Radiology Case Reports 19 (2024) 3488–3491

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journal homepage: www.elsevier.com/locate/radcr

Case Report

Mechanical thrombectomy for cerebrovascular occlusion in a patient with situs inversus ☆

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ARTICLE INFO

Article history:
Received 2 February 2024
Revised 24 April 2024
Accepted 1 May 2024

Keywords:
Cerebral infarction
Thrombectomy
Situs inversus
Tetralogy of Fallot
Case reports

ABSTRACT

Situs inversus is a rare congenital abnormality characterized by mirror-image transposition of the major visceral organs and vessels. Few reports have discussed the use of mechanical thrombectomy in acute ischemic stroke with situs inversus. We present such a case, to raise awareness and deepen the knowledge on these cases. A 44-year-old man was admitted to our hospital with sudden-onset dysarthria and left-sided paresis. Computed tomography (CT) angiography revealed situs inversus and occlusion in the internal carotid artery. First, intravenous tissue plasminogen activator was administered, followed by immediate reperfusion with mechanical thrombectomy. We achieved thrombolysis in cerebral infarction grade 3. After the procedure, the patient fully recovered. Prompt diagnosis is crucial for rapid recanalization in patients with vascular anomalies such as situs inversus.

Introduction

Situs inversus is a rare congenital abnormality characterized by mirror-image transposition of the major visceral organs and vessels. Its prevalence is approximately 0.01% of individuals [1]. Due to its low prevalence, few case reports reported on the use of mechanical thrombectomy (MT) in patients with situs inversus [2,3]. Here, we present a case of a patient with situs inversus who underwent MT for acute ischemic stroke (AIS) with internal carotid artery (ICA) occlusion.

Case report

A 44-year-old male was transported to our hospital because he was suddenly unable to stand up. This was his first visit to

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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https://doi.org/10.1016/j.radcr.2024.05.012

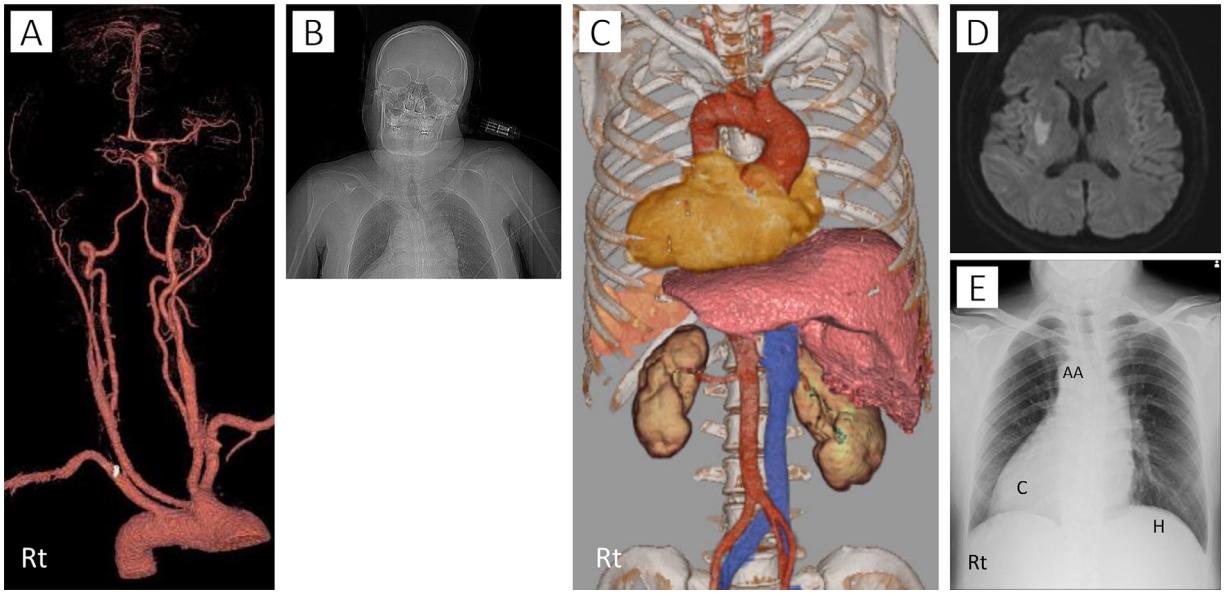

Fig. 1 – Imaging examinations of the patient reported in this case. (A) Head and neck computed tomography (CT) angiography showing right internal carotid artery occlusion. (B) CT scout view showing dextrocardia. (C) Chest and abdominal CT confirmed situs inversus. (D) Diffusion-weighted imaging on the day after mechanical thrombectomy showing acute infarction in right putamen. (E) Chest X-ray reveals cardiac apex (C) and aortic arch (AA) on the right side with an elevated hemidiaphragm (H) on the left side.

