

Clinical Characteristics and Surgical Results of Spinal Intradural Tumor

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Study Design: A retrospective study about spinal intradural tumor.

Objectives: We analyzed clinical symptom, findings of MRI, and surgical outcome of spinal intradural tumor.

Summary of Literature Review: Intradural tumors are not commonly reported and they show non-specific clinical features.

Materials and Methods: In this study, 18 patients who underwent surgical treatment and radiologically and pathologically diagnosed as spinal intradural tumor from 1997 to 2009 were reviewed. We evaluated pain, neurological symptoms, location of tumor as well as degrees of signal intensity and its enhancement of MRI(T1 and T2). And clinical outcomes were analyzed according to Klekamp-Samii scoring system and Visual Analogue Scale(VAS).

Results: All patients were clinically suffered from back pain and radiating pain of lower extremity including 3 patients with neurological symptoms. We radiologically found single tumor in 16 cases and masses more than two lesion in 2 cases. 1 case was located on cord level(T7), 14 cases cauda equine level, and 3 cases sacral level. We performed laminectomy in 18 cases and posterior instrumentation was applied to 8 cases. In clinical features, mean Klekamp-Samii score was improved from 21.6 to 23.5($p<0.05$) and VAS was recovered from 5.2 to 3.0 ($p<0.05$).

Conclusions: Spinal intradural tumor has non-specific clinical symptoms. Therefore we should perform MRI to find intradural tumor and active management including surgical treatment should be performed due to clinically good results.

Key Words: Spinal intradural tumor, MRI, Clinical symptom

INTRODUCTION

Spinal tumors are divided broadly to intradural tumors and epidural tumors according to their location. Intradural tumors are subdivided to extraspinal tumors and intraspinal tumors. Generally, epidural tumors consist of 60 % spinal tumors, it is most common, and they are metastatic tumors in most cases. Intradural tumors are rare,^{1,2)} it accounts for 30 % spinal tumors, and most of them are extraspinal tumors. Among them, meningioma and nerve sheath tumors(Schwannoma and neurofibromatosis) have been reported to be the most frequent. In addition, in approximately 10 % cases of spinal tumors, intradural tumors and epidural tumors occur together.^{3,4)} Such spinal tumors are relatively rare diseases that may induce back pain, radiating pain in the lower extremities, sensory deterioration, and dysergias, and clinical features are also nonspecific. Therefore, in regard to intradural tumors that could not be encountered frequently in the orthopedic and spinal field, through the clinical symptoms,

characteristics of magnetic resonance imaging, and surgical outcomes of patients who were diagnosed by us and performed surgery, efforts have been made to be of help to diagnosis and treatments

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CASE REPORT

A 45 years old female patient visited our hospital for the chief complaint spondylalgia and radiating pain in the left extremity started from 2 months ago. She was treated with conservative treatments at another hospital, nonetheless, pain became severe and thus magnetic resonance imaging was performed. Two epidural tumors were detected, one in the 1st lumbar vertebral area and the others in the 4th lumbar vertebral area. Special family history or disease history were not detected, and except that the detection of a lipoma in the left forearm, special findings were not observed. At the time of visit, it was difficult to bend the waist because of pain, and the pattern of the dysesthesia of the left hip after a long walk was shown. The symptoms became severe in the evening. Particularly, the pattern that the pain became severe, and the pattern that the pain in the left lower extremity becomes severe at bedtimes was shown. The pain was felt from the posterior area of the left thigh to the lateral side of ankle and the instep, and neurological symptoms were not detected. Although the sleep was interrupted because of pain, the pattern that it was reduced upon the bending of the hip joint and the knee was shown.

On lumbar plain radiographs, special findings were not

shown (Fig. 1). Nonetheless, in magnetic resonance imaging, 2 tumors, one each in the 1st lumbar area and the 4th lumbar area, were detected. T1 weighted images and T2 weighted images showed moderate signal intensity, and on contrast enhanced images, even enhancement findings were shown (Fig. 2).

