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CASE REPORT

Pseudoaneurysm with Median Nerve Injury Caused by Right Radial Artery Puncture: A Case Report

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Abstract

Background: Pseudoaneurysm with median nerve injury is a serious complication of radial artery puncture. It is very important to summarize the prevention and treatment experience of this complication through case discussion.
Case report: A 66-year-old woman was admitted to the hospital because of "paroxysmal chest tightness and suffocation for 5 days." Coronary angiography was performed. During insertion of the arterial sheath, the patient experienced severe pain in the right forearm, which radiated to the palm. The puncture sheath did not return blood after the sheath core was withdrawn. The sheath was removed and local compression was used to stop bleeding. There was no obvious bleeding at the puncture point, and the compression was removed 6 hours after the procedure. Local swelling and increased tension were seen in the right forearm. At the 1-week follow-up she exhibited swelling, high local tension, small blisters, and bluish-purple skin of the right forearm, with an acceptable right radial artery pulsation. She had severe pain in the affected limb, which radiated to the thumb, index finger, and middle finger.
Case discussion: We discuss the causes of and treatment measures for pseudoaneurysm with median nerve injury caused by radial artery puncture.

Keywords: Puncture; radial artery; median nerve; complications

Patient Consent

We declare that patient consent was obtained and that all reasonable steps have been taken to maintain patient confidentiality, including illustrations, which have been anonymized as far as possible.

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Case Presentation

A 66-year-old woman was admitted to the Department of Cardiology, Langfang People's Hospital, on May 20, 2020, because of "paroxysmal chest tightness and suffocation for 5 days." She reported chest tightness and suffocation after activity over the 5 days before admission, accompanied by dizziness, fatigue, sweating, and left limb numbness, but without chest pain. She had a history of smoking for 2 years (average of ten cigarettes per day), but had quit smoking

more than 30 years previously. She had no history of hypertension, diabetes, or stroke.

On examination at admission, she had a heart rate of 85 beats per minute and blood pressure of 149/77 mmHg. Breath sounds in both lungs were clear, without any dry or wet rales. Her heart rhythm was regular with no pathological murmur in the valve auscultation area. Her abdomen was soft, her liver and spleen were not palpable, and there was no lower limb edema. Her admission electrocardiogram was normal without obvious ST-T changes. Echocardiography showed a left atrium size of 33 mm, left ventricle size of 43 mm, and left ventricular ejection fraction of 61%. The ventricular wall motion range was normal, with no obvious value structure abnormalities. Chest computed tomography showed bronchiectasis of the upper and lower lobes of the left lung and the lower lobe of the right lung, with local chronic lesion formation, scattered chronic inflammatory changes in the middle and lower lobes of the right lung and in the left lung, upper lobe lingual nodules in the right lung, and small nodules in the anterior basal segment of the left lung. There were no abnormalities in routine blood and biochemical examination findings after admission. Our initial diagnosis was coronary heart disease involving unstable angina.

Coronary angiography was performed on May 25, 2020. After right radial artery puncture, the blood returned from the puncture needle "dripping" rather than "gushing". During insertion of the arterial sheath, the patient experienced severe pain in the right forearm, which radiated to the palm. The puncture sheath did not return blood after the sheath core was withdrawn, indicating that the sheath may be located in the false lumen of the blood vessel. The sheath was removed and local compression was used to stop bleeding. There was no obvious bleeding from the local puncture point after 5 minutes. The radial artery was punctured again 2 cm above the original puncture point and the sheath was successfully inserted. Coronary angiography showed a left-dominant type of coronary artery distribution, with 70% tubular stenosis in the middle of the anterior descending branch, 60% tubular stenosis in the middle of the circumflex branch, and TIMI (Thrombolysis in Myocardial Infarction) grade 3 blood flow in the distal region.

After consent had been obtained from the patient's family members, the fractional flow reserve (FFR) was measured at the middle anterior descending branch (FFR 0.82) and the middle circumflex branch (FFR 0.96) lesions (Figure 1). The sheath of the right radial artery was removed immediately after the procedure. A compression device was placed on the puncture site to stop bleeding and the puncture point was compressed with an elastic bandage. There was no obvious bleeding at the puncture point and the compression was removed 6 hours after the procedure. Local swelling and increased tension were seen in the right forearm. The skin temperature and color were normal, with a good right radial artery pulse. The right forearm was compression-wrapped in an elastic bandage for 2 days before removal. The patient was discharged with medicine.

