Letter to the Editor

A very rare complication after knee arthroplasty: a case description of postoperative acute paraplegia

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Introduction

Total knee arthroplasty is a reliable and effective treatment for osteoarthritis, and after the procedure, patients generally show a significant improvement in knee function. However, paraplegia is a very rare postoperative complication of knee arthroplasty and does not appear to have been reported in the literature thus far.

Spinal dural arteriovenous fistula (SDAVF) is a rare type of spinal cord vascular malformation and often clinically manifests as progressive congestive myelopathy (1). The main pathogenic mechanism is the abnormal communication between the spinal root artery and the spinal drainage vein, resulting in a fistula, venous hypertension, stagnant blood flow, edema and necrosis of the spinal cord neuronal cells, and progressive ischemic and hypoxic myelopathy (2,3). SDAVF is insidious and has a low incidence rate, an atypical clinical presentation, and an insensitivity to conventional imaging; moreover, magnetic resonance imaging (MRI) is required for screening, while spinal angiography is required for a definitive diagnosis (4). The disease is difficult to diagnose at an early stage and is easily missed and misdiagnosed, with the majority of patients already experiencing varying degrees of spinal cord dysfunction at the time of consultation (5).

Early diagnosis, effective treatment, and scientific rehabilitation provide satisfactory clinical results (6,7). In this report, we present a very rare case of paraplegia after knee arthroplasty in a patient with osteoarthritis of the knee combined with SDAVF, with the aim of establishing the importance of the early diagnosis and timely treatment of patients with SDAVF. Without early diagnosis and timely treatment, there is a risk of irreversible spinal cord injury, which can seriously affect the quality of life of patients.

Case presentation

The patient, a 60-year-old female, attended our outpatient clinic complaining of left knee pain that had persisted for 10 years. A physical examination suggested a flexion and a varus deformity of the left knee joint, obvious pressure pain in the left knee joint, and normal muscle strength and sensation in both lower extremities. A knee X-ray suggested osteoarthritis of the left knee.

The patient underwent left knee arthroplasty with

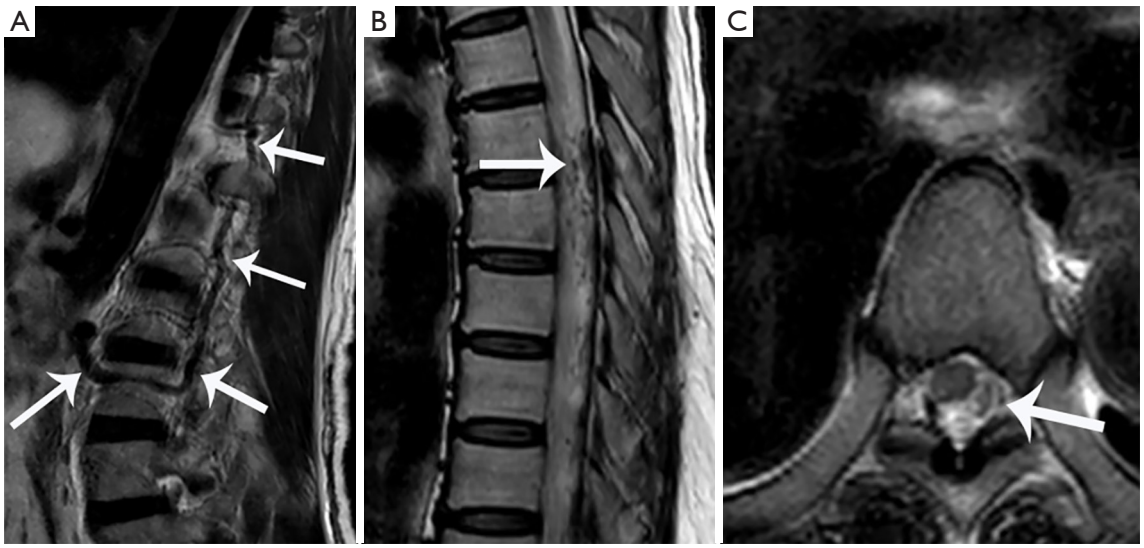

Figure 1 MRI scan showing (A) the malformed draining veins and (B,C) the cord and draining veins. MRI, magnetic resonance imaging.

