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Case Report
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Distal Limb Reperfusion During Percutaneous Femoral Arterial Cannulation for Veno-Arterial Extracorporeal Membrane Oxygenation in an Adult Patient

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Abstract

Ischemia and compartment syndrome may be seen, especially in the distal limb, after femora-femoral cannulation for extracorporeal membrane oxygenation (ECMO). Several techniques have been used to decrease the rate of complications. Arterial hypoxemia may be prevented by reperfusion with distal limb. Prophylactic superficial femoral artery cannulation results in ease in operation and prevents perfusion. In the present case, we present prophylactic superficial femoral artery cannulation for limb reperfusion.

Keywords: Distal limb perfusion, ECMO, prophylactic cannulation

Introduction

While planning and administering definite treatment, the patients with persistent cardiogenic shock or respiratory failure are attempted to be stabilised through extracorporeal membrane oxygenation (ECMO). The installation of venoarterial (VA) ECMO, in which the blood taken from the venous system is given back through the arterial system, is easy and fast. This method is preferred because it provides biventricular support and easy cannulation of the femoral vessels. However, complications such as stasis and oedema due to ischaemia and venous obstruction associated with arterial hypoperfusion in the distal extremity are encountered (1, 2).

To reduce the risk of ischaemia, the reperfusion of the ipsilateral extremity is achieved using various techniques. Here, we present a patient provided with lower extremity reperfusion by superficial femoral artery cannulation.

Case presentation

A 53-year-old male patient with a history of hypertension, diabetes mellitus and atherosclerotic heart disease with the complaints of cold sweating and epigastric pain was admitted to our emergency department. According to the result of coronary angiography, it was decided to follow up the patient medically. However, the complaints of respiratory distress that started on the same day and the pulmonary artery pressure (70 mmHg)

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Figure 1. Before antegrade perfusion

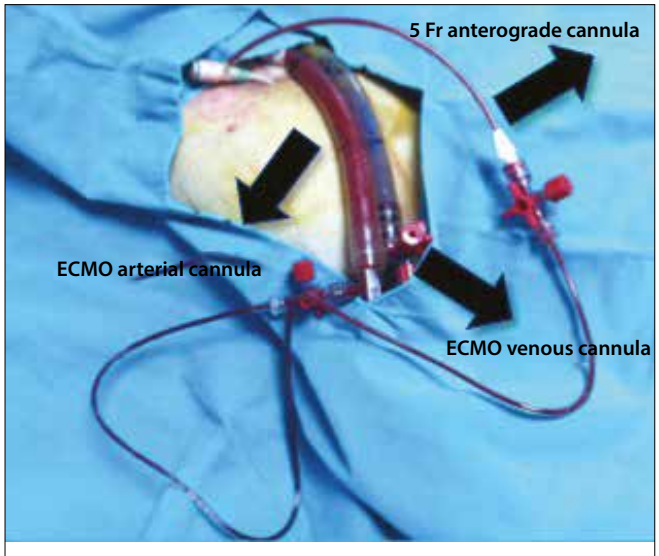

Figure 2. Antegrade perfusion with superficial femoral artery cannulation

Figure 3. After antegrade perfusion

increased. Because of the detection of mitral insufficiency 4/4 and the development of pulmonary oedema in his echocardiography, it was decided to insert peripheral type VA ECMO percutaneously. When the patient's arterial blood gas values in the last 24 hours prior to the insertion of ECMO were examined, pH was 7.19±0.14, pO_2 was 87.4±24 mmHg, pCO_2 was 43.6±10.4 mmHg, lactate was 4.5±5.7 mmol L^{-1} and HCO_3 was 17.7±5.1 mmol L^{-1}. Before ECMO was inserted, the patient was receiving adrenaline 0.3 g µcg kg^{-1} min^{-1}, dopamine 10 µcg kg^{-1} min^{-1} and dobutamine 10 µcg kg^{-1} min^{-1} µcg. The arterial blood gas values in the first 24 hours after the insertion of ECMO were as follows: pH: 7.45±0.08, pO_2: 180.4±97 mmHg, pCO_2: 36.4±9.5 mmHg, lactate: 3.5±4.4 mmol L^{-1} and HCO_3: 23.4±4.7 mmol L^{-1}, and there was a positive improvement. 21 Fr, 55 cm venous cannula and 19 Fr, 15 cm arterial cannula were percutaneously inserted from the femoral vein and femoral artery, respectively. One day after the cannulation of the femoral artery, the patient developed paleness and coldness at the distal lower extremity (Figure 1). Therefore, 5 Fr cannula was placed into the superficial femoral artery under the guidance of ultrasonography, and antegrade perfusion of the lower extremity was achieved with another line from the cannula in the femoral artery (Figure 2). One day later, by considering the insufficient blood flow, the 5 Fr cannula was replaced with 6 Fr cannula, and the perfusion of the leg was completely recovered (Figure 3). Written informed consent was obtained from the patient.

Discussion

Percutaneous cannulation of the femoral artery and/or vein provides a faster onset of supportive treatment, but ischaemia and compartment syndrome may be seen particularly in the distal lower extremity after femoral artery cannulation. This may result in perfusion disorder in the extremity, and consequently, the loss of the extremity (2, 3).