At the 1-week follow-up she exhibited swelling, high local tension, small blisters, and bluish-purple

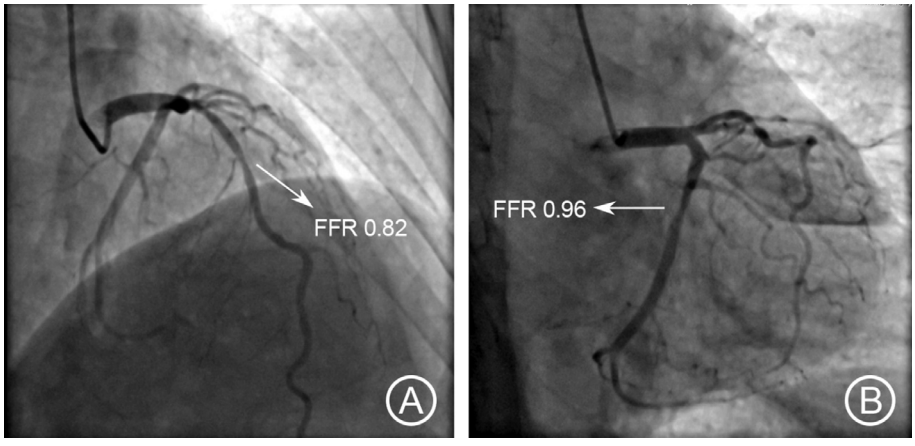

Figure 1 Coronary Angiography of the Patient.
FFR, fractional flow reserve. (A) A 70% tubular stenosis can be seen in the middle of the anterior descending branch, and FFR value of the lesion is 0.82. (B) A 60% tubular stenosis can be seen in the middle of the circumflex branch, and FFR value of the lesion is 0.96.

skin of the right forearm, with an acceptable right radial artery pulsation (Figure 2A–C). She had severe pain in the affected limb, which radiated to the thumb, index finger, and middle finger. She found it difficult to fall asleep at night. Polysulfonic mucopolysaccharide cream was applied topically to the affected area, and she was prescribed orally administered ibuprofen sustained-release capsules for pain relief. At the 2-week outpatient follow-up, she reported that the affected area remained swollen and painful, with no significant relief from the prior follow-up. The radiation pain was obvious. Physical examination showed reduced skin ecchymosis of the affected limb and slightly reduced swelling (but local tension), normal arterial pulsation, and no local vascular murmur. Pulsation of the right radial artery was normal, the radial sensation of the right arm was slightly reduced, and abduction of the thumb was slightly restricted. Ultrasonography of the right forearm blood vessel showed a hypoanechoic region next to the middle and distal parts of the right radial artery, while the surrounding muscle layer had an uneven echo. Color Doppler flow imaging showed thinner blood flow between the radial artery and the hypoanechoic region, which contained a small amount of red and blue blood flow. Pulsed wave Doppler imaging showed a biphasic and bidirectional blood flow spectrum at the fistula. Ultrasonography showed signs of a pseudoaneurysm (Figure 3).

Figure 2 The Patient's Right Forearm Puncture Site.
(A, B) 2 days after operation. (C) 2 weeks after operation. (D) 2 months after operation.

