is responsible for up to 65% of epidermoid tumors of the oral cavity[9]), leads us to conclude that it is a metastatic lesion of an airway squamous cell carcinoma, making this one of the first reported cases of this type of metastasis in the gallbladder.

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Refractory hypoxemia in critical trauma patient. Usefulness of extra-corporeal membrane oxygenation☆

Hipoxemia refractaria en la enfermedad traumática grave. Utilidad de la ECMO veno-venosa

The use of veno-venous extracorporeal membrane oxygenation devices (VV-ECMO) in severe respiratory failure due to trauma has been controversial and is not completely defined, which is probably due to its underuse in this population. VV-ECMO provides adequate oxygenation until the lungs recover. However, one limiting factor for its generalized use has been the risk of bleeding due to both the trauma as well as the anticoagulation necessary to use this system[1]. In this article, we describe a case of trauma-related refractory hypoxemia treated with ECMO without using anticoagulation, which demonstrates that these devices can be considered a rescue measure once previous therapeutic options have been optimized.

We present the case of a 65-year-old woman who had been hit by a car. Upon admission to the Intensive Medicine Unit, she was conscious and showed no focal lesions; BP 90/60, HR 90 bpm, tachypnea RR 20, $SatO_2$ 90%. Physical examination revealed a hematoma on the left cheekbone, hypoventilation in the base of the right lung, slight abdominal guarding, and pelvic pain on palpation. An imaging study showed a fracture of two unifocal right ribs with bilateral pulmonary contusion (Fig. 1A), lacerated liver, spinal trauma (fracture of five right transverse processes from T12 to L4) and skeletal trauma (fractures in both sacra alae, communicated fracture of the left pubis with fractures of both pubic branches, and right anterior acetabular rim). No intracranial injuries were observed.

During the first few hours of treatment, the patient presented hemorrhagic shock, requiring blood products and vasoactive drugs (massive bleeding protocol was activated). Orotracheal intubation was performed, and the study was completed with arteriography. Several foci of contrast extravasation were identified, suggestive of bleeding from

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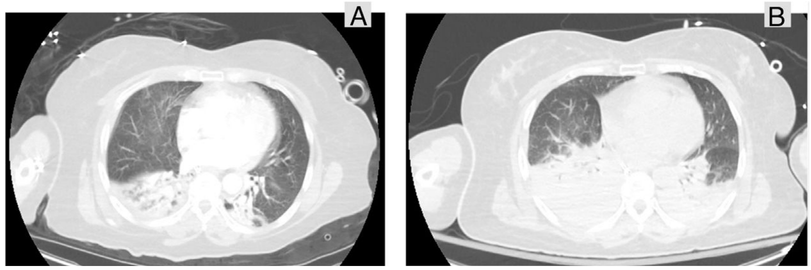

Fig. 1 – A) Computed tomography (CT) scan upon admission to the Intensive Care Unit; B) CT scan 16 h after admission, coinciding with severe hypoxemia.

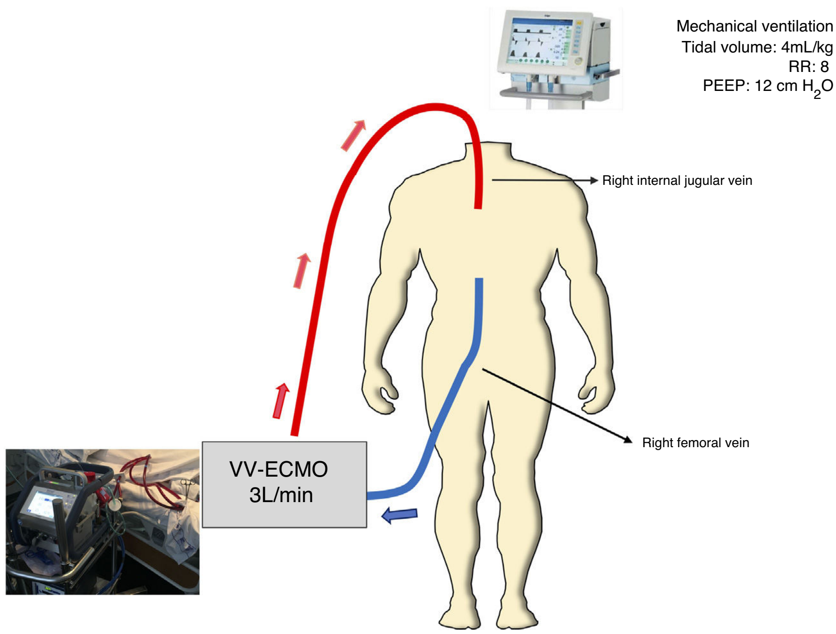

Fig. 2 – Diagram of the VV-ECMO device used. VV-ECMO: veno-venous extracorporeal membrane oxygenation; PEEP: positive end-expiratory pressure; RR: respiratory rate.

the left hypogastric and epigastric arteries. These were embolized, and hemodynamic stability was achieved.