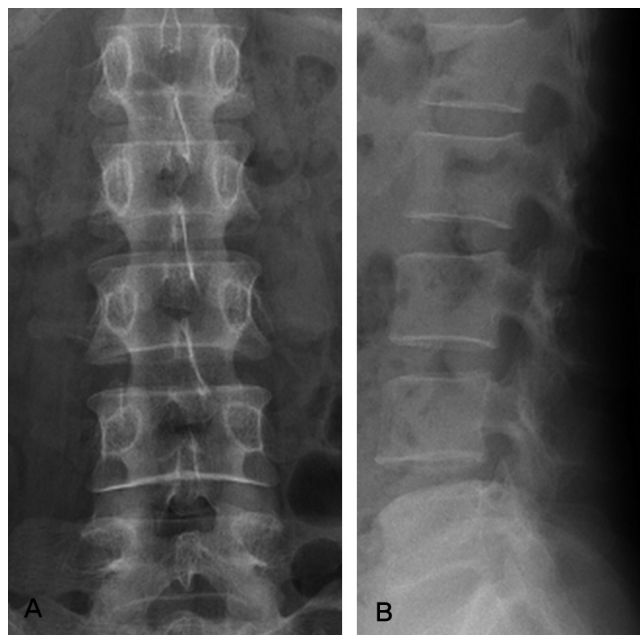


Fig. 1. Anteroposterior(A) and lateral(B) radiographs show non-specific findings.



Fig. 2. There are well-defined masses lesion with intermediate signal intensity on both T1(A) and T2 weighted images(B) at the level of L1 and L4, respectively. The lesions show homogenous, strong enhancement(C).

Although the possibility was low, in multicentric tumor cases, metastasis could not be ruled out completely. Thus, first surgery was performed for the purpose of histological tests, and based on the obtained histological test results, the second surgery was performed. In addition, by considering the possibility of the deterioration of neurological symptoms due to surgical treatments for 2 areas simultaneously, the distal tumor was removed first. In the 1st surgery, the tumor in the 4th lumbar area was removed. In the 2nd surgery, the tumor in the 1st lumbar area and the lipoma in the forearm were removed. Laminectomy was performed by posterior approach, and subsequently, the tumors were exposed by resecting the dura horizontally, and the tumors were removed by dissecting the adhesion area with the dura. The tumor in the 1st lumbar area was $13 \times 7 \times 7$ mm in size, and it compressed the posterior cauda equina. The tumor in the 4th lumbar area was $15 \times 15 \times 15$ mm in size, and it almost occupied the entire spinal canal (Fig. 3). After assessing the presence of residual tumors, the dura was sutured.

In pathological findings, it was diagnosed as Schwannoma (Fig. 4). After surgery, back pain and the radiating pain in the left

extremity were reduced, and neurological abnormal findings were not observed.

RESEARCH SUBJECTS AND METHODS

The subjects were 18 patients who received surgical treatments under the diagnosis of spinal intradural tumors by magnetic resonance imaging and definitely diagnosed histologically from 1997 to 2009. The male was 3 cases, the female was 15 cases, the mean age was 49 years (27–69), and the average follow-up period was 64 months (5–148). As clinical symptoms, the duration of illness, the pattern of spinal pain, radiating pain, and the presence or absence of neurological symptoms were evaluated. As magnetic resonance imaging findings, in the lesion site as well as T1 and T2 weighted images, signal intensity and the pattern of contrast enhancement were evaluated. As surgical treatments, the level of surgery area was assessed by magnetic resonance imaging, and only laminectomy was performed on the corresponding area, or the facet joint was resected if required, and by the comparison of the site detected by magnetic resonance imaging with

