

Arterial Misplacement of a Femoral Central Venous Catheter Complicated with Acute Arterial Occlusion

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Femoral vein catheterization is often carried out during resuscitation and in critical care units. It is usually achieved via a blind, external landmark-guided technique, through manual localization of the femoral artery. However, this approach can be challenging in patients with severe shock because of absence or ambiguity of the arterial pulse. We report a case of inadvertent cannulation, with a large-bore catheter, of the right femoral artery, which was mistaken as a venous route for medication and massive transfusion. The large cannula caused direct mechanical obstruction, while intra-arterial medications induced vascular injury and vasospasm. Both factors led to thrombosis and occlusion of the right external iliac artery, thus jeopardizing the distal blood supply, and ultimately resulting in muscle necrosis of the involved limb, and the need for thrombectomy and extensive fasciotomy to salvage the extremity. This case highlights that correct placement of a central venous catheter should be clearly ascertained before the catheter is used for medical treatment, especially when catheterization is performed in shock status. [*J Chin Med Assoc* 2005;68(3):138-141]

Key Words: central venous catheterization, intra-arterial injection, thrombosis

Introduction

Femoral central venous catheterization is usually achieved with a blind, external landmark-guided technique. However, the femoral vein is not easily identified in patients with circulatory shock, in whom emergency insertion of a femoral central venous catheter can be challenging. Serious complications can occur with inappropriate technique or catheter misplacement.^{1,2} Here, we report a case of inadvertent cannulation, with a large-bore catheter, of the right femoral artery, which was mistaken for the femoral vein; medications and a massive transfusion were given via the misplaced catheter. The patient experienced acute thrombosis and occlusion of the right external iliac artery, which resulted in necrosis of the ipsilateral lower limb, and the need for emergency thrombectomy and extensive fasciotomy to salvage the involved limb.

Case Report

A 53-year-old woman was sent to our emergency department in profound shock. She presented with multiple deep and long cutting wounds, with skin defects over the scalp, neck and upper trunk, and active bleeding. She had lost consciousness and had rapid, shallow breathing. She was intubated immediately to secure the airway for assisted ventilation. The patient's pulse was weak, and her blood pressure could not be measured accurately using a pressure cuff. Her peripheral veins were not easy to cannulate because of considerable obesity and hypovolemic shock. Cannulation of the right femoral vein was attempted quickly to insert a large-bore catheter (8.5 Fr high-flow fluid administration set). With smooth blood return from the catheter on aspiration, 2 Y-type pumping sets (Abbott Y-type blood set with pump;

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Abbott Laboratories Ireland Ltd, Dublin, Ireland) were connected to the catheter for quick volume replacement by manual pressure; meanwhile, a pumping machine was used to deliver a dopamine infusion. Routine blood testing revealed a hematocrit of 20%. As bleeding persisted, the patient was sent immediately to the operating room for cessation of the bleeding and wound repair.

During the operation, electrocardiography showed sinus tachycardia, but pulse oximetry was not readable because of severe digital vasoconstriction. Peripheral arterial cannulation was difficult, so no blood pressure reading was available. Anesthesia was induced and maintained with ketamine and rocuronium bromide. During the first 3 hours of surgery, the patient continued bleeding and was hemodynamically unstable, so intravenous solutions, blood and various medications, including sodium bicarbonate, calcium chloride and vasopressors, were administered via the femoral catheter. After about 4 hours of operation, the patient's major wounds were repaired and blood pressure was retrieved to about 90/60 mmHg, with heart rate at about 120 beats per minute.

As rapid intravenous infusion was no longer urgently required, 1 lumen of the femoral catheter was switched to measure central venous pressure to evaluate volume status. However, typical arterial waveforms and high pressure readings were shown on the monitor screen, thus revealing that the catheter had been misplaced in the femoral artery instead of the vein. All infusions were stopped immediately. Meanwhile, to establish central venous access, a 3-lumen catheter (7 Fr) was cautiously inserted into the left femoral vein. Insertion was confirmed by waveforms and pressure readings. The misplaced catheter in the right femoral artery was left in place for a few moments as a reserve for invasive arterial pressure monitoring, in case of possible failure of the arterial line that had been established in a small artery. The operation lasted about 6 hours, and estimated blood loss was 8.6 L. Approximately the same volume of blood products, plus 4 L of crystalloid and colloid solutions, were administered; most were infused through the misplaced catheter in the right femoral artery. At the end of the operation, the patient's vital signs were stable (blood pressure, 108/66 mmHg; heart rate, 116 beats /minute), but body temperature was low at 33.1°C. All the patient's limbs were pale and cold, but no marked difference was noticeable between the right and left lower limbs. The patient was transferred to the intensive care unit (ICU) for close observation and ventilatory support.

In the ICU, the patient was draped well with warm packs to rewarm her body. The misplaced femoral

artery catheter replaced the brachial artery catheter for continuous pressure monitoring, because the latter device seemed to have failed. A plain kidney, ureter and bladder film taken at bedside showed that the tip of the right femoral artery catheter had been advanced into the right external iliac artery (Figure 1). Three hours after admission to the ICU, the patient regained complete consciousness and enough muscle strength for breathing. After extubation, she complained of numbness and pain over her right lower limb. A careful survey revealed that her right thigh and leg were cold and ashen with mottling cyanosis, which distinguished the limb from the left lower limb. The right dorsalis pedis and popliteal artery pulses could not be felt, and Doppler techniques failed to detect any blood flow.

