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Outcomes of Surgical Treatment of Intraspinal Intradural Lumbar Schwannomas

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ABSTRACT

Background Data: Safe surgical resection of intradural schwannomas in the lumbar region is considered challenging. This is due to the proximity and sometimes the adhesiveness of these lesions to the cauda equina rootlets.

Purpose: This article aims to evaluate the safety and efficacy of surgical excision of solitary lumbar intradural schwannomas with the excision of the affected rootlet.

Study Design: A retrospective descriptive clinical case study.

Patients and Methods: From January 2016 to January 2019, 20 patients presented with intraspinal intradural lumbar schwannoma were retrospectively included in this study. We evaluated all the patients preoperatively, immediately postoperatively, and after one month. The clinical and radiological outcomes were assessed.

Results: The mean age of presentation was 39.45 years. The mean duration of preoperative complaint was 4.15 months. All patients presented with localized low back pain associated with radicular pain along the lower limbs according to the affected level, with some sort of voiding difficulties. The mean preoperative VAS was 8.95. No preoperative motor deficit was observed. Moreover, all lesions were solitary. Total gross resection with the division of the parent rootlet was achieved in 19 cases, and the patients showed postoperative significant pain reduction without any neurological deficit. Subtotal resection was achieved in 1 patient who had unsatisfactory pain relief. Minor complications were observed in the form of transient CSF leak in 1 case and transient superficial wound infection in 2 cases.

Conclusion: Total microsurgical excision of solitary intradural intraspinal schwannoma below the level of thoracolumbar junction with the resection of the parent rootlet is considered safe and effective. (2021ESJ232)

Keywords: Lumbar schwannoma; intradural; nerve sheath tumor; neurofibroma.

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INTRODUCTION

Nerve sheath tumors are a group of lesions that arises from the neoplastic differentiation of Schwann cells. They grow as a peripheral appendage to the parent nerve. Conventional schwannoma is the most common type of the major variants of schwannomas in adults.[2] Spinal schwannomas constitute nearly 30% of primary spinal tumors and are among the most common spinal tumors that face spine surgeons.[3, 9, 26] Spinal schwannomas are found to grow from the sensory (dorsal) nerve root. Multiple schwannomas are associated with neurofibromatosis type 2 (NF-2).[13, 22, 32] The most common anatomical type of schwannomas is the intradural extramedullary one (49%–83%).[9, 25, 30]

Clinically, schwannomas initially present with nonspecific symptoms such as segmental pain and paresthesia as they are usually slowly growing benign lesions.[17] With further growth of the tumor, they compress the adjacent neural elements causing some degree of paresis. The usual age of presentation ranges from 30 to 50 years.[6, 30, 32] Total excision is the gold standard treatment in symptomatic patients or in the radiological picture of an enlarging lesion. It usually results in clinical improvement with minimal postoperative morbidity, especially in patients who presented early.[6, 14, 18, 30, 32]

In this study, the operative findings and clinical outcomes after surgical excision of 20 solitary intradural lumbar schwannomas were evaluated.

PATIENTS AND METHODS

This study included 20 consecutive patients with lumbar intradural schwannomas. Patients' data were retrospectively collected from the patients' medical records after the exclusion of 2 patients due to insufficient medical record data and follow-up. Personal data, diagnosis, and treatment outcomes were kept private, and patients were represented by specific codes. All patients had solitary lumbar intradural schwannomas. They were admitted and underwent operations at the Department of Neurosurgery, Tanta University Hospitals, from January 2016 to January 2019.

We included all patients who have undergone operations for intradural solitary schwannoma within the lumbar spine that was verified histopathologically. The exclusion criteria were as follows: those with multiple lesions, those with foraminal and/or extraforaminal extension, those with other pathologies, general contraindications for surgery, and those with incomplete follow-up or data.

All patients were evaluated and subjected to clinical history, general and neurological examination, and routine laboratory investigations. Visual Analogue Score (VAS) was used to quantify the degree of pain in every patient preoperatively. We also used the modified McCormick grading system to assess functional status before and after surgery (Table 1).

All patients were evaluated preoperatively with Magnetic Resonance Imaging (MRI). Written consent was obtained from all patients before scheduling surgery. The study was conducted after the approval of our institutional review board

Table 1. Modified McCormick grading system.

Grade 1	Neurologically intact, ambulates normally with minimal dysesthesia
Grade 2	Mild motor or sensory deficit, maintains functional independence
Grade 3	Moderate deficits, limitation of function, independent with external aid
Grade 4	Severe deficits, limitation of function, dependent
Grade 5	(Paraplegia (or quadriplegia

(IRB) and according to the WMA Declaration of Helsinki–Ethical Principles for Medical Research Involving Human Subjects.