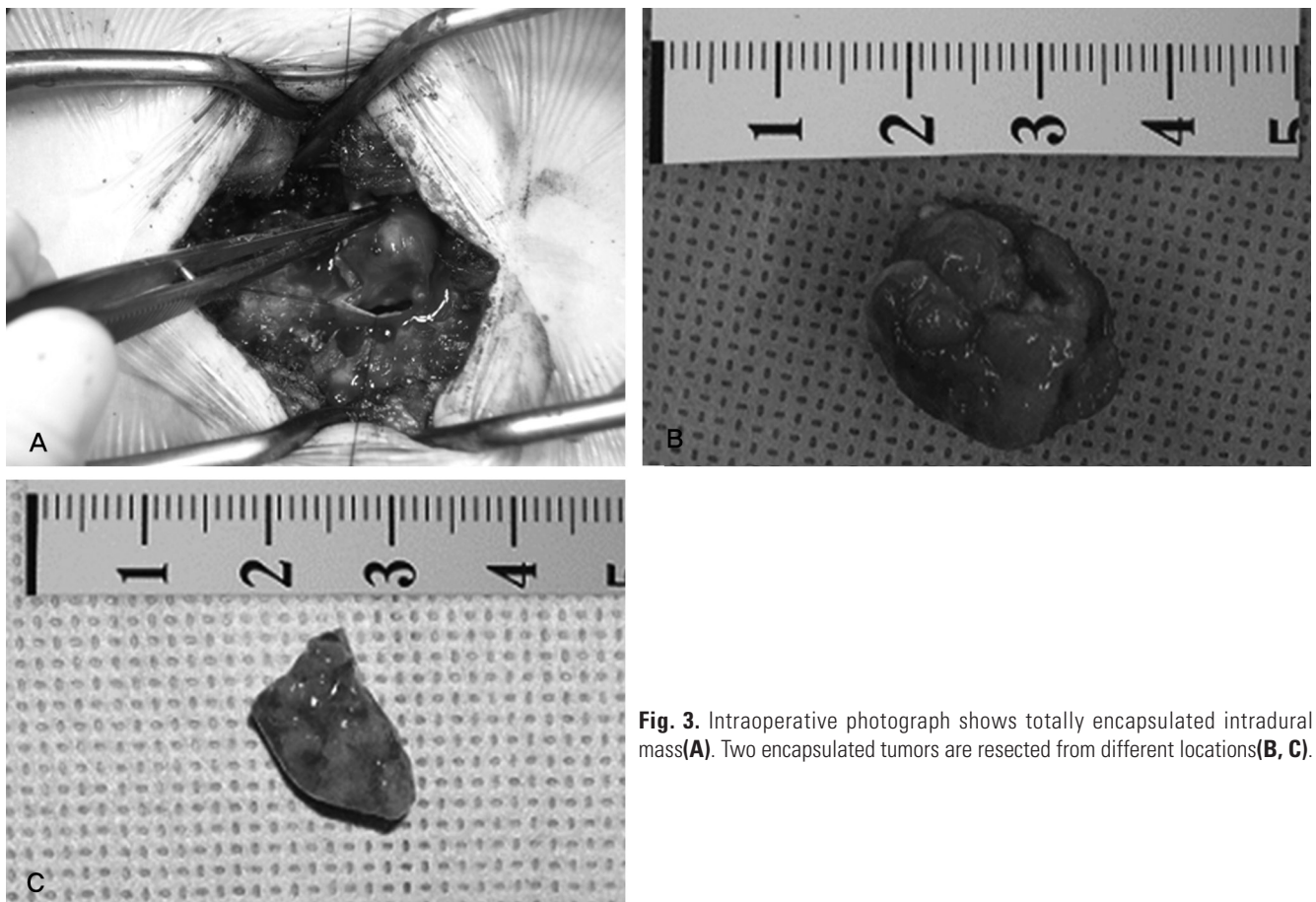


Fig. 3. Intraoperative photograph shows totally encapsulated intradural mass (A). Two encapsulated tumors are resected from different locations (B, C).