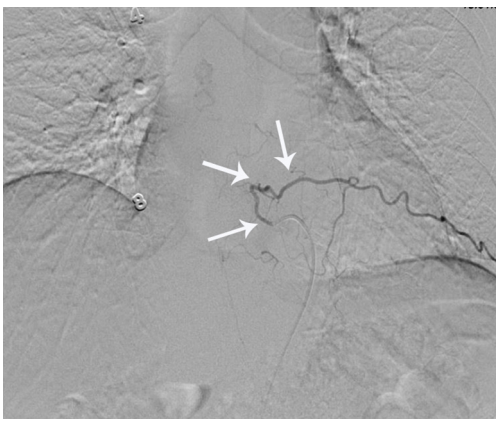

Figure 2 A spinal angiogram showing the spinal dural arteriovenous fistula formed by the intercostal artery.

spinal anesthesia 2 days later. However, 14 hours after the surgery, the patient had hyperalgesia in the plane below the 12th thoracic vertebra. According the grading of the UK Medical Research Council (MRC), the patient had grade 1 muscle strength in both lower extremities. All muscles of the hip, knee, and ankle joints had a muscle strength of 1 grade. The muscles could contract but could not induce joint movement. As these symptoms suggested nerve damage, we treated the patient with steroids. The steroids applied included 500 mg of methylprednisolone sodium succinate mixed with 250 mL of saline that was administered via intravenous infusion once a day for 3 days. However, after the steroid therapy, the patient's symptoms, which included hyperalgesia in the perineum and bowel and urinary incontinence, worsened significantly. The patient was then sent to the hospital's emergency room where we performed MRI of the lumbar spine, which suggested SDAVF (*Figure 1*).

To further confirm our diagnosis, a myelogram was performed that suggested a dural arteriovenous fistula at the left nerve root of the seventh thoracic vertebra and the presence of an abnormal dilated venous network in the sixth and seventh thoracic vertebrae within the spinal canal (*Figure 2*). The patient was then transferred to the Department of Neurosurgery for further treatment, and 2 days later, the patient underwent a dural arteriovenous fistulotomy (*Figure 3*). After the operation, the patient performed functional exercises and received nutrition-related nerve therapy (methylcobalamin).

Two weeks later, the patient's muscle strength of both lower extremities recovered to grade 3, her ankle muscle strength recovered to grade 3, and the hypesthesia and numbness of both lower extremities improved significantly. At the 3-month follow-up visit, the patient was able to walk slowly with crutches but had severe numbness in both lower extremities and uncontrolled urination and defecation. After 16 months of rehabilitation, the patient was left with moderate numbness in both lower limbs and controlled urination and defecation.

This study was reviewed by the Ethics Committee of the Shandong Provincial Qianfoshan Hospital (Jinan, China). Written informed consent was obtained from the patient for

Figure 3 A spinal angiogram showing the disappearance of the tortuous venous masses after fistulotomy.

the publication of this case report and any accompanying images. A copy of the written consent is available for review by the editorial office of this journal. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Discussion

Total knee arthroplasty is a highly mature procedure that can relieve knee pain and improve knee function. Many studies have confirmed that spinal anesthesia is a very safe method. Although neurological complications from lumbar puncture are relatively rare, they are a constant concern for anesthesiologists. Lumbar puncture has been documented as being associated with the development of spinal dural arteriovenous fistulas (8). In spinal anesthesia, choosing a high lumbar or thoracic puncture for spinal anesthesia may result in spinal cord injury in some patients with difficult punctures (9). Spinal anesthesia is exceedingly common in surgery, but spinal anesthesia is also particularly risky, and it requires extensive knowledge, skill, and experience in anatomy to perform, with the correct site of needle entry being especially important. In our case, repeated punctures during spinal anesthesia had the potential to damage the arteries of the spinal cord with the anesthesia needle, resulting in the formation of a spinal arteriovenous fistula. Due to the presence of a pressure gradient, a hematoma formed in the subpleural or spinal canal, which is the same mechanism as that causing fistula between the femoral artery and vein after femoral puncture.

