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Factors Affecting Surgical Outcome of Intramedullary Spinal Cord Tumors: A Prospective One-year Follow-Up Study

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ABSTRACT

Background Data: Identification of the prognostic factors of the surgical outcomes of intramedullary spinal cord tumors (IMSCTs) is essential. Many studies have established that early surgical intervention was associated with better outcomes and enhanced survival rates.

Purpose: This study investigated the prognostic factors of the one-year surgical outcomes of patients with IMSCTs.

Study Design: A prospective clinical case study.

Patients and Methods: Twenty patients with IMSCTs, who underwent surgery in our institution and were followed up at our clinic were recruited for this study. Patients were followed up for one year to assess postoperative functional outcomes using the modified McCormick Scale (MMS). The reported parameters included preoperative MMS, use of operative monitoring, use of ultrasonic aspirator, the extent of tumor resection, and postoperative adjuvant therapy.

Results: Operatively, 85% of patients underwent laminectomy, 55% reported growth total resection (GTR), 55% intraoperative monitoring, 75% underwent ultrasonic aspiration, 55% had syrinx, and 20% had duraplasty. The preoperative MMS improved from 3.0 to 2.32 and 2.42 postoperatively at six months and one year of follow-up, respectively. Patients with postoperative MMS ≤3 were more likely to undergo GTR with better postoperative MMS than those with preoperative MMS >3 at six-month follow-up (81.8% vs. 25%, respectively; $p = 0.013$) and at one-year follow-up (84.4 vs. 0%, respectively; $p = 0.001$). Good preoperative MMS, use of ultrasonic aspirator, and neuromonitoring were associated with better MMS. There were no significant associations between MMS at the sixth month and reported parameters including gender, symptoms duration, tumor location, bony work whether laminectomy or laminoplasty, number of segments involved, tumor histopathology, duraplasty, and postoperative adjuvant therapy.

Conclusion: The findings of the current study showed that patients with GTR, good preoperative MMS, intraoperative monitoring, and ultrasonic aspirator usage might be associated with better functional outcomes. (2021ESJ229)

Keywords: Intramedullary, Spinal cord tumors, Prognostic factors, Functional outcomes

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INTRODUCTION

Intramedullary spinal cord tumors (IMSCTs) account for 10% to 20% of primary SCTs, with an incidence of 1.1 per 100,000 people.[3,11] The prevalence of IMSCTs in children is much higher than in adults (35% vs. 20% respectively).[24] Ependymomas and astrocytomas are the most frequent (80%) histological types of IMSCTs.[26] Compared to children, ependymoma is most common in adults and associated with various clinical presentations based on location and malignancy.[3] However, in elderly patients (≥65 years), the incidence of ependymomas and astrocytomas is comparable.[3] Children's astrocytomas display indolent biological activity, which can only be explained by the histological characteristics.[1] Notwithstanding, age is one of the most valuable prognostic factors in IMSCTs, especially astrocytomas.[6]

Cushing initiated the first surgical decompression of the IMSCTs in 1905,[10]and Von Eiselberg and Ranzi removed an IMSCT successfully in 1907.[12] Since then, developments in surgical techniques, anesthesia, and even pharmacological management have followed successively.[21]

The IMSCTs remain a major challenge for neurosurgeons, despite recent advancements in neurophysiological monitoring techniques, microsurgical instruments, and medical equipment.[21,25] These challenges are attributed to its relatively low prevalence, uncertain natural history, and difficulty in standardizing therapy.[33] Therefore, identification of the prognostic factors of the surgical outcomes of IMSCTs is essential. Many studies have established that early surgical intervention for IMSCTs was associated with better outcomes and enhanced survival rates.[17,34] Moreover, it was suggested that tumor histology, growth total resection, and preoperative neurological function have a significant predictive value in such cases.[15,18,32]

This case series clinical study reports the prognostic factors of the one-year outcomes of patients with IMSCTs undergoing surgery.

PATIENTS AND METHODS

The preparation of this manuscript has been in concordance with the STROBE guidelines.[13] A prospective clinical case study was performed on 20 patients with IMSCTs with one-year follow-up. Patients underwent surgery at our main university hospitals between January 2017 and May 2018. Patients were submitted for full history taking, general examination, neurological examination, and routine laboratory investigations. Preoperatively, contrast-enhanced MRI of the index spinal segment, spinal angiography, and MRI tractography study, if needed, were performed. We included all radiologically proved symptomatic fresh IMSCT with no restrictions regarding age, sex, clinical status, race, and tumor characteristics. We excluded patients with no reliable data to calculate postoperative functional outcomes, filum terminale lesions, recurrent intramedullary tumors, and contraindications to general anesthesia. Informed consent was signed by all eligible patients. The study has been approved by our IBR.

