

Non-Pharmacological Intervention to Reduce Lower Limb Hypoperfusion in VA-ECMO how to do it

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Abstract

Introduction: During ECMO VA many complications can occur: an example is represented by limb ischemia. During the 7th EuroELSO, a nursing case report was presented about an intervention on VA ECMO limb that had a hypoperfusion with difference of temperature (ΔT) treated by a dressing medication that reduced the differential temperature. During the 8th EUROELSO in Barcelona a retrospective study was presented to confirm the validation of these medication.

Materials and Methods: In relation to the medication German cotton bandage and hydrocolloid plaque were used to the dressing medication plus a skin probe to record the skin temperature.

In relation to the studies about medication, a case report on august 2017 was presented at 7th EUROELSO, with a literature review to the management of microcirculatory disease in ECMO VA while during 8th EUROELSO a retrospective study, from May 2018 to October 2018, was presented.

Results: from literature review, 51 articles about "ISCHEMIA" AND "LIMB" AND "ECMO" were founded, with VA ECMO and adults as inclusion criteria. No pediatrics or VV ECMO were included. From the case report we observed a reduction of difference of temperature within 6 hours with an echo Doppler with normal flow. From the retrospective study 7 cases of VA ECMO were recorded.

Discussion: From the analysis of data, the application of dressing medication plays a key role to reduce an hypoperfusion related to microcirculatory disease.

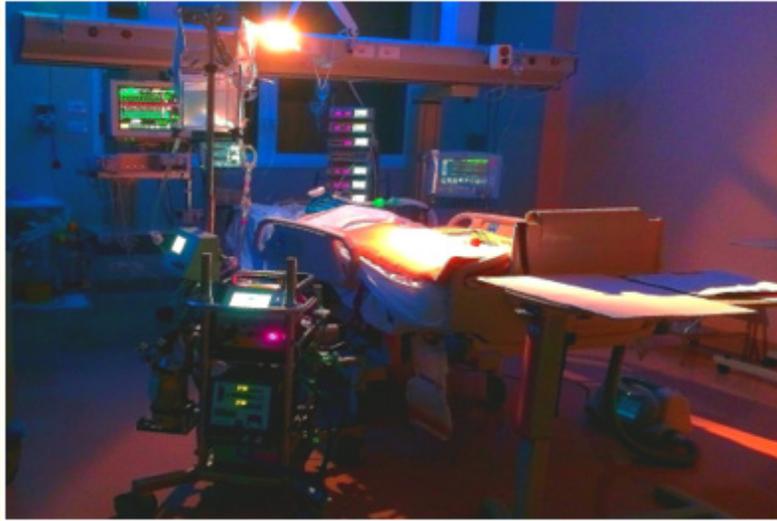
Keywords: Lower Limb Hypoperfusion; VA-ECMO

Introduction

During 7th and 8th EUROELSO a case report with literature review and a retrospective study were presented about a problem that can occur during VA ECMO: limb ischemia.

VA ECMO, as indicated by ELSO guidelines, is indicated to some specific cases of patient who had an excellent CPR [1] or in adults with cardiogenic shock and low cardiac output, in persisting shock despite volume, drugs administration and intraortic balloon pump (IABP), in septic shock, or in many cardiac diagnosis (i.e. acute myocardial infarction, myocarditis, post cardiotomy shock) [2]. Its role is to support both cardiac and respiratory system by an extracorporeal pump, an evolution of extracorporeal machine used in cardiac surgery [3].

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Figure

During VA ECMO some complications can occur as skin ulcers, thromboembolic risk, hemolysis and limb ischemia. In particular the last complication is avoid with a reperfusion cannula that can perfuse the leg in which VA ECMO is implanted: in particular the conformation of VA ECMO is represented by a drainage of venous blood from a cannula next to the right atrium and an admission of blood through a cannula in femoral artery [2]. Femoral artery is partially or totally closed so a reperfusion cannula of Fr5 is implanted to the distal part of femoral artery to perfuse the leg.

From the pilot study by Krupickova., *et al.* (2016), the microcirculation in pulsatility VS pulse-less in VA ECMO has no difference. The reperfusion cannula is fundamental to limb perfusion but microcirculation disease can occur. In literature there is no evidence about microcirculation problem management without drugs [4-27].

Following a case report and retrospective study, we found a non-pharmacological intervention to reduce the hypoperfusion in VA ECMO due to microcirculatory problem.

