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CASE REPORT

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Mediastinal and thoracic hematoma following transradial cerebral angiography: a case report

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Abstract

Background Cerebral angiography through the transradial approach (TRA) is associated with a low risk of complications, but in rare cases, these complications can be life-threatening.

Case presentation A 56-year-old female patient was admitted for transradial cerebral angiography due to the complaint of right limb weakness and the diagnosis of cerebral infarction and cerebral artery stenosis. During the procedure, the patient coughed with expectoration and complained of throat discomfort, palpitations, and pains in the right shoulder and back. Emergency CT scan indicated hematoma in the middle mediastinum and the right thoracic cavity, and perforation of a branch of the subclavian artery was highly suspected. Subclavian artery angiography was conducted immediately, which revealed a patchy contrast medium overflow in a branch of the right costocervical trunk. Selective endovascular occlusion therapy was performed successfully with gelfoam particles and placement of 2 microcoils. At 12 days after cerebral angiography, the patient recovered well and was discharged from the hospital.

Conclusion Mediastinal and thoracic hematoma may occur due to vessel perforation during TRA cerebral angiography, in which guidewire advancement must be cautious. Early detection and appropriate countermeasures can reduce the severity of vascular perforation and subsequent hematoma.

Keywords Cerebral angiography, Mediastinal hematoma, Thoracic hematoma, Complications, Transradial approach, Case report

Background

The development of neurointerventional devices has enabled surgeons to perform most of the cerebrovascular interventional operations for either diagnostic or therapeutic purposes through the transradial approach (TRA) [1, 2]. Compared to the more conventional transfemoral approach (TFA), the TRA is associated with a lower risk of complications, shorter hospital stay and better patient satisfaction [3–5]. But in rare cases, TRA might still lead to life-threatening deep vascular complications, including perforation of the brachiocephalic trunk (BCT), the internal mammary artery (IMA), and the thyrocervical trunk (TCT). Herein we report a case of serious mediastinal and thoracic hematoma following transradial cerebral angiography and its successful management. This case is reported according to CARE guidelines.

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Case presentation

A 56-year-old female patient with a history of hypertension and diabetes mellitus was admitted to the Department of Neurology of our hospital due to the complaint of weakness of the right limbs. Upon admission, the patient had a normal blood pressure (119/75 mmHg). Neurological examination showed decreased muscle strength in the right upper and lower limbs of grade 4 assessed using the Medical Research Council (MRC) scores. Magnetic resonance imaging (MRI) revealed subacute cerebral infarction in the left basal ganglia-radiocoronal region (Fig. 1). Computed tomography angiography (CTA) demonstrated multiple atherosclerotic stenoses in the head and neck with severe stenosis in the left middle cerebral artery, which was considered to cause cerebral infarction. To more accurately evaluate the conditions of cerebral vascular stenosis, cerebral blood flow and collateral circulation, the patient underwent cerebral angiography through the TRA on the third day after admission. A 6 French (Fr) sheath was inserted into the right radial artery, and a 0.035 inch ×260 cm, angled, J-type Radifocus hydrophilic guidewire (Terumo, Tokyo, Japan), a 5 F pigtail catheter (Cordis, Miami Lakes, USA) and a 5 F Sim2 catheter (Cook, Bloomington, USA) were used for cerebral angiography. During the procedure, resistance was felt when the guidewire entered the BCT. The guidewire was then withdrawn, and after adjustment of its direction, was further advanced into the ascending aorta without experiencing resistance. With guidance by the hydrophilic guidewire, the pigtail catheter was placed in the ascending aorta for angiography of the aortic arch and the arteries above the arch, followed then by placement of the Sim2 catheter for angiography of the bilateral carotid arteries and the left subclavian artery. During the process, the patient coughed with expectoration and complained of palpitations, throat discomfort, and pains in the right shoulder and back. Immediate physical examination showed that the patient had clear consciousness with arterial oxygen saturation (SaO_2) of 100%, a pulse rate of 135 bpm (105 bpm when entering the operating room), blood pressure of 186/100 mmHg, and tenderness near the right scapula. The initial consideration was allergic reactions to the contrast agent. The angiography procedure was thus aborted and 5 mg dexamethasone was administered intravenously. Review of the imaging results showed no signs of vascular dissection or contrast agent extravasation in the BCT or the right subclavian artery (RSCA) (Fig. 2A). After cerebral angiography, the patient reported partial relief of shoulder and back pain, and her heart rate dropped to 125 bpm. Emergency computed tomography (CT) scan indicated hematoma in the middle mediastinum with a small amount of blood in the right thoracic cavity (Fig. 2B, C). Perforation of a branch of the RSCA was therefore highly suspected. We reviewed the angiogram of the aortic arch and found contrast agent extravasation from a small branch of the RSCA (Fig. 2A). Right brachial artery puncture was performed immediately, a 5 F arterial sheath was inserted, and a 5 F Vert catheter (Merit Medical, Utah, USA) was placed at the proximal part of the RSCA with the guidance of a 0.035 inch ×150 cm, angled, J-type Radifocus hydrophilic guidewire (Terumo, Tokyo, Japan). Emergency RSCA angiography revealed a patchy overflow of the contrast agent in a branch of the right costocervical trunk (RCCT), indicating the presence of hemorrhage (Fig. 2D, E). Instantpass™ 2.7 F microcatheter (APT Medical, Hunan, China) and guide wire LMGW180S (MicroPort, Jiaxing, China) were used for super selection of the bleeding artery, and the lesion was confirmed again by angiography. Approximately 1/10 bottle of gelfoam particles (particle size of 350 µm) (Alicon, Hangzhou, China) and 1/20 bottle of gelfoam particles (710 µm) (Alicon, Hangzhou, China) were used for embolization of the perforated artery. Selective endovascular occlusion therapy was performed successfully with the gelfoam particles and placement of 2 MWCE-18 S-3-2 microcoils (0.46 mm*3–2 mm*2.0 mm) (Cook, Bloomington, USA; Fig. 2F). Subsequent angiogram confirmed the absence of contrast agent extravasation after the occlusion therapy.

