Update in
Anaesthesia

Venovenous extracorporeal membrane oxygenation for an emergent 'can't intubate' scenario: A Case Report

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Abstract

Extracorporeal Membrane Oxygenation (ECMO) provides cardiac and respiratory support to patients. It has been applied to various situations and its usage has increased. This paper describes a 26-year-old patient presenting with airway compromise due to multiple tracheal and endobronchial stenoses secondary to tuberculosis. The lack of cardiothoracic support at scene and failure in intubation prompted the decision of initiating ECMO support. After ECMO circuit was established, the patient was able to transfer out for definitive treatment and had good recovery. This case supplements current literature that ECMO is a potentially useful alternative for patients with difficult airway, particularly in an emergency setting.

Key words: extracorporeal membrane oxygenation; constriction, pathologic; respiratory insufficiency

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SUMMARY

Extracorporeal Membrane Oxygenation (ECMO) provides cardiac and respiratory support to patients. It has been applied to various situations and its usage has increased. This paper describes a 26-year-old patient presenting with airway compromise due to multiple tracheal and endobronchial stenoses secondary to tuberculosis. The lack of cardiothoracic support at scene and failure in intubation prompted the decision of initiating ECMO support. After ECMO circuit was established, the patient was able to transfer out for definitive treatment and had a good recovery. This case supplements current literature that ECMO is a potentially useful alternative for patients with a difficult airway, particularly in an emergency setting.

INTRODUCTION

ECMO is a mechanical device that can support heart or lung function temporarily. Indications include acute severe heart failure, acute severe respiratory failure with high mortality despite optimal conventional treatment, temporary support during elective operations etc[1]. ECMO is divided into two types: venoarterial ECMO (VA-ECMO) and venovenous ECMO (VV-ECMO). While VA-ECMO provides support to both the lungs and the heart, VV-ECMO only support the lungs. Over the years, ECMO has become more widely used. From 1990 to 2020, the Extracorporeal Life Support Organization has recorded a total of 151,683 runs[2]. Case reports have described ECMO use in patients with difficult airway, including suspected congenital tracheal stenosis and extrinsic airway compression. It is useful in elective and emergency settings and has supported patients undergoing various procedures, such as tracheostomy and resection of mass[3-5]. We present a case of severe tracheal and endobronchial stenoses with acute respiratory failure. After multiple attempts of intubation failed, the patient ultimately required VV-ECMO while waiting for tracheal dilatation.

CASE PRESENTATION

A 26-year-old woman had history of pulmonary tuberculosis with treatment completed. It was complicated with tracheal and left main bronchial stenoses, requiring repeated operations for dilatation and stenting. Rigid bronchoscopy was done in another hospital the day before this episode, showing two 3mm severe stenoses at the trachea and a 2mm stenosis at the left main bronchus. Dilatation was performed, the tracheal and bronchial stents

previously inserted were confirmed in situ. She was discharged the next day after the procedures. However, she soon developed severe shortness of breath and was rushed to our hospital after discharge.

Upon arrival at the Accident and Emergency Department (AED), the woman was stridorous and in severe respiratory distress. Glasgow Coma Scale score was full (15/15), blood pressure was high at 161/111 mmHg, pulse was high at 136 beats per minute and respiratory rate was high at 32 per minute. Oxygen saturation was low at 51% on room air. She was then given 15l of oxygen through non-rebreathing mask and oxygen saturation improved to 87%. Arterial blood gas after oxygen therapy showed type II respiratory failure with pH at 7.14 and pCO_2 at 12.3kPa.

There was no cardiothoracic support available in our hospital for performing dilatation and stenting. Cardiothoracic surgeons of the hospital that the patient was discharged from were contacted and they had agreed to takeover. However, the patient was not stable to transfer out.

At the AED, assessment by anaesthesiologists using fiberoptic bronchoscope showed severe subglottic stenosis. The tracheal stent was not seen. No sedatives were given during the procedure to avoid further collapse of airways. Intubation was not attempted at that moment as a very difficult airway was foreseen. We transferred the patient to the operation theatre for immediate airway management, where more manpower and equipment was available.

