Title: Is the "tethered cord" synonymous to "tethered cord syndrome (TCS)"?

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ABSTRACT

Object: TCS is a physiological term for the stretch-induced functional disorder that is caused by the anchoring effect of a caudally located inelastic structure. Neurological lesions are clearly focused in the lumbosacral area cephalic to the tethering site. However, various interpretations for the correlation between the pathophysiology and the anatomical nomenclature of caudal anomalies easily lead to controversy in management of TCS. To solve this basic problem, the authors endeavor to distinguish true TCS from disorders with similar clinical presentations.
Method: Four types of patients that are clinically considered to be related to TCS are presented.
Results: The patients divided into four categories. 1) true TCS, 2) partial TCS, 3) non-stretch-induced disorder with the symptomatology and anomalies similar to TCS. 4) A large myelomeningocele in the high lumbar area.
1) Category1 patients had overall the best surgical outcome. 2) Category 2 had recovery from the deficits that were correlated with stretch-induced dysfunction. 3) Category 3 had pain relief but no neurological improvement, 4) Category 4 patients were expected to have no effect on neurological signs.
Conclusion: The categorization of the disorders with the caudal anomalies allows neurosurgeons to determine the disorders of different categories. The management of each category with accurate prognostication will gain the confidence from other specialists as well as from the public.

INTRODUCTION

The term "tethered cord" was debated since Lichtenstein's proposal (1920),[3] because of its visually oriented expression without physiological analysis. Although our paper "pathophysiology of tethered cord syndrome" [9] elucidated the underlying mechanism of 'tethered spinal cord " (1976) described by Hoffman et al, "tethered cord" is often interpreted as synonymous to the TCS. [1, 4] Our effort is now concentrated in dividing "tethered cord " patients into four categories based on pathophysiology of TCS.

MATERIAL

Case 1(Category 1)
A 26-year-old man had a 3-year history of severe back and leg pain that was initiated by falling on the buttocks. It was followed by loss of urinary, bowel, and sexual control and muscle bulk in legs. Findings were 3Bs postural aggravation of back pain, [2, 6] bilateral weakness of the extensor hallucics longus, peroneus longus, sensory diminution extended from the dorsa of the feet up to the thighs in patchy distributions. Post-void urinary

residual was 50cc. An elongated cord was noted to the lower L5 vertebra by MRI, which was confirmed at surgery together with an inelastic filum displaced posterior to the cauda equina fibers.[5] Resection of the filum resulted in ascension and relaxation of the spinal cord. The back and leg pain was completely relieved, and sensory function returned in 5 days, urinary residual was 0cc.

Case 2 (Category 1)
A 68 -year-old woman presented with a history of mild back pain after a rear-ended car collision, followed by severe back and leg pain for one year. She showed similar signs and symptoms as the first case, except for the filum being 1 mm thick and the conus tip at L1-2 vertebral space. After sectioning the filum, she was relieved of all signs and symptoms and returned to work in 6 months.

Case 3 (Category 2)
A 22 year-old-woman with a history of myelomeningocele repair at newborn began to have weakness and numbness in legs one year before admission. Since childhood she required intermittent catheterization. High arched feet, hammer toes, exaggerated lumbosacral lordosis and scoliosis were found. The posteriorly displaced filum was found by MRI and at surgery. After resection of 1 mm thick fibrous filum and dissection of nerve roots surrounded by scar tissue, the conus ascended 2mm. Motor and sensory function improved to normal within 2 weeks. 3Bs postural pain aggravation ceased. She felt bladder sensation of fullness for the first in her life, but continued catheterization.

Case 4 (Category 3)
A 33 year-old woman had slowly progressive weakness and numbness of lower limbs and incontinence since childhood. At surgery, a large lumbar Lipomyelomeningocele was found with fat tissue extending into the glial tissue in the dorsal part of the spinal cord. Fat tissue was removed flush to the surrounding pia mater. There was no postoperative neurological improvement. Apparently the cause of neurological deficits were related to the dysgenesis, accentuated by local compression and ischemia.

RESULTS

1) Cases 1 and 2 are typical for Category 1, true TCS, with the tethering site at the caudal end of the spinal cord. Anomalies in this category are 1) an inelastic, fibrosed filum, 2) caudal lipomyelomeningocele, 3) sacral myelomeningocele.
2) Case 3 represents Category 2, partial TCS, with a combination of stretch-induced signs and symptoms above the tethering site, and local effect on the spinal cord at the site of the anomaly. Anomalies are 1) relatively small dorsal or transitional lipomyelomeningocele, and 2) myelomeningocele with its plaque located at lower position of the spinal cord, usually at the conus medullaris.
3) Case 4 is representative of cases with local effect alone by the anomalies, such as large dorsal and transitional Lipomyelomeningocele, and myelomeningocele covering the large area of the spinal cord.

4) Patients with myelomeningocele in the high lumbar level have no functional neurons in the lumbosacral cord belong to Category 4.

DISCUSSION AND CONCLUSION

Excellent surgical outcome in category-1 patients is expected, while partial effect in Category 2. The insight into the prognosis of these cases will allow neurosurgeons provide them with favorable prognosis before surgical approach to the anomalies. Categories-3 and -4 patients are not expected to have neurological benefit from surgical procedures, and must be warned, should surgery is done with the reasons other than untethering procedure. [7]

The categorization of the customary term "tethered cord" will allow neurosurgeons to multicenter studies for more meaningful therapeutic results. However, there are many ramifications of pathophysiology, diagnosis, treatment and prognosis, which bring controversies in the different areas. These subjects must be discussed in some other sessions in the future. They include diagnostic methods, the significance of cord elongation and filum thickening, identification of the caudal end of the spinal cord, MRI diagnosis of TCS assisted by intrathecal endoscopy, spina bifida occulta and occult TCS, differential diagnosis, electropysiological diagnosis and intraoperative recording, Urinary and rectal incontinence, Mechanisms of back and leg pain, fetal surgery of myelomeningoceles, and socioeconomic consideration.

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