Lower limb overflow syndrome in extracorporeal membrane oxygenation

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Abstract

Peripheral extracorporeal membrane oxygenation (ECMO) is associated with a not negligible rate of vascular morbidity. Most vascular complications are related to limb ischaemia mainly due to insufficient limb perfusion or embolic events. To the best of our knowledge, this is the first report of a severe epidermolysis and overflow syndrome as a result of an overperfusion phenomenon through an unknown femoral arterio-venous fistula in a patient requiring ECMO support.

Keywords: Extracorporeal membrane oxygenation, Peripheral vascular disease • Arterio-venous fistula • Surgery, Complications

INTRODUCTION

Although extracorporeal membrane oxygenation (ECMO) can improve survival of patients with cardiogenic shock, the associated vascular morbidity is not negligible [1, 2]. To the best of our knowledge, this is the first report of a case of severe epidermolysis as a result of an overflow phenomenon due to an unknown femoral arterio-venous fistula in a patient requiring ECMO support.

CASE

A 70-year old male with a previous history of chronic kidney disease and mitral valve replacement and coronary bypass grafting surgery underwent an uneventful orthotopic heart transplant because of end-stage chronic ischaemic dilated cardiomyopathy.

Thirty hours after the heart transplant, the patient developed a primary graft dysfunction, which required the implantation of a veno arterial ECMO. A veno arterial CARDIOHELP® SLS 7.0 System (MAQUET, Rastatt, Germany) was implanted by right common femoral vein percutaneous cannulation using the Seldinger technique (22 Fr) and left common femoral artery cannulation through a side-to-end anastomosed 8-mm ePTFE FUSION® vascular graft (MAQUET, Rastatt, Germany).

The ECMO provided optimal haemodynamic support with a pump flow maintained between 4 and 4.5 l/min. The fraction of inspired oxygen was set at 0.5. Patient’s vital signs were stabilized and his O₂ saturation was maintained at 98%. Nonetheless, 5 h after establishment of the ECMO support, the patient developed a critical swelling and severe epidermolysis limited to the region of the left thigh with second- and third-degree skin injuries (Fig. 1). His left foot was otherwise warm and well perfused, and capillary refill was not delayed. Physical examination of the right limb was anodyne. Doppler ultrasonography revealed a high-flow distal signal in the left limb. A compartment syndrome was suspected despite the lack of ischaemic signs or distal perfusion impairment.

Multidetector computed tomography (MDCT) angiography was performed to identify the cause. Fifty milliliters of iodinated contrast media were administered into the venous line of the ECMO through a side Luer connector to allow the direct passage of the contrast media to the arterial line, thereby obtaining early images of the affected limb. An ultrafast scan triggering was also selected to identify early anomalies in the left limb perfusion. Axial MDCT scan images (Fig. 2A and Video 1) and multiplanar reconstructions (Fig. 2B) showed a previously unknown arterio venous fistula between the left deep femoral artery and left femoral vein through a superficial communicating vein (arrow, Fig. 2A and B), causing overflow and increased intravascular pressure in the left limb. A moderate perianastomotic haematoma was also noticed (asterisk, Fig. 2A).

The patient’s peak creatine kinase was 1398 IU/l, reached at the time of diagnosis and before reoperation.

The patient underwent an emergent reoperation that involved closure of the femoral fistula by ligature of the aberrant communicating vein, drainage of the haematoma and an anterolateral fasciotomy of the left thigh. The muscle and connective tissue in the anterior and lateral compartments were viable and well perfused.

The oedema decreased over the following hours, alleviating the compartment pressure and improving the epidermolysis. The serum creatine kinase levels progressively reduced as well.

The patient was weaned from ECMO 12 days later, and the fasciotomy was closed at the same time. The patient was eventually discharged from hospital and is doing well at the outpatient clinic controls.
DISCUSSION

The rate of vascular complications of peripheral ECMO is not negligible. Most vascular complications are related to limb ischaemia mainly due to insufficient limb perfusion or embolic events [1, 2]. However, the rate of vascular complications tends to decrease when distal perfusion techniques are incorporated [3]. Peripheral cannulation through a side graft, such as the one we advocate, is an optimal alternative, especially in cases when peripheral vascular disease or small diameter vessels may be present.

The case we describe does not precisely match the definition of a compartment syndrome because, despite the clinical evidence of increased pressure in the anterolateral compartment of the left thigh, there were neither clinical signs of muscular necrosis nor Doppler signs of distal ischaemia. In fact, there are no previous reports of lower limb compartment syndrome presenting with second- and third-degree epidermolytic injuries and lack of ischaemic manifestations. Hyperperfusion syndrome has been reported to be more frequently associated with ECMO support with axillary artery side graft technique [4]. Chamogeorgakis et al. [4] described hyperperfusion of the ipsilateral upper limb in up to 24.7% of patients, presenting with significant swelling and venous ischaemia. Nevertheless, the authors reported no case of hyperperfusion due to an arteriovenous fistula.

There are other potential causes of limb overflow in peripheral ECMO support that must be considered, namely causes resulting from arterial inflow obstruction and those associated with venous return obstruction. In our case, the contrast-enhanced MDCT scan arteriography ruled out the presence of a significant stenosis in any proximal artery (i.e. iliac artery) that might have resulted in arterial inflow obstruction and explained a preferential flow to the left limb. Another cause to be considered is the wrong direction of the graft cannulation. In this case, previous to performing the end-to-side graft anastomosis, the graft had been adequately bevelled to favour in-flow towards the proximal vascular bed.

We postulate two complementary mechanisms that explain the intravascular overpressure and subsequent massive oedema limited to the thigh soft tissues. On the one hand, the presence of an unknown arteriovenous femoral fistula led to an overflow and secondary hyperperfusion of the left lower limb. In our case, the fistula was caused by a communicating superficial vein that connected the left femoral vein and artery. This vascular shunt had previously remained silent, yet it debuted clinically when the lower limb was perfused at 200 mmHg and over by the ECMO. We resorted to an MDCT angiography by directly injecting the contrast media in the ECMO in combination with an ultra early scan triggering. This technique permitted us to visualize how the venous system of the lower limb presented an early enhancement due to the presence of an

Figure 1: Severe swelling and epidermolysis limited to the region of the left thigh with second- and third-degree skin injuries.

Figure 2: (A) Axial multidetector computed tomography (MDCT) scan image shows an aberrant superficial vein that connects the left deep femoral artery and left femoral vein (arrow), thereby causing early enhancement of left lower limb venous system. Note a moderate perianastomotic haematoma (asterisk). (B) 3D MDCT scan reconstruction showing the anomalous arteriovenous fistula (arrow).

Video 1: Axial MDCT angiography slices demonstrating early contrast-enhancing of left limb venous system through an aberrant superficial vein (arrow), which connects left femoral vein and artery.
arterio venous fistula. On the other hand, the presence of a moderate haematoma might have also contributed to impair the venous return of the left lower limb.

Early detection of vascular complications of ECMO is of utmost importance to prevent severe sequelae like limb amputation. Therefore, a strict protocol should be followed when a peripheral ECMO is established regardless of whether it is performed through a side graft or a percutaneous approach. This protocol must include thorough surveillance of adequate limb perfusion with clinical and laboratory data, regular assessment of distal flow by means of Doppler sonography as well as early performance of an angiography whenever a vascular complication is suspected.

Conflict of interest: none declared.

REFERENCES