Table 1. Klekamp-Samii neurological scoring system.

| Score | Sensory deficit | Motor weakness | Gait ataxia | Bladder function | Bowel function |
|-------|--------------------------------------|------------------------------|--------------------|--------------------------|------------------------|
| 5 | No symptoms | Full power | Normal | Normal | Normal |
| 4 | Present, not significant | Movement against resistance | Unsteady, no aid | Slight dist, no catheter | Slight dist, control |
| 3 | Significant, function not restricted | Movement against gravity | Mobile with aid | Residual, no catheter | Laxatives, control |
| 2 | Some restriction of function | Contraction without movement | Few steps with aid | Ready incontinent | Rarely, Incontinent |
| 1 | Severe restriction of function | Contraction without movement | Standing with aid | Often catheter | Often, incontinent |
| 0 | Incapacitated function | Plegia | Plegia | Permanent catheter | Permanent incontinence |

c-arm fluoroscopy, the accurate site of tumors was assessed. The dura was resected vertically, tumors were exposed, and masses were extracted while preserving the nerve. The dura was sutured with nylon. For patients who received resection of the facet joint, posterior instrumentation and fusion were performed. As surgical results, changes of neurological findings from prior to surgery to after surgery were compared according to Klekamp-Samii scoring system³⁾(Table. 1). The change of pains was evaluated by comparing visual analog score. As statistical analysis, changes from presurgical to **postsurgical neurological findings were compared** by paired t-test(SPSSv16.0). The significant level was $p < 0.05$.

RESULTS

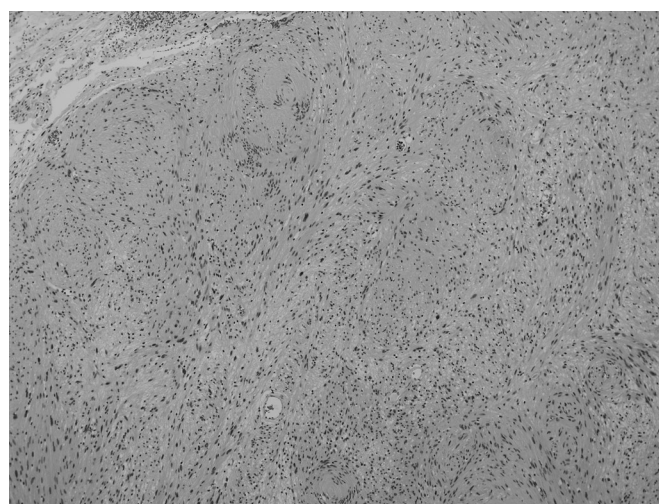
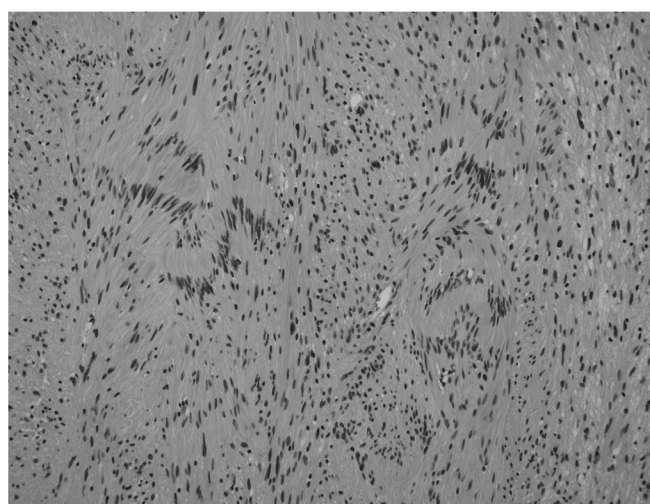
As surgical methods, laminectomy was performed on the entire 18 cases. Among them, in 8 cases, after facet joint resection, posterior instrumentation and fusion were performed.

All removed tumors were intradural extramedullary tumors covered with a capsule, and they could be readily removed by

surgery. In histological tests, it was diagnosed as Schwannoma in 15 cases, and neurofibromatosis, meningioma, and ependymoma were one case each.

