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Case Report

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Two-year follow-up after treatment of an aortic transection in the presence of an aberrant right subclavian artery

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Abstract

Objectives: An aberrant right subclavian artery (ARSA) is one of the most common anatomic variants of the aortic arch. The combination of an ARSA and a transection is naturally rare.

Methods: This case report describes the treatment of a transection in the presence of an ARSA and the follow-up of two years.

Results: We successfully treated the contained rupture with a stentgraft. Both subclavian arteries had to be covered in the emergency setting. At the two-year follow-up, the patient did not suffer from any neurological impairment.

Conclusions: In emergency settings, primary cover of both subclavian arteries with a stentgraft can be performed in individual cases after risk assessment. Severe complications such as development of upper limb ischaemia, ASAS or reduced perfusion of the posterior cerebral circulation should be considered in treatment planning.

Keywords

aberrant right subclavian artery, traumatic aortic rupture, TEVAR, anterior spinal artery syndrome

Introduction

An aberrant right subclavian artery (ARSA) is an embryonic developmental variant of the 4th gill arch artery. With an incidence of up to 2%, the ARSA is one of the most common anatomic variants of the aortic arch.[1] Despite being asymptomatic in most cases, it can clinically manifest in compression syndromes of various thoracic structures, such as dysphagia. The abnormality of the vessel wall, due to the thinned-out proportion of elastic fibres in the tunica media, predisposes an ARSA to locally develop aneurysms or dissections.[2] A traumatic rupture of the aorta (transection) was found in approximately 20% of all fatal traffic crashes in an autopsy study.[3] The predilection site is the descending aorta, immediately after the origin of the left subclavian artery (LSA).[3] The combination of an ARSA and a transection is naturally rare. Only a few case reports can be found in recent literature with different therapeutic approaches.

Case report

The 79-years-old healthy driver of a passenger car, wearing a seat belt, had collided with an oncoming vehicle while turning left.

The initial polytrauma computer tomography (CT) scan showed a left-sided clavicle and a right-sided rib series fracture, a sternal facture and a bilateral pulmonary contusion. Furthermore, a transection of the thoracic aorta, distal to the LSA could be diagnosed in the presence of an ARSA. The rupture site was located at the origin of this anatomical norm variant from the aortic arch (Figure 1).

The injury appeared as a contained rupture, corresponding to a grade III laceration according to the expanded classification of the Society of Vascular Surgery.[4]

Due to the presence of vascular pathology, the patient was transferred to our maximum care hospital. The decision for urgent surgical treatment was based on the morphologically distinct findings with a large contained rupture as well as a large tear at the site of the ARSA. In a triage

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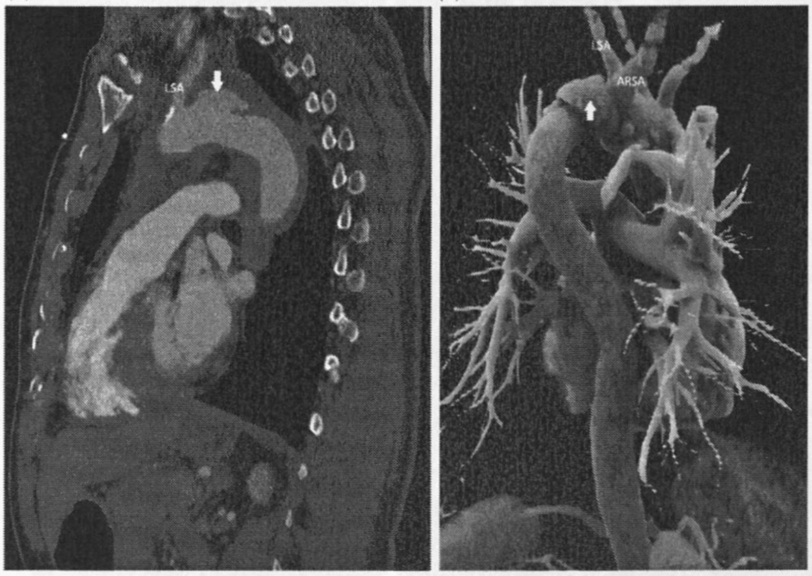

