Radial neuropathy following arterial line removal: A rare complication from a routine ICU procedure

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Abstract
Radial artery thrombosis is a rare complication of cannulation. There are no reported cases of acute thrombosis and severe acute neuropathy in the setting of cannula discontinuation. We report a case of acute radial nerve mono-neuropathy following thrombosis after radial arterial line removal. The thrombus was immediately evident on exam and diagnostic imaging after cannula discontinuation. The patient was consented and promptly taken to OR for immediate repair. Mild radial neuropathy persisted despite immediate repair. Immediate recognition of signs and symptoms is essential for diagnosis and management, especially in the high-risk population.

Keywords
Radial artery, thrombosis, radial neuropathy, radial artery line

Date received: 26 September 2017; accepted: 30 January 2018

Introduction
Radial artery cannulation is a reliable and safe method for continuous hemodynamic monitoring in the intensive care setting. However, severe cases of radial artery thrombosis can cause ischemic loss of limb. In rare occasions when flow is restored, ischemic neuropathy can persist. We present a case of acute radial artery thrombosis and radial neuropathy after discontinuation of cannula. Informed patient consent was obtained for publication of this case report including images.

Case presentation
A 65-year-old male was referred to our center for treatment of severe coronary artery disease. The patient had a medical history significant for extensive tobacco use, diabetes, hypertension, and peripheral arterial disease requiring an aorto-bi-femoral bypass, lower extremity bypass, and left carotid endarterectomy. He reported having intermittent right upper extremity numbness for over 5 years without weakness. After completion of the preoperative cardiac surgery evaluation, the patient underwent coronary artery bypass using his left internal mammary artery in addition to a saphenous vein graft to re-perfuse his left anterior descending and obtuse marginal coronary arteries, respectively. Prior to his operation, a left radial artery cannula was placed by an experienced anesthesiology staff for close hemodynamic monitoring. A 10 cm 20-gauge arterial cannula was placed under ultrasound guidance after the first attempt. There were no intra-operative issues with the arterial cannula, and it remained in place when the patient was transferred to the intensive care unit for recovery. On postoperative day 1, arterial cannula was discontinued, by first disconnecting the IV from pressure bag followed by immediate

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removal of the cannula and non-occlusive digital pressure for 5 min. The patient immediately complained of left-hand numbness and weakness. On examination, he had loss of left radial artery pulse and poikilothermia. Noninvasive vascular studies showed occlusion of the left radial artery, proximal peak systolic velocity (PSV) of 10 cm/s, and no distal flow at the wrist with absence of digital pressures (Figure 1). There was a patent ulnar artery feeding the palmar arch and no other clinically significant lesions in the subclavian, axillary, or brachial arteries. After obtaining surgical consent, an emergent cut-down and open thromboembolectomy under local anesthesia and sedation was performed within 2 hours of initial consultation. A 5 cm fresh thrombus was removed via an arteriotomy and several passes of fogarty balloons. We elected to repair the arteriotomy with a bovine patch angioplasty. Although vein patch angioplasty might have been a better option, both lower extremity saphenous veins were used in previous vascular and cardiac operations and the patient did not have adequate upper extremity veins. Postoperatively, the patient had return of his left radial pulse; however, he had persistent weak left wrist extension, finger extension at the metacarpophalangeal joint, and thumb extension which were graded as 2/5 on the Medical Research Council (MRC) scale.5–7 Thumb range of motion, finger and wrist flexion, hand grasp were all 4/5, as well as an intact forearm supination and pronation (Figure 2). Sensation to pinprick and light touch in the left hand was intact. The examination was consistent with involvement of the deep branch of the radial nerve in the forearm and the posterior interosseous nerve.

