Intraforaminal Neurinoma in the Lumbosacral Region

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Abstract

A series of 12 patients with intraforaminal neurinomas in the lumbosacral space was reviewed. Our classification according to tumor extension relative to the affected root into intradural intra-arachnoid, intraforaminal extra-arachnoid, and extraforaminal types was useful in determining the best surgical approach to achieve root preservation and minimal postoperative deficits. Where sacrifice of roots was unavoidable, surprisingly few neurological deficits occurred.

Key words: neurinoma, neurofibroma, melanotic schwannoma, intravertebral foramen, lumbosacral spine

Introduction

Intraspinal neurinomas localized to the sacrum are uncommon, accounting for 1–5% of all spinal axis neurinomas. Neurinomas in the lumbosacral foramen are also relatively infrequent. Neurinoma in the spinal canal is characterized by late diagnosis due to the slow growth, a tendency to cystic degeneration, usually an hour-glass shape especially in the cervical region, and generally good prognosis. Management requires knowledge of the tumor characteristics and the anatomy of the lumbosacral region.

Here, we present a series of patients with intraspinal neurinomas and discuss the diagnostic and surgical problems, such as operative approach and preservation of the affected root.

Patients

Twelve patients with benign tumors in the lumbosacral foramen received surgery at our clinic between October, 1981 and September, 1991. The clinical presentation, diagnostic evaluation, surgical intervention, histological findings, and postoperative evaluation were analyzed.

Results

Table 1 summarizes the clinical data. There were seven males and five females aged at diagnosis from 32 to 64 years old (mean, 48.7 yrs). The most common symptom was radiculopathy associated with sciatica (11 cases), all but one with only low-back pain and paresthesia. The duration of symptoms ranged from 6 months to 15 years (mean, 5.5 yrs).

Neurological examination found diminished deep-tendon reflex of the ankle in eight patients with tumors localized in the L5 or S1 roots and decreased knee jerk in one patient with L4 root tumor. Four patients had lower extremity weakness with hypesthesia, and three patients only hypesthesia. One patient had no neurological symptoms.

Myelography was performed in eight patients, showing intra-arachnoid extension of the tumor in four, and defects of the root sleeve (extra-arachnoid lesion) in four. Computed tomography (CT) of 10 patients demonstrated all tumors to be homogeneous expansive lesions with neuroforaminal enlargement. Magnetic resonance (MR) imaging in the most recent four patients showed intraforaminal extension of the tumor on the T1-weighted coronal image, and tumor enhancement by gadolinium on the T1-weighted axial image. The affected roots were the S1 in five patients.
Intraforaminal Neurinomas

Table 1 Clinical summary of 12 patients

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age/ Sex</th>
<th>Presenting signs and symptoms</th>
<th>Duration</th>
<th>Diagnostic procedure</th>
<th>Location; Type</th>
<th>Histology</th>
<th>Conservation of the affected roots</th>
<th>Follow-up duration; Residual symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44/M</td>
<td>sciatica, weakness and hypesthesia, diminished reflex</td>
<td>10 yrs</td>
<td>CT, MR imaging</td>
<td>rt L5; I-I</td>
<td>schwannoma</td>
<td>+</td>
<td>1 yr 10 mos; asymptomatic</td>
</tr>
<tr>
<td>2</td>
<td>57/F</td>
<td>sciatica, weakness and hypesthesia, diminished reflex</td>
<td>4 yrs</td>
<td>MLG, CT</td>
<td>rt L4, L5, and S1; I-II</td>
<td>neurofibroma</td>
<td>-*</td>
<td>5 yrs 8 mos; recurrence of pain, weakness and hypesthesia</td>
</tr>
<tr>
<td>3</td>
<td>62/F</td>
<td>low-back pain, paresthesia, weakness and hypesthesia</td>
<td>7 mos</td>
<td>MLG, CT</td>
<td>lt L4; I-II</td>
<td>schwannoma</td>
<td>-</td>
<td>6 yrs 7 mos; paresthesia, slight weakness</td>
</tr>
<tr>
<td>4</td>
<td>59/M</td>
<td>sciatica, diminished reflex</td>
<td>10 yrs</td>
<td>MLG, CT</td>
<td>lt L4; I-II</td>
<td>schwannoma</td>
<td>-</td>
<td>6 yrs 8 mos; asymptomatic</td>
</tr>
<tr>
<td>5</td>
<td>60/M</td>
<td>sciatica</td>
<td>6 mos</td>
<td>MLG</td>
<td>rt S2; I-I</td>
<td>schwannoma</td>
<td>+</td>
<td>7 yrs 8 mos; asymptomatic</td>
</tr>
<tr>
<td>6</td>
<td>48/F</td>
<td>sciatica, diminished reflex</td>
<td>10 yrs</td>
<td>CT, MR imaging</td>
<td>lt S1; II</td>
<td>schwannoma</td>
<td>+</td>
<td>1 yr; asymptomatic</td>
</tr>
<tr>
<td>7</td>
<td>64/M</td>
<td>sciatica, diminished reflex</td>
<td>5 yrs</td>
<td>MLG, CT</td>
<td>rt L5; II</td>
<td>schwannoma</td>
<td>+**</td>
<td>1 yr; asymptomatic</td>
</tr>
<tr>
<td>8</td>
<td>32/M</td>
<td>sciatica, diminished reflex</td>
<td>15 yrs</td>
<td>CT, MR imaging</td>
<td>rt S1; II</td>
<td>schwannoma</td>
<td>+</td>
<td>1 yr; asymptomatic</td>
</tr>
<tr>
<td>9</td>
<td>41/M</td>
<td>sciatica, hypesthesia, diminished reflex</td>
<td>2 yrs</td>
<td>MLG, CT</td>
<td>rt S1; II</td>
<td>neurofibroma</td>
<td>+**</td>
<td>1 yr 6 mos; hypesthesia</td>
</tr>
<tr>
<td>10</td>
<td>37/F</td>
<td>sciatica, hypesthesia, diminished reflex</td>
<td>6 mos</td>
<td>MLG</td>
<td>lt S1; II</td>
<td>schwannoma</td>
<td>+</td>
<td>9 yrs 1 mos; asymptomatic</td>
</tr>
<tr>
<td>11</td>
<td>40/M</td>
<td>sciatica, hypesthesia</td>
<td>4 yrs</td>
<td>CT, MR imaging</td>
<td>rt L5; II</td>
<td>schwannoma</td>
<td>+</td>
<td>6 mos; hypesthesia</td>
</tr>
<tr>
<td>12</td>
<td>40/F</td>
<td>sciatica, weakness and hypesthesia, diminished reflex</td>
<td>4 yrs</td>
<td>MLG, CT</td>
<td>lt S1; II-III</td>
<td>melanotic schwannoma</td>
<td>-</td>
<td>6 yrs 10 mos; hypesthesia</td>
</tr>
</tbody>
</table>