our hospital. The onset-to-door time was 99 min. At 3 years of age, the patient underwent open chest surgery for Fallot tetralogy at another hospital. He was not currently taking any antithrombotic medication. Neurological examination revealed dysarthria, left incomplete paresis, unilateral spatial neglect, and conjugate deviation. The National Institutes of Health Stroke Scale score (NIHSS) was 15.

Noncontrast CT and CT angiography (CTA) from the aortic arch to the head were conducted (door-to-image time, 7 min). We did not observe early ischemic changes and the Alberta Stroke Program Early CT score was 10. CTA demonstrated right ICA occlusion (Fig. 1A). Situs inverse was suspected based on the presence of dextrocardia (Fig. 1B), right-sided aortic arch, and a changed course of the aortic arch, along with the patient's history of congenital heart disease. Subsequently, a thoracoabdominal CT scan, performed to evaluate the access route, confirmed the diagnosis of situs inversus (Fig. 1C).

First, low-dose intravenous tissue plasminogen activator (0.6 mg/kg) was administered (door-to-needle time, 26 min). Subsequently, endovascular thrombectomy was performed. Following access through the right femoral artery, a 9-Fr Optimo balloon catheter (Tokai medical, Aichi, Japan) was advanced to the right ICA using the co-axial method with a 6-Fr SY6 Simmons catheter (SILUX, Saitama, Japan). Given the sharp angles between the aortic arch and the right common carotid artery, a Simmons-shaped catheter was selected as inner catheter instead of the simpler curved catheter usually employed. Then, the SALVA71 aspiration catheter (NIPRO, Aichi, Japan) was advanced to the cavernous portion of the ICA via a Phenom21 microcatheter (Medtronic, MN, USA) and Synchro standard 014 wire (Stryker, CA, USA). Next, the microcatheter was further advanced to the M2 segment of the middle cerebral artery. Thrombus location was confirmed by dual injection using a guiding catheter and microcatheter. Then, the Embotrap II 5/33 mm (Cerenovus, CA, USA) was fully deployed over the thrombus, and the aspiration catheter was delivered to the proximal clot face, when the balloon catheter was inflated to occlude blood flow. The stent retriever and aspiration catheter were then retrieved as a unit while manual suction was applied through the balloon catheter. A red thrombus was successfully removed, resulting in complete recanalization with TICI grade 3 after the first pass (Fig. 2). The door-to-puncture and puncture-to-recanalization times were 32 and 31 min, respectively. The NIHSS score decreased to 0 approximately 4 h after treatment. An MRI acquired the day after treatment revealed a cerebral infarction in the right putamen (Fig. 1D).

The embolic source of stroke was a cardiac thrombus resulting from a cardiac apical aneurysm. Accordingly, anticoagulation with heparin and warfarin was initiated. On the 12th day of hospitalization, the patient was discharged without any neurological deterioration.

Discussion

MT is the gold standard treatment for AIS complicated by large vessel occlusion [4]. The time to recanalization is crucial because it is closely related to prognosis. In fact, the odds of a good outcome decrease by 10% for every 15-min delay in recanalization [5]. To shorten the time to recanalization, a prompt and accurate evaluation of the access route for catheter placement into the target artery before endovascular