**Discussion**

Continuous hemodynamic monitoring in critically ill patients can be safely and effectively performed through arterial cannulation. Rates of complications, specifically arterial thrombosis, have been variable and reported to range from 10% to 40% in different case series.1,3,4 Some reports have suggested that smaller gauge cannula can decrease the risk for radial artery thrombosis; however, they may provide lower quality signals.8,9 Management of this complication is dependent on the patient’s symptoms and severity of the underlying comorbidities. As such, traumatic radial artery thrombosis has been treated with several modalities including thrombolysis, anticoagulation, open repair, or endovascular therapy.10

In the case of our patient, he underwent preoperative screening utilizing the Allen11,12 bedside exam and the procedure was uncomplicated with a single needle pass under ultrasound guidance. We believe that during the cannulation process, there was a traumatic dissection flap that remained stented while the arterial cannula was in place. Upon removal of the cannula with digital compression to prevent a
hematoma or pseudoaneurysm, the distal radial artery throb-
bosed. Due to his recent cardiac surgery, endovascular lysis
therapy would have been high risk of re-bleeding, as such we
opted for open exploration and repair under local anesthesia
and sedation. The patient’s hand was warm with resolution
of numbness and pain postoperatively; however, he contin-
ued to complain of weakness.

Although radial artery thrombosis after cannulation is not
an uncommon complication, persistent radial neuropathy after
reperfusion is not commonly reported. To our knowledge, this
is the first case reported in the literature of radial artery throm-
bosis after removal of an arterial cannula. It is also the first
case that the arterial thrombosis is associated with a severe and
acute onset radial neuropathy. Data on radial artery occlusion
and associated neuropathies mainly come from larger cardiac
surgery series. These series report long-term sensory neuropa-
thies after harvesting radial arteries for coronary artery
bypasses without any significant motor symptoms.8,12 These
events are also well documented in patients with Arterio-
Veinous (AV) fistulas causing ischemic steal syndrome. Steal
syndrome develops in 2%–20% of patients with AV fistulas
and presents with paresthesia, pain, hand stiffness and pallor,
and diminished sensation on physical examination.13 Radial
nerve sensory and motor neuropathy following arterial line
removal is an extremely rare complication and the suggested
mechanism is embolic occlusion of the distal radial artery and
its branches leading to ischemia. Ischemic neuropathies can
occur in patients who have risk factors for vascular disease
such as diabetes mellitus, hypertension, obesity, and hyperli-
pedia, as is the case of our patient.

In retrospect, the patient did have a normal Allen test per-
fomed by anesthesia professional prior to cannulation. This,
however, did not predict ulnar artery adequate blood supply
to the affect hand. In addition to the Allen test, the Barbeau
test14 can better predict palmar flow and anticipate sympto-
matic complications in cases of radial artery injury. It is
essential to emphasize that both of these exams do not pre-
vent possible complications. In high-risk populations, such
as our patient, vigilant monitoring is key for early identifica-
tion and management of arterial injury.

Figure 2. Neurological exam of left-hand post repair. At 2-week postoperative follow-up, the wound is well healed (a). The patient
still has weak wrist extension, finger extension at the metacarpophalangeal joint, and thumb extension (2/5 MRC) (b). Thumb adduction,
abduction and flexion, finger, and wrist flexion were 4+/5, grasp +4/5, and forearm supination and pronation were intact. Sensation to
pinprick and light touch in left hand was intact.

Conclusion
Radial artery cannulation is a routine procedure performed in
critical care settings and complications can occur as a con-
sequence. Bedside evaluation of upper extremity ulnopalmar
flow allows providers to predict risk of symptomatic complica-
tions if radial artery injury were to occur. However, it does not
predict occurrence of the complication itself. In addition to
limb loss, a very rare complications of radial artery occlusion
includes focal sensory and motor neuropathies. Patients with
extensive comorbidities for peripheral vascular disease may be
at increased risk for such complications. As is the case in this
scenario, vigilant monitoring led to early detection of compri-
mation and immediate intervention for revascularization.

Declaration of conflicting interests
The author(s) declared no potential conflicts of interest with respect
to the research, authorship, and/or publication of this article.

Funding
The author(s) received no financial support for the research, author-
ship, and/or publication of this article.

Informed consent
Written informed consent was obtained from the patient(s) for their
anonymized information to be published in this article.

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