Difficult airway trolley and resuscitation equipment were on standby. Intubation was first attempted by anaesthesiologists by awake fibreoptic bronchoscope supported by high flow oxygen therapy (Optiflow). After advancing the bronchoscope to the subglottic region, a stenosis of 3mm was seen. (Fig. 1) A size five microlaryngeal tube was used but failed to bypass the stenosis. After discussion with the otorhinolaryngologist, rigid bronchoscopy was done under co-induction with sevoflurane and propofol. Despite prolonged preoxygenation in a sitting position, rapid desaturation occurred in less than a minute, limiting the duration of the attempt. After multiple attempts of rigid bronchoscopy to bypass the stenosis failed, intubation with a cook airway exchange catheter (OD 4.6mm) had been tried. The proximal tracheal stenosis was bypassed but high resistance was encountered when negotiating the catheter through. A high pressure (30cmH2O) was also required to maintain adequate minute ventilation. With the concern of barotrauma, the catheter was removed. ICU was then consulted for VV-ECMO support.

A VV-ECMO had been set up by trained ICU doctors with a Fr21 access cannula at the right femoral vein and a Fr19 return cannula at the right internal jugular vein. There was no vascular team in our hospital. However, there were surgeons who had previous experience in vascular surgeries available should complications arise. A laryngeal mask with pressure support ventilatory mode was used to support the ventilation during the procedure.

Post-procedure, laryngeal mask was removed and the patient was escorted to ICU while keeping her on low dose sedatives. On day two, we had weaned off all sedatives and the patient was conscious and alert, able to breathe on her own while on ECMO.

Eventually, the patient was transferred to the cardiothoracic unit of the designated hospital on day four and repeated dilatations of multiple stenotic sites were performed. Tracheostomy was done on day nineteen with a size eight wire reinforced adjustable tracheostomy tube inserted. With the tip of tracheostomy tube able to bypass the distal tracheal obstruction, ECMO was subsequently weaned off.

The Montgomery T-tube, a flexible silicon device, was inserted with rigid bronchoscopy for temporary management of her subglottic stenosis a month later. The T-tube has the advantage of negligible stimulation and reduced granulation formation at its end. In contrary to the tracheostomy tube and the endotracheal stent, it is stable and avoids migration. It is more comfortable and is beneficial for patients to resume oral ventilation and speech.

The patient was then regularly monitored with fibreoptic bronchoscopy and cardiothoracic follow-ups. She later opted for computed tomography monitoring in view of respiratory distress during fibreoptic bronchoscopy assessment. She was also educated to seek help immediately if alarming signs and symptoms occur. In the future, this patient will likely require multiple rigid bronchoscopies with airway dilatation and stenting.

DISCUSSION

This patient with multiple tracheal and bronchial stenoses presented to us with acute respiratory failure and cannot be intubated. VV-ECMO was established as a rescue therapy to allow transferring the patient out to designated hospital for further management of tracheal and bronchial stenoses.

When the patient first presented to the AED, although transferring her out to the cardiothoracic unit would allow definitive treatment, we had chosen to proceed to airway management at our own hospital to secure the patient's oxygenation. This was because the patient was in a critical condition with airway compromise, there was a high risk of deterioration during transport, especially as there might not be enough personnel and equipment available. It was unsafe to transfer her out without securing airway and supporting ventilation. Airway management was at our top priority. In a cohort study done in Thailand, it is concluded that patients are at risk of clinical deterioration during inter-facility transfer if they have unstable clinical conditions, high pre-transfer risk scores and, circulatory, respiratory, and neurological signs and symptoms [6].

