

Spinal Cord Infarction with a Negative MRI Finding: A Case Report and Literature Review

Jingya Wei*, Juan Kang, Bo Hui

Department of Neurology, Xijing Hospital, Fourth Military Medical University, Xi'an, China

Email: *iamtrn@126.com

How to cite this paper: Wei, J.Y., Kang, J. and Hui, B. (2022) Spinal Cord Infarction with a Negative MRI Finding: A Case Report and Literature Review. *Neuroscience & Medicine*, 13, 53-60.

<https://doi.org/10.4236/nm.2022.132005>

Received: April 3, 2022

Accepted: June 6, 2022

Published: June 9, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Introduction: Spinal cord infarction (SCI) is a relatively rare disease. Abnormality on magnetic resonance imaging (MRI) is an important diagnostic criterion. It may be normal on the first day. Then abnormal signal will appear a few days later. There were some reports with negative MRI findings at the beginning. However, those reports were neither found abnormalities on repeat MRI nor without repeat MRI. **Case Presentation:** We report a case of SCI presented as paralysis of lower limbs and chest pain with no abnormalities on MRI through the course of disease in a 74-year-old female. Anti-platelet aggregation drugs, stabilizing plaque treatments and rehabilitation exercise were performed. The patient recovered significantly. She could walk independently a month after the onset. **Conclusions:** Although MRI provides important evidence for diagnosis, clinical manifestations are the most important when diagnosing. For patients who were highly suspected of SCI clinically, treatment for vascular diseases should be applied as soon as possible even if no lesion is found on imaging examination.

Keywords

Spinal Cord Infarction, Magnetic Resonance Imaging, MRI, Paralysis, Case Report

1. Introduction

Spinal cord infarction (SCI) is an acute ischemic disease caused by thrombosis or embolism in the arteries supplying the spinal cord. It is a relatively rare vascular disease that only accounted for 0.3% - 1% of all strokes [1]. It usually manifested as weakness of limbs, dissociative anesthesia, neck or back pain, and autonomic symptoms. The course of the disease progresses rapidly. It usually worsens within a few hours. Generally, the initial manifestation is radicular pain,

or diffuse pain below a certain spinal cord stage. After a short period of time, flaccid paralysis below the infarct level will appear, followed by spastic paralysis, sometimes accompanied by incontinence.

SCI can be classified into different syndromes according to the position of lesions. The anterior spinal artery supplies the anterior two thirds of the spinal cord through the sulcal (central) artery. The posterior spinal artery syndrome is the most common type of spinal cord infarction. Brown-Sequard syndrome is also relatively common. The central cord syndrome and transverse infarction are relatively rare. Abnormality on magnetic resonance imaging (MRI) is an important diagnostic criterion. It may be normal at the onset. Then abnormal signal will appear a few days later.

The principles of treatment of spinal cord infarction are the same as those of cerebral infarction. Drugs that improve blood circulation can be used to increase blood supply to ischemic foci, dehydrating agents can be used to eliminate spinal cord edema, and neuroprotective therapy can also be used. Though the onset and the progress are rapid, the long-term prognosis is relatively good and the probability of returning to working is higher when compared with cerebral infarction [2].

We herein report a case of SCI with a negative MRI finding throughout the course of disease. The diagnostic criterion for the case was proposed in a study conducted by Mayo Clinic in 2018, which has the known largest sample number in the studies of SCI so far [3].

2. Case Presentation

A 74 years old female got a pain in prothorax after laboring bending over for an hour, with chest distress, hard breathing and transient difficulty in urination. The symptoms disappeared an hour later. Then the patient went home and made lunch. Two hours after the first attack, she underwent the pain in right prothorax again when laboring bending over, with weakness and numbness in bilateral lower limbs, and inability to urinate. The chest pain was relieved within an hour, but the legs were still numbness and weakness. She got to a local hospital then.

The patient has been suffering from hypertension for more than 20 years. The highest blood pressure was 170/100 mmHg. She took amlodipine regularly to control the blood pressure. She got hypertensive heart disease five years ago. The patient also suffered from diabetes, atherosclerosis and cerebral infarction in the recent seven years. Percutaneous vertebroplasty with bone cement was performed because of the compression fracture of the eighth and tenth thoracic vertebral bodies one year ago. She denied the history of hepatitis, tuberculosis, and other infectious diseases. No history of blood transfusion and allergy. Personal history and family history are unremarkable.

