efficient mechanical ventilation, the endo-tracheal tube was replaced. There was no evidence of obstruction of the original tube but the inability to ventilate the lungs remained unchanged. Multiple attempts were made to improve ventilation by re-positioning the patient to the right and left lateral and sitting-up position but ventilation of the lungs remained impossible. Rigid bronchoscopy confirmed extrinsic compression of the distal trachea, but it was not possible to advance the rigid scope past the obstruction. Hypoxic cardiac arrest occurred 15 minutes after induction of anesthesia and conventional cardiopulmonary resuscitation (CPR) was established immediately.

Because of the failure to respond to conventional CPR, we decided to attempt ECPR. During ongoing chest compressions, the femoral artery and vein were cannulated and peripheral veno-arterial extracorporeal life support (VA ECLS) was established 15 minutes after the cardiac arrest. There was a rapid increase in arterial oxygen saturation with reversal of the shock state and both pupils were noted to respond to light. We proceeded with biopsy of the mediastinal mass and histological examination indicated an un-differentiated T-cell lymphoma.

The patient was transferred to the Intensive Care Unit (ICU) with VA ECLS and high dose chemotherapy was started that evening. There was a reduction in the size of the mediastinal mass over the next 10 days and it was possible to wean off VA ECLS without difficulty.

During the first week in ICU, the patient was slow to wake up although he did open his eyes to voice and withdraw his upper limbs to painful stimuli. Magnetic resonance imaging of the brain did not show definite features of hypoxic ischemic brain injury. During the second and third week in ICU, there was no improvement in his neurological status and no sign of marrow recovery. Despite broad-spectrum antimicrobial therapy, the patient developed repeated episodes of gram negative bacterial and fungal sepsis with progressive pulmonary and renal failure. Twenty-eight days after ICU admission, the patient died of neutropenic sepsis.

## DISCUSSION

Our case report highlights the risk of abrupt and complete distal airway obstruction leading to refractory cardiac arrest after induction of general

anesthesia in a patient with a large mediastinal mass. It also highlights that even if ECPR can be deployed rapidly, there is a real risk of the patient sustaining a hypoxic brain injury.

Tissue biopsy of a mediastinal mass should be carried out using the least invasive method. Needle biopsy using local anesthesia in an awake, spontaneously breathing patient in the slightly head-up position with CT or ultrasound (US) guidance has been well described. Anterior mediastinoscopy and biopsy under local anesthesia or US-guided aspiration of pleural fluid can lead to a definitive diagnosis.

In patients with a mediastinal mass presenting for a surgical procedure, there should be a high index of suspicion that abrupt collapse may occur even in previously asymptomatic patients.

Pre-operative assessment includes a history and clinical examination for evidence of compression of the SVC (edema or distension of the superficial veins in the upper body and neck) or the airway (dyspnea, stridor, syncope) and in particular, if there is a postural component to symptoms<sup>1</sup>.

Thoracic CT images should be reviewed to assess the location of the mass and the degree of associated vascular or airway compression. Pre-operative echocardiography is indicated if there is evidence of compression of the heart or in the presence of a pericardial effusion. Flow volume loops have been used to document intra-thoracic airflow obstruction, but do not add significantly to the information obtained with chest imaging (2).

Patients should be considered at high risk of peri-operative complications if they have severe postural symptoms, stridor, cyanosis, have > 50% decrease in the cross-sectional area of the trachea, have evidence of bronchial compression in association with tracheal compression or evidence of SVC compression or pericardial effusion (1).

If general anesthesia is being considered for a patient with a mediastinal mass, a pre-operative multidisciplinary meeting is essential to discuss the procedure and plan any additional interventions that may be required. A clinician skilled in fiberoptic and rigid bronchoscopy should be immediately available along with a range of reinforced endotracheal tubes.

In carefully selected cardiac arrest patients who remain unresponsive to conventional cardiopulmonary resuscitation, ECPR is being used successfully<sup>3</sup>. The indications for ECPR include a potentially reversible or treatable cause for the cardiac arrest (acute myocardial infarction, hypothermia, cardiac drug intoxication), the ability to deploy ECLS within 60 minutes of the collapse and

the provision of high quality conventional CPR from the time of the arrest. Contraindications to ECPR include aortic dissection, severe aortic regurgitation, patients at increased risk of hypoxic brain injury (un-witnessed cardiac arrest) and patients with a definite contra-indication to anti-coagulation.

Many authors have warned about the dangers of 'stand-by' cardiopulmonary bypass (CPB) or ECLS deployed after refractory cardiac arrest in patients with a mediastinal mass (2,4).

The time from the collapse to the decision to request extracorporeal support and the time from that call to starting extracorporeal blood flow is likely to be prolonged even with ready access to an experienced team and rapid uncomplicated deployment of ECLS. It is also likely that closed chest compressions in a patient with a mediastinal mass may increase the degree of vascular or airway obstruction so that the quality of brain perfusion and oxygenation during this protracted period may not be optimal.

If delayed attempts to deploy CPB or ECLS after cardiac arrest in these patients are associated with an increased risk of hypoxic brain injury, the same arguments should apply to ECPR. Despite our best efforts, institution of ECPR in the present case report did take some time and this may have contributed to the limited neurological recovery.

Pre-operative femoral cannulation under local anesthesia has been described so that extracorporeal

support can be instituted without delay after airway obstruction<sup>4</sup>.

In conclusion, we present a case report of abrupt cardiac arrest after induction of general anesthesia in a patient with a mediastinal mass. All conventional resuscitation measures were ineffective.

Deployment of ECPR may have restored early hemodynamic stability and facilitated a chemotherapy-induced decrease in the vascular and airway compression by the tumor mass. However, the time required to institute ECPR and restore brain perfusion and oxygenation may have contributed to poor neurological outcome. In our view, there should be no place for ECPR in patients with a mediastinal mass after refractory cardiac arrest.

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