

A Sheared Catheter Fragment in the Wrist after Arterial Cannulation Attempt

– A Case Report –

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Continuous measurement of arterial pressure is frequently required in the perioperative management of critically ill patients and major surgeries. The complications following arterial cannulation include hematoma, thrombosis, ischemia, infection, aneurysm formation at the site of catheter insertion, and so on. The authors report a case of the sheared catheter during the arterial cannulation and the subsequent surgical removal of its remnant.

Key Words: arterial cannulation, complications, sheared catheter.

Percutaneous cannulation of an accessible artery allows continuous display of arterial pressure and repeated acquisition of blood samples for arterial blood gas analysis or other quantitative assays. Thus, it is frequently used in the perioperative management of critically ill patients and major surgeries, such as cardiovascular or neurosurgical operations and so on.

Arterial cannulation is performed in several superficial arteries, including the radial, ulnar, brachial, axillary, dorsalis pedis, posterior popliteal. The radial artery is chosen most frequently, because it is readily accessible, easy to maintain, and the hand has an extensive collateral circulation via ulnar artery, therefore possible complications were less common than other sites.¹⁻³⁾ Overall complications after an arterial cannulation include hematoma, thrombosis, ischemia, infection, and aneurysm formation at the site of catheter insertion.^{2,4-7)} Such complications may result in appreciable long-term injury, morbidity, prolonged length of hospital stay, and additional medical cost.

Here, we report a case of the sheared catheter during the arterial cannulation and the subsequent surgical removal of its remnant.

CASE REPORT

The patient was a 69 year-old man scheduled for laparoscopic peripheral segmentectomy of hepatocellular carcinoma. He had been on medication for hypertension and undergone a cholecystectomy under general anesthesia without incident two years ago.

Upon arrival in the operating room, ECG, noninvasive arterial pressure and pulse oximetry monitoring were established. Anesthesia was induced by target controlled infusions (TCI) using an Orchestra[®] infusion pump system (Fresenius vial, Brezins, France). Patients received propofol at a target effect site concentration (Ce) of 4 μ g/ml and remifentanyl at a target Ce of 4 ng/ml. After loss of consciousness and adequate manual ventilation, rocuronium 0.6 mg/kg was administered to facilitate orotracheal intubation. Anesthesia was maintained using remifentanyl and propofol. Patients were ventilated with oxygen and medical air (inspired oxygen fraction: 50%).

A right radial arterial cannulation was planned for intraoperative monitoring. The presence of collateral circulation was determined by modified Allen's test prior to the placement of the radial artery catheter. After cleansing with alcohol sponge, the right radial artery was punctured with a 20-gauge angio-catheter (Becton Dickson Korea Ltd., Seoul, South Korea) at a 45° angle proximally. The flash back chamber of the angio-catheter was filled with arterial blood in a moment, and then

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Fig. 1. Wrist CT scan identifying 1.2 cm catheter fragment within the subcutaneous tissue adjacent to the radial artery. (A) Coronal section, (B) Sagittal section, (C) Horizontal section. Arrow, remnant catheter fragment; Arrow head, radial artery.

the cannular sheath over the needle was attempted to advance. However, a resistance was felt and the sheath was not advanced further. Assuming that the tip of cannular sheath passed through the posterior wall of the artery, the needle was removed from the angiocatheter and a 5 ml syringe was attached to the cannular sheath hub. No arterial blood was aspirated into the syringe while the cannular sheath was withdrawn slowly. Before removal of the cannular sheath from the wrist, the anesthesiologist placed the needle carefully back into the sheath again and penetrated the anterior and posterior radial artery wall entirely. During trying again with the same procedure (removal of the needle from the angiocatheter, and then withdrawn of the catheter sheath and aspiration of blood slowly by the syringe attached to the cannular sheath hub), the cannula sheath was removed abruptly from the wrist and it was found that only 1.8 cm of catheter sheath was removed and about 1.2 cm of distal remnant was missing. Firm pressure was applied to the puncture site of right wrist and arterial cannulation was performed at left radial artery without difficulty. The pulse of right radial artery was palpated well and the right hand appeared pink and warm with an acceptable pulse oximetry signal at the right index finger. The ultrasound (US) imaging (Prosound SSD-3500 Plus, ALOKA CO., LTD., Germany) could not reveal the remnant catheter sheath at that time, but intact radial arterial flow was confirmed by US doppler. Judging that the risk of digital ischemia by the remnant sheath was a remote possibility, we decided to proceed the operation first, and then perform the additional examination postoperatively. During the intraoperative period, the color of hand was not changed and the pulse oximetry signal from the right index finger was taken properly and oxygen saturation was