Concerning clinical symptoms, the interval from the onset of symptoms to surgery was average 4.7 months(1–36 months). The interval from the diagnosis by magnetic resonance imaging to surgery was average 15.7 days(8–35 days). All 18 cases presented with nonspecific back pain and radiating pain. 3 cases had neurological symptoms. Of them, cases with the deterioration of muscle strength and hypoesthesia simultaneously were 1 case, and cases with either the deterioration of muscle strength or hypoesthesia were 1 case each. In regard to the pattern of pain, cases whose pain became worsened in the supine position were 3 cases, and cases whose pain was aggravated at night were 5 cases. Neurological limping was not detected in any of cases. In the straight raising test 3 cases were positive, voiding & defecation dysfunction was not detected.

In magnetic resonance imaging, 16 cases were a solitary tumor. In 2 cases, more than 2 multiple tumors were observed, and both cases were Schwannoma. In regard to the lesion site, the

H & E stain ($\times 100$)H & E stain ($\times 200$)**Fig. 4.** Histopathologic findings show excised mass consists of Antony A and Antony B type portions.

cord level(T7) was 1 case, the cauda equine level was 14 cases, and the sacral area was 3 cases. Regarding Schwannoma, on T1 weighted images, moderate signal intensity was 8 cases, and low signal intensity was 7 cases. On T2 weighted images, high signal intensity was 14 cases, and moderate signal intensity was 1 case. On contrast enhanced images, even enhancement was 13 cases, and enhancement in the margin was 2 cases. Neurofibromatosis showed low signal intensity on T1 weighted images, **high signal** intensity on T2 images, and even contrast enhancement on contrast enhanced images. Meningioma showed moderate signal intensity on T1 weighed images, moderate signal intensity on T2 weighted images, and even contrast enhancement on contrast enhanced images. Ependymoma showed low signal intensity on

T1 weighted images, high signal intensity on T2 weighted images, and even contrast enhancement on contrast enhanced images.

Regarding the results of surgical treatments, neurological symptoms according to the Klekamp–Samii scoring system were average 21.6 points prior to surgery, average 23.5 points after surgery, and the improvement of symptoms was shown($p<0.05$). In regard to pain levels, visual analog scores(VAS) were improved from average 5.7 points prior to surgery to average 3.0 points after surgery($p<0.05$). During the average 64 months postsurgical follow-up period, special complications caused by the resection of the dura were not observed.

