Anterior Approach for Dumbbell Type Cervical Neurinoma

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Abstract

A one-stage anterior approach was performed in four patients for total removal of dumbbell type neurinoma at the cervical level. In each case, the neurinoma compressed the spinal cord in the cervical canal, developed anteriorly through the intervertebral foramen, and compressed the vertebral artery. A conventional cervical anterior approach at the tumor site was performed, followed by confirmation of the tumor located outside the spinal canal. After identification of the vertebral artery, corpectomy was carried out and the extradural component of the tumor was resected. In cases with a portion of the tumor located also within the dura mater, the dura mater was opened for removal of the intradural tumor. We found the anterior approach to be effective for the total removal of some kinds of cervical dumbbell type neurinomas.

Key words: anterior approach, spinal cord tumor, dumbbell type neurinoma

Introduction

Generally, surgical intervention for the removal of cervical cord tumors is carried out using a posterior approach. However, in the case the dumbbell type of tumor, which includes a large extension toward the outside of the spinal canal at the level of the cervical vertebrae, the posterior approach only arrows removal of intraspinal canal tumors, whereas extraspinal canal tumors are relatively inaccessible. In the latter case, the remaining tumor must be removed through an additional anterior or lateral approach. We used the anterior approach in four cases for removal of dumbbell type neurinomas at the cervical level and succeeded in total removal of the tumors in only one operational stage.

Patients and Methods

Surgery using the anterior approach to the cervical spine was performed for the removal of a cervical dumbbell type neurinoma in four patients. Table 1 summarizes the age, sex, location of the tumor, and initial symptoms of these patients.

According to the method for the conventional anterior approach, the patient is placed in a supine position with the neck slightly rotated to the contralateral side for tumor locating. A transverse skin incision on the tumor side is made at the appropriate level. The field is then opened between the carotid artery and the parathyroid muscle, and the prevertebral space is opened. After reaching the targeted vertebral body, the longus colli muscle of the tumor side is completely exposed. At this time, the tumor located outside the spinal canal may be observed. The longus colli muscle is cut transversely. During this procedure, the Doppler blood flow detector (Pen Doppler; Hayashi Electric Co., Kawasaki, Kanagawa) is very useful to detect the vertebral artery. The vertebral artery is controlled by resection of the anterior branch of the transverse processes. After the vertebral artery is disclosed and controlled freely, the feeding arteries from the vertebral artery to the tumor, provided that they can be confirmed, are coagulated and cut. Next, the tumor lo-

Table 1 Summary of the clinical data

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age/ Sex</th>
<th>Location</th>
<th>Histology</th>
<th>Initial sign</th>
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<tr>
<td>1</td>
<td>58/M</td>
<td>Lt C5-6</td>
<td>neurinoma</td>
<td>numbness of lt arm</td>
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<tr>
<td>2</td>
<td>28/F</td>
<td>Lt C6-7</td>
<td>neurinoma</td>
<td>numbness of lt arm</td>
</tr>
<tr>
<td>3</td>
<td>30/F</td>
<td>rt C4-5</td>
<td>neurinoma</td>
<td>back pain</td>
</tr>
<tr>
<td>4</td>
<td>36/F</td>
<td>rt C3-4</td>
<td>neurinoma</td>
<td>—</td>
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cated outside the spinal canal is removed. Then partial or wide corpectomy at the tumor side is performed according to the size of the intracanal component of the tumor, after which the extradural component is excised. If the tumor is also located in the dura mater, the dura mater is opened longitudinally, and the intradural component of the tumor is removed. The intradural part of the root can be identified easily. After excision, anterior fusion of the cervical spine is carried out by an iliac bone graft.

Total removal of the tumor was obtained in all four patients. The tumor had developed from the anterior root in Cases 1 and 4, and from the posterior root in Cases 2 and 3. Three of four patients showed excellent neurological improvement. Case 1 had preoperative hemiparesis and hypesthesia and hypalgesia of the left C5-7 area, and motor weakness of the left lower extremity and sensory disturbance disappeared immediately following surgery, although motor weakness of the left upper extremity remained up to one year after surgery (Table 2).

### Representative Cases

**Case 1**: A 58-year-old male was admitted to our department because of numbness of the left arm and muscle weakness in his left upper and lower extremities that had begun 3 years previously and grown progressively worse. Neurological examination found decreased muscle power and hyperreflexia in the left upper and lower extremities, as well as hypesthesia and hypalgesia over the left C5-7 dermatomes. Preoperative examination revealed enlargement of the intervertebral foramen in the left C5-6 intervertebral space, and a dumbbell type tumor at that level, extending toward the intradural canal and compressing the cord toward the right as seen on magnetic resonance (MR) imaging with gadolinium-diethylenetriaminepentaacetic acid (Gd-DTPA) (Fig. 1 left). Vertebral angiography revealed that the vertebral artery was compressed toward the medial side by the tumor.