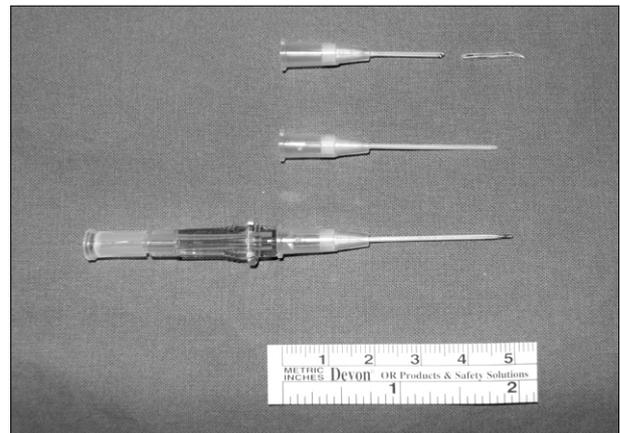


Fig. 2. Angiocatheter and its sheath used in the present case. Upper, sheared catheter sheath used in this case; Middle, original catheter sheath; Lower, original 20-gauge angiocatheter.

maintained $> 98\%$ with 50% inspired oxygen fraction supplement. Total operation time was 270 minutes and anesthesia time was 345 minutes.

After finishing the surgery, simple X-ray and CT of right wrist were taken. The remnant sheath was not shown in the X-ray finding, but the wrist CT revealed a retained 1.2-cm fragment located within the subcutaneous tissue adjacent to the radial artery at a depth of approximately 0.4–0.6 cm (Fig. 1).

Surgical removal was decided. Prior to the surgery, US imaging was performed again for the surface marking on the basis of the information of CT image. After sedation with propofol, skin incision was made under local anesthesia. The remnant sheath, located parallel to the radial artery, was removed without any complications (Fig. 2). The operation and anesthesia took 20 and 35 minutes, respectively. The patient

showed a rapid and uneventful recovery from both operations and had no problem regarding hand function when assessed 6 weeks after the operation.

DISCUSSION

Perioperative continuous and direct measurement of arterial pressure tends to increase as the expansion of old and medically ill patient population with more complex surgical procedures. The complications caused by the arterial cannulation are unpredictable and usually occur unexpectedly. Fortunately, the serious complication of radial artery cannulation is rare, therefore, it is regarded as high benefit and low risk procedure.^{2,8)}

Although sheared catheter sheath was a rare complication, similar cases have been reported. Moody et al.⁹⁾ reported that the 20-gauge arterial cannula was accidentally cut from the catheter hub on pulling it out from the left radial artery, and remnant catheter was surgically removed under the ultrasonography-guided localization like the present case. Shah et al.¹⁰⁾ reported that iatrogenic catheter damage occurred inadvertently by the needle during the suture to hold the cannula firmly. The detached fragment of the cannula was removed using the Fogarty catheter.¹⁰⁾

In this case, we suspected two causes explaining the breakdown of the catheter sheath. First, the reinserted needle could have damaged the catheter sheath. When the anesthesiologist was inserting the needle into the catheter sheath again, the sheath might not be straightened out within the wrist, so it had a chance to be torn by the needle tip. Although the sheath was not completely cut off at the moment, it could be severed by the process of withdrawal. Second, it is conceivable that the angiocatheter might have manufacturing defect. However, faulty catheter sheath is relatively rare and even if that is the case, it should have been detected before the catheterization or on the process of the first withdrawal. Therefore it is less likely to be the direct cause.

To identify the sheath fragment, X-ray, CT scan and ultrasonography were applied. The X-ray had no capability of differentiating the catheter sheath. CT scan and ultrasonography were useful to distinguish the cannular sheath from the surrounding tissue. Ultrasonography in a situation like this was recommended for a rapid and non-invasive assessment at the bedside.¹¹⁾ We also consider that ultrasonography is more convenient than CT scan in real time imaging and exact localization of fragment for surgical exploration. However, the pre-

sumption is that proper frequency of US should be set for finding the catheter sheath. High frequency transducer probe (8–12 MHz) is usually chosen for the superficial structure distinction¹²⁾ such as this case, and Moody et al.⁹⁾ reported a successful removal of the retained arterial cannula fragment under the 5–10 MHz US-guided localization and emphasized its usefulness. Although the exact frequencies of US were not recorded in this case, it was thought that the cause of non-visualization of catheter sheath on initial US imaging might be ascribed to the inappropriate frequency. If proper high frequency ultrasonography was applied, the catheter fragment could be found easily and X-ray or CT scan might not be required. CT scan may be suitable for the next step evaluation when the remnant catheter sheath is not found by ultrasonography around the puncture site or it is necessary to distinguish the arterial wall from the catheter.

