Case Report

Unilateral Posterior Spinal Cord Ischemia Due to a Floating Aortic Thrombus: A Case Report

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Abstract: Introduction. Spinal cord ischemia (SCI) accounts for less than 1% of all strokes, and mostly affects the anterior cord. The ascending aorta (AA) is the rarest site of localization for aortic thrombi (5%). We report a singular case of posterior SCI due to a floating thrombus in the AA.

Case presentation. A 75-year-old male with acute left hemiparesis and left tactile and proprioceptive sensory loss below the C5 dermatome (NIHSS 3) is presented. Spinal cord MRI showed a C4–C6 ischemic lesion, involving the left lateral posterior hemi-cord. CT angiography showed a 6 mm floating thrombus in the AA. According to cardiovascular surgeons, dual antiplatelet therapy and high-dose statin were started. After seven days, the patient was discharged with mild left distal hemiparesis and an unchanged sensory deficit.

Conclusions. Posterior SCI is rarer than anterior ischemia and potentially unilateral. Its clinical presentation is mainly sensory with possible, but not systematic, weakness of the homolateral limbs. SCI is often caused by aortic pathologies in the elderly, but the incidence rate of non-aneurysmal aortic mural thrombus is about 0.45% and the AA represents a very rare location. In similar cases, conservative medical treatment is preferred despite the high-risk rates of embolic recurrences.

Keywords: spinal cord ischemia case report; free-floating thrombus; aortic atherosclerosis; hemodynamic stroke; posterior spinal artery occlusion

1. Introduction

Compared to cerebral ischemic stroke, spinal cord ischemia (SCI) is quite an uncommon event, representing less than 1% of all strokes, and mostly affecting the anterior cord [1]. The differential diagnosis of SCI is broad, and the nonspecific definition of “acute nontraumatic myelopathy” includes multiple entities, such as inflammation, infection, compressive myelopathy and venous congestion related to vascular malformations such as spinal dural arteriovenous fistula and tumor. The most common diseases to exclude are multiple sclerosis, spinal cord neoplasms, idiopathic transverse myelitis, spinal cord arteriovenous shunts, Guillain–Barrè syndrome, acute disseminated encephalomyelitis, subacute combined degeneration, AIDS-associated myelopathy, radiation myelitis and compressive myelopathy [2].

Hypercoagulability and vessel wall alterations represent the major risks for thrombotic formation in the aorta [3]. Aortic thrombus is frequently detected at the thoracic descending tract (28%) or the distal arch (16%), while the ascending aorta (AA) is the rarest site of
localization (5%) [4]. A definite diagnosis requires histological and immunohistochemical studies, whereas it is useful to consider magnetic resonance imaging (MRI) for differential diagnosis with other mass lesions, such as tumors [5,6]. In the case described herein, we demonstrated a floating aortic thrombus in the ascending aorta likely responsible for a cervical posterior spinal cord infarction.

2. Case Presentation

A 75-year-old man was admitted to our hospital with an acute cervical pain, weakness in left upper and lower limbs and a left tactile and proprioceptive sensory deficit below the C5 dermatome [7] (National Institutes of Health Stroke Scale, NIHSS 3). His medical history was unremarkable, except for the previous history of a heavy smoking habit (30 cigarettes per day, quit 10 years ago) and surgical excision of a lumbosacral herniated disk. The patient underwent brain-computed tomography (CT) and brain MRI, which excluded a cerebral involvement, while the spinal cord MRI showed a C4–C6 ischemic lesion, involving the left posterior horn of the grey matter and the left lateral corticospinal tract (Figure 1). We could exclude the most common diseases for differential diagnosis thanks to the acute onset of symptoms, the pattern of cord involvement, a single lesion limited to the vascular territory and the marked diffusion restriction in MRI. In order to detect the cause of stroke, the diagnostic workup included blood laboratory tests (showing hypertriglyceridemia), clinical cardiac assessment (unremarkable findings) and a transthoracic echocardiogram. The latter assessment highlighted an aortic ecasia, and a floating thrombus was suspected, but the patient was not collaborative enough to perform transesophageal echocardiogram for confirmation. Finally, a contrast-enhanced CT angiography (CTA) was performed: the supra-aortic trunks study demonstrated severe atherosclerosis of the right vertebral artery (VA), with a lack of opacification from the V0 to the V3 segment and very filiform flow from V3 to the basilar trunk (Figure 2), and a concomitant tortuous course of the left VA. The thoracic study also revealed a 6 mm floating thrombus in the distal ascending aorta (Figure 3). Observation parameters for the definition included location, morphology, size of the lesion, the involved aortic segment, concomitant visceral or vascular embolism, stent and the break-off risk ratio (boRR), according to Yang's formula (length of the free portion/length of the attached portion) [4]. A multidisciplinary committee discussed this clinical case. Considering that the break-off risk ratio was relatively low (Figure 4), and the localization was just opposite to aortic arch convexity (place of supra-aortic vessels offspring), we opted for conservative treatment; finally, dual antiplatelet therapy and atorvastatin 80 mg were administered. The hospitalization was uneventful, and the patient was discharged on the seventh day with an improved motor deficit: he was able to walk with unilateral support and the left hemiparesis was mild and predominantly distal (NIHSS 2). At the 3-month follow-up, no complications were reported. The neurological examination was unchanged, with a moderate disability (modified Rankin Scale = 3), and the CTA scan confirmed the stability of the thrombus, which appeared more regular in shape (Figure 5).
Figure 1. Magnetic resonance imaging (MRI) of the cervical spinal cord. (On the left panel), MRI showing a C4-C6 ischemic lesion on T2–STIR (short TI inversion recovery) sequences (sagittal view, red arrow). (Right panel): on the upper row, T2–FFE (fast field echo) sequences (axial view) showing the ischemic lesion of the left posterior cord, involving both grey (posterior horn) and white matter (lateral corticospinal tract, dorsal column-medial lemniscus) (red arrow); on the lower row, DWI (diffusion-weighted imaging) sequences (sagittal projection) showing the hyperintense lesion corresponding to decreased apparent diffusion coefficient in an area of 22 mm² (ADC average infarct core/average normal cord 1.0/1.86 × 10⁻³ mm²/s; ADC ratio 53.8%) (red arrow).