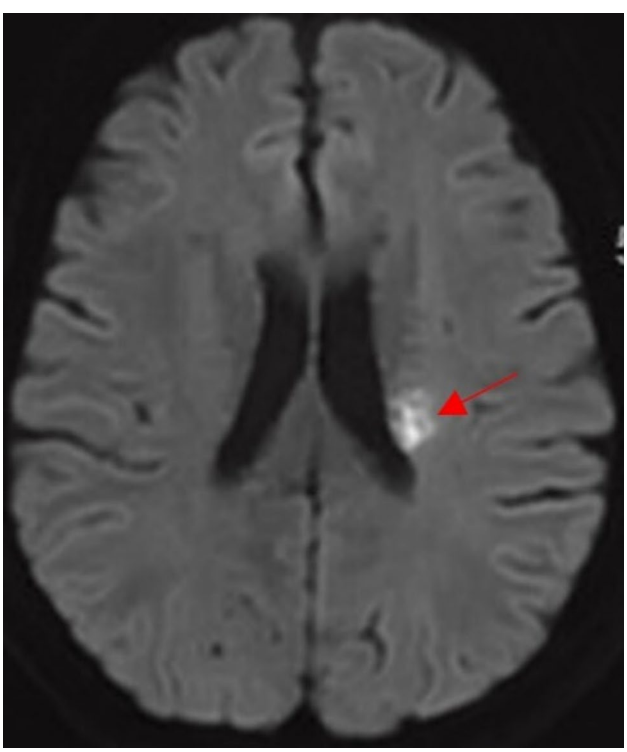

Fig. 1 Diffusion weighted imaging (DWI) revealing subacute cerebral infarction in the left basal ganglia-radiocoronal region (red arrow)

The patient also received treatment with fluid supplementation. On the second day after the initial angiography, the muscle strength of the patient's right lower