*Only L4 and S1 roots were sacrificed. **Only sensory roots were sacrificed with conservation of the motor roots. MLG: myelography.

L5 in three, L4 in two, S2 in one, and L4, L5, and S1 simultaneously in one.

Neurinomas can be classified in three types according to extension of the tumor: type I, intradural in-para-arachnoid tumor; type II, intraforaminal extra-arachnoid tumor; and type III, extraforaminal tumor (Fig. 1). Our cases were divided into type I-III, extending into the subarachnoid space (Cases 1-5) (Fig. 2); type II, strictly intraforaminal extra-arachnoid extension (Cases 6-11) (Figs. 3 and 4); and type II-III, extending distally out of the foramen (Case 12) (Fig. 5).

All tumors in our series were completely removed by the posterior translumbar or trans-sacral approaches except in one patient with a giant sacral tumor requiring two-stage anterior retroperitoneal and posterior trans-sacral approaches. Type II tumors were removed piecemeal after opening the perineural sheath with foraminotomy. The root was preserved completely in four cases, while the sensory root was sacrificed and the motor root conserved in two cases under the operating microscope. Mixed type I-II tumors were relatively large, requiring opening the dural sac and the perineural sheath for complete removal after laminectomy with foraminotomy (Fig. 6). It was difficult to preserve the affected root, especially in neurofibroma because of the histological characteristics. The root was sacrificed in three of five patients. A giant sacral mixed II-III type tumor was completely removed by the two-stage operation with sacrifice of the root.

All 12 patients who presented with radicular pain...
had resolved symptoms following surgery, including the four cases (Cases 2-4 and 12) with sacrificed roots. However, one patient (Case 2) reported a different pain after temporary postoperative improvement. Neurological examinations during the follow-up, ranging from 6 months to 9 years, revealed that hypesthesia or paresthesia persisted in the area of the affected root in five patients. Of four patients with preoperative motor deficit, two recovered completely, one improved, and the other remained unchanged.

The symptoms in the four patients with sacrificed roots were: weakness and hypesthesia with pain (Case 2), weakness improved but persistent paresthesia (Case 3), asymptomatic (Case 4), and recovered weakness but persistent hypesthesia (Case 12).

Histological examination of microscopic sections from the tumors showed nine schwannomas, two neurofibromas, and one melanotic schwannoma. All schwannomas had characteristic features (Antoni types A and B) including monomorphous composition of spindle-shaped cells with palisading and nearly total absence of mitosis. Hyalinized vessels accompanied by perivascular hemosiderin deposits were noted in a few cases. Neurofibromas were characteristically gelatinous and composed of fascicles of typical Schwann cells with some
fibroblasts, separated by a mucoid matrix. HE staining of sections of macroscopically black tumor specimens from Case 12 showed the neoplasm consisted of spindle-pattern cells, with palisading nuclei in many areas. Most nuclei were small to medium in size and oval to spindle in shape. Mitotic figures were rarely seen. Many cells contained dark pigmented granules, identified as melanin by Fontana-Masson silver stain. The overall impression was melanotic schwannoma (Fig. 7).

**Discussion**

The most common symptom of intraforaminal neurinoma is radiculopathy, and 11 of our 12 cases had sciatica. The absence of a specific symptom of lumbosacral foramen neurinoma and the difficulty in differentiation from lumbar disc herniation delay surgical treatment as in our series.