Figure 2. CTA on axial view at the level of C2 (left panel) and C1 (right panel) vertebrae. The supra-aortic trunks study demonstrating severe atherosclerosis of the right vertebral artery (red arrows), with a lack of opacification from the V0 to the V3 segment (left panel) and filiform flow from V3 to basilar trunk (right panel).
Figure 3. Contrast-enhanced CT angiography (CTA) in axial (left panel) and coronal (right panel) views. The thoracic study revealed a 6 mm floating thrombus (red arrows) in the distal ascending aorta.

Figure 4. Volume rendering reconstructions of contrast-enhanced CTA in oblique sagittal reformation view. The floating thrombus appeared as a cylinder-shaped filling defect (6 mm × 2.5 mm) in the distal ascending aorta. The break-off risk ratio (boRR) calculated was 2.4.
3. Discussion

Posterior SCI is rarer than anterior ischemia. It is potentially unilateral, and its clinical presentation is mainly sensory with possible, but not systematic, weakness of the homolateral limbs. Conversely, anterior ischemia is more frequently bilateral [8]. In this case, the sensory deficit was ipsilateral to the motor deficit, unlike classical spinal cord syndromes, which usually occur with bilateral sensory/motor abnormalities. However, the presence of a sensory level suggested the possible injury of the spinal cord. Once spinal cord MRI was performed, a clear ischemic lesion was shown in the T2-weighted short tau inversion recovery (STIR) and diffusion-weighted imaging (DWI) scans. In this case, the lesion at the dorsal column-lateral lemniscus (tactile and proprioception) and lateral corticospinal tract (motor) causes symptoms ipsilaterally, according to the current neuro-anatomical knowledge. DWI has the highest sensitivity, showing hyperintense signal changes and abnormalities that could be detected within 3 h. A marked diffusion restriction may provide another indicator leading to the specific diagnosis of SCI. In fact, a mild hyperintensity could be seen in DWI of myelitis or tumors, allowing the differential diagnosis of infarction from inflammatory cord lesions to intramedullary tumors, by the different range of ADC values [2,9]. A transient lesion expansion in MRI after SCI has been previously reported as pencil-shaped necrosis [10], with a length usually limited to several
vertebral segments [11]. Actually, vasogenic edema in the spinal cord may occur from the acute phase, when a cervical cord compression due to cervical spondylosis causes secondary venous congestion [12]. Venous congestion is a known cause of longitudinally extensive spinal cord swelling, and may initially mimic a peripheral nerve disorder; however, the T2-hyperintense lesion is most often seen in the center of the spinal cord with peripheral sparing [12,13]. In our case, the marked hyperintensity in DWI was associated with decreased ADC (brightness), due to the T2-shine-through effect, which allowed us to differentiate between the cytotoxic edema due to the acute infarction and the vasogenic component of the edema, which most likely depended on the venous congestion.

Due to the unilateral posterior hemi-cord involvement, we supposed that the identified cervical lesion might be due to posterior spinal artery occlusion. In fact, the spinal cord is supplied by three spinal arteries (one anterior and two posteriors, arising from the VAs) and several radicular arteries (often arising from direct aortic branches).