Although the usage of ECMO is not described in the intubation guidelines published by the Difficult Airway Society [7], we believe

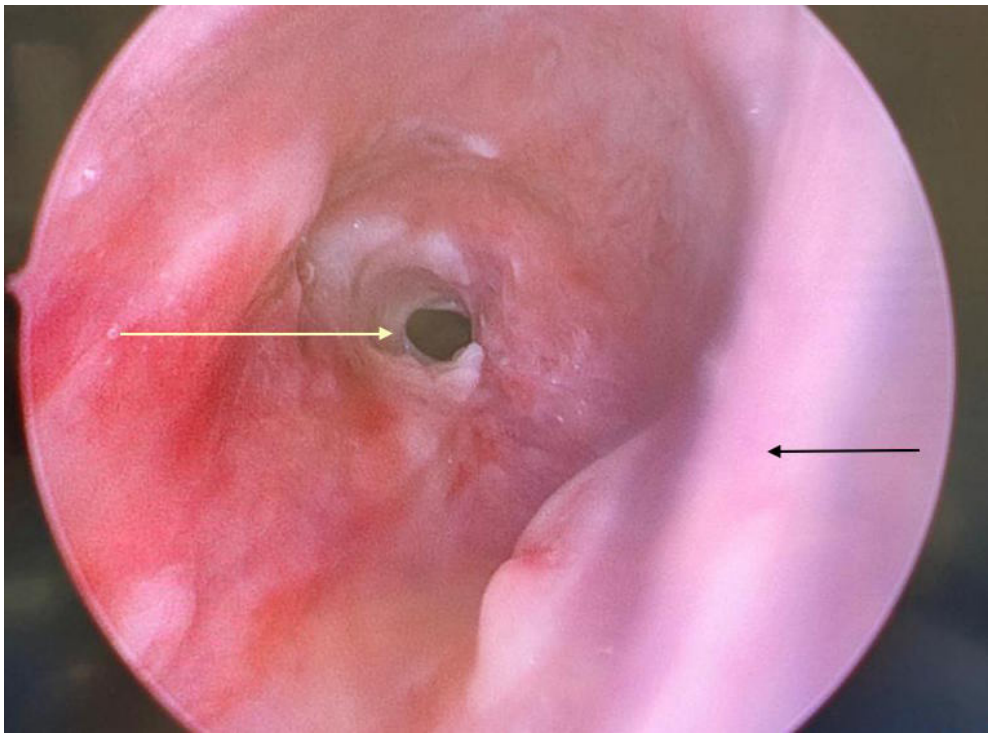

Figure 1. *Subglottic region: A 3mm tracheal stenosis (yellow arrow) obscuring the view of the tracheal stent. The right vocal cord (black arrow) is shown for size reference.*

VV-ECMO provides the best outcome for this patient. After VV-ECMO was established, the patient could also be transferred safely with adherence to proper transfer protocol [8]. Our hospital also had sufficient resources in interfacility transfer of patients already on ECMO with well-established guidelines, trained personnel and adequate equipment. Cricothyroidotomy and tracheostomy was not considered as the patient had multiple stenoses, we might not be able to bypass them all to achieve successful ventilation. Dilatation was also not feasible as there were no cardiothoracic surgeons and equipment available. The patient was also very unstable and could not tolerate the procedures.

Despite VV-ECMO provides life-saving respiratory support, it is a highly invasive procedure with risks including bleeding, air embolism, malposition of cannulas, injuries to major vessels or internal organs etc.. Risks have to be weighed against benefits. In an article reviewing twenty-two patients with severe tracheal stenosis requiring urgent stenting, it is suggested that the choice of ventilation technique should be an individualised decision, based on the etiology, severity and location of tracheal stenosis. Nonetheless, it is suggested that ECMO should be available for severe tracheal stenosis [9].

ECMO is expensive with cost varying with different indications. It is labour intensive, requiring high level of expertise and technology. Despite its obvious usefulness in patient care, assumed cost effectiveness are important in implementing ECMO[10]. The high cost might also hinder its usage in low- and middle-income countries.

In difficult intubation cases where the standard intubation protocol is not applicable, ECMO is probably an alternative option in spite of its cost. With proper patient selection and expertise, it will improve patient's outcome. For our patient, we had demonstrated that ECMO allows safe interfacility transfer in order for the patient to receive required definitive treatment, which was not possible previously. With the increasing prevalence of ECMO, healthcare professionals should be familiar with this supportive treatment modality.

ACKNOWLEDGEMENTS

Published with the written consent of the patient.

Approved by the Research Ethics Committee (Kowloon Central/ Kowloon East) by an expedited process, ref: KC/KE-21-0217/ER-1.

CONFLICT OF INTEREST

No external funding and no competing interests declared.

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