How to Cite:
Khan, M. I., Munir, A., Aziz, S., & Zahid, H. (2023). Functional outcome after surgical treatment of spinal meningioma. *International Journal of Health Sciences*, *7*(S1), 1970–1976.
https://doi.org/10.53730/ijhs.v7nS1.14439

Functional outcome after surgical treatment of spinal meningioma

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***Abstract*---**Objective: This study aims to identify the key factors influencing functional outcomes in patients with surgically treated space-occupying spinal meningiomas (SM), specifically focusing on the role of intraoperative neuromonitoring in determining these outcomes. Methodology: This retrospective analysis included a substantial number of patients. We conducted a comprehensive examination of pre- and postoperative records, surgical reports, and radiographic data to assess population trends, symptom duration, histology, co-morbidities, surgical approach, and neurological function. Results: Among the total of 55 patients, 48 (86.7%) were women and 7 (13.3%) were men. Laminectomy and hemi-laminectomy were the most commonly performed surgical techniques. The thoracic spine was the primary location for spinal meningiomas. The most prevalent symptoms included sensory abnormalities, gait issues, motor deficits, and radiating pain. In most of the cases total resection was performed. After treatment, most patients experienced complete healing and good functional recovery.

***Keywords*---**intradural spinal tumor, space-occupying spinal meningiomas.

Introduction

About 20–45% of all intradural spinal tumors (Arnautovic & Arnautovic, 2009) and up to 10% of all meningiomas are spinal meningiomas (SM; Dudley et al., 2018). SM, in general, is an arachnoid membrane-derived benign tumor that grows slowly. SM is mostly found in the intradural compartment because it nearly usually attaches to the inner layer of the dura. The pial layer of the spinal cord, which can serve as an anatomical dissection plane, is normally respected by SM (Hohenberger et al., (2023). 85% of SM may be seen in the thoracic spine. Although SM can occur at any age, its peak is during the fourth and seventh decades of life, with a preference for women.

In general, the clinical signs and symptoms of SM are frequently fairly vague; roughly 55% of the people who are afflicted suffer back discomfort, although radiating pain, motor impairments, and sensory loss are found in long standing cases. Brown-Sequard's syndrome or dissociated long tract symptoms may occur from eccentric tumor growth in advanced illness that is characterized by persistent spinal cord compression (Cash, 1982). In essence, spinal surgery entails a broad range of technically complex procedures that run the danger of harming the spinal cord, nerve roots, or major blood arteries. During surgery, IOM gives the chance to evaluate the functional integrity of vulnerable brain components (Gonzalez et al., 2009). IOM makes it possible to monitor the sensory and motor functions of the spinal cord continuously using D-waves, somatosensory-evoked potentials (SSEP), motor evoked potentials (MEP), and neurogenic motor evoked potentials (NMEP), which lowers the risk of post-surgical neurological complications. This study aims to identify the key factors influencing functional outcomes in patients with surgically treated space-occupying SM.

Methods

Several individuals who had undergone surgery for newly diagnosed SM at the Neurosurgical Department were identified after screening our institutional database. Some patients didn't have complete datasets or were lost to follow-up after 12 months. These patients were turned away. Due to the unexpected and aggressive biological behavior of numerous meningioma-like lesions, a small number of patients with the diagnosis of neurofibromatosis I and II were eliminated. A patient who had a foramen magnum meningioma was disqualified.

We analyzed demographics, symptom duration, medical history, medication history, co-morbidities, radiographic extension of the SM, surgical approach (laminectomy and hemilaminectomy), and pre- and postoperative neurological performance from patient charts, surgical reports, and radiographic data. The class of neurological performance the postoperative MRI done within 48 hours after surgery and/or after 3 months, together with the yearly MRIs completed for at least 5 years, validated the intraoperative evaluation of the degree of resection.

The “Preoperative surgical grading system for spinal meningiomas” was used to assess the degree of spinal cord compression, which is divided into mild, moderate, and severe. According to preoperative MRI and surgical results, the

precise location of the dural attachment at the ventral, lateral, or dorsal portion of the spinal canal was determined.

In terms of gender distribution, the participants were 6 men (representing 10.9% of the total) and 49 women (representing 89.1% of the total; figure 1). Moving on to the clinical presentation category, the symptoms or presentations observed in the participants indicate that 23 participants (41.8%) experienced radiating pain, 16 participants (29.1%) had motor deficit, 22 participants (39.1%) reported local pain, and 42 participants (76.4%) had sensory deficit.

