Postoperative Spinal Cord Swelling and Intramedullary Gd-DTPA Enhancement in Cervical Spondylotic Myelopathy

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Disclosures:

Introduction: A few reports regarding on the cases of the postoperative spinal cord swelling in cervical myelopathy have been published. The spinal cord swelling was described as mimicking intramedullary tumor, spinal cord edema and spinal cord enlargement in the literatures. In the most cases of the spinal cord swelling, the involvement in the intramedullary Gadolinium-diethylenetriamine pentaacetic acid (Gd-DTPA) enhancement on MRI has been reported. Since there have been no systemic studies regarding the postoperative spinal cord swelling, we investigated the prevalence and clinical relevance of the postoperative spinal cord swelling and the relationship with the intramedullary Gd-DTPA enhancement.

Methods: Subjects This study was designed as a prospective multicenter study. Patients with cervical myelopathy who underwent Kurokawa’s laminoplasty were consecutively investigated. However, the patients with disapproval of the study, trauma-induced, a history of spinal surgery, rheumatoid arthritis, cerebral palsy and other brain disorders, Gd-DTPA hypersensitivity and claustrophobia were excluded. A total of 683 patients were enrolled in the study. The age of the patients was 63.1 ± 13.0 (mean ± SD) (95% confidence interval; 62.3 to 63.9) years.

MRI Sagittal T1, 2-weighted and Gd-DTPA enhanced T1-weighted MRI and axial T2 weighted and Gd-DTPA enhanced MRI were taken one month before surgery. A 1.0-Tesla superconducting imaging system or a 1.5-T superconducting imaging system were used for MRI.

Grouping According to the intramedullary Gd-DTPA enhancement on MRI, a enhancement group and a non-enhancement group were set up. All patients who had intramedullary enhancement were referred to neurologists, or had their cerebrospinal fluid (CSF) checked before surgery, and the enhancements were confirmed to not be caused by other diseases. Fifty consecutive patients without the intramedullary enhancement in one hospital were allocated in a non-enhancement group. For these two groups, sagittal T1, 2-weighted and Gd-DTPA enhanced T1-weighted MRI and axial T2 weighted and Gd-DTPA enhanced MRI were taken one month and 12 months after surgery.

Investigation points
1. Prevalence of the intramedullary Gd-DTPA enhancement
2. Prevalence of the spinal cord swelling at 1 month after surgery and changes of the swelling at 12 months after surgery
3. Relationship between the spinal cord swelling and high signal intensity on T2WI 12 months after surgery
4. Relationship between the spinal cord swelling and the Japanese Orthopedic Association (JOA) score for cervical myelopathy

Results: Case presentation In a 69-year-old female with cervical spondylotic myelopathy, the intramedullary enhancement at C4/5 was observed in the enhanced MRI before surgery (Fig. 1). Her symptoms were improved immediately after Kurokawa’s laminoplasty. One month after surgery, spinal cord swelling and strong intramedullary enhancement was observed. Her neurological symptoms became aggravated 6 months later without any specific cause. The JOA score aggravated from 5 points to 4 points 12 months after surgery. MR images demonstrated extensive swelling of the spinal cord and enlargement of the intramedullary enhancement.

1. Prevalence of the intramedullary Gd-DTPA enhancement Intramedullary enhancement was observed in 50 cases (7.3%) out of 683 cases of cervical myelopathy.
2. Prevalence of the spinal cord swelling at 1 month after surgery and changes of the swelling at 12 months after surgery The postoperative spinal cord swelling was observed in 2 cases (4%) in non-enhancement group and 13 cases (26%) in enhancement group at 1 month after surgery. The prevalence of the spinal cord swelling was significantly higher in enhancement group (p=0.0038). The spinal cord swelling disappeared in all cases in non-enhancement group and remained in 3 of 13 cases (23%) in enhancement group at 1 year after surgery (Fig.2).
3. Relationship between the spinal cord swelling and high signal on T2WI Intramedullary high signal areas on T2WI were observed in all swelling cases and 88% of the no-swelling cases before surgery. Looking at the shapes of the high signal area on axial T2WI, the diffuse high signal area was most common in the swelling cases. On the other hand, the snake-eye high signal area was most common in the no-swelling cases. 4. Relationship between the spinal cord swelling and the JOA score for cervical myelopathy.
The swelling cases of the enhancement group, the swelling cases of the non-enhancement group, the non-swelling cases of the enhancement group, the non-swelling cases of the non-enhancement group were compared. There were no significant differences of the JOA score among groups before surgery. The JOA score in the swelling cases of enhancement group was significantly lower than that of the non-swelling cases of the non-enhancement group at 12 months after surgery (Fig. 3).

**Discussion:** Spinal cord edema is a common finding in acute spinal cord injury, tumor, or inflammatory lesions of the spinal cord. However, it is rare in cervical spondylotic myelopathy. There have been a few reports of patients who showed spinal cord swelling after surgery [1][2][3]. Although there were no systemic studies regarding the postoperative spinal cord swelling in cervical spondylotic myelopathy, we have clearly demonstrated the prevalence of the postoperative spinal cord swelling and the relationship with the intramedullary enhancement in the present study. Henderson et al. [4] described two types of immediate and gradual expansion of the cord following decompression. They hypothesized that the immediate acute expansion observed during the early postoperative period reflects edematous changes of the parenchyma, which have little impact on neurological recovery. On the other hand, a progressive expansion of the cord during the late stages of postoperative period correlates with the return of axonal transport of the lateral funiculi, a significant process in the recovery from spasticity and motor paresis. In the present study, the spinal cord swelling was observed more frequently in the enhancement group, and rarely observed in the non-enhancement group at early postoperative stage. The spinal cord swelling disappeared in 77% of the enhancement group and all cases of the non-enhancement group at 12 months after surgery. Thus, the spinal cord swelling was considered to be edematous changes of the parenchyma described by Henderson et al.

**Significance:** The spinal cord swelling was observed more frequently and remained longer in enhancement group; on the other hand, the swelling was rarely observed in non-enhancement group at early postoperative stage, and it disappeared later. The spinal cord swelling with intramedullary enhancement was one of the factors inducing poor prognosis.

**Acknowledgments:** N/A

Fig. 1 MRI before surgery showed compressed spinal cord and intramedullary enhancement at C4-5 (A, B). One month after surgery, spinal cord swelling and strong intramedullary enhancement was observed (C, D). 12 months after surgery, the spinal cord swelling and intramedullary enhancement were reduced (E, F).
Fig. 2 Prevalence of postoperative spinal cord swelling

Fig. 3 Change of JOA score