We retrieved preoperative data related to demographic characteristics of the patients, symptoms, tumor location, and level of tumor extension. The preoperative functional status was assessed using the modified McCormick Scale (MMS).[23] In this scale, patients are graded into one of five categories according to their functional status: grade I, normal functions; grade II, mild sensorimotor disturbance with no need for support; grade III, more severe disturbance with the need for support; grade IV, severe disturbance with essential assistance; grade V, severe deficit requiring a wheelchair.

Operative Procedure:

Patients underwent their procedures under general anesthesia with no muscle relaxants, in case of electrophysiological monitoring, in the prone position. We performed a linear, midline skin incision, followed by muscle splitting. Then, laminectomy or laminoplasty was performed,

with the aid of an ultrasound probe whenever feasible. The dura was incised in the midline and retracted by tenting sutures. This step was followed by a midline incision of the crossing nerve fibers localized to the posterior median sulcus and the tumors were exposed. The tumors were removed by central debulking, with the aid of the ultrasound aspirator whenever feasible (Figures 1 and 2). Consequently, an attempt to excise the tumor totally was made, with the guidance of electrophysiological monitoring used whenever feasible. After removing the tumor, wound layers were closed tightly, and drains with no negative suction were inserted if feasible. The excised tumors were sent for histological typing and grading. According to our center protocols, the intraoperative monitoring of the patients was done via somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs).

Patients were assessed during the postoperative period for perioperative complications, MMS functional outcomes, postoperative radiotherapy, and chemotherapy. The postoperative MMS was collected at six months and one year after the operation.

Statistical Analysis:

Retrieved data were summarized and processed with IBM SPSS statistical software (version 25). Frequencies were used to describe gender, symptoms, tumor location, histological type, histological grade, the extent of resection, type of surgical repair, use of duraplasty, intraoperative monitoring, ultrasound aspiration, postoperative radiotherapy, postoperative chemotherapy, and incidence of complications. On the other hand, age, duration of the tumor, and MMS were summarized into median (range) or mean ± standard deviation (SD). The hypothesis of significant associations between various parameters and MMS was tested using chi-square test for categorical variables and Mann–Whitney test for continuous variables. A p value <0.05 was regarded as statistically significant.

RESULTS

A total of 20 patients were included, 19 patients completed the follow-up, and one patient died before the end of the first year. The mean age of the patients was 36.5 ± 17.3 (range, 12–68) and the majority were females (60%). The mean duration of symptoms was 4 ± 2.7 (range, 0.13–10) months. Most of the patients had pain, motor, and sensory involvements (30%) or motor and sensory involvements only (30%). The most common tumor location was cervical tumors (70%), followed by dorsal tumors (30%). Overall, 40% of the patients had segmental involvement of >4 segments. The median preoperative MMS was 3.0 ± 1.1 (range, 1–5) (Table 1).

Intraoperatively, growth total resection (GTR) has been achieved in 55% of patients, whereas a subtotal resection (STR) of tumors has been achieved in 45%. Meanwhile, in 55% of the patients, intraoperative monitoring IOM (SSEP and MEP) was used; in 75%, an ultrasonic aspiration was used; in 20%, a duraplasty has been used. The mean operative time was 126.5 ± 27.6 (range, 90–190) minutes, and the mean blood loss was 542.5 ± 196.2 (range, 200–900) ml. The mean hospital stay was 5.2 ± 2.8 (range, 3–14) days (Table 2).

Following surgery, 65% and 25% of the patients underwent postoperative radiotherapy and chemotherapy alone, respectively, while 10% received both chemotherapy and radiotherapy. The mean preoperative MMS (3 ± 1.1) improved postoperatively to 2.95 ± 1.1, 2.42 ± 0.82, and 2.31 ± 0.83 at the immediate, six-month, and one-year postoperative follow-up, respectively. Eleven patients (55%) and 13 patients (65%) had MMS <3 the end of the sixth month and one year of follow-up, respectively ($p < 0.005$) (Figure 3).