The computer tomography (CT) of chest showed interstitial changes in lungs, pulmonary bullae in the left lower lobe, thickening of bilateral pleura and sclero-

sis and calcification of aortic and coronary. Brain MRI revealed multiple stale cerebral infarctions. MRI of the cervical, thoracic and lumbar spine found the hernia of fourth-fifth, fifth-sixth, sixth-seventh cervical discs, and oppression of cervical spinal cord at fourth-fifth disc level. Obsolete compression fractures in the eighth, tenth and eleventh thoracic vertebrae and an old pontine infarction lesion were found. No lesions were found in spinal cord on the MRI. Aorta CT angiography (CTA) showed multiple atherosclerosis and aortic plaques with ulcer. Coronary artery CTA revealed multiple mixed plaques in left coronary artery, left descending branch and diagonal branch, multiple calcified plaques in proximal right coronary artery, moderate stenosis in proximal left anterior descending branch and proximal diagonal branch.

Aspirin, atorvastatin, and circulation-improving drugs were used to treat the disease. The sensation and strength of bilateral lower limbs began to get better slowly two days later. The thoracalgia attacked her again on the fifth day of the course of the disease. It lasted only several minutes this time. On the seventh day of the course, she received a surgery for lumbar spinal stenosis. The strength and sensation of both lower extremities were significantly improved after the operation. Pain in both lower extremities appeared after activity. The pain in the right lower extremity gradually relieved, and the pain in the left lower extremity persisted, which was related to the position. She came to our department on the sixteenth day because the recovery of the sensation and strength stopped.

On admission, the patient was clearly conscious, with normal cognitive function and normal cranial nerve function. The myodynamia and muscular tension of the bilateral upper limbs were normal. The myodynamia of lower limbs were on grade three. The muscular tension of lower extremities was decreased. The deep sensation and superficial sensation were both reduced below the plane of the eighth thoracic nerve. Tendon reflex of lower limbs was diminished. The Babinski sign and the Chaddock sign of both lower extremities were all positive. The neck was soft. The Brudzinski's sign and bilateral Kernig's signs were negative.

Treponema pallidum antibody, HIV antigen and antibody, hepatitis B related antigens and antibodies, hepatitis C antibody were all negative. The result of stool occult blood test was slightly positive. The albumin level was 31.8 (normal values range from 40 to 55) g/L. The level of D-dimer was 4.14 (normal value is <0.6) mg/L FEU. The fibrinogen degradation product level was 9.17 (<5) ug/mL. The fibrinogen content level was 6.68 (1.5 - 3.8) g/L.

The electrocardiogram showed sinus rhythm, 1° atrioventricular block, and complete right bundle branch block. Ultrasound of liver, gallbladder, pancreas, spleen and kidneys showed no abnormality. Ultrasound of the neck vessels revealed atherosclerotic plaques in the right subclavian artery and bilateral common carotid arteries. Echocardiography showed accidental arrhythmia, slightly limitation opening and calcification on bicuspid valve, generally thickened ventricular septum and left ventricular wall, aortic atherosclerosis, calcification of aortic valve, and reduced left ventricular diastolic function.

Chest CT on admission revealed scattered inflammatory lesions in bilateral dorsal segments, a slight amount of right pleural effusion, aortic atherosclerosis (**Figure 1**). Thoracoabdominal aorta CTA showed aortic atherosclerosis with ulcers and a limited dissection in proximal superior mesenteric artery. MRI of the thoracic spine found no lesion in spinal cord on the 19th day (**Figure 2**), when the patient's symptoms improved significantly. She did not receive the MRI of the thoracic spine later in the course of disease. No abnormality was found in diffusion weighted imaging (DWI) of thoracic spine. Nerve conduction velocity revealed that the amplitude of the bilateral peroneal motor nerve is low (recorded from extensor digitorum brevis), the conduction velocity of the bilateral median sensory nerve is slightly slowed down. There was no abnormality found in test of somatosensory evoked potential (SEP). After communicating with the electrophysiology examiner, we consider the low amplitude recorded from extensor digitorum brevis was not clinically significant. Lumbar puncture was unable to achieve because the surgery on lumbar spinal canal.