Case Report

A female of 55 y.o. was admitted to a peripheral hospital for a asymptomatic wide QRS from a cardiac ambulatory. At ECG an atrial tachycardia was recovered and after administration of adenosine a ST elevation was founded in D1-AvL. She was transferred to a central hospital for coronary angiography in which there is absence of multivessels coronary disease with cardiogenic shock. The airway was managed by a endotracheal tube, intraortic balloon pump was applied and noradrenaline was administered and after ten hours VA ECMO was implanted in cardiac surgery intensive care unit, after a diagnosis of myocarditis. VA ECMO support was applied for eight days: in these days also the continuous renal replacement started.

At third day of VA ECMO, a temperature difference between limbs was noticed, where ECMO leg was colder than the left leg by the skin temperature probe on the foot. This difference has been confirmed by a reduced flow with ECHO by vascular surgeon.

The reperfusion cannula was pervious, she was with BMI > 40, noradrenaline IV with a blood pressure with heamodynamic stable. The focus was on a microcirculatory disease.

Method and Materials

Case report-Literature review

During the clinical case, a literature review was applied to research a non-pharmacological intervention. PubMed and the principal guidelines were consulted with a search strategy of "ISCHEMIA" AND "LIMB" AND "ECMO", including adults undergoing VA ECMO.

About medication, German cotton bandage, hydrocolloid plaque to prevent pressure injuries, skin probe to record temperature value on both legs. The time interval of renewal dressing was changed from once on shift (7 hours) to once on 24 hours. Water logged of bandage and skin assessment was done to prevent injuries through control if bandage was too close to the skin by little cannula's movement.

Retrospective study

From May 2018 to October 2018, 7 VA-ECMO support were applied in car-diac surgery intensive care unit of our hospital. A retrospective study was carried out on vital signs charts, where the limb temperature were registered.

Results

After application of dressing, within six hour, the differential temperature from 6°C became 0.5°C, with a modification by echo Doppler from a low flow to a normal flow, confirmed by vascular surgeon.

The VA ECMO was removed after eight days of support, the patient was extubated after 14 days of mechanical ventilation and she was dismissed by hospital after 60 days after VA ECMO implantation.

From the literature review, 51 articles were founded but no studies had a non-pharmacological intervention to avoid microcirculation hypoperfusion.

Retrospective study

From the 7 cases, in 3 cases we had no data, in 4 data are complete: one case of ten days of ECMO support with a reduction of ΔT after the dressing applying is present. In the others, the dressing application was done immediately after cannula positioning: the results were a low ΔT ($< 0.4^\circ\text{C}$). About pressure injuries, one patient presented an EPUAP grade I ulcer with hydrocolloid, regressed upon a new wider bandage. About body's water loss assessment and bandage saturation of water, no one dressing was wet.

Discussion

Why a dressing can reduce a lower limb hypoperfusion?

In relation to the global warming theory, in which there is the greenhouse effect, the attention was focused on the trans epidermal water loss in which the water has the body temperature around 37°C .

During VA ECMO the blood is drained by the body to a circuit and return into the body through a roller (cardiac support) and after oxygenation through an oxygenator (respiratory support).

From the drainage to the admission into the body, the blood temperature decreases because of the extracorporeal running without thermal protection by the PVC circuit.

To avoid the thermal dispersion, in relation to the global warming theory, a dressing was applied to reproduce the greenhouse effect.

The steps to apply the dressing medication are:

1. Skin protection (Figure 1a and 1b) from pressure ulcers by hydrocolloid dressing (Figure 1) where cannulas can touch the skin leg.



Figure 1a



Figure 1b

2. Bandage first of all of the leg to reduce the pressure and after a bandage including the cannulas. The Cotton Patch was chosen for the thermal protection and absorbent properties (Figure 2 and 3).
3. Skin probe application outside the bandage to both legs.



Figure 2



Figure 3

The theory is based on:

- Warming of the leg with reduction of thermal loss from ECMO cannulas.
- Vasodilatation due to higher temperature inside the bandage from the thermal body loss by the cannulas.
- Vasodilatation induces major flow that increase the temperature inside the bandage.
- Normal flow is achieved by vasodilatation due to warming of the leg.

Conclusion

Finally, the reperfusion cannula is fundamental to limb perfusion but microcirculation disease can occur. In literature there is no evidence about microcirculation problem management without drugs. From Prague, we observed that the bandage is an alternative and water absorption wasn't such to change it every shift. The bandage by nurses has not to be tight, improving ulcers even though the hydrocolloid plaque, cause of cannula too close to skin. This medication is actually applied by nursing staff as normal practice in peripheral VA EC-MO: the first aim is to maintain in a direct line with "ECMO leg" and the second aim is to improve vasodilatation in microcirculation, with tissue hypoperfusion reduction of ECMO leg.

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