Transformation of percutaneous venoarterial extracorporeal membrane oxygenation access to a safe peripheral arterial cannulation

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Venoarterial extracorporeal membrane oxygenation (ECMO) support is an accepted lifesaving approach for cardiogenic shock both in and, more recently, out of the hospital setting. In these circumstances percutaneous cannulation of the groin vessels is frequently used to initiate extracorporeal support and stabilize the patient. Inadequate arterial flow distal to the cannulation site can cause limb ischemia and significant morbidity.¹ A timely transformation of this percutaneous access to a safe peripheral arterial cannulation could possibly prevent the deleterious effect of distal limb ischemia.

SURGICAL TECHNIQUE

A curved vertical inguinal incision (leaving the cannula insertion site medially) is preferred. The femoral arteries are prepared for proximal and distal control, and the cannula and its entrance in the femoral artery are visualized (Figure 1, A). Two umbilical tapes are passed around the common femoral artery and secured with tourniquets. The tourniquets are then tightened (Figure 1, B). This maneuver ensures that the segment of the common femoral artery between the tourniquets, which contains the percutaneously inserted cannula, does not have any flow. A longitudinal arteriotomy is made and extended as appropriate to accommodate an end-to-side anastomosis between the vessel and a beveled 8-mm vascular prosthesis. The anastomosis is sewn in the usual manner (continuous suture of 5-0 polypropylene thread with a C1 needle; Figure 1, C). A new cannula is then introduced into the prosthesis and secured with ligatures. The distal tourniquet is loosened for retrograde de-airing, and the cannula is clamped. The proximal tourniquet is then released, and the prosthesis is perfused. Eventual anastomotic bleeding is thus controlled. The switch from the percutaneous cannula to the transprosthetic cannula is accomplished during a short interruption of the ECMO perfusion (usually within

FIGURE 1. The four major steps for transforming a percutaneous cannulation to a safe transprosthetic cannulation. See the text for a detailed description. A, Exposure and visualization; B, tourniquet placement. C, prosthetic anastomosis. D, recannulation through graft.

seconds). The distal tourniquet remains under manual control. The distal femoral vessels are controlled by means of bulldog clamps and the percutaneous cannula is extracted (Figure 1, D). The insertion site can be sutured directly, or the respective femoral artery can be reconstructed with

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appropriate surgical techniques. Depending on the clinical situation and judgment, a Fogarty maneuver can also be performed at this stage, eventually making use of the cannula insertion side. The wound is drained and closed in the usual manner.

RESULTS

We applied this technique in 3 male patients (62 ± 6 years). Of these, 2 required salvage and 1 urgent preventive venoarterial ECMO support in the catheterization laboratory. All presented with cardiogenic shock due to ST-segment elevation myocardial infarction. All underwent percutaneous transluminal coronary angioplasty of the proximal left anterior descending artery or the main stem of the left coronary artery. Perfusion cannulas (18F and 24F) were introduced percutaneously through the already wired groin vessels. Transformation to a transprosthetic cannulation was performed in all cases, either electively at the end of the percutaneous transluminal coronary angioplasty or after disappearance of the peripheral pulses (by Doppler ultrasonography) 8 and 22 hours after initiation of the venoarterial ECMO (urgent transformation). In neither cases were there any clinical signs of manifest tissue ischemia and no thrombotic material was retrieved from the peripheral arterial branches; relief fasciotomy was therefore not performed.

DISCUSSION

Prevention of distal limb ischemia is a clinical priority after percutaneous institution of venoarterial ECMO. The adequacy of the arterial perfusion distal to the cannulation site can be monitored clinically and by means of Doppler ultrasonography. Adequate arterial perfusion to the distal

limb should be established as soon as possible to prevent the deleterious consequences of distal limb ischemia.

Current techniques for distal perfusion after peripheral arterial cannulation²⁻⁵ consist of the introduction of an additional perfusion catheter in the distal artery. The effective distal perfusion flow can be inadequate, however, because it is determined by the resistance of the stopcock connection of the perfusion catheter to the circuit and of the catheter itself. After decannulation, the artery is left with two openings requiring care. The surgical technique proposed here ensures adequate distal perfusion, prepares a safe decannulation and stenosis-free reconstruction of the artery, and gives the surgeon the chance to reconstruct the insertion hole of the percutaneous cannula or the possibility of performing an embolectomy of the distal femoral arteries under undisturbed ECMO perfusion. This technique should be seen as an enrichment of the armamentarium and lower the threshold for a proactive approach toward prevention of distal limb ischemia in critically ill patients placed on percutaneous venoarterial ECMO.

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Correction of pectus excavatum through a minimally invasive approach with subxyphoid incision and 3-point fixation

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The development of the minimally invasive technique known as the Nuss procedure for pectus excavatum has clearly been a benefit to children with this chest wall deformity.¹ There have already been several modifications, and certainly additional modifications will be developed as the technique continues to be implemented. Many of these modifications have been developed in response to procedural complications. Cardiac and aortic lacerations have been described after minimally invasive repair of pectus excavatum.² Proposed solutions have included a subxyphoid