

Complications after spinal anesthesia in adult tethered cord syndrome

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Abstract

Since little has been reported about complications of spinal anesthesia in adult tethered cord syndrome (TCS), we sought to delineate the characteristics of the condition.

A total of 4 cases of adult TCS after spinal anesthesia were reviewed. The medical charts of the patients were obtained. Anesthesia, which was combined spinal and epidural anesthesia or spinal anesthesia was performed, and follow-up were carried out in all patients.

The most common neurological symptom of adult TCS before surgery was occasional severe pain in back, perineal region, or legs. Frequent micturition, diminished knee and ankle reflexes, and difficulty in bending were exhibited in partial patients. Paraesthesia of perineal region or/and lower extremities existed 2 to 3 days after spinal anesthesia in all the cases. Weakness of lower extremities existed in 1 case. Lumbar magnetic resonance imaging showed the low location of conus medullaris. At follow-up, 3 cases recovered completely within 3 weeks, and 1 case underwent permanent disability.

These cases suggest anesthesiologists and surgeons alert to the association of adult TCS and spinal anesthesia. Spinal anesthesia should be prohibited in patients with adult TCS to prevent neurological damages.

Abbreviations: MRI = magnetic resonance imaging, SNAP = sensory nerve action potential, TCS = tethered cord syndrome.

Keywords: adult, complications, spinal anesthesia, tethered cord syndrome

1. Introduction

Spinal anesthesia may result in various neurological complications. The incidence of spinal anesthesia-related neurological complications is 3.78 per 10,000, and some are the permanent neurological deficits.^[1] The possible component factors leading to spinal injury include direct mechanical trauma, local anesthetic neurotoxicity, and secondary spinal cord ischemia.^[2] The tethered cord syndrome (TCS) is common in children but rare in adults.^[3] Adult TCS, as a cause of neurological complication that occurs after spinal anesthesia, has been reported rarely.

TCS is a diverse clinical entity, which is caused by excessive tension on the spinal cord. In this condition, lumbar puncture is dangerous. It can lead to injuries of lower lumbar spinal cord and conus medullaris. In adult, TCS always manifests with mild

weakness of lower limbs, diminished knee reflex or achilles tendon reflex, abnormal sensation (especially pain in back, perineal region, or lower extremities), and slight neurogenic bladder.^[3] Because the symptoms and signs are inconspicuous, adult TCS is very difficult to detect before anesthesia. Not much about adult TCS after spinal anesthesia had been published. Most of the original articles were case reports.^[4–6] Because this condition is rare, it is possible that patients would be misdiagnosed and treated incorrectly. Its specific clinical characteristics should be identified. The authors, herein, report another 4 cases and also discuss its clinical characteristics and management strategies.

2. Materials and methods

The study protocol was approved by the Ethics Committee of the Second Affiliated Hospital, School of Medicine, Xi'an Jiaotong University, Xi'an, China. Written informed consent was obtained from all the patients included in this study. From January 2008 to December 2015, a total of 28,160 patients underwent combined spinal and epidural anesthesia or spinal anesthesia, and 4 of them were recognized to be adult TCS postoperatively. The clinical data of the 4 patients were obtained, including age, gender, history of past illness, clinical presentation, anesthetic procedure, surgical procedure, neurological status, and ancillary tests, and was analyzed retrospectively.

During anesthesia, all the patients felt radiating pain in the lower extremities or perineal region when a spinal needle was attempted to insert into the subarachnoid space. The pain disappeared immediately when the spinal needle was withdrawn. The anesthetic effects were satisfactory, and the operations were completed successfully. All the patients were given postoperative analgesia. The onset of paraesthesia or weakness of lower

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Table 1**Summary of clinical findings in 4 patients.**

Case no.	Sex/age, y	Illness	Surgery	Anesthesia	Site of dural puncture	Drugs	Analgesia postsurgery
1	Female/28	Pregnancy	Cesarean section	Combined spinal and epidural anesthesia	L2/3 intervertebral space	0.5% Bupivacaine 1.6 mL	Intravenous analgesia
2	Female/31	Pregnancy	Cesarean section	Spinal anesthesia	L3/4 intervertebral space	0.5% Bupivacaine 1.8 mL	Intravenous analgesia
3	Female/52	Hysteromyoma	Total hysterectomy	Combined spinal and epidural anesthesia	L3/4 intervertebral space	0.5% Ropivacaine 2.3 mL	Epidural analgesia
4	Male/47	Appendicitis	Appendectomy	Combined spinal and epidural anesthesia	L3/4 intervertebral space	0.5% Bupivacaine 2.4 mL	Epidural analgesia

L = lumbar.

Table 2**Neurologic performance before surgery.**

Case no.	Weakness	Reflex	Babinski sign	Paraesthesia	Neurogenic bladder	Feet deformity
1	None	Normal	Negative	Occasional pain of the lower extremity	None	None
2	None	Normal	Negative	Occasional pain of the back and perineal region	None	None
3	None	Decreased knee and ankle reflexes	Negative	Occasional pain of the back and perineal region	Frequent micturition	None
4	Difficulty in bending	None	Negative	Occasional pain of the back and perineal region	None	None

extremities was 2 to 3 days after operation. Then they underwent neurological and radiological examinations, including magnetic resonance imaging (MRI), and adult TCS was diagnosed. All patients received corticosteroid (dexamethasone or methylprednisolone), vitamin B1, and vitamin B12. All patients were followed up.