SCI is mostly caused by VA pathologies (e.g., arteriosclerosis, dissection), hypotension, inflammatory vascular diseases, hematologic alterations and drug abuse. In the elderly population, most reports identify aortic aneurysms and aortic/spinal surgical procedures as the main causes of spinal syndromes; however, in clinical practice, the pathogenesis of spinal cord strokes remains frequently unclear. Aortic mural thrombus (AMT) is often found on atherosclerotic or aneurysmatic walls, and it might be able to determine significant arterial emboli [1]. In this case, the patient’s medical history did not reveal any cardiac disease, previous vascular surgery or aortic aneurysms, while former strong cigarette smoking only suggested an atherosclerotic predisposition. Whilst searching for a source of embolism, we investigated the heart and the aorta with an electrocardiogram, transthoracic echocardiogram and a thoracic contrast-enhanced CTA, finally finding a 6 mm floating thrombus in the ascending aorta. Most of the arterial emboli originate from cardiac disease or severe aortic pathologies (80–90%) [4]. The CTA is the first-choice investigation when there is a suspicion of arterial thrombus, but a transesophageal echocardiogram could be preferred if the patient has a history of iodine-anaphylaxis. We supposed that the detected non-aneurysmal aortic thrombus could have been the possible source of the arterial embolism causing cervical SCI. As opposed to aneurysmal AMT, the incidence rate of non-aneurysmal AMT seems to be only about 0.45% [1]. Considering how rarely a floating thrombus in the aorta can occlude a posterior spinal artery, an alternative mechanism that could explain this case could be a transient hypoperfusion, caused by the severe atherosclerosis of the right VA and the concomitant tortuous course of the left VA detected by CTA. Nevertheless, as shown, the left vertebral artery is widely patent without significant stenosis or an atherosclerotic disease (unlike the right) and thus the left infarct is most likely embolic from the detected thrombus, as we supposed.

Possible treatment for SCI due to a floating thrombus is very heterogeneous, including antiplatelets, anticoagulants, thrombolytics, endovascular surgery and open surgery. The choice of treatment mostly depends on the patient’s conditions, thrombus morphology and the physician’s experience, and nowadays there is no consensus on the best management of this pathology [3]. Generally, when unstable aortic plaques or aortic floating thrombus are detected, conservative medication is preferred because of the elevated efficacy rate and the fewer adverse effects, even if it coexists with a high risk of embolic recurrences (about 73% of floating thrombus, compared to 12% of sessile thrombus) [4]. Following the ESC guidelines on diagnosing and treating aortic diseases, anticoagulation or antiplatelet therapy should be considered when an aortic thrombus is detected after stroke or peripheral embolism [14]. Contraindication to anticoagulation or recurrent embolism can lead to surgical intervention [4]. Furthermore, we considered the Yang’s boRR formula [4] (ranged from 2.0 to 8.0), in order to calculate the risk for recurrent embolism. In the present case, the relatively low boRR and the localization of the floating thrombus opposite to the aortic arch convexity reduced the risk of recurrent embolization in the supraaortic vessels, as the blood flow in the arch is predominantly directed in the descending aorta and not in the innominate artery. Hence, we preferred a conservative treatment rather than a surgical
intervention. However, as this is a single case, more research and data are needed to better understand the causes and the best treatment for the disease’s management.

We reported a comprehensive table including the 17 cases about unilateral posterior spinal cord infarction, which have been reported in the literature to date (see Supplemental Table S1 with table references [15–29]). In conclusion, SCI is a rare event, and the unilateral involvement of the posterior medullary territories is extremely peculiar, i.e., the identified primary source of the embolism was supposedly a floating thrombus located in the ascending aorta. Spinal cord MRI with DWI should be a routine investigation when ischemic events are suspected, and the CTA best identifies any aortic wall alterations. Generally, unilateral posterior infarcts are less severe with a better prognosis. Due to the rarity of this disease, there is no standardized protocol or clinical guideline, and therapy relies on clinical judgment and the physician’s experience.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/ctn7030026/s1, Table S1: Case reports of unilateral posterior spinal cord infarction (n = 17).

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Institutional Review Board Statement: All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964’s Declaration of Helsinki and its later amendments or comparable ethical standards. This paper does not report on primary research. Our analysis looked retrospectively at the outcomes for a large cohort of treated patients. All analyzed data were collected as part of the routine diagnosis and treatment.

Informed Consent Statement: Informed consent was waived and given to the retrospective anonymous collection of data, according to Italian regulations. Written informed consent to publish this paper was not possible to be obtained from the patients, because of the restrictive measures in place due to COVID-19. However, we obtained an audio recording of oral consent from the patient and the digital signature from the patient’s closest relative.

Data Availability Statement: No datasets were generated or analyzed during this study.

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References