The left side anterior approach exposed the C-5 and C-6 vertebrae, then the tumor located in the left paravertebral was carefully separated from the vertebral artery and excised (Fig. 1 center). After removal of the extracanal component of the tumor, corpectomy of the C-5 vertebra was performed. Then the component of the extradural tumor in the intraspinal canal was removed, followed by incision of the dura mater to excise the anterior rootlet of the C-6 level, which was swollen due to the tumor. The whole tumor was successfully removed, and an-
terior fusion using iliac bone was performed (Fig. 1 right).

The patient experienced postoperative transient decrease of muscular power in his left upper extremity, but this symptom improved gradually and disappeared completely after one year. Histological examination showed that the tumor was a neurinoma.

Case 3: A 39-year-old female had suffered from nuchal pain for 4 years and was admitted with symptoms of numbness that had gradually appeared in the right upper and left lower extremities. Neurological examination revealed motor deficit of the right arm, hyperreflexia of both legs, and hypalgesia in the C4-7 dermatomes of the right arm and under the left T-5 sensory area. MR imaging with Gd-DTPA revealed a dumbbell type tumor at the right C4-5 intervertebral space and the vertebral artery (Fig. 2 left).

A right-side anterior approach was performed. After corpectomy of the C-4 and C-5 vertebrae on the right side, the extradural component of the tumor was removed subtotally and without injury to the right vertebral artery, then the dura mater was incised. The intradural component of the tumor was then easily identified and removed without damaging the cord (Fig. 2 center). Finally, the extradural and extracanal residual component of the tumor was completely excised. The tumor had developed from the posterior rootlet of C-5, but the anterior root was preserved. After dural closure, a bone graft was performed (Fig. 2 right).

Histological examination determined that the tumor was a neurinoma. After surgery, the patient’s preoperative symptoms disappeared.

Discussion

The majority of dumbbell type cord tumors are neurinomas, frequently located at the cervical level. Twenty-two of 51 patients we have treated for spinal neurinoma (cervical level 28, thoracic level 17, lumbosacral level 6) over the past 13 years, including the present four cases, had tumors of the dumbbell type. Further, 20 of these 22 cases were located at the cervical level. Therefore, 71% of tumors at the cervical level were the dumbbell type. This high percentage may be due to the fact that the root of the spinal cord is shorter in the spinal canal at this level than at any other. Prior to selection of the anterior approach for some special cases, we treated 11 cases of cervical dumbbell type neurinoma by the posterior approach. Seven patients with very small extracanal component of the neurinoma had the total tumor removal, whereas four patients with extracanal component too large to permit total tumor removal required subsequent surgery for extracanal tumor regrowth.

The anterior or lateral approach have been used at second surgery for cases of cervical dumbbell type tumor originally subtotally removed by the posterior approach. Subtotal removal by the posterior approach is a result of the limited operative field and the danger of injuring the spinal cord or vertebral artery. Dumbbell type neurinoma at the cervical level with a large extracanal component usually has
the intraspinal component located at the anterolateral part of the cord, and the vertebral artery of the tumor side is compressed and shifted. Under these circumstances, it is risky to attempt to separate the tumor from the vertebral artery using the posterior approach. Total removal of the tumor in one stage is ideal, and there have been some reports of one-stage removal of dumbbell type tumors of the cervical spinal cord. Good results were achieved using the antero- or posterolateral approach for cervical neurinoma with extradural components. The posterolateral approach was selected for tumors above C-2, and the anterolateral approach for tumors below C-3. Osteosynthesis was not performed, but no postoperative spinal destabilization occurred. Bone grafting is likely to be less necessary in such cases, in which the corpectomy and dural opening, if necessary, are very small. A combined anterior and lateral approach for cervical dumbbell type tumors was reported, with an iliac bone graft in addition to a partial corpectomy. We agree with this methodology; bone graft is necessary to establish postoperative spinal column stability. However, these various approaches require a great deal of skillful technique and surgical experience to perform. Moreover, there is a possibility of injuring the lower cranial nerves, such as the vagus, accessory, and hypoglossal nerves. Therefore, we selected the conventional anterior approach and partial corpectomy to attempt one-stage total removal of the tumor for the present four cases of cervical dumbbell type neurinoma with large extension toward the extraspinal canal through the intervertebral foramen.

We described the successful use of the anterior approach, which included two of the four neurinoma cases in this report. Here we discuss two additional cases of cervical neurinoma in which we used the anterior approach for total one-stage tumor removal. In the previous cases (Cases 1 and 2 corresponding to Cases 3 and 2 of the previous report), we performed preoperative vertebral angiography to confirm the degree of compression and shift of the vertebral artery and prevent injury to the artery. However, in the additional cases (Cases 3 and 4), vertebral angiography was not used because we had sufficient experience to surgically manage the separation between the artery and tumor, and were able to confirm the vertebral artery on preoperative MR imaging.