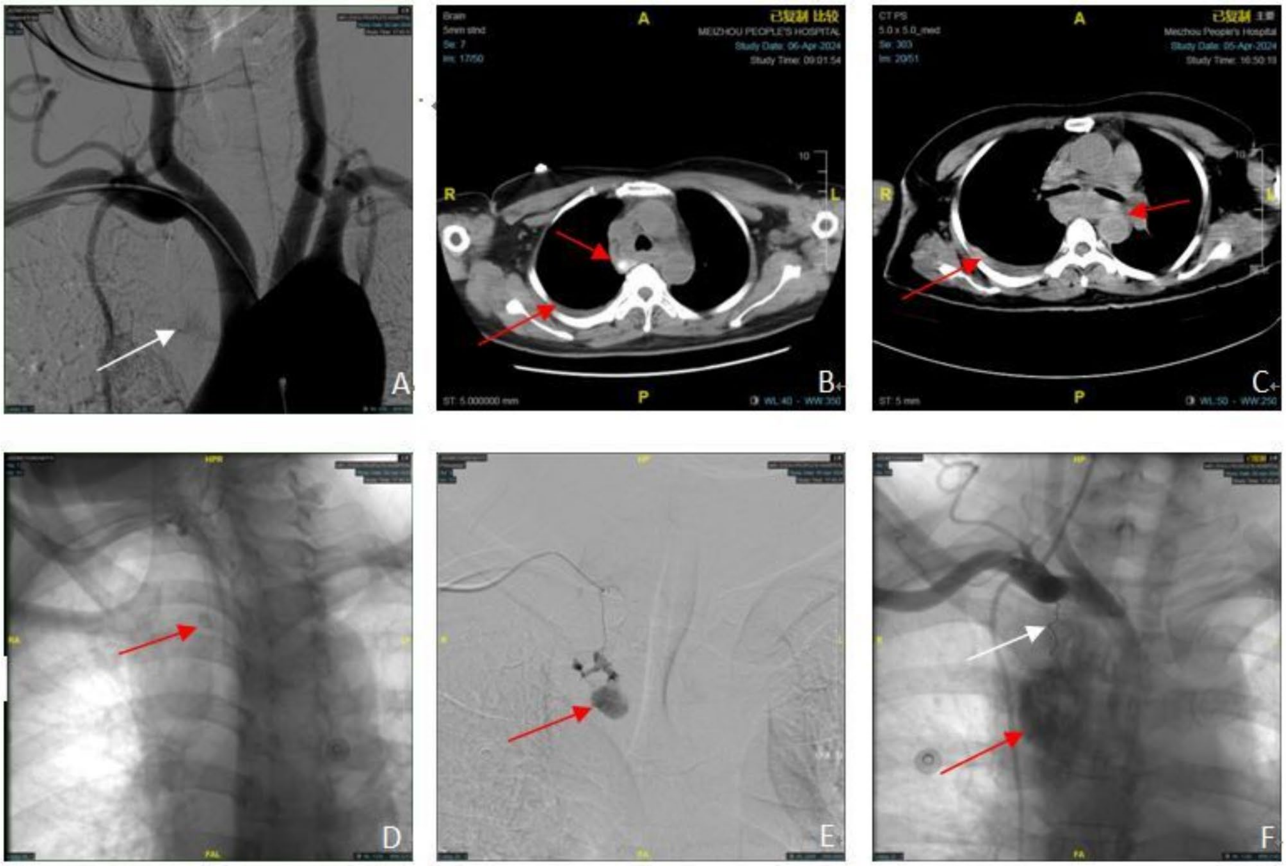

Fig. 2 Aortic arch angiogram showing inconspicuous extravasation of the contrast agent in the thoracic cavity (**A**). CT scan indicates hematoma in the middle mediastinum and right thoracic cavity (**B**, **C**). Angiograms show the perforation (red arrow) before (**D**, **E**) and after (**F**) embolization using microcoils (white arrow)

limb decreased from grade 4 to grade 1, and hemoglobin level dropped from 113 g/L to 103 g/L. CT scan showed a decrease of the volume of mediastinal hematoma but a slight increase of blood accumulation in the right thoracic cavity with a small amount of blood in the left thoracic cavity. The decrease of muscle strength suggested worsening of cerebral infarction, although CT scans taken within 18 h showed no obvious changes of the lesion(Fig. 3). Considering the risk of ischemic stroke progression caused by hypoperfusion, the patient was given further treatments with antiplatelet aggregation agents, statins, and fluid infusion. CT examination on the fourth day after the procedure showed further reduction of the volume of the mediastinal hematoma, but blood accumulation in the bilateral thoracic cavity remained almost unchanged. At 12 days after cerebral angiography, the patient reported obvious relief of the right shoulder and back pain, and her muscle strength of the right limb increased to grade 4, suggesting good recovery of the patient. The patient was then discharged uneventfully from the hospital.

Discussion

Cerebral angiography through the radial and femoral accesses can achieve similar success rates [3]. The TFA has a higher risk of lower limb venous thrombosis, pulmonary embolism, vagus nerve reflex, and puncture of the local arteries [2, 3]. Considering these potential risks, we did not choose the femoral access for cerebral angiography, although the patient did not have iliac or aortic stenosis or occlusions. The radial artery is more superficial than the femoral artery to allow easier management of bleeding events. Compared with the TFA, the TRA is associated with a significantly shorter puncture time, a shorter fluoroscopy time, a lower incidence of complications, and faster postoperative recovery [4, 5], and has thus become a preferred vascular access for cerebral angiography. The overall technical success rate of TRA in both diagnostic angiographies and interventional procedures was reported to reach 97.7% [1]. TRA also has a lower access site complication rate (1.62% vs. 3.31%) and a lower rate of neurological complications than TFA (1.64% vs. 3.82%) [2]. Nevertheless, the limitations of the TRA lies in the potential risks of causing complications including radial artery spasm or occlusion, forearm hematoma induced

Fig. 3 On the second day after the initial angiography, CT scan showing cerebral infarction in the left basal ganglia-radiocoronal region (red arrow)

by radial artery perforation, and even such severe complications as subclavian artery (SCA) entrapment and perforation of the BCT, TCT or IMA [6, 7]. Previous reports suggested that the occurrence of hematomas in the thorax during angiography were mostly a result of inappropriate manipulation of the hydrophilic guidewires [8, 9]. In theory, both the wires and the catheter can cause injuries to any branch of the arteries along their path to result in artery perforation and bleeding.