Operative Technique:

All operations were conducted in a prone position under general anesthesia. The targeted spinal level was confirmed using operative fluoroscopy. After skin incision and muscle dissection, central laminectomy was done to minimize the extent of bone removal to prevent postoperative instability.

Under the magnification of an intraoperative microscope, the dura mater was incised in the midline over the lesion. Then, the lesion was dissected from the adjacent rootlets. After meticulous dissection from all neural structures, extracapsular en bloc excision of the lesion was carried out along with the division of its parent rootlet. The dura was then closed tightly, followed by the closure of muscle, fascia, and skin in layers with an epidural suction drain inserted for 48 hours. The extent of gross tumor resection was documented.

Postoperative Care:

Patients were ambulated and discharged from the hospital after assessment of his/her wound and clinical status. Outpatient clinic visits were scheduled for all patients to assess functional outcomes postoperatively regarding the motor power in both lower limbs and pain relief using the VAS and modified McCormick grading system. We compared the preoperative MRI with the one-month postoperative images to determine the extent of resection.

RESULTS

We operated on 20 patients with intradural lumbar schwannomas, including 11 (55%) females and 9 (45%) males. The mean age at the presentation was 39.45 ± 12.5 (range, 16–46) years. Moreover, the mean duration of preoperative complaint was 4.15 ± 2.28 (range, 1–9) months. All patients presented with localized low back pain associated with radicular pain along the lower limbs according to the affected level. Six patients (30%) suffered from either urgency or precipitancy. The mean preoperative VAS of the radicular pain was 8.95 ± 1.1 (range, 7–10). Likely, no preoperative motor deficit was observed in any of our patients. The neurological evaluation showed a specific dermatomal hypothesis in 7 patients (35%), saddle area hypothesis in 3 patients (15%), diminished knee jerk in 4 patients (20%), and diminished ankle jerk in 3 patients (15%).

All schwannomas were solitary and affected lumber levels as follows: 6 cases at L1 (30%), 5 cases at each of L2 and L3 (25% each), and 2 cases at each of L4 and L5 (10% each). MRI study of the lumbar showed the lesions as a single oblong intradural lesion that is isointense in T1WI and hyperintense in T2WI and with homogenous enhancement after intravenous gadolinium injection. None of our patients had any neural foramina widening or spinal deformities.

The gross total resection (GTR) of the tumor with the division of the parent rootlet was achieved in 19 patients (95%). MRI study with intravenous gadolinium after one-month follow-up confirmed GTR in all but one patient (Figures 1,2). Subtotal resection (STR) was achieved in one patient (5%) at the level of L1 because of its proximity and adherence to the conus medullaris that made its GTR and preservation of neurological functions relatively difficult (Figure 3). All lesions were encapsulated, yellowish in color, firm in consistency, and were histopathologically confirmed to be schwannoma.

All patients underwent their scheduled surgery with uneventful operative and postoperative course without any reported added deficit. At the time of discharge, 19 patients (95%) showed significant improvement compared to their preoperative status without any new neurological deficits. At one-month follow-up, the mean VAS improved from 8.95 ± 1.1 (range, 7–10) to 4.3 ± 1.78 (range, 2–9) and at 6-months follow-up to 1.33 ± 1.57 (range, 0–7).

Figure 1. Patient's images showing (A) sagittal and (B) axial T1 MRI with gadolinium contrast showing solitary oblong intradural enhanced lesion at L4-L5 level, (C) Gross picture of the resected schwannoma after GTR.

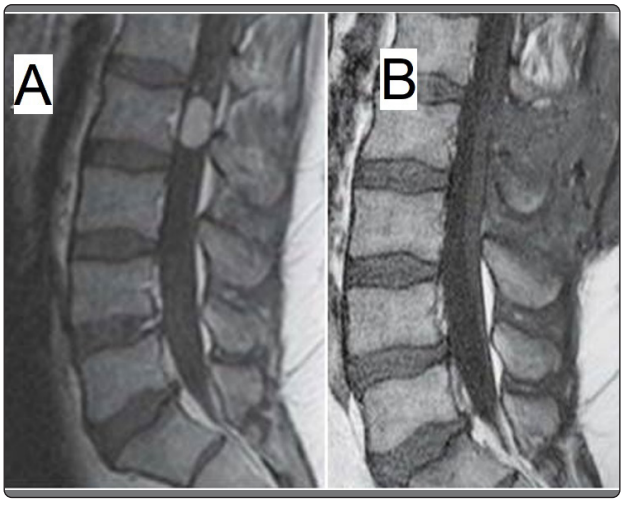

Figure 2. Patient's images showing (A) preoperative sagittal T1 MRI with gadolinium contrast showing intradural schwannoma at L2 level, (B) postoperative sagittal T1 MRI of the same patient showing GTR of the lesion and decompression of the cauda equina rootlets.