Figure 1. (a) Computed-tomography angiography (CTA) with visualization of the left subclavian artery (LSA) and rupture site (white arrow) at the origin of the aberrant right subclavian artery (ARSA). (b) 3D reconstruction showing the LSA, ARSA, and rupture site (white arrow).

consultation with colleagues in the Department of Trauma Surgery, surgical treatment of the present fractures was not currently indicated, which is why we indicated the urgent endovascular treatment. The preoperative preparation included an assessment of the circle of Willis, which was shown in the initial polytrauma CT scan. Both vertebral arteries were unobstructed and of equal calibre, the circle of Willis was patent. In our hybrid operating room, endovascular treatment of the aortic transection was performed by implanting a conformable Gore® Tag® endoprosthesis (34 mm/34 mm/200 mm) via right femoral cut-down. Safe sealing of the rupture site required positioning of the stentgraft distal to the left common carotid artery, covering of both the LSA and the ARSA, and therefore made the use of a relatively long device necessary. An additional preoperative non-invasive blood pressure measurement was performed on the left lower leg. Final angiography showed a sealed rupture site with retrograde perfusion of the ARSA and the LSA, but without relevant endoleak (see Figure 2(a)). Postoperatively, pulsing on the upper extremities was no longer palpable on either side. The duration of the procedure was 44 minutes.

Postoperatively, the patient was transferred to the intensive care unit. After six hours, the patient developed neurological symptoms in the form of a sensory deficit in the right side of the body, which, within three hours, evolved into paraparesis of both legs in the form of an anterior spinal artery syndrome (ASAS). Cerebral ischaemia could be excluded with a cranial CT scan with concomitant angiographic imaging of the vessels supplying the brain. The aortic prosthesis checked in the same session showed a regular position (Figure 2(b)). Additional performed magnetic resonance imaging could not exclude post-traumatic damage to the spinal cord as a differential diagnosis. This was followed by placement of a spinal catheter for cerebrospinal fluid (CSF) drainage and elevation of mean arterial blood pressure to increase spinal perfusion pressure. Neurological symptoms regressed rapidly under the therapy until restitutio ad integrum was achieved so that carotid-subclavian bypass was not performed to further improve spinal perfusion. The CSF drain could be removed after two days without complications. The further inpatient stay was unremarkable, and the patient could be discharged home after eleven days in stable general condition without functional limitations. At the two-year follow-up, the patient presented in good general condition, without functional impairments and with no neurologic deficits. Both upper extremities appeared without sensorimotor deficit. Ischaemic symptoms did not occur even after physical exertion of the arms. There was no relevant blood pressure difference between the upper and lower extremities. The performed control CT angiography showed a correct fit of the aortic prosthesis without endoleak (Figure 3).

Discussion

In the following section, we would like to discuss the case presented, the consecutive treatment and possible therapeutic alternatives. As the patient presented with a big contained rupture in presence of a large tear and contour loss of the aorta, we indicated an immediate treatment due to the risk of uncontrollable haemorrhage in case of progress to a

Figure 2. (a) Intraoperative angiography: Stent graft positioning just distal to the left common carotid artery (LCCA) with covering of the left subclavian artery (LSA) and the aberrant right subclavian artery (ARSA); RCCA = right common carotid artery. (b) Postoperative CT angiography shows the correct position of the aortic prosthesis with successful endovascular sealing of the rupture site and the LSA already thrombosed (white arrow).

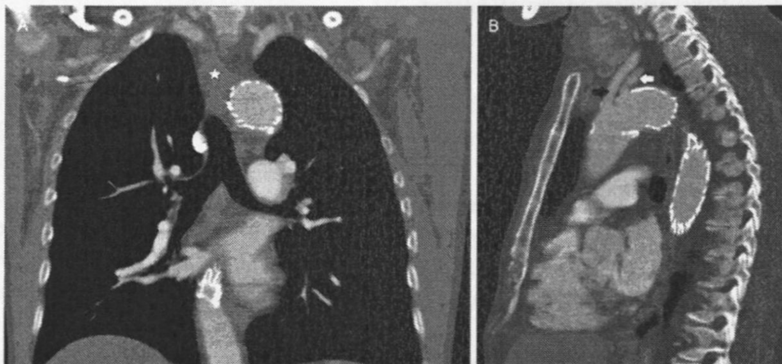

Figure 3. Images of the two-year follow-up (a) CT angiography in coronar reconstruction with thrombosed ARSA (white star). (b) CT angiography with open LCCA (black arrow) and retrograde perfusion of the LSA (white arrow).