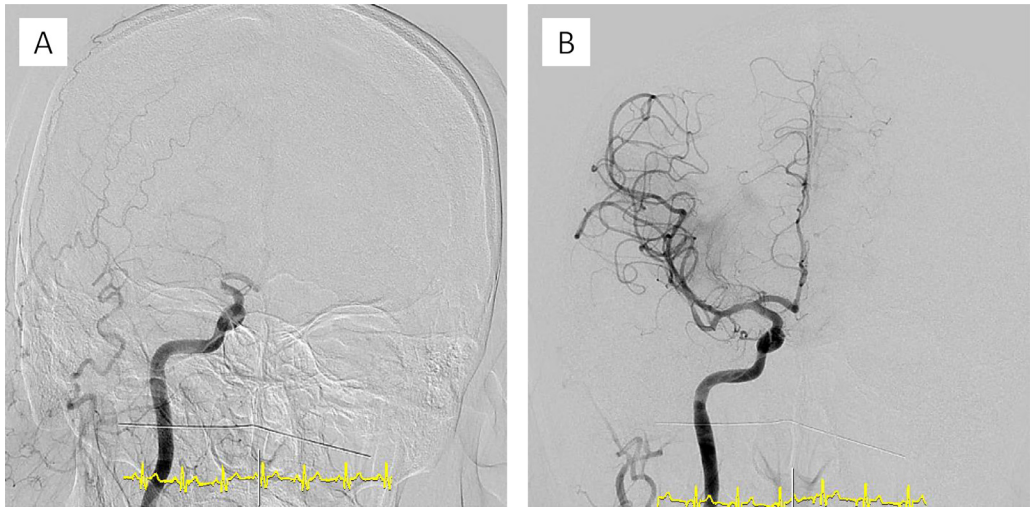

Fig. 2 – Anteroposterior internal carotid artery injection (A) before and (B) after the thrombectomy. The final injection shows complete recanalization.

procedures is essential [6]. In case of vascular anomalies, such as in the present case, it is crucial to diagnose the disease as soon as possible. The 2 reported cases in which patients with situs inversus underwent thrombectomy required a lengthy treatment time, with puncture-to-recanalization times of 66 and 170 min, respectively [2,3]. In these cases, the use of MRI to diagnose AIS may have contributed to the lack of an accurate diagnosis of vascular anomalies before endovascular treatment, potentially affecting treatment duration.

Medical history and imaging studies provide clues for diagnosing situs inversus. The prevalence of situs inversus is rare in the general population, ranging from 1/8000 to 25,000 [2], but it is relatively high in patients with congenital heart disease, as in the present case, having an incidence of 3%–5% [7]. However, this condition is reportedly observed in 40%–50% of individuals with primary ciliary dyskinesia [5]. Thus, when examining a patient with these underlying diseases, the possibility of situs inversus should be considered.

In the emergency room, situs inversus can be diagnosed through chest X-rays and electrocardiograms. Characteristic findings on chest X-ray include a gastric bubble, and apex of the heart and aortic arch on the right side, along with an elevated hemidiaphragm (Fig. 1E). In an electrocardiogram, inverted P and T waves, amplitude loss in the precordial leads toward V6, and a reversed QRS complex are indicative of it [8]. However, to shorten the treatment time for patients with AIS, these examinations are often avoided before endovascular treatment.

Upon arrival at the emergency room, CT/CTA or MRI are typically performed immediately to assess indications for acute revascularization [9,10]. However, since for diagnosing AIS, MRI usually images cover only the head and neck, recognizing abnormalities such as situs inversus can be challenging. Therefore, CTA is preferred as it can be performed concurrently with the assessment of the occluded artery and anatomic variants. To evaluate catheter access and exclude aortic dissection, CTA coverage should extend till at least the aortic arch (ie, aortic arch anatomy, aortic atherosclerosis, vessel angles, and tortuisity) [9,10]. An unusual course of the aortic arch should be carefully noted. Approximately 80% of situs inversus cases are associated with a right aortic arch. Specifically, the ascending aorta is anterior and to the right of the pulmonary artery, whereas the descending aorta is located to the right of the vertebral column [11,12]. Situs inversus has 2 main subtypes: dextrocardia and levocardia, most being dextrocardia [13]. If the heart is included in the CT scout view, its location can provide helpful information (Fig. 1B). Noticing these abnormal findings during CT scanning allows for additional measures such as thoracoabdominal CT imaging, facilitating treatment based on accurate recognition of abnormalities in the access route and ultimately leading to improved outcomes.

Conclusion

We report a case of a patient with situs inversus who underwent MT for ICA occlusion. Prompt diagnosis of this rare variation is particularly important for rapid recanalization of the occluded artery. In addition, preoperative CT evaluations are useful in identifying such vascular variations.

Patient consent

Written informed consent was obtained from the patient for the publication of this case report.

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