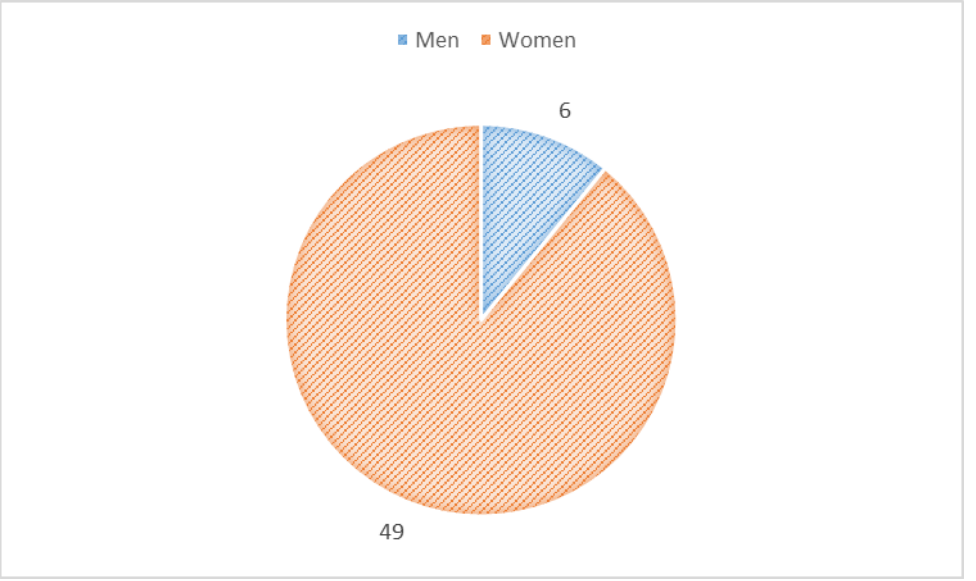

Figure 1: Gender-based distribution

The table 1 also includes information about the duration of preoperative symptoms, which was found to be 3.5 months on average. Additionally, the neurological status at the 12-month follow-up shows (5.5%) with lumbar involvement in 3 participants, 23 participants (41.8%) with thoracic involvement, and 30 participants (54.5%) with cervical involvement.

The attachment location of the dura, a protective membrane covering the spinal cord show that 2 participants (3.6%) had ventrolateral attachment, 38 participants (69.1%) had dorsolateral attachment, 1 participant (1.8%) had dorsal attachment, 7 participants (12.7%) had lateral attachment, and 6 participants (10.9%) had ventral attachment.

Regarding the worse preoperative neurological status among ambulatory patients, the frequencies indicate that 6 participants (10.9%) did not have a worse preoperative neurological status, while 49 participants (89.1%) did. Lastly, in terms of recurrent lesions, none of the participants had a recurrent lesion (representing 0%), while 56 participants (100%) did not experience a recurrent lesion.

Table 1: Baseline data and clinical presentation

Category	Frequency	Percentage
Sex		
Men	6	10.9%
Women	49	89.1%
Clinical Presentation		
Radiating pain	23	41.8%
Motor deficit	16	29.1%
Local pain	22	39.1%
Sensory deficit	42	76.4%
Duration of Preoperative Symptoms (mean range)	3.5 months	
Neurological Status at Follow-up (12 months)		
Lumbar	3	5.5%
Thoracic	23	41.8%
Cervical	30	54.5%
Dural Attachment		
Ventrolateral	2	3.6%
Dorsolateral	38	69.1%
Dorsal	1	1.8%
Lateral	7	12.7%
Ventral	6	10.9%
Worse Preoperative Neurological Status (ambulatory patients)		
No	6	10.9%
Yes	49	89.1%
Recurrent Lesion		
No	56	100%
Yes	0	0%

The average procedure took 233 minutes. The surgical technique that was used the most commonly was laminectomy, followed by durotomy and microsurgical resection. The thoracic spine, cervical spine, and lumbar spine were the main sites of the SM. Only a small number of individuals had only one spinal level affected, and others had two levels. Th1-Th2 was the portion that was most commonly affected. An extra intracranial meningioma was seen in the patient.

Table 2: Scoring Criteria for Motor Function, Sensory Function, and Bladder Function

Criterion	Points
Motor function Paralysis	1
Upper extremity Fine motor function massively decreased Fine motor function decelerated Discreet weakness in hands or proximal arms Normal function	2 3 4 5
Motor function Unable to walk	1
Lower extremity Need walking aid on flat floor Need handrail on stairs Able to walk without walking aid, but inadequate Normal function	2 3 4 5
Sensory Upper extremity/lower extremity/trunk	
Upper extremity/lower extremity/trunk Apparent sensory loss Minimal sensory loss Normal function	1 2 3
Bladder function Urinary retention Severe dysfunction Mild dysfunction Normal function	1 2 3 4

Discussion

The spinal canal is home to SM, an uncommon but significant space-occupying oncologic lesion (Hohenberger et al., 2020). However, there is a lack of information on the clinical presentation, surgical result, and recurrence rate of SM. This study aimed to further clinical understanding of the morphological and anatomical characteristics, symptoms, and postoperative course of SM, on functional postoperative outcome.

Complete surgical removal is the preferred course of therapy for SM, where feasible. The most important predictor of recurrence and progression-free survival is Simpson grading (Quddusi & Shamim, 2018). Simpson grade I resection is frequently challenging to achieve, particularly in patients with ventral dural connection, because to the possibility of spinal cord injury or the challenge of dural healing following severe excision. Therefore, Simpson grade I resection is not possible in every patient, as documented in the present literature by a number of authors. Additionally, Simpson grade II resection has a low recurrence rate. Only a recurring tumor was seen in our patients' very low recurrence rates.