Diagnostic methods include myelography, CT, and MR imaging. Myelography can easily diagnose intradural intra-arachnoid tumor (type I) and intraforaminal extra-arachnoid tumor (type II), in particular the characteristic cupuliform block on the root in the latter. However, distal lesions of the neuroforamen are difficult to diagnose. CT cannot always differentiate neurinoma from extruded disc. The sagittal and coronal MR images are very useful to evaluate the relationship between tumor and disc, and tumor extension into the neuroforamen.

Benzel et al. divided nerve sheath tumors of the sciatic nerve and sacral plexus into four groups based on surgical presentation: group I, subgluteal and/or thigh; group II, neuroforaminal; group III, intrapelvic with extension into thigh; and group IV, intrapelvic without extension into thigh. The group II cases offered a difficult therapeutic challenge due to the tumor location as the neuroforaminal region in the lumbosacral spine and the proximal lateral
tissues could not be invaded surgically.

We used a different classification into three types, requiring various approaches. The posterior translaminal approach was selected for types I and II. Type I requires opening of the dural sac to remove the intradural intrarachnoid lesion (laminctomy). The type II requires opening of the neuroforamen as far as possible distally (foraminotomy). The presence of type III component indicates the anterior retroperitoneal approach in the same or a second operation.

Abernath ey et al. considered the surgical approach (anterior retroperitoneal or posterior trans-sacral) to giant sacral schwannoma depended on sacral destruction, intrapelvic extension, and sacroiliac joint involvement. Schwannoma with a modest presacral component can usually be removed by the posterior trans-sacral approach alone. A large presacral portion requires an initial anterior transabdominal operation to control the vascular plexus that encompasses the mass and ensure identification and protection of important intrapelvic structures. The remaining intrasacral tumor can then be removed safely and easily via a combined or second posterior trans-sacral procedure. Instability in the sacroiliac joint following tumor removal indicates a fusion procedure. We investigated two-stage operations in two cases (Cases 6 and 12) (Figs. 4 and 5), but performed only one (Case 12) in which the intrapelvic tumor extension was relatively large.

Another surgical problem is preservation of the affected root during total tumor removal. The procedure selected depends on the histological characteristics of the tumor. Schwannomas are generally encapsulated and imply eccentric growth of solid tumor from the roots, so can be removed completely sparing the roots in most cases. Only two of our nine schwannomas required sacrifice of the roots because the tumors were relatively large. Neurofibromas require a more complex surgical procedure because the nerve fibers are intermingled with the tumor parenchyma. Neurofibromas are nonencapsulated and infiltrate interneurally, possibly precluding complete removal without sacrifice of part or all the affected roots. Therefore, the alternatives are root sacrifice or residual tumor. In one of our two neurofibromas, however, enucleation of the tumor and preservation of the motor root, visible under the operating microscope, was possible.

Thomas et al. recommended en-bloc removal of neurofibroma and nerve, if the tumor was large or the neurological deficit severe, with careful sampling of the proximal end of the nerve to ensure absence of neoplasm. For small tumors, mild or absent neurological deficit, or where tumor enucleation is not possible, subtotal removal attempting to preserve nerve function seems justified. We believe that L4 and S1 roots, in contrast to the L5 root, may be sacrificed when unavoidable as loss of these roots results in minimal motor deficits. All roots sacrificed in our series were L4 or S1 roots.

All symptoms of radicular pain in our series were resolved following surgery except for a patient with multiple neurofibromas (Case 2) who reported in a different location. This recurrence was considered due to regrowth of the tumor at the unsacrificed L5 root. Postoperative neurological examinations revealed that deficits improved in all patients, but hypesthesia or paresthesia persisted in the areas of the affected roots in five patients. The neurological outcome of patients with sacrificed roots were surprising: one patient recovered completely, two improved, and another was unchanged. Therefore, resection does not always result in postoperative neurological deficit.

Kim et al. investigated neurological deficits occurring after root resection at total removal of spinal schwannomas in 31 patients. Postoperative neurological deficits were correlated with: site and extent of tumor (intradural, dumb-bell, or extradural), histological pattern (neurilemmoma or neurofibroma), levels of lesion (C5-Th1, L3-S1, or cauda equina), and preoperative electromyography (presence or absence of denervation pattern). Only the presence or absence of a denervation pattern in the preoperative electromyography was statistically significant. They suggested the absence of a denervation pattern reflected total dysfunction of the involved nerve, and functional replacement by the adjacent segments. Presumably, in most cases the nerve function replacement was completed before surgery and therefore sacrifice of the involved root caused no segmental deficits. Alternatively, the nerve may have been congenitally non-functional. However, we did not examine the preoperative electromyography in our series.

Neurinomas in the lumbosacral foramen require a careful choice of surgical approach according to tumor localization to achieve preservation of the affected root. The prognosis appears unexpectedly good even if the affected root is sacrificed.

References


Neurol Med Chir (Tokyo) 33, February, 1993


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