Pressure criterion for placement of distal perfusion catheter to prevent limb ischemia during adult extracorporeal life support

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Femoral venoarterial extracorporeal membrane oxygenation (ECMO) provides effective cardiopulmonary support for critically ill patients. However, distal leg ischemia is a significant complication after femoral artery cannulation. The clinical decision of in whom and when a distal perfusion catheter should be inserted to prevent limb ischemia remains controversial. We conducted a prospective study by measuring the blood pressure in the superficial femoral artery to select the patients at risk. From our data, we wished to develop a standardized method to prevent limb ischemia in femoral venoarterial ECMO.

Technique

We cannulated patients with a modified open Seldinger method. The femoral vessels were dissected out and the cannulas (BioMedicus cannula; Medtronic BioMedicus, Inc, Minneapolis, Minn) were inserted with a guidewire under direct vision. This method is particularly useful during cardiopulmonary resuscitation with impalpable femoral pulse. Because the surgical instruments are placed on our wheeled ECMO cart, this technique is now our standard procedure. Purse-string sutures could be placed around the cannula if possible to prevent bleeding. With this technique, femoral ECMO support can be started securely within 15 minutes.

After the hemodynamic status was restored by ECMO, the pressure in the superficial femoral artery, 2 to 3 cm distal to the cannulation site, was measured by direct puncture with a 23-gauge needle. If the mean pressure was below 50 mm Hg, a perfusion catheter was inserted distal to the cannulation site for limb perfusion. We chose an 8.5F, 13-cm Super Arrow-Flex central venous catheter (ARROW International, Reading, Pa) as the distal perfusion catheter. This catheter can be placed into the superficial femoral artery through the open Seldinger method as well. We used a short 0.25-inch tubing and the special connectors (LA 71 adapter kit; MINNTECH, Minneapolis, Minn) on both ends to

connect the ECMO arterial cannula and the distal perfusion catheter (Figure 1). The flowmeter (Transonic Systems, Inc, Ithaca, NY) was set on the 0.25-inch tubing to measure the leg perfusion flow.

Results

From June 2002 to December 2003, this protocol was applied to 26 patients receiving femoral endoarterial ECMO in our institute. In the cohort, 9 patients (34.6%) received the distal perfusion catheter. The duration for ECMO support was 140.7 ± 119.4 hours (range 18-442 hours). For these 9 patients, the flow through the perfusion catheter was 258.3 ± 58.6 mL/min (range 168-350 mL/min). If the flow decreased, we checked whether there was thrombosis in the circuit and replaced it if necessary. No patient in this cohort had limb ischemia. Seventeen patients (65.4%) could be separated from ECMO, and 14 patients (50.4%) survived to discharge.

Discussion

Distal perfusion from the arterial inflow cannula is a simple and well-accepted way to increase the circulation. However, selection criteria for placement of a distal perfusion catheter have never been documented. In our previous experience,¹ limb ischemia was noted in 16 of 61 (26.2%) of our adult cardiac patients. A distal perfusion catheter was placed when the clinical signs of ischemia developed, but compartment syndrome might occur after reperfusion started. In some centers,² a distal perfusion cannula is placed in every patient, but we think this is not necessary. We therefore conducted the prospective protocol to select high-risk patients to set up distal perfusion catheters.

Our proposed criterion (pressure less than 50 mm Hg) was based on that of critical limb ischemia. An ankle pressure of 50 mm Hg is generally accepted as threshold for limb ischemia.³ We choose the particular catheter (Arrow-Flex) because it is resistant to kink and does not require additional surgical instruments, such as clamps and knife, to place it. The blood flow through the catheter is 260 mL/min under 100 mm Hg according to the manufacturer. Because the resting blood flow in the superficial femoral artery of a normal resting leg is approximately 150 mL/min,⁴ the average measured flow of the catheter, 258 mL/min, is adequate for the distal limb.

Another method to perfuse the distal leg is cannulation through the vascular prosthesis,⁵ which is anastomosed to the femoral artery. Although this method can provide blood flow to both the body and leg, it is a relatively time-consuming and demanding technique. Blood oozing from the needle hole may be a significant

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Figure 1. Distal perfusion catheter (Arrow-Flex, 8.5F and 13 cm long) is connected to Luer syringe port of arterial cannula, with flowmeter applied on tubing.

problem in the heparinized patient. Axillary artery cannulation is an alternative method to avoid leg ischemia during ECMO, but it is more difficult and not suitable in patients under cardiac massage.

In conclusion, distal mean pressure less than 50 mm Hg is an appropriate criterion for suggesting to place a catheter for distal perfusion during femoral venoarterial ECMO.

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