3. Results**3.1. Clinical features**

There were 1 male and 3 females ranging from 28 to 52 years (Table 1). There was no history of trauma, back surgery, or nervous system diseases in any of these patients. No abnormalities of posture or gait were observed. Careful inspection revealed no changes of the dorsal skin. Neurological performance before surgery is shown in Table 2. Case 1 was healthy except occasional and severe pain in the right lower extremity. Cases 2 to 4 felt occasional pain in the back and perineal region. Case 3 felt frequent micturition occasionally, and Case 4 had difficulty in bending.

3.2. Operative findings

The postoperative recovery was uneventful until the onset of paraesthesia or weakness of lower extremities 2 to 3 days after operation. On postoperative day 2, Case 1 felt severe pain in the lower extremities, especially both knees. Case 2 felt numbness in the lower extremities. On postoperative day 3, Case 4 felt numbness in the lower extremities and perineal region, and he was sensitive to pinprick. The strength and movement of the above patients was normal. The knee and ankle reflexes were normal, and the Babinski signs were negative. Case 3 felt numbness in the lower extremities and perineal region. In addition, bilateral weakness of the lower extremities, especially below knees, was noted. The muscle power of right rectus femoris, tibialis anterior, and gastrocnemius was grade 2 to 3/5, and the left was grade 4/5. The knee and ankle reflexes decreased, and the Babinski signs were negative.

3.3. Radiological findings

After the patients had neurological exacerbation caused by anesthesia, lumbar MRI was performed (Table 3). The ends of

Table 3**Features of magnetic resonance imaging.**

Case no.	End of conus medullaris	Myelomeningocele	Lipoma	Diastematomyelia	Syringomyelus	Sacral canal cyst	Conus medullaris edema
1	Inferior margin of L3	None	None	Yes	Yes	None	Yes
2	Superior margin of L4	None	None	None	None	None	Yes
3	Vertebral body of L5	None	None	None	None	Yes	Yes
4	Vertebral body of L4	None	None	None	None	None	Yes

L = lumbar.

Table 4
Amplitude of peripheral nerve in lower extremities.

	CMAP, mv			SNAP, μv		
	Right	Left	Control	Right	Left	Control
Femoral nerve	1.2	3.0	>5	/	/	/
Common peroneal nerve	0.7	1.3	>3	/	/	/
Tibial nerve	0.9	2.1	>5	/	/	/
Sural nerve	/	/	No response	1.2	>6	

CMAP = complex muscle action potential, SNAP = sensory nerve action potential.

conus medullaris were below inferior margin of L3 in all 4 cases. Diastematomyelia and syringomyelus existed in Case 1. Sacral canal cyst existed in Case 3. Conus medullaris edema existed in all cases.

3.4. Follow-up

The follow-up period ranged from 3 weeks to 4 months. The dysfunction of nervous system in Cases 1, 2, and 4 disappeared within 3 weeks. But in Case 3, the paraesthesia and weakness of lower extremities were persistent, and there was not any improvement until 4 months after surgery. Nerve conduction examination (Table 4) in Case 3 was performed 3 months after surgery. It showed marked reduction in the amplitude of complex muscle action potential. Sensory nerve action potential (SNAP) of right sural nerve was not evoked. SNAP of left sural nerve decreased sharply. Electromyography demonstrated massive positive sharp waves and fibrillations in bilateral rectus femoris, muscoli hippicus, and gastrocnemius.

4. Discussion

TCS occurs commonly in children but rarely in adults. The incidence of complications of spinal anesthesia in adult TCS is unknown. During the past decades, only 3 cases^[4-6] were diagnosed adult TCS after spinal anesthesia (Table 5). The 4 cases we observed were out of a total of 28,160 cases underwent combined spinal and epidural anesthesia or spinal anesthesia during January 2008 to December 2015; the incidence of adult TCS after spinal anesthesia is 1 per 7000 (4/28,160).

In the patients with adult TCS, the end of spinal cord is restricted inside vertebral canal and results in low location of the conus medullaris. The spinal cord and conus medullaris are elongated and blood flow diminishes.^[7] The clinical manifestation depends on the degree of traction, which differs greatly in adult TCS. Typical symptoms of adult TCS are severe pain located in back, perineal region, or legs. Neurogenic bladder, such as frequent micturition, urgent urination, urgent incontinence, is common.^[3] In some patients, a subtle onset of motor or sensory changes can be seen.^[8] But feet deformities are less common. Our cases underwent occasional and severe pain. Case 3 underwent frequent micturition. And diminished reflexes were found in Case 3. Case 4 underwent difficulty in bending. The symptoms in all cases were mild, nonspecific, similar but different. But in the cases reported previously, one of them manifested slightly shortened right leg with right foot deformity, another manifested pelvic deformity with kyphosis of the sacrococcygeal junction, they were more evident to detect than ours.