During a neurointerventional procedure through the TRA, the operator often stands on the patient's right side, as the left TRA can cause lumbar fatigue and increase X-ray exposure of the operator. It is also difficult to access the right vertebral artery through the left TRA for angiography, thus the right radial access is generally preferred for cerebral angiography. In our case, the patient did not show any stenosis in the epioaortic vessels but had a tortuous junction between the RSCA and the BCT. In the initial attempt, we failed to anticipate the risk that the bend would allow the guidewire to enter the vessel branch to cause bleeding. Therefore, we chose to perform angiography via the right radial access in this case. Compared with the right radial access, the left radial access has a shorter distance to the aortic arch and does not need to pass through the brachiocephalic trunk, which may reduce the risk of vascular perforation complications. The choice of the left versus right access can be determined after full evaluation of the specific conditions of the target blood vessels of the patient. According to the Chinese expert consensus, 5 F arterial sheaths are routinely used for cerebral angiography via the radial or distal radial artery, while 6 F arterial sheaths or 7 F thin-walled arterial sheaths are recommended for endovascular treatment [10]. However, the patient in our case had symptomatic intracranial and extracranial artery stenosis, and it was not clear at that time whether interventional therapy was necessary. We therefore chose to use a 6 F sheath for cerebral angiography. The subsequent endovascular treatment involved embolization of small blood vessels, for which a 5 F sheath could well meet the operational requirements.

In this report, we present a rare case of RCCT branch perforation during TRA cerebral angiography, and the perforation resulted in mediastinal and thoracic hematomas. There is a bend in the RSCA before its entry into the BCT, and the path of the small branch of the RCCT is very similar to that of the BCT under X-ray. During the procedure, the guidewire was accidentally advanced into the RCCT and its small branch and caused vascular perforation and bleeding. In most of reported cases, the penetration did not cause immediate specific symptoms or signs, which delayed its detection [11, 12]. Similarly, the patient in our case did not report any discomfort during aortic arch angiography, nor was contrast agent extravasation detected on the angiogram due to the concealed subdivision of the RSCA, so that cerebral angiography procedure continued until symptom onset.

Prompt imaging examination may help identify possible complications in catheterization procedures [11], and timely management of vessel perforation is critical for improving the patients' outcomes. The management of vascular perforation include covered stent implantation and branch vessel embolization. Covered stents are commonly used for management of perforation of a large diameter artery such as the IMA [13], while for the branch vessels (such as IMA bridge branches), angioembolization can be both safe and effective. The embolization materials include microcoils, gelatin sponges, and autologous clotting blocks [12, 14]. TRA-related mediastinal hematoma and hemothorax can cause serious compression to the neighboring organs with potentially fatal consequences. In this case, as the patient's symptoms gradually became apparent, we immediately aborted the angiography procedure and performed chest CT scan. After discovering mediastinal and thoracic hematoma, we directly embolized the damaged blood vessels with gelatin sponge and spring coils. Prompt sealing of the arterial breach alleviated the bleeding and eventually stabilized the vital signs of the patient.

Our experience with this case calls for cautions when performing TRA cerebral angiography. The operator needs to be familiar with the reconstructed images of

CTA and the vascular pathways above the aortic arch before the procedure. When the vessel is tortuous through the right radial access, the delivery of guide wire can easily cause bleeding, and the left TRA or TRF should be considered. In addition, when resistance is felt, further guidewire advancement must stop immediately, and the guidewire needs to be withdrawn to adjust its moving direction before further delivery. Close monitoring of digital subtraction angiography (DSA) images can be crucial for early detection of contrast agent extravasation. The changes of the patient's condition needs to be constantly observed during the perioperative period, and prompt management must be carried out should any abnormalities occur.

In conclusion, although TRA reduces the risks of complications of cerebral angiography compared with TRF, life-threating vascular complications such as mediastinal and thoracic hematoma due to vessel perforation can still be possible, thus urging cautious advancement of the guidewire during the procedure. Early detection and appropriate emergency countermeasures can reduce the severity of vascular perforation and subsequent hematoma.

Abbreviations

TRA	Transradial approach
TFA	Transfemoral approach
BCT	Brachiocephalic trunk
IMA	Internal mammary artery
TCT	Thyrocervical trunk
BP	Blood pressure
MRI	Magnetic resonance imaging
CTA	Computed tomography angiography
CT	Computed tomogram
SaO_2	Arterial oxygen saturation
SCA	Subclavian artery
RSCA	Right subclavian artery
RCCT	Right costocervical trunk
DSA	Digital subtraction angiography

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Author contributions
JS Tu wrote the main manuscript text and W Qiu prepared the figures. Both authors reviewed the manuscript.

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Data availability
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Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Written informed consent for publication was obtained from the patient.

Competing interests
The authors declare no competing interests.

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