Based on our experience we established criteria for the selection of this surgical method. Dumbbell type tumor can be classified as follows: Type I has both intra- and extradural components, but is situated entirely within the spinal canal; type II has intra- and extradural and paravertebral components; type III has both extradural and paravertebral components; and type IV has both foraminal and paravertebral components (Fig. 3). Figure 4 shows...
the types of our cases according to this classification. According to this classification, our criteria for the anterior approach is as follows: Most type IV tumors; and cases of types II and III in which the extracanal component of the tumor compresses and shifts the vertebral artery and extends anteriorly beyond the vertebral artery. In contrast, type I tumors and cases with small tumor extensions within the enlarged intervertebral foramen or extracranial component can be totally removed by laminectomy and facetectomy. The anterior approach has several advantages. The surgical procedures are familiar and relatively easy compared with those of the lateral approach, because the anterior approach uses an operative microscope for the cervical spine that is common to many neurosurgical institutes. The vertebral artery can always be visualized directly and controlled before resection of the tumor, so the tumor can be separated safely from the vertebral artery. The feeding artery supplied by the vertebral artery can be treated easily. The extraspinal canal tumor and the tumor located in the spinal canal, including intradural tumor, can be removed without risking injury to the cord. Postoperative deformity of the spinal column can be prevented by anterior fusion with grafted bone.

The most important point in performing the anterior approach is to secure the vertebral artery. The longus colli muscle is cut, effectively widening the surgical field toward the outside of the tumor. The vertebral artery must be freely immobilized to remove the tumor safely. The range of corpectomy should be determined according to the radiological findings. Even in Case 3, in which the component of the intradural tumor was large, we were able to remove the tumor easily by performing a wide corpectomy. We believe that the anterior approach is effective for total one-stage tumor removal in selected cases of cervical dumbbell type neurinomas with large extension into the extraspinal canal.

References


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Commentary

The authors report surgical extirpation of cervical dumbbell-type neurinomas, which extended anterolaterally from the intervertebral foramen. The familiar and simple way of accessing the tumor and the easy identification of the most important vital structure, the vertebral artery, next to the tumor are the great advantages of this approach. Indications for this approach, instead of the posterior approach, were well documented by the authors, who have considerable experience in the surgical treatment of dumbbell-type tumors. It is agreed that preoperative angiography to identify the vertebral artery is not always essential even if the posterior approach is used. The authors could surgically remove a large amount of the intradural component of the tumor through the anterior approach via wide corpectomy. The authors should have mentioned special technical aspects of closing the penetrated and widely opened dura mater and sealing cerebrospinal fluid leakage.
from their own experience for the benefit of surgeons who may attempt a similar approach.

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Over the years, we have had experience with five similar such tumors as described in the article by Iwasaki et al. We have looked at various classifications of this kind of tumor. Our material was presented to the ANS-CNS Spine Section Meetings. We have modified the old Eden classification. The first classification of the schwannoma cell tumor is by location of the tumor. Some of these tumors are almost entirely intradural. Next, some are the same as Type I or as Picture A (Fig. 3). These are tumors which are intradural and extradural, without major displacement or enlargement of the bony foramen. Our next group includes both Types II and III where there is major erosion of the neuroforamen and the adjacent facet joint, extending off to the adjacent structures which includes the vertebral artery. Finally, there is the group of tumors which have significant extradural and intraforaminal portions with erosion of both the vertebral body and the facet joints posteriorly. We next try to classify the bony stability, once we have completed our operation. We divide the anterior cervical vertebral body structures into three areas, central and the two lateral aspects. We then divide the posterior structures into three areas, which includes the two lateral facet areas and the posterior laminar and spinoius process structures. This basically gives us six quadrants. With removal of just one of those quadrants, the spine is stable. Removal of two of those quadrants leads to a discussion on stability, where the primary influential factor is in a pre-existing deformity. Removal or damage of three of those structures makes the spine unstable, in our opinion. This has led us to do many procedures

with a unilateral approach just posteriorly where we leave the lamina and spinous process only to do a hemilaminectomy and a partial facetectomy. We have found that this would work well in those cases where primarily the tumor is in the neuroforamen. If there is truly and intradural component, we still prefer to approach posteriorly to make sure there is a complete excision from the spinal cord. We think this is the most important structure to have properly protected and decompressed. When we use only the anterior approach, the tumors erode into the vertebral body and are clearly extradural and out the foramen and near the vertebral artery. In the old Eden classification, that would be the Type IV tumors. In this review series, it would be Case 4. In all honesty, Cases 1 and 2 in this report would have had an anterior and a posterior exposure. The posterior exposure would have been a hemilaminectomy, partial facetectomy and removal of all of the tumor from the intradural contents, going as far forward as possible. Using the cavitron, we would try to remove as much tumor as possible. We then would allow the patient to recover. Six months later we would do a follow-up MRI scan. If there is a residual tumor, we would then do the anterior resection similar to what the authors here describe. In the anterior reconstruction, we would use a plate for stabilization. These authors are to be congratulated on their technical skills. As they state, they have found the anterior approach to be effective in the removal of “some kinds of cervical dumbbell type neurilemmomas.” This does not apply to all cases. We would only advise caution in those cases where there is extensive intradural components. We still prefer the posterior and anterior approach in those cases, and it can safely be staged.

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