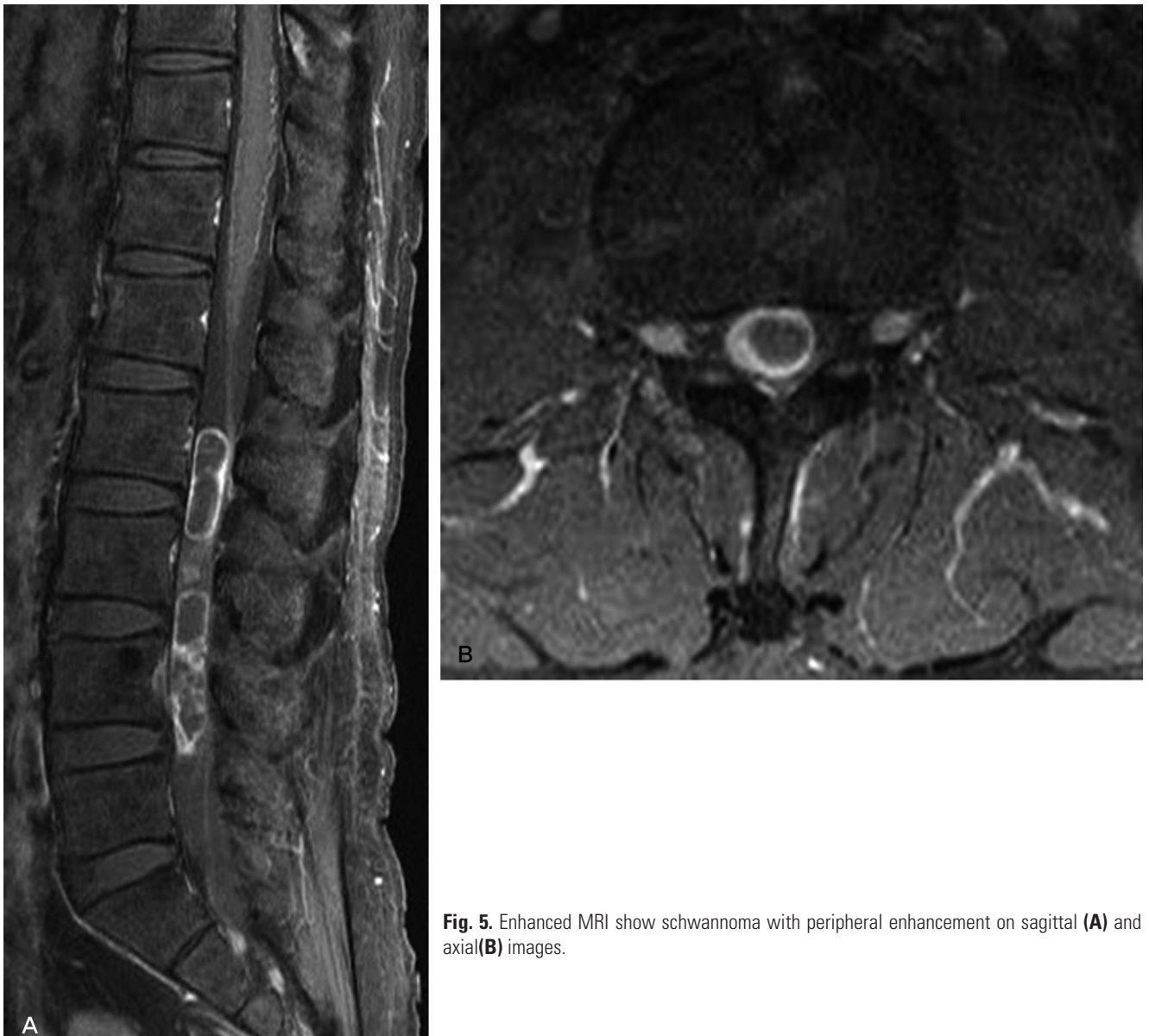


Fig. 5. Enhanced MRI show schwannoma with peripheral enhancement on sagittal (A) and axial(B) images.

Table 2. Intradural spinal cord neoplasms.

| Extramedullary tumors | Intramedullary tumors |
|---|----------------------------------|
| Neuroepithelial tumors | Neuroepithelial tumors |
| Ependymal myxopapillary ependymomas | Astrocystic astrocytomas |
| Other CNS tumors | Ependymal ependymomas |
| Meningial meningiomas | Oligodendroglioligodendrogliomas |
| Benign mesenchymal lipomas | Mixed neuronal-glial gangliomas |
| Malignant mesenchymal hemangiopericytomas | Embryonal neuroblastomas |
| Tumors of spinal nerves | Other CNS tumors |
| Nerve sheath schwannomas | Benign mesenchymal lipomas |
| Nerve sheath neurofibromas | Germ cell teratomas |
| Local extension of regional tumors | Uncertain hemangioblastomas |
| Parangliomas | Vascular malformations |
| Tumor-like cysts | Capillary hemangiomas |
| Dermoid | Cavernous hemangiomas |
| Epidermoid | |

DISCUSSION

In adults, more than 70% of intradural tumors are extra-medullary tumors, and the representatives are Schwannoma, neurofibromatosis and meningioma. 20–30% are intramedullary tumors, and the representatives are ependymoma and astrocytoma (Table 2).⁶⁾ Nerve sheath tumors (Schwannoma and neurofibromatosis) are detected in approximately 1/3 intraspinal tumors, and Schwannoma is detected more frequently than neurofibromatosis. In our study, similarly, Schwannoma was 15 cases, and Neurofibroma was one case. Shin et al.⁷⁾ have reported that based on pathohistological diagnosis, Schwannoma was most prevalent, and as the site, the most prevalent site was the thoracic region. Nonetheless, most nerve sheath tumors are frequently observed in the lumbosacral region than the cervical region or the thoracic region because Cauda equina is present in the lumbosacral region.^{4,8)} In our study, similarly, only 1 case was detected in the 7th–8th thoracic region, and 17 cases were detected in the lumbosacral region.

