Fracture and migration of a retained microcatheter into the cauda equina after endovascular neurointervention for dural arteriovenous fistula as a rare cause of tethered spinal cord: case report

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The evaluation of spinal cord vascular malformations in neuroradiology departments remains valid for both diagnosis and endovascular embolization, and for adjuvant as well as definitive treatment. The most commonly encountered complications of endovascular approaches are the recurrence or the incomplete embolization of the lesion and accidental damage to the medullary arteries, which leads to spinal cord infarction. Failure to remember a microcatheter in the abdominal aorta after catheterization is an underestimated complication. A retained guidewire in the circulation may not necessarily cause symptoms, and it may remain unnoticed for a significant period of time. However, severe complications may be faced even many years later. In this article, a case report on a fracture and migration of a retained microcatheter in the cauda equina is presented. This occurred after an endovascular neurointervention for dural arteriovenous fistula as a rare cause of tethered spinal cord.

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WHEN the retrieval of a guidewire is impossible in the abdominal aorta, the preferred treatment is controversial. It is mostly influenced by the clinical situation and the position of the wire. There are well-known complications of a retained guidewire, such as the risk of thrombosis with total occlusion of an artery or emboli formation. There is also a clear and unpredictable risk of catheter migration. In order to prevent the migration of the retained catheters and wires, they should be transected at the puncture site level of the common femoral artery and should be fixed against the vascular wall by stent grafts.^{3,4} However, wires even in these situations may not stay intact within the vessel lumen and may eventually break and migrate out of the aorta to somewhere else in the body.¹⁰ In this report, we describe the first published case of fracture and migration of a retained microcatheter into the cauda equina after endovascular neurointervention for dural arteriovenous fistula as a rare cause of tethered spinal cord.

Case Report

History and Examination

A 61-year-old patient was admitted to our outpatient clinic with an inability to walk for the last 4 years. In his past medical history, he had a thoracolumbar arteriovenous fistula, which had been treated via intravascular intervention 5 years earlier in an institution in another country. The patient had given informed consent to the intravascular intervention. The procedure was performed uneventfully, and the fistula was successfully treated. In the medical records about this procedure no complication was mentioned, nor was any other follow-up radiological evaluation available on admission to our clinic. The patient claimed that he had no neurological deficit right after the procedure, but he had urinary problems and difficulty in walking. When the patient was admitted to our clinic his neurological status was total plegia in his left lower extremity and 3/5 motor deficit in his right lower extremity,

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FIG. 1. Sagittal T2-weighted lumbar spinal MRI (A) shows metallic artifacts in the abdominal aorta and sacral spinal canal areas (arrows). Low on the conus medullaris at the L4 level, a tethered cord is seen. Sagittal (B) and coronal (C) 2D reformatted CT images of the lumbar spine show a retained broken microcatheter in the abdominal aorta (arrowheads) and a metallic foreign body in the sacral spinal canal (arrows). A coronal reformatted image of an abdominal CT angiography sequence (D) shows retained and broken guidewire within the lumen of the abdominal aorta.

and due to urinary retention, he had received follow-up treatment with a suprapubic catheter shortly after the procedure. His past medical history included hypertension.

Neuroimaging Findings

A lumbar MRI scan was performed and metal artifacts were visible in the abdominal aorta, and in the intradural area at the sacral level. Conus medullaris was visualized at the L4 level, and tethering of the spinal cord was obvious (Fig. 1A). CT examination of the lumbar spine was performed to clarify the cause of the artifact and it was revealed that there was a retained broken microcatheter in the abdominal aorta and a metallic foreign body in the intradural compartment at the sacral level (Fig. 1B and C). An abdominal CT angiography study was performed to check the abdominal aorta and the branches. It was revealed that the broken guidewire was within the aorta and a patent lumen was present. Anteroposterior and lateral radiographs of the lumbar spine demonstrated these metallic structures as fragments of a broken guidewire (Fig. 2). Our final diagnosis was that the fracture and migration of a retained microcatheter into the cauda equina had caused tethering of the spinal cord 5 years after the endovascular neurointervention.

