Nerve injury in an undiagnosed adult tethered cord syndrome patients following spinal anesthesia
-A case report-

Department of Anesthesiology and Pain Medicine, Presbyterian Medical Center, Jeonju, Korea

Yu Yil Kim, Jae Wook Song, Jin Hun Lim, Yong Seok Kim, Young Eun Kwon, and Jun Hak Lee

Spinal anesthesia is a safe and widely used procedure. Spinal cord injury is a rare but serious complication from spinal anesthesia occurs, unexpectedly. Risks of direct neural injury from spinal anesthesia increase in tethered cord syndrome that the spinal cord is tethered by the inelastic structure and is, also, extended to the lower lumbar vertebra. A 52-years-old female patient undergoing anti-incontinence surgery developed neurologic symptoms following spinal anesthesia. The low-lying conus (L5 body level) and tethered cord were found during the assessment of neurological symptoms.

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Key Words: Spinal anesthesia, Spinal cord injury, Tethered cord syndrome.

Spinal anesthesia is a temporary nerve block using local anesthetics in the subarachnoid space. It is often used in lower extremities and urological surgeries. Complications of spinal anesthesia are hypotension, post dural puncture headache, lumbago, hematoma, infection and neural damage. Among those, neural damage is less frequent (2.2 per 100,000) and recovered in most cases [1].

Tethered spinal cord is a condition that the spinal cord is extended and the conus medullaris is located in the lower lumbar vertebra level [2], which increases the possibility of direct neural damages at spinal anesthesia.

We are reporting a case of neural damage following spinal anesthesia in undiagnosed the tethered cord syndrome (TCS) patients.

CASE REPORT

A 52-years-old female was admitted to department of neurology with pain and abnormal sensation in the right lower extremity. Two months ago, the patient had the anti-incontinence surgery after spinal anesthesia, and the pain and abnormal sensation started during the recovery.

The symptom had been gradually relieved. However, the symptom had persisted 2 months after the surgery. The neurologist suspected spinal cord injury due to spinal anesthesia and referred to the department of anesthesiology and pain medicine for pain control and further evaluation. The spinal anesthesia was performed at L4-5 level using 25 gauge pencil point needle in the sitting position. The patient complained shooting pain to the right foot when the needle advanced. Therefore the needle was withdrawn, and the pain was relieved at the same time. The hyperbaric 0.5% bupivacaine 9 mg was injected after the free flow of clear cerebrospinal fluid, and the patient had no complaints. The anti-incontinence surgery was preceded, relaxed and peacefully after the spinal anesthesia.

The painful sensation on the L4-5 dermatomes, and abnormal sensations on the dorsal and plantar aspect of the right foot were noted, but the motor function and reflex were normal at the physical and neurologic examination. Thickened filum terminale and syringomyelia were found on magnetic resonance imaging (MRI). As a result, tethered cord syndrome was diagnosed.

The conus medullaris was at the L5 vertebral body level.
However, other abnormal findings, such as hematoma and abscess, were not observed (Fig. 1). Also, quantitative sensory test and somatosensory evoked potential was performed, which were within normal limits.

The conus medullaris was extended to L5 vertebral body, and fixed to the thickened filum terminale made mobility of the spinal cord decrease. As a result, the spinal needle had caused possible damages in the spinal cord during spinal anesthesia with a high chance. However, her symptom was gradually improved. The conservative care with oral medication and physical therapy for pain control was ordered. After ten months from the symptom appeared, her pain was relieved except the lateral side of the right knee.

### DISCUSSION

The type of anesthesia is chosen based on the patient’s condition, type of surgery and the patient’s preference. Among the other types of anesthesia, spinal anesthesia can decrease stress reaction, intraoperative bleeding, incidence of the thromboembolism from surgery, and has the benefit of better postoperative pain management. Spinal anesthesia is often used in the lower extremity and inguinal region surgeries, especially in gynecological and urological surgeries. However, spinal anesthesia has weak points including hypotension, low back pain, nausea-vomiting, post dural puncture headache, epidural hematoma and abscess, and nerve damages by the systemic reaction of local anesthetics, direct trauma to nerve tissue, and physiological changes by the spinal anesthesia. Among those complications, nerve damage from direct needle trauma or toxicity of local anesthetics [3] is very rare and recovered within 6 months in most cases [1], but permanent nerve damage is also possible. Therefore early diagnosis and treatment are required to prevent.