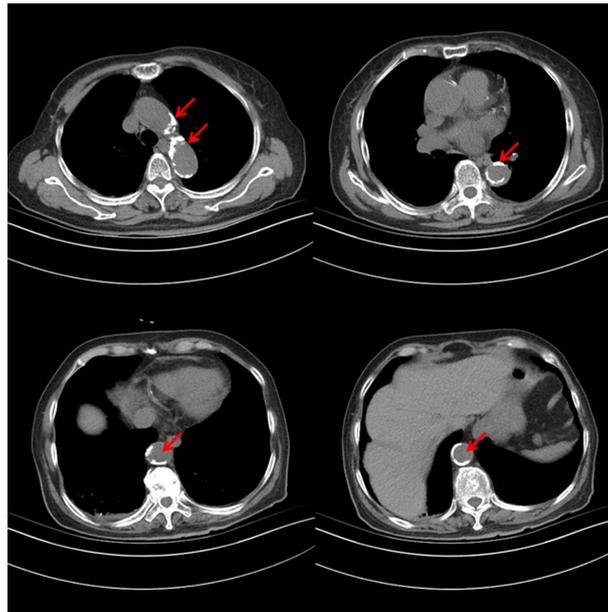


Figure 1. Multiple aortic atherosclerosis showed by chest CT.



Figure 2. No lesions in spinal cord on the 19th day.

In summary, the clinical symptoms of the patient were the weakness in both lower limbs, sensory disturbance and dysuria, with a sudden onset accompanied by severe pain. Imaging examination showed no lesion within or closed to spinal cord. Extensive atherosclerosis was found.

According to the diagnostic criteria of SCI proposed by Zalewski NL *et al.* in 2018 [3], this case met the diagnostic criteria 1 (acute nontraumatic myelopathy with less than 12 hours from onset to nadir severe deficits), and the diagnostic criteria 4 (Alternative diagnosis is not more likely). The patient should be diagnosed as possible spinal cord infarction.

The initial ASIA score was B. The condition of this patient began to be relieved in 24 hours, and the ASIA score was improved to C a week later and D two weeks after the onset.

Aspirin, clopidogrel, atorvastatin, Ginkgo biloba extract and rehabilitation exercises were performed. The patient's condition improved significantly. She could walk independently when discharged (three weeks after admission, 35 days after the onset). The patient was very satisfied with the outcome. She continued to take the medication.

3. Discussion

The typical presentation of SCI was acute weakness, urinary retention, and pain. Anterior spinal artery syndrome is the most common syndrome, which is characterized by a loss of motor function, pain and/or temperature sensation, with proprioception and vibratory sense spared. Around one-third of patients present with posterior spinal artery syndrome, Brown-Sequard syndrome, central cord syndrome and transverse infarction [4] [5]. Sometimes "man-in-the-barrel syndrome" can also be triggered [6]. The symptoms of our patient are transverse damage of the spinal cord, which is usually found after prolonged hypoperfusion [7].

MRI findings provide important evidence for the diagnosis of SCI, though it can be negative within the first 24 hours in up to 50% of cases [8]. Abnormalities will appear within the next few days [9]. DWI contributes in differential diagnosis. It can demonstrate high signal in the infarcted area about eight hours after the onset. Enhancement often showed after five days, and can persist for three weeks [8]. Focal atrophy or intraspinal cavity can be revealed months or years later [10].

There were some reports with negative MRI findings at the beginning. However, those reports were neither found abnormalities on repeat MRI nor without repeat MRI. The report of the longest time with a negative MRI came from Robertson, C. E. *et al.* [11]. There were five patients with negative MRI on the initial and repeat MRI in their study, the average time to initial MRI was 3.1 days (median one day), and the average time to repeat MRI was 13.2 days. Our patient did not receive spinal cord imaging examination after the 19th day of the course. The patient's symptoms had improved significantly on the 19th day, and

the patient had passed the nadir severe more than a week. She was in the recovery period. To our knowledge, this is the first spinal cord infarction case with no MRI abnormalities throughout the course of disease.