It has been shown that in most cases, Schwannoma occurs in the dural root sleeve of nerve roots, and neurofibromatosis occurs in the ventral nerve root frequently, nonetheless, it is very difficult to distinguish them actually by magnetic resonance imaging. However, in most cases, it shows low signal intensity on T1 weighted images, high signal intensity on T2 weighted images, and even enhancement or enhancement in the margin on contrast enhanced images. Irregular contrast enhancement is associated with malignant lesions, however, it has been reported that it is difficult to distinguish benign lesions from malignant lesions only by magnetic resonance imaging.³⁾ In our study, on

T1 weighted images, moderate signal intensity was detected in 8 cases, and low signal intensity in 8 cases. On T2 weighted images, high signal intensity was detected in 15 cases, and moderate signal intensity in 1 case. On contrast enhanced images, even enhancement was shown in 14 cases, and enhancement in the margin was shown in 2 cases. Thus, in comparison with current studies, **more cases with moderate signal intensity on T1 weighted images** were observed. The 2 cases of our study who showed enhancement in the margin were Schwannoma. It is due to cystic changes within tumors, local hemorrhage, mucosal changes, collagen, and the density of Schwann cells (Fig. 5).⁹⁾

It has been reported that meningioma is detected in 46% spinal tumors, intradural tumors are detected more frequently than epidural tumors, it is more prevalent in the female, it is benign in most cases, and non-invasive.^{10,11)} On T1 weighted image of magnetic resonance imaging, it shows low signal intensity or moderate signal intensity, and on T2 weighted images, it shows high signal intensity. On contrast enhanced images, it shows even enhancement, nonetheless, contrast enhancement may not be shown due to calcification in some cases.¹²⁾ Meningioma has been reported to occur in the thoracic area primarily, however, in our study, it was detected in the 2nd–3rd lumbar area, it was shown as moderate signal intensity on T1 weighted image, moderate signal intensity on T2 weighted images, and even enhancement findings on contrast enhancement images.

40–60% ependymomas are observed as intraspinal tumors, most of them are observed in the cervicospinal area and the cervicothoracic area. Myxopapillary ependymomas may be observed in the conus medullaris or the filum terminale.^{13–15)} On T1 weighted image of magnetic resonance imaging, it shows low

signal intensity, high signal intensity on T2 weighted images, and even enhancement on contrast enhanced images.³⁾ In our study, it was observed in the 3rd–4th lumbar area, it showed low signal intensity on T1 weighted images, high signal intensity on T2 weighted images, and even enhancement on contrast enhanced images.

In regard to clinical symptoms, among intradural epispinal(IDEM) tumors, Schwannoma induces radiation pain primarily, it is associated with dysesthesia or reduced muscle strength, the characteristic is hypnalgia. Concerning meningioma, radiation pain is not associated in most cases, and reduced muscle strength, dysesthesia, gait disturbance or voiding dysfunction is not associated generally.³⁾ In our study, 15 cases(83%) were Schwannoma, and most cases presented with back pain as well as radiation pain in the lower extremities, nonetheless, gait disturbance or voiding dysfunction was not observed. The back pain as well as radiation pain of the patient who participated in this study were nonspecific symptoms that were not different from common spinal diseases, particularly intervertebral disc hernia in most cases.