Although the remnant sheath was located outside of the vessel and there were no other complications in our patient, safety measures such as checking color of hand, pulse oximetry signal and Allen's test were not enough to rule out the ischemic damage caused by radial artery injury. Clearly, multiple attempts will increase the risk of arterial injury due not only to the direct trauma but also to vasospasm. However, ischemic damage has been reported even in the cases of successful arterial cannulation on the first attempt^{3,13)} because the blood supply of the palmar arch has several variations. If the remnant fragment was located completely within the radial artery and migrated to the distal artery, it could result in a serious complication. That must be localized by radiologic and angiographic evaluations and retrieved immediately. It was reported that the detached catheter fragment was removed from the radial artery proximal to the insertion point using the Fogarty embolectomy catheter.¹⁰⁾ Small peripheral arteries are beyond the reach of radiologic intervention and therefore surgical removal may be required.

As the present case has shown, when the catheter sheath is cut during the arterial cannulation, it is necessary to check the location of the retained fragment in the cannulation site first of all, and then to measure and compare the blood circulation of the affected hand. In addition, if blood circulation seems inappropriate, foreign body removal should be the first step to take and close observation should be kept on the affected hand during the following period. Another lesson of this case is that we had better use a new angiocatheter or reinsert the angiocatheter needle carefully into the catheter sheath after its complete withdrawal from the patient's wrist.

REFERENCES

- 1) Cousins TR, O'Donnell JM: Arterial cannulation: a critical review. *AANA J* 2004; 72: 267-71.
- 2) Brzezinski M, Luisetti T, London MJ: Radial artery cannulation: a comprehensive review of recent anatomic and physiologic investigations. *Anesth Analg* 2009; 109: 1763-81.
- 3) Wallach SG: Cannulation injury of the radial artery: diagnosis and treatment algorithm. *Am J Crit Care* 2004; 13: 315-9.
- 4) Park CH, Kim BI, Kang WJ: Pseudoaneurysm following cannulation of radial artery in cerebral aneurysm patient. *Korean J Anesthesiol* 2000; 38: 559-62.
- 5) Scheer B, Perel A, Pfeiffer UJ: Clinical review: complications and risk factors of peripheral arterial catheters used for haemodynamic monitoring in anaesthesia and intensive care medicine. *Crit Care* 2002; 6: 199-204.
- 6) Durie M, Beckmann U, Gillies DM: Incidents relating to arterial cannulation as identified in 7,525 reports submitted to the Australian incident monitoring study (AIMS-ICU). *Anaesth Intensive Care* 2002; 30: 60-5.
- 7) Kim SS, Han SH, Suh MG, Yu SC: Finger necrosis following percutaneous radial artery cannulation: a case report. *Korean J Anesthesiol* 2008; 54: 598-602.
- 8) Slogoff S, Keats AS, Arlund C: On the safety of radial artery cannulation. *Anesthesiology* 1983; 59: 42-7.
- 9) Moody C, Bhimarasetty C, Deshmukh S: Ultrasound guided location and removal of retained arterial cannula fragment. *Anaesthesia* 2009; 64: 338-9.
- 10) Shah US, Downing R, Davis I: An iatrogenic arterial foreign body. *Br J Anaesth* 1996; 77: 430-1.
- 11) Ball DR, Stott SA, Rouse R: Locating an arterial foreign body by ultrasonography. *Br J Anaesth* 1996; 77: 811.
- 12) Sites BD, Brull R, Chan VW, Spence BC, Gallagher J, Beach ML et al: Artifacts and pitfall errors associated with ultrasound-guided regional anesthesia. Part I: understanding the basic principles of ultrasound physics and machine operations. *Reg Anesth Pain Med* 2007; 32: 412-8.
- 13) English LA, Maye JP, Dalton-Link MT: Hand ischemia associated with profound hypotension and radial artery catheterization in a pediatric patient: a case report. *AANA J* 2003; 71: 41-3.