Although no lesion was found on imaging examinations in our patient, the clinical manifestations were consistent with spinal cord infarction. The rapid onset with pain and the progress accorded with vascular disease too. Considering the history of extensive atherosclerosis and hypertension, and the effect of treatment of vascular disease, the final diagnosis is still spinal cord infarction. The etiology of infarction was considered as arteriosclerosis of the aorta, which accounts for 23.6% of all etiologies [12].

Considering that the symptoms appeared after the patient repeatedly bending over for one hour, the possibility of fibrocartilaginous embolism (FCE) cannot be ruled out according to the proposed diagnostic criteria of FCE in 2016 [13]. Though the patient had aortic pathologies (multiple atherosclerosis with ulcers), which didn't meet the diagnostic criteria.

The strength and numbness began to restore after the surgery for lumbar spinal stenosis. We believed that it was because the surgery released the stretching of nerve roots. Lumbar puncture was unable to achieve because of the surgery wound. Cerebrospinal fluid could not be tested for identification with acute myelitis. Though the clinical manifestations of the patient were consistent with typical SCI, the differential diagnosis was imperfect.

The prognosis of nontraumatic SCI is strongly correlated with the severity of motor or sensory involvement. Prognostic factors for poor recovery include aortic dissection/rupture, high cervical lesions, severe impairment at presentation, initial and nadir ASIA A/B scores, female gender, advanced age, and lack of improvement in the first 24 hours [4] [14] [15]. A good prognosis is related to fewer common etiologies, such as disc herniation, and opportune and effective treatment and rehabilitation [16] [17] [18].

This patient was a gender female, with a severe symptom at initial presentation. The initial ASIA score was B. These suggested a poor prognosis. The condition of this patient began to relieve within the first 24 hours. The ASIA score was improved to C within a week and to D two weeks later. The patient had no aortic dissection and high cervical lesions. These suggested a good outcome. The prognosis of this patient was relatively good. It may be related to the rapid remission, early treatment and rehabilitation. We proposed that the disease without a clear focus may have a better prognosis. Unfortunately, there is currently no more evidence to support this speculation.

4. Conclusion

Although MRI provides evidence for diagnosis, clinical manifestations are the most important in the diagnosis of SCI. For patient who was highly suspected of SCI clinically, treatment for vascular diseases should be applied as soon as possible even if no lesion is found on imaging examination. Early treatment is beneficial to the prognosis.

Acknowledgements

Professor Xuedong Liu, Zhirong Liu and Dong Wei contributed in the diagnosis process.

Ethics Approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Consent to Participate

Informed consent was obtained from the patient.

Conflicts of Interest

Author Jingya Wei, Author Juan Kang, and Author Bo Hui declare that they have no conflict of interest.

References

- [1] Romi, F. and Naess, H. (2011) Characteristics of Spinal Cord Stroke in Clinical Neurology. *European Neurology*, **66**, 305-309. <https://doi.org/10.1159/000332616>
- [2] Romi, F. and Naess, H. (2016) Spinal Cord Infarction in Clinical Neurology: A Review of Characteristics and Long-Term Prognosis in Comparison to Cerebral Infarction. *European Neurology*, **76**, 95-98. <https://doi.org/10.1159/000446700>
- [3] Zalewski, N.L., Rabinstein, A.A., Krecke, K.N., Brown Jr., R.D., Wijdicks, E.F.M., Weinschenker, B.G., *et al.* (2019) Characteristics of Spontaneous Spinal Cord Infarction and Proposed Diagnostic Criteria. *JAMA Neurology*, **76**, 56-63. <https://doi.org/10.1001/jamaneurol.2018.2734>
- [4] Nardone, R., Pikija, S., Mutzenbach, J.S., Seidl, M., Leis, S., Trinkla, E., *et al.* (2016) Current and emerging Treatment Options for Spinal Cord Ischemia. *Drug Discovery Today*, **21**, 1632-1641. <https://doi.org/10.1016/j.drudis.2016.06.015>
- [5] Ogawa, K., Akimoto, T., Hara, M., Morita, A., Fujishiro, M., Suzuki, Y., *et al.* (2019) Clinical Study of Thirteen Patients with Spinal Cord Infarction. *Journal of Stroke and Cerebrovascular Diseases*, **28**, Article ID: 104418. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.104418>
- [6] Rouanet, C., Reges, D., Rocha, E., Gagliardi, V., Uehara, M.K., Miranda, M.A., *et al.* (2017) "Man in the Barrel" Syndrome with Anterior Spinal Artery Infarct due to Vertebral Artery Dissection. *Journal of Stroke and Cerebrovascular Diseases*, **26**, E41-E42. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2016.12.016>
- [7] Novy, J. (2012) Spinal Cord Syndromes. In: Paciaroni, M., Agnelli, G., Caso, V. and Bogousslavsky, J., Eds., *Frontiers of Neurology and Neuroscience*, Vol. 30, Karger, Basel, 195-198. <https://doi.org/10.1159/000333682>
- [8] Peckham, M.E. and Hutchins, T.A. (2019) Imaging of Vascular Disorders of the Spine. *Radiologic Clinics of North America*, **57**, 307-318.
- [9] Alblas, C.L., Bouvy, W.H., Lycklama, A.N.G.J. and Boiten, J. (2012) Acute Spinal-Cord Ischemia: Evolution of MRI Findings. *Journal of Clinical Neurology*, **8**, 218-223.
- [10] Leys, D. and Pruvo, J.P. (2021) Spinal Infarcts. *Revue Neurologique*, **177**, 459-468. <https://doi.org/10.1016/j.neurol.2020.12.002>