Reynolds [4] reported cases regarding direct nerve damages from atraumatic spinal needle during the spinal anesthesia or combined spinal-epidural anesthesia. In all cases, procedures were performed at L2-3, and all the patients complained pain when inserting the atraumatic spinal needle, and the nerve damage was observed on the same side. Hamandi et al. [5], also, reported 5 nerve damage cases occurred following spinal anesthesia, and the insertion sites were L2-3 or L3-4. Except the 2 cases, 3 patients complained the pain when spinal needle was inserted or during the injection of local anesthetics. From the cases reported by Reynolds and Hamandi et al. [4,5], no cases have existed with extension of conus medullaris such as TCS on the MRI. Shim et al. [6] reported nerve damages from the spinal anesthesia in urological surgery. They reported that MRI after surgery showed TCS on the lumbar spine.

The spinal cord ascends as we grow. As a result, the conus medullaris is located on the inferior L1 or between the L1 and L2 disc level. Therefore, spinal needle insertion should be performed at lower lumbar spine levels to avoid direct damages in the spinal cord. Tuffier’s line is the landmark that connects between superior iliac crests and lies on L4 body or L4-5 intervertebral disc level. However, Tuffier’s line does not have definite accuracy, therefore many studies have reported that the exact lumbar vertebral level is very difficult, and inserting spinal needle at the higher level than the predicted level particularly if the patient is obese or has abnormality in

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**Fig. 1.** Sagittal (A) and axial (B) T2-weighted MRI of patient. The conus medullaris terminates at L5 vertebral body (A). The syrinx is clearly visible on ipsilateral to the side of neurologic deficit (B).
Tethered spinal cord is a condition that the spinal cord is extended by several causes, and it describes a condition that the conus medullaris is located inferior to the L2 vertebral body. In most cases, the spinal cord is tethered by the inelastic structure fixed in the caudal part, which blocks ascension of the spinal cord. The common etiology is spinal dysraphism including myelomeningocele, lipomyelomeningoceles, diastematomyelia, thickened filum terminale, intradural lipoma and cystic lesions. Also, fibrous tissue adhesion and arachnoiditis may be caused after surgery. TCS is a functional disorder, and it describes accompanied symptoms caused by tethered cord. At birth, TCS with spinal dysraphism is discovered in most cases; therefore it is usually removed by operation. However, occult spinal dysraphism can be found as appeared symptoms or skin lesions such as hirsutism, angioma, skin dimple, dermal sinus and subcutaneous lipoma [2]. In this case, the spinal cord was extended to L5 vertebral body and there were no skin lesions.

TCS in adults appears as pain, neurologic deficit in motor and sensory that progresses gradually at the bilateral lower extremities, and urologic disorder from the dysfunction of the sphincter. It is known that the mechanism is dysfunction of oxidative metabolism in the spinal cord from the expansion and the reduced blood flow in the spinal cord and repetitive mechanical stimulation from the exercise at the thoracolumbar region or accompanied spinal disorder are considered as causes of neurological symptoms [9].

It is important to diagnose the TCS before irreversible nerve damages, radiological exam is essential to confirm as it is difficult to diagnose only with symptoms. MRI is an accurate method in evaluating the location of the conus medullaris, lesions in the spine and accompanied malformations. Also, ultrasound can be used in neonate and infants [10].

The treatment for TCS is detethering the tethered region in the spinal cord, or removing accompanied cysts or lipomas, surgically. Surgical treatment of asymptomatic TSC in adults is controversial even if the surgical treatment can prevent the permanent damage from the neurological dysfunctions.

In this case, the spinal cord is tethered by the thickened filum terminale on the MRI. However, the patient has no pain and neurological dysfunctions in the lower extremities before the surgery; only urinary incontinence is appeared as a suspected symptom of TCS. Urinary incontinence was improved after the surgery, and the pain and the abnormal sensation in the right lower extremity associated with the spinal anesthesia were getting improved. Therefore, the surgical treatment for TCS was postponed.

Spinal cord damages related to the spinal anesthesia are not predictable, and they can cause critical results. To prevent this accident, spinal needle insertion at the lower lumber levels and the determination of exact level by ultrasound or fluoroscopy should be performed. Furthermore, the anesthesiologist should always remember that the abnormality of conus medullaris may exist in the lower lumbar as shown in this patient. When patients complain pain or abnormal sensations during the spinal needle insertion or drug injection, the anesthesiologist should stop the procedure to prevent the further nerve damages. If neurological symptoms are persistent and prominent, radiological evaluation including MRI at the early phase should be performed to find the exact causes, and proper management can reduce the irreversible neural damages.

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