The incidence of critical leg ischaemia is approximately 500-1000 per 1.000.000. One of the most important risk factors is diabetes mellitus (4). In a meta-analysis of 1866 cases published by Cheng et al. (5), it was reported that the incidence of ischaemia in the lower extremity was 16.9%, and the rate of amputation requirement was 4.7%. This rate increases in paediatric patients. In a study of 22 cases with the ages ranging from 2 to 22 years (6), which was conducted by Gander et al. (6), the rate of ischaemia was reported as 52%, and the amputation rate as 10%. Between January 2012 and January 2015, 69 ECMOs, 46 of which were VA, were inserted in our hospital. The ages of our patients who were inserted ECMO were between 11 and 83 years. Routinely, cannulations are applied under the guidance of ultrasonography by intensive care specialist or anaesthesiologist. Superficial femoral artery cannulation is performed in all patients inserted ECMO to provide distal extremity perfusion. Ultrasonography-guided cannulation increases the success of the procedure, and decreases the complications associated with this procedure. Three of the patients developed circulatory disorder, and one patient developed compartment syndrome. No amputation was needed (7).

Percutaneous VA is the distal extremity perfusion that should be firstly followed up clinically after the insertion of ECMO. There are many ways to evaluate and monitor leg ischaemia. Clinical signs such as temperature changes or the absence of pulse in the leg are reliable. In addition, Doppler ultrasonography can also be used to assess arterial perfusion. Some clinicians even claim that it is enough to monitor leg perfusion with near-infrared spectroscopy. However, several strategies have been developed to provide leg perfusion (8). One of them is to provide antegrade perfusion through a small cannula.

In a three-year series published by Foley et al. (9), they reported that they did not see any ischaemia in patients who underwent prophylactic superficial femoral artery cannulation. They also stated that in patients not undergoing cannulation (21% of all patients), antegrade perfusion did not always provide complete return, and amputation was needed even after reperfusion. In the same study, it was also shown that there was no relationship between the frequency of leg ischaemia and body surface area, body mass index and cannula diameter. In this patient, we selected a 19 Fr cannula as an arterial cannula. And in the following patients, we changed the arterial cannula to 17 Fr. Although Foley et al. (9) have shown that there is no association with the diameter of the cannula, the general belief is that the small diameter of the arterial cannula is better for extremity perfusion, but it increases the risk of haemolysis.

Conclusion

Arterial insufficiency caused by femoral cannulation performed for extracorporeal membrane oxygenation can be prevented by the perfusion of the lower extremity. After this case, we decided to perform prophylactic cannulation to all patients who were inserted ECMO. The cannulation of the prophylactic superficial artery causes both easiness of procedure and prevention of perfusion problems. Moreover, ultrasonography-guided cannulations in the intensive care unit and in the operating room reduce the complications associated with cannulations.

Informed Consent: Written informed consent was obtained from patient who participated in this study.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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References

1. Aziz F, Brehm CE, El-Banyosy A, Han DC, Atnip RG, Reed AB. Arterial complications in patients undergoing extracorporeal membrane oxygenation via femoral cannulation. Ann Vasc Surg 2014; 28: 178-83. **[CrossRef]**
2. Bisdas T, Beutel G, Warnecke G, Hoeper MM, Kuehn C, Haverich A, et al. Vascular complications in patients undergoing femoral cannulation for extracorporeal membrane oxygenation support. Ann Thorac Surg 2011; 92: 626-31. **[CrossRef]**
3. Arlt M, Philipp A, Voelkel S, Schopka S, Husser O, Hengstenberg C, et al. Early experiences with miniaturized extracorpo-

real life-support in the catheterization laboratory. Eur J Cardiothorac Surg 2012; 42: 858-63. **[CrossRef]**

4. Poonam Malhotra Kapoor, Manual of Extracorporeal Membrane Oxygenation (ECMO) in the ICU, First edition 2014.
5. Cheng R, Hachamowitch R, Kittleson M, Patel J, Arabia F, Moriquchi J, et al. Complications of extracorporeal membrane oxygenation for treatment of cardiogenic shock and cardiac arrest: a meta-analysis of 1866 adult patients. Ann Thorac Surg 2014; 97: 610-6. **[CrossRef]**
6. Gander JW, Fisher JC, Reichstein AR, Gross ER, Aspelund G, Middlesworth W, et al. Limb ischemia after common femoral artery cannulation for venoarterial extracorporeal membrane oxygenation: an unresolved problem. J Pediatr Surg 2010; 45: 2136-40. **[CrossRef]**
7. Adıbelli B, Ekstrakorporeal membrane oksijenizasyonu uygulanan hastaların değerlendirilmesi: Dört yıllık sonuçlarımız. Uzmanlık Tezi, Başkent Üniversitesi 2016.
8. Roussel A, Al-Attar N, Khaliel F, Alkhoder S, Raffoul R, Alfayyadh F, et al. Arterial vascular complications in peripheral extracorporeal membrane oxygenation upport: a review of techniques and outcomes. Future Cardiol 2013; 9: 489-95. **[CrossRef]**
9. Foley P, Morris RJ, Woo EY, Acker MA, Wang GJ, Fairman RM, et al. Limb ischemia during femoral cannulation for cardiopulmonary support. J Vasc Surg 2010; 52: 850-3. **[CrossRef]**