complete rupture. The challenge in this case was the need for covering of both subclavian arteries and, consecutively, their branches in the emergency situation. The current SVS Guidelines note that in the treatment of a traumatic aortic rupture a revascularization of the LSA should be considered.[5] In addition to upper limb ischaemia, the reduced perfusion may also promote ASAS or cause perfusion insufficiency of the posterior cerebral circulation. Prior publications reported spinal cord ischaemia (SCI) rates in TEVAR of 2–15%.[6] For traumatic aortic rupture, a lower SCI rate of 1.1% was reported.[6] In an elective situation, for example, the treatment of an aneurysm of the ARSA (Kommerell diverticulum) or grade I and II transections, a one- or two-stage surgical revascularization of one or both subclavian arteries by carotid-subclavian bypasses should therefore be considered.[7] If possible, at least one subclavian artery should be revascularized – preferably the one with a dominant vertebral artery to preserve the aforementioned collateral circulation. In the present case, due to the advanced stage of transection, with external contour loss of the aorta, and the possibly higher rupture risk of an ARSA with its untypical vessel wall, we opted for primary treatment of the rupture site by stentgraft implantation. The procedure of a unilateral or bilateral carotid-subclavian bypass was not performed in the emergency setting, as the cerebral arterial circle showed no obstruction in the initial CT scan. The implantation of a vascular plug in both subclavian arteries to prevent retrograde perfusion was discussed but not performed in the emergency setting.[8] In case of a postoperative endoleak, a plug application could have been conducted in a second stage procedure. Due to the range of possible complications described above, the patient was closely monitored during the postoperative phase. When the patient developed neurological symptoms, he was examined by the colleagues of the Neurological Department, who prescribed a spinal and cerebral imaging to exclude bleeding or ischaemia. With inconspicuous findings the symptoms were attributed to an ASAS. The patient could be successfully treated by immediate placement of a spinal catheter and by increasing the spinal perfusion pressure by elevating the mean arterial pressure above 80 mmHg and reducing the CSF pressure below 15 mmHg. Simultaneously, the implantation of carotid-subclavian bypass was discussed. The measures taken rapidly improved the symptoms of the ASAS, which is why the two-stage bypass was no longer deemed necessary.[9] Due to the arterial supply of the spinal cord often being variable and being provided by multiple collateral circuits, these can take over if one system fails.[9] This may be preceded by a temporal latency (conditioning phase), which we also observed in our case.

Conclusion

In emergency settings, primary cover of both subclavian arteries with a stentgraft can be performed in individual cases after risk assessment. A preoperative evaluation of the circle of Willis should be performed. A lower risk of SCI has been described for traumatic aortic rupture than for other aortic pathologies.[6] Further complications with development of upper limb ischaemia, ASAS or reduced perfusion of the posterior cerebral circulation should be considered in treatment planning. The extension of the stentgraft should be as short as possible to preserve the origins of intercostal arteries. The arterial supply to the spinal cord is often variable; a loss of perfusion can be compensated for by the various collateral circuits. In elective cases, a combined procedure with primary creation of a carotid-subclavian bypass should be favoured to avoid the above-mentioned complications.

Author contributions

Conceptualization: Tobias Dominik Warm; All authors contributed to the study design. Writing - original draft preparation: Tobias Dominik Warm; Writing - review and editing: Tobias Dominik Warm, Yvonne Gosslau, Christian Scheurig-Muenkler, and Alexander Hyhlik-Duerr; Imaging: Christian Scheurig-Muenkler, and Tobias Dominik Warm; Supervision: Alexander Hyhlik-Duerr.

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Informed consent

Informed consent was obtained from all individual participants included in the article.

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