SDAVF is a relatively rare group of diseases with a low incidence, and the exact etiology of SDAVF is currently unclear, but it is often thought to be acquired and may possibly be associated with trauma, infection, and lumbar puncture (10). The main pathogenic mechanism of SDAVF is the abnormal communication between the spinal root artery and the spinal drainage vein, which leads to the formation of a fistula and a lack of venous valves in the spinal veins (11). Their inability to stop reverse blood flow results in increased pressure and tortuous expansion in the perimedullary veins, impaired normal venous return in the spinal cord, and reduced tissue perfusion, which in turn results in spinal cord ischemia and hypoxia, leading to edema and necrosis of the spinal neurons and subsequent progressive spinal cord ischemia. Progressive spinal cord ischemia causes irreversible damage (12,13). For acute spinal cord injury (SCI), surgery is critical, as it can stabilize the spinal cord and prevent potential secondary injury to the spinal cord. However, SCI often leads to persistent hypotension, which is an important complicating factor and should therefore be given special consideration when an induction agent is chosen for spinal anesthesia (14).

SDAVF usually has a subtle onset and progresses slowly. Numbness, hypoesthesia, and limited movement of the lower extremities are often the first symptoms, and lower extremity paraplegia may develop as the disease progresses. In the early stages, mild autonomic dysfunction may occur, and in the severe stages, urinary retention or incontinence and severe constipation or fecal incontinence may occur (15,16).

MRI is an important tool for diagnosing SDAVF, as it can detect abnormal vascular flow-void images in the spinal canal and initially determine the location of the malformed vessels, their direction, and the degree of spinal cord oedema (17). On MRI, the fluid that causes spinal edema thickens to a slightly low signal on the T1 images and a high signal in the medulla on the T2 images, and enhanced sequences reveal twisted, enlarged, and malformed draining veins (18). Spinal angiography can identify the location of the fistula, the blood supply artery, and the drainage vein and is considered by most investigators to be the current gold standard for the diagnosis of SDAVF.

SDAVF mainly presents with various spinal cord dysfunctions, which are similar to other spinal cord diseases, difficult to diagnose, and easily missed and misdiagnosed (19,20). However, in clinical practice, paraplegia needs to be differentiated from plexopathy. The clinical presentations

of lumbar spondylosis and plexopathy are highly similar, with the most common symptom of lumbar spondylosis being bilateral leg pain, but the common symptom in patients with plexopathy is unilateral radiation (21). If the clinical symptoms do not improve significantly, an MRI examination reveals no significant improvement in spinal edema, and an abnormal vascular shadow is observed in the spinal canal, cerebral and spinal angiography should be performed to confirm the type of lesion.

The key to treating SDAVF is to eliminate the abnormal shunt, occlude the blood flow from the fistula and the venous side of the fistula, and restore normal venous drainage to the spinal cord. It is generally accepted that SDAVF should be treated as soon as it is diagnosed and that good clinical outcomes can be achieved if the patient is treated before irreversible changes in the spinal cord occur and cause dysfunction (22). Currently, the treatment methods include microsurgery, interventional embolization, or a combination of both. The advantages of microsurgery are its simplicity, ease of use, and broad surgical indications, as well as its efficacy and low recurrence rate. Endovascular intervention is less invasive, has fewer complications, and has a shorter hospital stay than does open microneurosurgical treatment (23). If the blood supplying artery is small and twisted, the microcatheter cannot reach the fistula during interventional embolization, and interventional embolization is not suitable (24). In addition, numerous studies have proven simulation training to be a highly effective teaching tool because trainees need effective communication and cooperation in handling crisis situations. Through simulation training, trainees exercise their ability to handle critical situations, which leads to better medical behavior (25). Meanwhile, spinal bracing plays a critical role in the treatment of spinal nerve injuries. Spinal bracing is a common nonsurgical technique that is key in treating spinal nerve injuries, while spinal bracing has many indications and applications that allow clinicians to prevent and correct deformities or injuries to the patient's spine (26). Imaging techniques such as radiographs and CT scans can determine the nature of acute trauma pathology such as a fracture or dislocation that may indicate brace usage (26).

Conclusions

Given the increasing number of reported cases in the literature, clinicians should be aware of the potential outcome of common neurological interventions. SDAVF usually presents with vague symptoms, which create a challenge in diagnosing the condition. The possibility of SDAVF needs to be considered in cases of difficult-to-diagnose neurological dysfunction caused by spinal cord disorders. Steroids are contraindicated in patients with SDAVF, as clinical symptoms can rapidly worsen once steroids are administered. Thus, SDAVF should be treated with early surgery, as early treatment is the only means to achieving a satisfactory outcome.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-23-308/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was reviewed by the Ethics Committee of the Shandong Provincial Qianfoshan Hospital (Jinan, China). Written informed consent was obtained from the patient for the publication of this case report and any accompanying images. A copy of the written consent is available for review by the editorial office of this journal. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

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