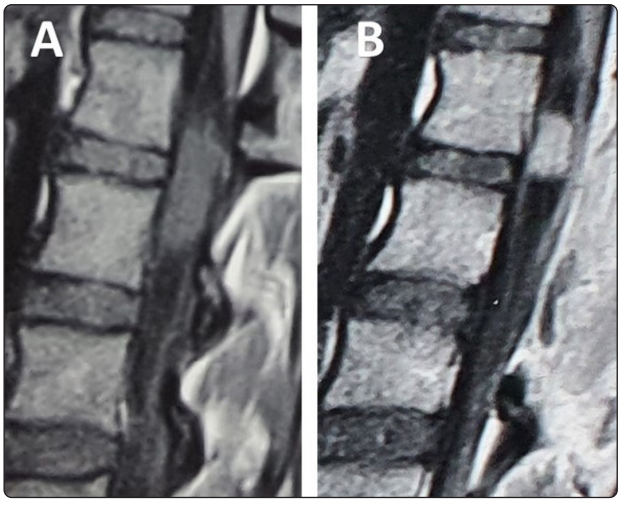

Figure 3. Patient's images showing (A) preoperative sagittal T1 MRI with gadolinium contrast showing intradural schwannoma at L1 level, (B) Postoperative sagittal T1 MRI with gadolinium contrast of the same patient showing STR of the lesion.

Six patients with dysuria experienced significant gradual improvement with the complete resolution of their complaints at the end of the follow-up period.

A patient with STR showed unsatisfactory pain relief with a postoperative VAS of 9 and 7 at one- and six-month follow-up postoperatively, respectively. She refused to do further surgical interventions at our service and was transferred to another center.

According to the modified McCormick grading system for assessing the functional outcome, the mean preoperative score was 2.1 (range, 1–3) and improved to 1.25 (range, 1-2) and 1.05 (range 1-2) at one- and six-month follow-up postoperatively.

Some minor complications were observed, including transient CSF wound leak in one patient (5%) that responded within seven days to diuretics and secondary skin sutures and superficial wound infection in 2 patients (10%) treated within 10 days after administering topical and intravenous fourth-generation cephalosporins.

DISCUSSION

Spinal schwannomas represent about 30% of primary spinal tumors. Sex prevalence showed no significant difference between males (45%) and females (55%) in this study and in other literature.[5, 10, 11, 30] The mean age at presentation in our series was 39.45 years, which agrees with other published data that have reported a mean age range between 30 and 50 years.[18, 21, 30] All of our patients presented with axial and radicular pain, which again represents the most common initial symptom of patients in other literature.[11,18,28,29] The least common presentation in literature is motor or sensory deficits, which are due to the nerve root irritation by the growing tumor. Moreover, the further growth of the tumor results in compression of the root and/or the cord, causing neurological deficits. In the lumbar region, the motor deficit was rarely the first presentation, which is similar to patients with lumbar canal stenosis in which neurological deficits occur very late.[9,18,31]

Our study aimed to assess the clinical outcome after GTR of the solitary intradural lumbar schwannoma with the division of the single parent rootlet. It has been demonstrated that satisfactory pain relief has been reported in patients with the GTR, whereas with STR, a patient had unsatisfactory pain relief. No postoperative neurological deficits were observed in all patients with GTR, despite resection of the parent rootlet.

In their study, Safaee et al.[28] have studied 221 cases with spinal nerve sheath tumors, including 74 lumbosacral tumors. They have achieved GTR in 86% of lumbosacral cases. The overall recurrence rate in their study was higher with neurofibroma (17%) than with schwannoma (7%) and in cases with STR (22%) than with GTR (4%). In their study, Satoh et al.[29] have studied 23 patients with solitary schwannomas below the thoracolumbar junction, including 19 intradural and 4 dumbbell tumors. All cases underwent parent rootlet resection, while only 3 of them developed postoperative neurological deficits and those three patients had dumbbell schwannomas. In their study, the mean preoperative modified Japanese Orthopaedic Association (JOA) score had significantly improved from 8.9 to 13.0 postoperatively.

The safety of resection of the parent rootlet is explained by the fact that the nerve rootlets descend as the cauda equina within the lumbar spinal canal. The schwannoma mostly arises from a single rootlet that is mostly the sensory dorsal rootlet.[8,22] During the microsurgical excision of the intradural spinal schwannoma, the rootlets could be easily dissected and detached from the well-encapsulated lesion.[29] Another explanation is that the tumor grows slowly; thus, the function of the affected rootlet is carried out and compensated by the regeneration and collateral sprout from the intact nearby healthy rootlets.[4,16,33] This differs from the schwannoma that extends outside the spinal canal through the intervertebral foramen in a dumbbell shape, where the transection of the parent rootlet may carry the risk of injuring the adjacent ventral motor rootlet, increasing the risk of postoperative neurological deficit.[12,29]