- [11] Robertson, C.E., Brown Jr., R.D., Wijdicks, E.F. and Rabinstein, A.A. (2012) Recovery after Spinal Cord Infarcts: Long-Term Outcome in 115 Patients. *Neurology*, **78**, 114-121. <https://doi.org/10.1212/WNL.0b013e31823efc93>
- [12] Weidauer, S., Nichtweiss, M., Hattingen, E. and Berkefeld, J. (2015) Spinal Cord Ischemia: Aetiology, Clinical Syndromes and Imaging Features. *Neuroradiology*, **57**, 241-257. <https://doi.org/10.1007/s00234-014-1464-6>
- [13] AbdelRazek, M.A., Mowla, A., Farooq, S., Silvestri, N., Sawyer, R. and Wolfe, G. (2016) Fibrocartilaginous Embolism: A Comprehensive Review of an Under-Studied Cause of Spinal Cord Infarction and Proposed Diagnostic Criteria. *The Journal of Spinal Cord Medicine*, **39**, 146-154. <https://doi.org/10.1080/10790268.2015.1116726>
- [14] Franceschini, M., Cerrel Bazo, H., Lauretani, F., Agosti, M. and Pagliacci, M.C. (2011) Age Influences Rehabilitative Outcomes in Patients with Spinal Cord Injury (SCI). *Aging Clinical and Experimental Research*, **23**, 202-208. <https://doi.org/10.1007/BF03324961>
- [15] Rigney, L., Cappelen-Smith, C., Sebire, D., Beran, R.G. and Cordato, D. (2015) Nontraumatic Spinal Cord Ischaemic Syndrome. *Journal of Clinical Neuroscience*, **22**, 1544-1549. <https://doi.org/10.1016/j.jocn.2015.03.037>
- [16] Peng, T. and Zhang, Z.F. (2019) Anterior Spinal Artery Syndrome in a Patient with Cervical Spondylosis Demonstrated by CT Angiography. *Orthopaedic Surgery*, **11**, 1220-1223. <https://doi.org/10.1111/os.12555>
- [17] Reynolds, J.M., Belvadi, Y.S., Kane, A.G. and Pouloupoulos, M. (2014) Thoracic Disc Herniation Leads to Anterior Spinal artery Syndrome Demonstrated by Diffusion-Weighted Magnetic Resonance Imaging (DWI): A Case Report and Literature Review. *Spine Journal*, **14**, e17-e22. <https://doi.org/10.1016/j.spinee.2013.10.050>
- [18] Shah, S. and Bryant, P. (2018) Fibrocartilaginous Emboli in the Pediatric Population: The Role of Rehabilitation in Facilitating Functional Recovery. *Journal of Pediatric Rehabilitation Medicine*, **11**, 53-56. <https://doi.org/10.3233/PRM-170502>