At the same time, the respiratory failure was worsening. PaO_2/F_iO_2 was 65 and PEEP 15. Sedation was maintained with midazolam and fentanyl, with the occasional addition of cisatracurium to optimize ventilatory function. The imaging test was repeated 16 h after admission to the ICU, which demonstrated progression of the pulmonary contusions (Fig. 1B). The transthoracic echocardiogram study did not reveal alterations. We then decided to establish femoral-jugular VV-ECMO (CardioHelp®, Maquet Holding, Germany) (Fig. 2). The placement of the cannulae was guided by transesophageal echocardiogram. Heparin was prescribed during implantation itself, using a flow rate of 3 bpm, and anticoagulation was reversed with protamine (80 mg) one hour later. We decided to reverse anticoagulation due to the risk of hemorrhage secondary to the liver injury, pelvic fractures, hematoma in the psoas and coagulopathy secondary to the massive hemorrhage over the previous hours. Mechanical ventilation was precautionary with PEEP 12 cm H_2O and TV 4 mL/kg, FiO_2 45%. After implantation, a bronchoscopy study showed no lesions or bloody secretions. With the therapy established, we observed improved oxygenation (PO_2 measured in the left radial artery), hemodynamics and serum lactate; diuresis was preserved, and a negative fluid balance was finally reached. On the 3rd day, weaning from ECMO was initiated after the improved radiology and arterial blood gas results. We reduced the ECMO oxygen flow, ventilating with $F_iO_2 < 45\%$ and PEEP < 10 cm H_2O, and $PaO_2/F_iO_2 > 200$ was observed. Therefore, VV-ECMO was withdrawn on the 4^{th} day. No device-related complications were detected during ECMO treatment. A tracheostomy was performed on the 7^{th} day due to the need for respiratory support due to polyneuropathy. Finally, the patient was transferred to the hospital ward.

Respiratory failure after severe trauma may be due to a trauma-related lung injury itself, but it also may be indirectly caused by massive transfusion, bronchial aspiration, or fat embolism. VV-ECMO systems make it possible to ensure correct oxygenation to the tissues while the lungs are recovering from the damage that caused severe respiratory failure. Its use could be considered due to the persistence of severe hypoxemia ($PaO_2/F_iO_2 < 120$ with $F_iO_2 > 90\%$ and PEEP > 10) after optimization of less invasive therapeutic measures (lung-protective ventilation)[2,3].

ECMO machines are used in critical care units both in situations of cardiorespiratory compromise and in asystole donation processes[4]. However, the accumulated experience in severe trauma has been limited to case series[5,6], probably due to the hemorrhagic risk involved[3]. This risk is present at the time of cannulation and facilitated by trauma-related coagulopathy, as well as by the anticoagulation entailed in the use of these systems. The need for anticoagulation and dosage for VV-ECMO machines must be individualized, and the risk–benefit ratio should be assessed for each patient. The decision to rule out the use of anticoagulation or to lower the dosage requires close monitoring of the flows through the device, and neither is an absolute limitation. In our case, we dismissed heparinization due to the high risk of bleeding given the patient's liver and pelvic injuries. In severe trauma, initial heparin administration has been reported to be associated with increased hemorrhagic complications. However, in our case, there was no incidence of this type, perhaps because we reversed the initial heparin.

Another point of debate is when to establish these therapies. The case described, in which VV-ECMO was initiated 12 h after admission and was maintained for a period of 80 h, supports the implementation of these machines early as they have been associated with better results and lower mortality[7,8]. In fact, in the trauma patient population, mortality associated with the use of ECMO has occurred predominantly in cases with delayed use and when veno-arterial ECMO was required due to circulatory failure, while the early initiation of VV-ECMO due to respiratory dysfunction had better results[9]. We believe that early initiation can contribute towards faster lung recovery, while avoiding the potential adverse effects associated with these systems. Initial results seem to show survival rates similar to those of non-trauma patients and make this support a promising therapeutic option for these highly complex patients[10].

After the optimization of other therapeutic options, VV-ECMO systems can be considered a rescue therapy against refractory hypoxemia in patients with severe trauma. Patient selection and early initiation are two key elements that should be addressed individually in each case. The hemorrhagic risk must be evaluated since it alone is not a contraindication.

Conflict of interests

The authors have no conflict of interests to declare.

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