An emergency angiography revealed complete obstruction of the right external iliac artery (Figure 2). This iatrogenic obstruction totally interrupted the major arterial blood flow to the right lower limb and resulted in severe ischemia, with some necrotic change. The misplaced catheter was thus removed immediately, but discoloration and bleakness of the limb remained unimproved. Arterial thrombosis was highly suspected, and emergency exploration of the right iliac-femoral artery was performed. A large number of blood clots



Figure 1. Plain kidney, ureter and bladder film showing arterial misplacement of a right femoral venous catheter, with the catheter tip advanced into the right external iliac artery.



Figure 2. Angiography showing total occlusion of the right external iliac artery (arrow).

was removed during Fogarty catheter thrombectomy. Muscle-compartment fasciotomies were also performed, and systemic heparinization was started. During the following 3 weeks, the patient underwent several procedures for tissue debridement and skin graft, and the injured limb was salvaged. Fortunately, the patient had an uneventful recovery without marked deformity.

Discussion

Femoral venous cannulation is usually achieved with a blind, external landmark-guided technique, which is easily done by manual localization of the femoral artery, in the femoral triangle inferior to the inguinal ligament, with needle insertion medial to the artery. However, when the arterial pulse is absent or ambiguous, as in our patient with profound shock, successful cannulation may be challenging. In our case, inadvertent cannulation of the femoral artery occurred, but was not recognized, since femoral arterial pressure and oxygen tension were rather low; this misled the emergency physician to believe that a right venous approach had been made, when in fact, a large-bore catheter had been inserted into the femoral artery. As our patient was in critical hypovolemic shock, the misplaced, but unrecognized, intra-arterial catheter was immediately used for blood transfusion and drug administration under pressure technique;

while this technique prevented backflow into the cannula tubing, it delayed recognition of the unintended arterial cannulation, which eventually led to a serious vascular complication.

Most series report that problems associated with femoral vein cannulation are few if a catheter of small size is used,³ thus indicating that cannula size may be an important determinant of vascular complications. In our patient, the misplaced, large-bore catheter remained in the right femoral artery for about 10 hours. Such a prolonged stay of a large cannula would cause mechanical obstruction of the vessel lumen and stasis of blood flow, which would increase the risk of thrombosis, especially in patients with existing hypotension and low blood flow. Further, the scientific literature indicates that vascular injury with serious complications can occur after intra-arterial injection of various drugs.⁴⁻⁶ In our patient, the misplaced catheter was mistakenly assumed to have created an intravenous route, via which various drugs, including ketamine, dopamine (continuously infused for several hours), sodium bicarbonate, and calcium chloride, were administered. Although not all of these drugs have their adverse effects well documented after intra-arterial injections, the potential risks of endothelial destruction, arterial vasospasm and thrombosis, with subsequent tissue injury, might be rational suppositions.⁷ Such detrimental vascular effects, together with mechanical obstruction from a large-bore catheter, would jeopardize the distal blood supply and possibly contribute to the formation of thrombus around the catheter. Indeed, as thrombosis progressed and extended in our patient, it resulted in total arterial occlusion and severe ischemic injury to the involved limb.

Intra-arterial blood transfusion has been used for the treatment of severe hypovolemic shock without major complications; however, most clinicians believe there are certain disadvantages associated with the transfusion process and therefore do not advocate such transfusion.⁸ In our patient, filtered blood was transfused into the right iliac artery rapidly and retrogradely by pressure pumping. This process would have impinged on the arterial wall and impeded free blood flow, and may have contributed to the vascular complication.

Initially, the misplaced intra-arterial catheter was not identified because of severe shock and the urgent need for large intravenous access. In the following resuscitative period, manual pressure pumping was used to overcome arterial retrograde flow, and fluid was infused without difficulty. In addition, there was a back-check valve in the Y-type pumping set that

prevented backflow in the tubing, and further delayed recognition of the unintentional arterial cannulation until several hours later. Hesitancy in removing the catheter immediately after recognition of its intra-arterial placement was another error, since the vascular complication may have been aggravated by prolonged blood-flow obstruction.

During the patient's first few hours in the ICU, she was well wrapped for body rewarming, and detailed re-evaluation of the peripheral circulation was neglected. The vascular complication was not found until the patient gained consciousness and mobilization, and complained of ischemic leg pain; therefore, correct diagnosis and timely treatment were further delayed. This event highlights that correct placement of a catheter is an essential prerequisite to the use of central venous access. Indeed, before use, correct placement should be ascertained by, for example, visual inspection of any pulsatile blood movement, the red appearance and gas analysis of aspirated blood, and waveform and pressure measurements by pressure transducer.⁹ Administering medication through a central venous catheter is not recommended until access to the central venous compartment has been confirmed. When arterial misplacement is identified, the catheter should be removed at once. If drugs likely to cause vascular injury are injected arterially, vasodilators, anticoagulants or thrombolytic agents should be administered to alleviate adverse effects.¹⁰

In conclusion, lower-extremity necrosis requiring thrombectomy and fasciotomy is a severe complication after femoral artery catheterization. In our case, both the misplaced, large-bore catheter and unintended intra-arterial drug administration may have been the major factors contributing to arterial thrombotic

occlusion. The diagnosis was delayed, in part, because of the physician's inexperience and negligence. This report highlights the need for, and importance of, vigilance during central venous cannulation. Whenever possible, and especially when catheterization is performed in shock status, proper placement of the catheter should be determined before it is used for medical treatment.

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