Operation and Postoperative Course

Surgery was performed with the supervision of intraoperative neuromonitoring. After the dura mater was opened all nerve roots were visualized. There was a severe arachnoiditis covering all roots. All nerve roots were

monitored and a microdissection of the rootlets from the thick arachnoid was performed. The migrated guidewire was successfully removed (Fig. 3) and untethering of the spinal cord was performed (Video 1).

VIDEO 1. Excision of the guidewire and untethering of the spinal cord. Copyright Gulden Demirci Otluoğlu. Published with permission. [Click here to view.](#)

There was no decline in the basal transcortical motor evoked potentials during the surgery. There was no attempt to withdraw the guidewire from the abdominal aorta due its complete incorporation into the vessel wall within the patent vessel lumen. In the postoperative period, the patient's neurological status improved to paraparesis (2/5 motor deficit), and he was able to walk with the aid of a walker (Video 2).

VIDEO 2. In the postoperative period the patient was able to ambulate with a walker. Copyright Gulden Demirci Otluoğlu. Published with permission. [Click here to view.](#)

His urinary condition has not improved yet.

Discussion

The most commonly seen complications in neurointerventional procedures—either diagnostic or therapeutic—include thromboembolic events, groin-site hematoma, contrast-induced nephropathy, intraoperative rupture, failure to treat the lesion, and radiation-induced effects.¹⁶ Retained wires in the arterial system during or after an intervention are very rare and may also be associated with serious complications such as perforation or dissection

FIG. 2. Anteroposterior (A) and lateral (B) radiographs of the lumbar spine show the fragments of guidewire in the location of the abdominal aorta (arrowheads) and in the sacral spinal canal (arrows).

of the artery. However, entrapment and/or fracture of a guidewire in an artery is very uncommon.^{6,9,14} Some opinions have been voiced regarding the causes of guidewire fracture. Entrapment or overrotation of the distal end or excessive bending that produces a high tensile load may result in guidewire fracture.^{11,15}

If broken, the migration of the intravascular guidewires to elsewhere in the body can happen more easily. The mechanism of the migration of the foreign bodies is not easy to comprehend and has always been a mystery. The migration into the thoracic cavities might be explained by negative intrathoracic pressures and continuous respiratory excursions. However, it should always be kept in mind that there are no rules governing the behavior of foreign bodies in the tissues.^{10,13} In this particular case, we speculate that high intravascular pressure, gravity, and soft-tissue activity might have a role in this unique guidewire travel to the cauda equina. The avoidance of this complication is another issue that must be underlined. In the literature on fixation of the guidewire to the artery, using a second stent for prevention of catheter migration and open surgical removal if possible are the main management options.^{3,4}

The host response to the biomaterials includes blood-material interactions, provisional matrix formation, acute inflammation, chronic inflammation, granulation tissue formation, foreign body reaction, fibrosis, and capsule development. During this pathological course, a migrated foreign body may remain quiescent or may lead to serious life-threatening complications. The clinical manifestations of a foreign body reaction may occur due to local inflammatory response, soft-tissue reaction far away from the implant, and scattered foci of secondary healing mixed in with patchy overgrown granulation tissue.¹

FIG. 3. Photograph of the migrated guidewire. Figure is available in color online only.

The tethered spinal cord syndrome is a neurological disorder caused by conditions that lead the filum terminale to lose its elasticity, and as a consequence limit the movement of the spinal cord within the spinal column. It is commonly associated with congenital malformations such as myelomeningocele, lipomyelomeningocele, diastematomyelia, and fatty filum terminale.^{2,7,8} Intradural lipoma, dermoid and epidermoid cysts, and arachnoiditis may be the other rare causes of this particular syndrome.⁵ A previous history of surgery for spinal dysraphism occasionally results in iatrogenic tethering of the spinal cord due to postoperative inflammatory processes. When we consider the condition from this point of view, intense dural fibrosis as a complication of foreign material in the cauda equina might be the cause of the tethered spinal cord syndrome, as in the current case presented here.¹² Because the patient was neurologically intact after the procedure and a gradual decline was seen, we speculate that the neurological decline was directly related to the tethering of the spinal cord.

Exploration and early removal of the migrated foreign body via an external approach is the treatment of choice to prevent unexpected complications. The patient who presented here underwent operation in another clinic and in another country, and unfortunately we are not sure about the details of the primary interventional neuroradiologist's strategy. According to our clinical philosophy the patient must be informed about the possible complications and, if needed, early treatment attempts should be suggested. This patient was not advised to have radiological follow-ups after the intervention, which would have been a warning of the retained guidewire in the early postoperative period.