Spinal anesthesia is a safely, routinely performed procedure. It is recommended to take the dural puncture at or below the L3/L4 intervertebral space because the conus medullaris ends at the

Table 5

Summary of previously reported adult TCS after spinal anesthesia.

Author, year	Sex/age, y	Surgery	Site of dural puncture	Drugs	Neurologic performance before surgery	End of conus medullaris	Other abnormalities of MRI	Treatment	Prognosis
Davies et al, 1996 ^[4]	M/53	Transurethral resection of prostate	L1/2 or L2/L3 intervertebral space	0.5% Bupivacaine 2.2 mL	Slightly shortened right leg with right foot deformities	L4/L5 intervertebral space	Hematoma at L2/L3 intervertebral space and diastematomyelia	Right-sided L1-L3 hemilaminectomy	Minor weakness and pain in lower extremities
Wenger et al, 2001 ^[5]	F/38	Cesarean section	L3/L4 intervertebral space	0.5% Bupivacaine 2.6 mL	Pelvic deformity with kyphosis and intermittently weakness in the right leg	L3/L4 intervertebral space	Diastematomyelia	None specific	Without neurologic deficits except absent ankle jerk
Xue et al, 2013 ^[6]	F/25	Cesarean section	L2/3	0.5% Bupivacaine 1.2 mL	Missing	Vertebral body of L4	Conus medullaris edema	None specific	Without neurologic deficits

F = female, L = lumbar, M = male, MRI = magnetic resonance imaging, TCS = tethered cord syndrome.

inferior margin of L1 in most adults and extends to L2 in a few persons.^[9,10] But in TCS, the conus medullaris ends at a lower level, even extends to L5-S1. In this condition, dural puncture should be avoided because of the possibility of the injury of spinal cord. In our cases, the conus medullaris ended below inferior margin of L3, and the site of dural puncture located at L2/3 or L3/4 intervertebral space. Therefore, there were not enough “buffer space” for spinal cord to avoid needle puncture. In addition, other neural tube defects such as spinal bifida, myelomeningocele, lipoma, diastematomyelia, syringomyelus, and sacral canal cyst often accompanied.^[4,11–18] In our cases, diastematomyelia and syringomyelus existed in Case 1, and sacral canal cyst existed in Case 3. Similar anesthetic procedure was performed in the cases reported previously. And conus medullaris in these cases ended below L3/L4 intervertebral space, diastematomyelia existed in 2 of them, the MRI features were similar with the cases we reported.

Spinal anesthesia for adult TCS can result in the injury of spinal cord. The prognosis was classified into 2 types: transient and persistent dysfunction. The dysfunction of nervous system in most patients is transient. They can recover rapidly and completely. In this condition, anesthesia puncture merely causes edematous injury of spinal cord.^[7] Corticosteroid may be effective. Even in some patients, they can recover without any specific treatment. Cases 1, 2, and 4 we reported and 2 cases reported previously belonged to this category. But in a few patients, anesthesia puncture can cause devastating injury of spinal cord.^[19] And secondary spinal hematoma can lead to mechanical compression injury.^[20] In this condition, the dysfunction of nervous system may be persistent. Case 3 underwent permanent disability. Muscle atrophy of lower extremities was noted 1 month after spinal anesthesia. Nerve conduction examination and electromyogram performed 3 months after operation demonstrated serious damage of peripheral nerves in lower extremities. But in 1 case reported by Davies in 1996,^[4] although there was a hematoma in L2/L3 intervertebral space, because of the prompt hemilaminectomy, mechanical compression was removed in time, so this case recovered well.

Despite these features, adult TCS remains a diagnostic challenge in regard to detecting it from patients after spinal anesthesia. However, when there are mild abnormalities such as back or leg pain, neurogenic bladder, motor, or sensory change, anesthesiologist should take adult TCS into consideration. Accurate and detailed illness history and systemic neurological examination are essential before surgery. MRI is crucial in making noninvasive diagnosis of spinal entity as well as in preoperative planning for the patients.^[11–18,21,22] Therefore, MRI scan should be administered preoperatively to make diagnosis for suspicious patients. In addition, because anesthesiologists and surgeons may be unfamiliar with some rare spinal complications,^[23,24] they can be misdiagnosed after surgery. For patients with acute onset of paraesthesia or weakness in lower extremities after surgery, we must be alert with adult TCS.

This study had the following limitations. The number of cases included in the study was small, which made it hard to reach definite conclusions. Given the low prevalence of the condition, a large patient sample was needed. In addition, the retrospective nature may increase the potential for uncontrolled bias.

5. Conclusion

Spinal anesthesia for adult TCS should be avoided because it can cause complex neurological complications. When a patient has mild symptom such as back pain, neurogenic bladder, motor, or sensory change, it is extremely important for anesthesiologist to be aware of the possibility of TCS. When acute onset of paraesthesia or weakness in lower extremities exists after operation, MRI should be timely performed to make diagnosis.

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