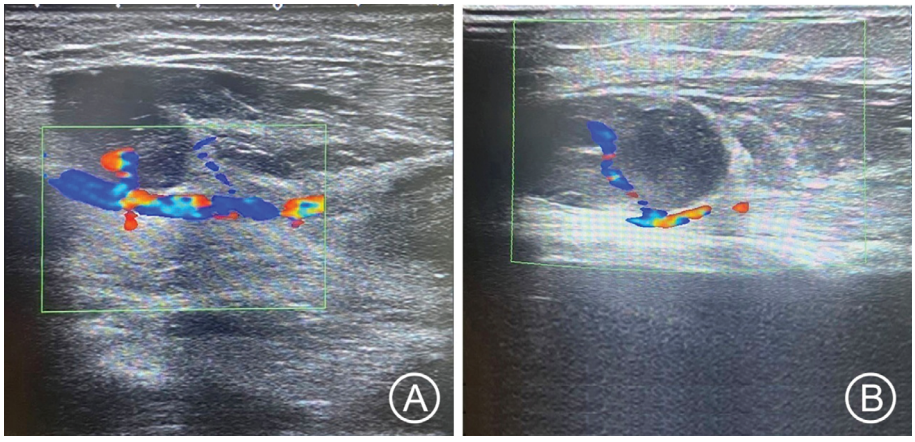

Figure 3 Ultrasound Images of the Blood Vessel in the Patient's Right Forearm.
(A) There is a breach at the right radial artery puncture site, and (B) the blood continues to leak.

Hand surgery consultation suggested that the puncture needle may have damaged the right median nerve, although carpal tunnel syndrome was not excluded. Conservative treatment and observation were recommended because of the short time from the puncture. Use of orally administered aspirin was discontinued, while symptomatic treatments were continued for pain relief and sedation as required, and vitamin B and methylcobalamin were used for neurotrophic therapy.

At the 2-month outpatient follow-up, the hematoma on the right forearm was completely absorbed and there was no skin bruising, local swelling, or pain. The radial sensation of the thumb, index finger, middle finger, and ring finger of the affected limb had disappeared, with slightly restricted thumb abduction (Figure 2D). The patient was asked to perform functional strengthening exercises. However, the affected side has not yet recovered.

Discussion

Transradial artery puncture is currently the main approach for interventional treatment of coronary heart disease [1]. Indeed, according to the National Center for Cardiovascular Quality Control [2], the radial artery route accounts for more than 90% of interventional treatments for coronary heart disease, including emergency direct percutaneous coronary interventions. Compared with the femoral artery approach, transradial artery puncture can increase patient comfort, encourage early movement out of bed, shorten the hospital stay, and reduce hospitalization costs [3]. Intubation via the radial artery is also very safe. With the standardization of intubation technology and use of peripheral vascular ultrasound technology, the incidence of vascular complications via the radial artery approach is approximately 2.36% [4]. Complications of the peripheral approach include hematoma, arteriovenous fistula, pseudoaneurysm, radial artery injury, perforation, radial artery occlusion, and rare compartment syndrome [5].

During the first radial artery puncture in our case, the puncture needle was located in the subintimal lacuna of the blood vessel. When the vascular sheath was inserted, the tip of the sheath core penetrated the vessel wall, passed into the extravascular lacuna, and damaged the adjacent median nerve. Because the patient did not stop using aspirin, the pores in the blood vessel wall penetrated by the sheath core continued to bleed despite compression bandaging. This continued bleeding caused the formation of local pseudoaneurysms, resulting in increased volume of the carpal tunnel. As the pressure in the carpal tunnel increases, the median nerve is compressed, causing radiation pain in the affected area along the median nerve distribution area.

Ultrasonography is useful for distinguishing between a false aneurysm and a hematoma. In our case, the bleeding was rapid because of arterial wall rupture and use of oral antiplatelet drugs, which reduce the coagulation time. As the continuously flowing blood was wrapped in a bandage, this formed a boundary with the surrounding tissues. Because the blood from the radial artery continued to enter the tissue at high speed through the breach, color Doppler ultrasound imaging showed blood flow bundles in the radial artery and the wrapped hematoma, with alternating red and blue blood flow signals between the hematomas. The frequency spectrum at the fistula was characterized as "biphasic and bidirectional," indicating the formation of a pseudoaneurysm. Hematoma formation is defined as cessation of blood flow into the interstitial space following blood coagulation at the breach or thrombosis in the hematoma that covers the breach (Figure 3). After use of antiplatelet drugs had stopped and neurotrophic and other treatments had been provided, bleeding at the vascular injury site stopped and the wound gradually healed. The swelling of the affected forearm was reduced after the hematoma had been gradually absorbed. Finally, the subcutaneous hemorrhage was gradually absorbed, although there was some remaining damage to the median nerve.