There is another surgical technique that may minimize the risk of the postoperative deficit is the enucleation leaving the tumor capsule; however, it carries a high risk of recurrence due to the presence of tumor cells of spinal schwannomas near the capsule.[15,22] In their study, Fehlings MG et al.[14] have reported that 5 of the 8 patients with recurrence (62.50%) underwent operation by enucleation of the tumor and concluded that patients with intralesional enucleation had a 4.18 times greater risk of recurrence when compared to patients with en bloc resection. Some authors have recommended using the intracapsular resection technique for those dumbbell-shaped schwannomas with both intradural and extradural components.[7] The use of electrophysiological monitoring, if available, could help in minimizing the risk of postoperative neurological deficit. [1, 20]

In our series, we had one case (5%) of STR because of its adherence of the tumor to the conus medullaris. In the literature, GTR of intradural

schwannomas was not feasible in some cases due to the subpial location of the tumor or adhesion of the tumor to the nearby neural structures as a consequence to previous hemorrhage or inflammation.[9, 18, 23] Some authors[18, 19] have recommended long-term follow-up of patients with residual lesions.

Regarding spinal stability, we did not need to stabilize the spine in any of our cases. This might be due to the use of an intraoperative C-Arm for precise localization of the affected level. This helped us in limiting the craniocaudal extension of the laminectomy. We did not remove more than two laminae in each of our cases. Moreover, we did not violate the articular facets. In the literature, spinal instability and/or kyphosis mostly occurred in cases with extensive laminectomy with violation of the articular facets. Spinal stabilization could be considered in dumbbell-shaped tumors and tumors with extradural extension, with cervicothoracic junction lesions, and with lesions that may require multilevel laminectomies.[18, 27] Another option is to perform a laminoplasty instead of laminectomy; however, the authors who compared both techniques have found no significant difference between both methods regarding the outcomes.[24]

There were some limitations in our study, such as the small number of patients and the short duration of follow-up. We recommend a longer follow-up period to detect the actual rate of recurrence and late drawbacks of surgery such as spinal instability.

CONCLUSION

Total microsurgical excision of solitary intradural lumbar schwannoma with the resection of the parent rootlet is considered a safe and effective procedure. Accurate localization of the lesion with minimization of the surgical exposure is mandatory for preserving spinal stability and preventing subsequent spinal deformity.

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الملخص العربي

نتائج مابعد جراحة استئصال ورم غمد الليف العصبي من داخل القناة الشوكية القطنية

البيانات الخلفية: يعتبر الاستئصال الجراحي الآمن لأورام غمد الليف العصبي داخل الأم الجافية في منطقة الفقرات القطنية تحديا صعبا و ذلك بسبب قرب الورم من جذور الأعصاب.

الغرض: تقييم سلامة وفعالية الاستئصال الجراحي لأورام غمد الليف العصبي من داخل الأم الجافية بالفقرات القطنية.

تصميم الدراسة: دراسة حالة سريرية وصفية بأثر رجعي.

المرضى والطرق: من يناير 2016 إلى يناير 2019 ، تم تضمين 20 مريضًا يعانون من ورم غمد الليف العصبي داخل الأم الجافية في منطقة الفقرات القطنية بأثر رجعي في هذه الدراسة. قمنا بتقييم جميع المرضى قبل الجراحة وبعد العملية الجراحية مباشرة وبعد شهر واحد. تم تقييم النتائج السريرية و فحوصات الأشعة.

النتائج: بلغ متوسط عمر المرضى 39.45 سنة. متوسط مدة الشكوى قبل الجراحة كان 4.15 شهر. عانى جميع المرضى من آلام أسفل الظهر مرتبطة بألم عصبي على طول الأطراف السفلية وفقًا للمستوى المصاب ، مع وجود صعوبات في التحكم في عملية التبول. كان متوسط درجة الألم قبل الجراحة 8.95. لم يلاحظ أي عجز حركي قبل الجراحة. كانت جميع الأورام منفردة. تم تحقيق الاستئصال الكلي مع استئصال الجذر الأصلي في 19 حالة وأظهروا انخفاضًا ملحوظًا في الألم بعد الجراحة دون أي عجز عصبي. تم إجراء الاستئصال الجزئي في حالة واحدة وأظهرت تخفيف الآلام بشكل غير مرض. ولوحظت مضاعفات بسيطة تتمثل في تسرب السائل النخاعي العابر في حالة واحدة ، وعدوى الجرح السطحية العابرة في حالتين.

الخلاصه: يعتبر الاستئصال الجراحي الدقيق الكامل غمد الليف العصبي داخل الأم الجافية في منطقة الفقرات القطنية مع استئصال الجذر الرئيسي آمنًا وفعالًا.