It has been shown that intradural tumors are common in adults, nonetheless, it is rare in children, most of them are benign, and malignant tumors are very rare.¹⁶⁾ In addition, it could be separated from the spine and removed readily in most cases, and with the development of microscopic surgery, the removal of tumors has been considered to be the best treatment method.^{17,18)} In addition, Jinnai et al.⁸⁾ have reported that different from neurofibromatosis, Schwannoma occurs in the dorsal nerve root in most cases, and even if tumors are resected, dysesthesia may be developed. Nonetheless, motor function is not damaged readily. In our study, similarly, at the time of the resection of tumors, using a Loupe, it could be extracted readily while minimizing injury of the area in the vicinity of lesion. For the complete resection, nerve roots were resected in some cases, nonetheless, except 1 case of meningioma, postsurgical neurological improvement was shown in all cases.

In regard to the time of surgery, Klekamp and Samii⁵⁾ have reported that the purpose of treatment is the complete resection of tumor, and the rapid diagnosis and surgery applying magnetic resonance imaging are of help to the complete resection of tumor, and if it was completely resected, the prognosis was good in long term follow-ups. In our study, the interval from the diagnosis by magnetic resonance imaging to surgery was average

15.7 days, and after its diagnosis, aggressive surgical treatments were performed.

CONCLUSION

Intradural spine tumors lack specific clinical symptoms other than nonspecific back pain and radiating pain, and thus early diagnosis through comprehensive examination and magnetic resonance imaging should be considered. Clinical outcomes after surgery are good, and complications are rarely developed, hence, it is considered that aggressive surgical therapies are required.

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척수 경막내 종양의 임상적 특징 및 수술결과

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연구 계획: 척수 경막내 종양을 가진 환자에 대한 후향적 연구

목적: 척수 경막내 종양의 임상증상 및 자기 공명 영상의 특징적 소견, 수술 결과 등을 알아보고자 하였다.

선행문헌의 요약: 경막내 척추종양은 드물게 보고되고 있으며 임상양상도 비특이적이다.

대상 및 방법: 1997년부터 2009년까지 자기 공명 영상 촬영을 통해 척수 경막내 종양 진단하에 수술적 치료를 시행 받고 조직학적으로 확진된 18명의 환자를 대상으로 하였다. 임상증상으로 통증의 양상과 신경학적 증상 유무를 평가하였으며, 자기 공명 영상 소견으로 병변 부위 및 T1, T2 강조영상에서 신호강도와 조영 증강 양상을 평가하였다. 수술 결과는 술 전 · 후 증상의 변화를 Klekamp-Samii scoring system에 따라 비교하였고, 통증의 변화를 시각 통증 지수(VAS)로 비교하여 평가하였다.

결과: 임상증상으로 전례에서 비특이적 요통 및 하지 방사통을 호소하였으며, 신경학적 증상이 있는 경우가 3례였고 16례가 단일 종양이었고 2례에서 복수 종양이 관찰되었다. 병변 부위는 cord level(T7) 1례, cauda equina level 14례였으며 천추 부위는 3례였다. 수술은 18례 모두에서 후궁 절제술을 시행하였으며 8례에서는 후방기기 고정술을 시행하였다. 수술 후 임상결과로 Klekamp-Samii scoring system에 따른 신경학적 증상은 평균 21.6점에서 23.5점으로 호전을 보였으며($p < 0.05$), 통증의 정도는 술 전 평균 5.2점에서 술 후 평균 3.0점으로 호전되었다($p < 0.05$)으며 경막 절개에 따른 합병증은 추시관찰상 발견되지 않았다.

결론: 척수 경막내 종양은 비특이적 요통과 방사통 외에 특징적인 임상증상이 없어 세밀한 관찰과 조기에 자기 공명 영상 촬영을 고려해야 하며 술 후 임상결과가 양호하고 합병증이 적어 수술적 방법을 통한 적극적 치료가 필요할 것으로 사료된다.

색인 단어: 척수 경막내 종양, 자기 공명 영상, 임상 양상

약칭 제목: 경막내 종양의 특징 및 수술결과