After surgical excision, SM recurrence rates are minimal, ranging from 1.3 to 4.7. In the majority of patients, including those in our study, Simpson grade II resection may be accomplished, and over the lengthy follow-up period, no patient had the development of recurrent SM in the same area. After Simpson grade I SM resection, it was discovered by analysis of the resected dural material that some patients had dural invasion, as did Nakamura et al. (2012). Consequently, the most successful surgical technique may involve full excision of the connected dural. However, because to the possibility of spinal cord damage, pseudo-meningoceles, or cerebrospinal fluid leaking, Simpson grade I resection poses a technical challenge, particularly for meningiomas that are ventrally situated. In 13.3% of patients, we were able to remove Simpson Grade I tumours, and in grade II tumors.

Our study's major flaws are its retrospective nature and the small number of patients in the subgroups that significantly hampered the examination of statistical subgroups. The study's (extremely) homogeneous group, lengthy median follow-up, and regular assessment of neurological function, performance. Throughout the course of the trial, surgical methods remained constant.

Conclusion

The gender distribution among the patients revealed a predominance of women, with 86.7% of the total patients being female. The average duration of preoperative symptoms was 3.5 months. Sensory abnormalities, gait issues, motor deficits, and radiating pain were the most common symptoms observed. Motor impairments were classified into para- and mono-paresis. Surgical procedures predominantly involved laminectomy and hemilaminectomy, with the thoracic spine being the most affected location. Mild spinal canal compression was observed in 46.5% of cases, categorized as mild, moderate, or severe compression. Patients showed improvement in pain and neurological function at the 12-month follow-up. The median JOA score significantly increased from admission to release, indicating neurological improvement. Few patients experienced new neurological deficits following surgery, and the use of intraoperative monitoring (IOM) could help reduce this complications.

Recommendations

Treatment Recommendations: It is recommended to explore minimally invasive surgical techniques to reduce surgical trauma and improve patient outcomes. A multidisciplinary approach involving neurosurgeons, neurologists, and rehabilitation specialists should be implemented for comprehensive postoperative care. Regular follow-up assessments are crucial to monitor long-term outcomes and quality of life. Consideration should be given to adjuvant therapies, such as radiation or targeted molecular therapies, when complete resection is not achievable or for recurrent lesions. Personalized medicine and genetic profiling hold promise in identifying molecular targets for tailored treatments.

Future Study Recommendations: To advance our understanding of spinal meningiomas, prospective multicenter studies with larger sample sizes are needed to validate current findings and investigate clinical presentation, treatment

outcomes, and prognostic factors. The role of advanced imaging techniques, such as functional MRI or diffusion tensor imaging, should be explored in preoperative planning and predicting functional outcomes. Further research into the molecular and genetic characteristics of spinal meningiomas can uncover potential therapeutic targets and biomarkers for prognosis and treatment response. Comparative studies on different surgical approaches and techniques are essential to determine the optimal strategy based on tumor subtype and location. Additionally, studying the impact of postoperative rehabilitation programs on functional recovery and quality of life is crucial for long-term patient outcomes.

References

Arnautovic, K., & Arnautovic, A. (2009). Extramedullary intradural spinal tumors: a review of modern diagnostic and treatment options and a report of a series. *Bosnian journal of basic medical sciences*, *9*(Suppl 1), S40.

Cash, W. C. (1982). *Histopathological and clinical study of the bovine spinal cord*. Kansas State University.

Dudley, R. W., Torok, M. R., Randall, S., Béland, B., Handler, M. H., Mulcahy-Levy, J. M., ... & Hankinson, T. C. (2018). Pediatric versus adult meningioma: comparison of epidemiology, treatments, and outcomes using the Surveillance, Epidemiology, and End Results database. *Journal of neuro-oncology*, *137*, 621-629.

Gonzalez, A. A., Jeyanandarajan, D., Hansen, C., Zada, G., & Hsieh, P. C. (2009). Intraoperative neurophysiological monitoring during spine surgery: a review. *Neurosurgical focus*, *27*(4), E6.

Hohenberger, C., Gugg, C., Schmidt, N. O., Zeman, F., & Schebesch, K. M. (2020). Functional outcome after surgical treatment of spinal meningioma. *Journal of Clinical Neuroscience*, *77*, 62-66.

Hohenberger, C., Hau, P., Schebesch, K. M., Kölbl, O., Riemenschneider, M. J., Pohl, F., ... & Schmidt, N. O. (2023). Spinal meningiomas. *Neuro-Oncology Advances*, *5*(Supplement_1), i112-i121.

Nakamura, M., Tsuji, O., Fujiyoshi, K., Hosogane, N., Watanabe, K., Tsuji, T., ... & Matsumoto, M. (2012). Long-term surgical outcomes of spinal meningiomas. *Spine*, *37*(10), E617-E623.

Quddusi, A., & Shamim, M. S. (2018). Simpson grading as predictor of meningioma recurrence. *JPMA. The Journal of the Pakistan Medical Association*, *68*(5), 819.