Conclusions

Interventional procedures can have very rare complications other than the common vascular problems. Tethering of the spinal cord is actually a very rare complication of the procedure.

References

1. Anderson JM, Rodriguez A, Chang DT: Foreign body reaction to biomaterials. *Semin Immunol* 20:86–100, 2008
2. Bowman RM, Mohan A, Ito J, Seibly JM, McLone DG: Tethered cord release: a long-term study in 114 patients. *J Neurosurg Pediatr* 3:181–187, 2009

3. De Praetere H, Di Bari N, Gutermann H, Van Kerrebroeck C, Dens J, Dion R: Extravascular migration of a guide wire with perforation of the heart eight months after percutaneous coronary intervention: consequence of a conservative approach. **Cardiology** **121**:83–86, 2012
4. DerDerian T, Ascher E, Hingorani A, Jimenez R: A rare complication of a retained wire during endovascular abdominal aortic aneurysm repair. **Ann Vasc Surg** **27**:1183.e11–1183.e15, 2013
5. Greene CS Jr: Tethered cord syndrome. **West J Med** **162**:258–259, 1995
6. Hartzler GO, Rutherford BD, McConahay DR: Retained percutaneous transluminal coronary angioplasty equipment components and their management. **Am J Cardiol** **60**:1260–1264, 1987
7. Herman JM, McLone DG, Storrs BB, Dauser RC: Analysis of 153 patients with myelomeningocele or spinal lipoma re-operated upon for a tethered cord. Presentation, management and outcome. **Pediatr Neurosurg** **19**:243–249, 1993
8. Hudgins RJ, Gilreath CL: Tethered spinal cord following repair of myelomeningocele. **Neurosurg Focus** **16**(2):E7, 2004
9. Konstas AA, Pile-Spellman J: Aortic dissection associated with a neurointerventional guidewire retained in a perforating branch of the right posterior cerebral artery. **Br J Radiol** **80**:e290–e292, 2007
10. Koo HW, Park W, Yang K, Park JC, Ahn JS, Kwon SU, et al: Fracture and migration of a retained wire into the thoracic cavity after endovascular neurointervention: report of 2 cases. **J Neurosurg** **126**:354–359, 2017
11. Lotan C, Hasin Y, Stone D, Meyers S, Applebaum A, Gotsman MS: Guide wire entrapment during PTCA: a potentially dangerous complication. **Cathet Cardiovasc Diagn** **13**:309–312, 1987
12. Martínez-Lage JF, Ferri Niguez B, Almagro MJ, Rodríguez MC, Pérez-Espejo MA: Foreign body reactions causing spinal cord tethering: a case-based update. **Childs Nerv Syst** **26**:601–606, 2010
13. Mazet RJ: Migration of a Kirschner wire from the shoulder region into the lung: report of two cases. **J Bone Joint Surg** **25**:477–483, 1943
14. Steffenino G, Meier B, Finci L, Velebit V, von Segesser L, Faidutti B, et al: Acute complications of elective coronary angioplasty: a review of 500 consecutive procedures. **Br Heart J** **59**:151–158, 1988
15. Vrolix M, Vanhaecke J, Piessens J, De Geest H: An unusual case of guide wire fracture during percutaneous transluminal coronary angioplasty. **Cathet Cardiovasc Diagn** **15**:99–102, 1988
16. Wong JM, Ziewacz JE, Panchmatia JR, Bader AM, Pandey AS, Thompson BG, et al: Patterns in neurosurgical adverse events: endovascular neurosurgery. **Neurosurg Focus** **33**(5):E14, 2012

Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Demirci Otluoğlu, Demir. Acquisition of data: Hasanov. Drafting the article: Demirci Otluoğlu. Critically revising the article: Demirci Otluoğlu, Toktas, Konya, Demir. Approved the final version of the manuscript on behalf of all authors: Demirci Otluoğlu. Administrative/technical/material support: Hasanov. Study supervision: Mert.

Supplemental Information

Videos

Video 1. <https://vimeo.com/367744863>.

Video 2. <https://vimeo.com/367744898>.

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