The median nerve in the axillary region is formed by the lateral and medial bundles of the brachial plexus. It runs along the biceps in the arm (accompanied by the brachial artery), descends to the elbow, passes down through the pronator teres muscle between the humeral head and the ulnar head, enters the distal end between the inner and outer heads of the superficial digital flexor muscle, and then descends. In the middle and distal segments of the forearm, the median nerve is always located in the deep layer of the superficial digital flexor muscle. On the wrist, the median nerve is slightly

superficial, located under the palmar longus tendon and slightly radial, and then passes through the carpal tunnel and is distributed to the palm. The nerve fibers of the lateral tract of the median nerve innervate mainly the flexor carpi radialis and pronator teres muscles, and contain more sensory fibers distributed to the hand. The nerve fibers of the medial tract of the median nerve innervate mainly the palmar longus muscle, all of the flexor muscles, the abductor pollicis brevis, the opponens pollicis, the flexor pollicis brevis, the superficial head of the adductor pollicis, and the first and second lumbrical muscles, while a small number of sensory fibers branch to the hand. The forearm section of the median nerve branches into the interosseous volar nerve, innervating the flexor pollicis longus, the index finger, and deep muscle (pronator quadratus) of the middle finger flexor.

Median nerve injury manifests itself as inability to pronate the forearm, weak wrist flexion, inability to flex the thumb and index finger, inability to oppose the thumb, atrophy of the outer thenar muscle, and a flat palm. Sensory disturbances are also evident in the radial half of the thumb, index finger, middle finger, and ring finger (Figure 4). Nerve damage caused by radial artery puncture may cause numbness and dullness. However, median nerve damage during radial artery puncture is rare, while it is more common in brachial artery puncture [6, 7]. Our patient showed recovery of normal motor function in the right hand 2 months after the procedure, although hypoesthesia in the median nerve distribution area remained, which may be related to puncture needle injury or damage to the inner core of the sheath. The repair period for nerve damage can range from 3 to 8 months. Some nerve damage can be completely restored to normal. However, in severe cases, the damaged nerve may be repaired by surgery. B-mode ultrasonography, magnetic resonance imaging, or electromyography is useful for diagnosis. A longer follow-up time is required in our patient to assess whether there is nerve recovery.

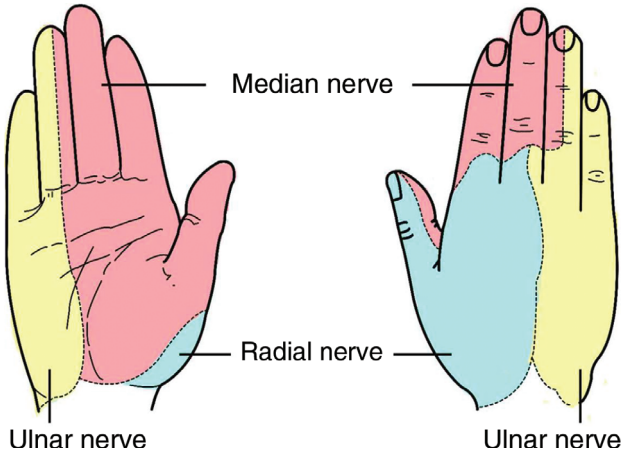

Figure 4 Nerve Distribution in the Hand.

On the basis of the diagnosis and treatment of our patient, we suggest the following considerations. First, if blood flow through the puncture needle is not smooth during radial artery puncture, the sheath should be inserted slowly. In particular, if the patient exhibits severe pain in the forearm during sheath insertion, this may indicate that the puncture needle or guidewire is located in the subintimal false cavity (i.e., the vascular endothelium without sensory nerve endings does not produce pain). Next, if no stent implantation is required after completion of coronary angiography, use of antithrombotic drugs must be stopped for several days if the patient experiences a forearm hematoma. Alternatively, in patients who require continued use of antithrombotic drugs, initiation should be delayed until the bleeding has stopped and the hematoma has been absorbed. Finally, when numbness, pain, other sensations, or movement obstacles occur along the nerves after surgery, the possibility of peripheral nerve damage should be considered. Thus, timely peripheral vascular ultrasound examinations should be performed, as well as consultation with relevant departments and use of appropriate treatments.

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Conflicts of Interest

We confirm that the article has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of the authors of the article has been approved by all of us. We confirm that we have

given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property.

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