Single site venovenous extracorporeal membrane oxygenation as an alternative to invasive ventilation in post-pneumonectomy fistula with acute respiratory failure

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Received 19 August 2011; accepted 11 October 2011

Abstract

We report the use of venovenous extracorporeal membrane oxygenation with a single dual lumen cannula in a 42-year-old patient suffering from a post-pneumonectomy fistula and severe respiratory insufficiency, avoiding the classical approach of invasive mechanical ventilation. We discussed the potential advantages of extracorporeal oxygenation as the main support in this particular clinical setting.

Keywords: Extracorporeal membrane oxygenation • ECMO • Pneumonectomy

We present the case of a 42-year-old man who was operated for a right malignant pleural mesothelioma staged as a cT2N0M0 epithelial subtype. A right pleuro-pneumo-phreno-pericardectomy was performed with mediastinal resection of the 2-4-7-8-9 right lymph node stations, and then we replaced the diaphragm and pericardium with a dual mesh of Gore-Tex® and bovine pericardium, respectively. The pathology confirmed R0 resection of a pT2N1M0 epithelial mesothelioma. On postoperative day (POD) 12, the patient was discharged from the hospital with a performance status of ECOG 1. The plan was to complete the treatment with pulmonary rehabilitation, and continue with sequential chemotherapy and radiotherapy.

In POD 30, the patient was readmitted due to cough and general compromise. The chest CT scan and fibre bronchoscopy showed a 1–2 mm fistula in a short right bronchial stump. We decided to clean the right cavity performing video-assisted thoracoscopy and tried to close the fistula using Beriplast® by bronchoscopy. In the following 2 weeks, we repeated the same approach three times unsuccessfully. Then we planned to apply gelatin–formaldehyde–resorcinol glue because of its properties of high adhesion and pressure resistance. The procedure was performed through a combined tracheal and post-pneumonectomy space approach achieving a satisfactory sealing. Twelve hours later, the patient started with massive mucous bronchorrhea and severe respiratory impairment requiring non-invasive ventilation (Fig. 1A and B). Flexible bronchoscopy, chest X ray and the chest tube rule out any airway obstruction or major air leak from the bronchial stump. The radiologic series and haemodynamic monitoring demonstrated pulmonary oedema with an unresponsive hypoxia to non-invasive ventilation (PaO2/FiO2 ratio 41). Venovenous ECMO assistance using a 31 French single lumen cannula (VVDL-ECMO) [Avalon Elite Bicaval Dual Lumen catheter. Avalon Laboratories LLC, Rancho California, CA, USA] through his right internal jugular vein was installed without intubation (Fig. 1C). The patient was assisted with full flow, ACT in the range of 180–200 s, without requirement of vasoactive drugs or conventional respiratory support. A protective mode of non-invasive ventilation was set in order to permit lung rest with PEEP 5 mmHg and low FiO2 (0.30). The patient was weaned off VVDL-ECMO after 6 days of resuming his spontaneous ventilation when he was able to sustain a PaO2/FiO2 ratio greater than 150 during more than 6 h without tachypnoea (Fig. 2B and C). There was not any significant morbidity related with cannula position, bleeding, recirculation or membrane thrombosis. Seven days after he was weaned, the patient was discharged from the ICU. He developed in his left lung a focus of Cryptogenic Organizing Pneumonitis (multiple condensations) proved by biopsy and bronchoalveolar lavage and this was treated with steroids with partial response; his functional status remained in ECOG 2–3.

COMMENTS

Acute respiratory failure (ARF) is a life-threatening complication in patients with post-pneumonectomy fistula (PNF). Kutlu et al. [1] in a 7-year retrospective review of pulmonary resections showed that the combination of ARF and right pneumonectomy was uniformly fatal. Invasive mechanical ventilation (IMV) in this setting could increase the damage over a bronchial defect due to an augmentation in the airway pressure and trauma by intubation, losing tidal volume through the PNF, increasing the size of the defect and the hypoxaemia and causing carbon dioxide retention by hypoventilation.
ECMO is an alternative to IMV in patients with ARF [2, 3], which permits to change one intensive ventilator strategy by one more protective [4], and in certain cases, the patient can be weaned off IMV. ECMO is able to provide full assistance in most of these cases without haemodynamic compromise, oxygenate efficiently and remove CO$_2$ completely even under suboptimal flow. Brogan et al. [3] show, in a retrospective review of a large multicentre ECMO database of adults with ARF, a survival of 50% at the time of hospital discharge, similar to the results found in the prospective CESAR trial at 6 months. In both, articles are included a wide range of respiratory causes of ARF like pneumonia, acute respiratory distress (ARDS), trauma, etc., validating this technique in severe ARF. Venovenous (VV) approach is the preferred mode of assistance in ARF because of its low morbidity, probably its lower mortality and easier handling [3, 5] when compared with the venaarterial mode. Other reports of ECMO in pneumonectomized [6] or post-thoracic surgery patients [7] also suggest the use of ECMO as valid rescue therapy in post-operated patients with low reserve.

In this case, we use VVDL-ECMO as an alternative to IMV planned in advance to avoid intubation. The clinical justification was based on the pneumonectomy and PNF. VVDL-ECMO has been described as an effective support with less adverse secondary morbidity than other modes of ECMO due to its VV single cannulation site and cannula [4, 8, 9], which is able to drain efficiently by two bicaval holes and inject the oxygenated blood without a relevant fraction of recirculation. It has the advantage of facilitating ambulatory rehabilitation while the lungs are kept in rest, fully supported by VV assistance. The new polymethylpentene membranes have contributed to the technique because of their low resistance, good gas exchange and easy priming. Javidfar et al. [4] that out of 27 VVDL-ECMO patients, 59% reported were able to be free of IMV after an ECMO instalment, and 70% of the cases were successfully weaned. This approach, of providing a less invasive venovenous support and facilitating mobilization, has also been described as useful in the context of bridging the patient to lung transplantation and seems to offer advantages over most classical methods of VV cannulation.

**Conflict of interest:** none declared.

**REFERENCES**