Patients with postoperative MMS ≤3 were more likely to undergo GTR with better postoperative MMS than those with preoperative MMS >3 at six-month follow-up (81.8% vs. 25%, respectively; $p = 0.013$) and at one-year follow-up (84.4 vs. 0%,

respectively; p = 0.001). The use of ultrasonic aspiration during tumor excision was associated with better postoperative MMS (p = 0.002), as patients with postoperative MMS ≥3 were less likely to undergo ultrasonic aspiration (37.5% vs. 100%, respectively. The use of IOM (SSEP and MEP) was associated with better postoperative MMS (p = 0.035). There were no significant associations between MMS at the sixth month and reported parameters, including gender, symptoms duration, tumor location, bony work whether laminectomy or laminoplasty, number of segments involved, tumor histopathology, duraplasty, and postoperative adjuvant therapy (p > 0.05) (Table 3).

Reported complications in this study showed that seven patients developed postoperative complications. Four patients (20%) developed postoperative motor deterioration motor weakness. They were grade 4-5 prior to surgery and developed dense paraplegia postoperative (grade 1). With follow-up, two improved to (grade 3), while the other two did not improve. One patient with cervicomedullary anaplastic ependymoma developed motor weakness with respiratory failure and subsequently died 14 days postoperatively. Another patient developed CSF leak that responded well to conservative treatment in one week. Finally, one of the patients showed rapid regrowth of a residual tumor one month after the operation that necessitated radical excision with recent modalities like intraoperative monitoring and Cavitron Ultrasonic Surgical Aspirator (CUSA). It is so important to start adjuvant therapy rapidly for high-grade lesions.

Table 1. Summary of epidemiological data (N = 20).

Parameters		Results
Age/years		36.5 ± 17.3
Gender	Male	8 (40%)
	Females	12 (60%)
Symptom's duration/months		4 ± 2.7 (range, 0.13–10)
Level	Cervical	16 (70%)
	Dorsal	6 (30%)
Pathology	Ependymoma	11 (55%)
	Astrocytoma	7 (35%)
	Cavernoma	2 (10%)
MMS	Preoperative	3 ± 1.1
	Postoperative	2.95 ± 1.1
	6 months postoperatively	2.42 ± 0.82
	12 months postoperatively	2.31 ± 0.83

Table 2. Summary of perioperative data (N = 20).

Parameters		Results
Operative time, minutes		126.5 ± 27.6
Operative blood loss, cc		542.5 ± 196.2
Technique	Laminectomy	17 (85%)
	Laminoplasty	3 (15%)
	Durolasty	4 (20%)
	IOM	8 (40%)
	Ultrasonic aspiration	15 (75%)
Tumor resection	GTR	11 (55%)
	STR	9 (45%)
Complications	CSF leak	1 (5%)
	Deterioration	4 (20%)
	Death	1 (5%)
	Recurrence	1 (5%)
Adjuvant therapy	Chemotherapy	13 (65%)
	Radiotherapy	5 (25%)
	Both	2 (10%)
Hospital stay/days		5.2 ± 2.8

Table 3. Pre-, intra-, and postoperative characteristics of the included patients.

Case Report	Six months			One year		
	MMS < 3 (N = 11)	MMS ≥3 (N = 8)	p value	MMS < 3 (N = 13)	MMS ≥3 (N = 6)	p value
Age/years	28 (20–68)	45.5 (12–60)	0.91	35 (20–68)	39 (16.5–60)	0.57
Females	4 (36.4%)	4 (50%)	0.55	5 (38.5%)	3 (50%)	0.63
Symptom's duration/ months	4 (0.13–8)	5 (2–10)	0.27	4 (0.13–9)	5 (2–10)	0.36
Symptoms						
Pain, motor, and sensory Pain and motor Pain and sensory Pain Pain, motor, sensory, sphincter	3 (27.3%) 4 (36.4%) 2 (18.2%) 0 2 (18.2%)	3 (37.5%) 2 (25%) 2 (25%) 1 (12.5%) 0	0.38	4 (30.8%) 4 (30.8%) 3 (23.1%) 0 2 (15.4%)	2 (33.3%) 2 (33.3%) 1 (16.7%) 1 (16.7%) 0	0.43
Location						
Cervical Cervicodorsal Cervicomedullary Dorsal Dorso-lumbar	4 (36.5%) 3 (27.3%) 2 (18.2%) 1 (9.1%) 1 (9.1%)	5 (62.5%) 0 1 (12.5%) 1 (12.5%) 1 (12.5%)	0.44	5 (38.5%) 3 (23.1%) 2 (15.4%) 1 (9.1%) 2 (15.4%)	4 (66.7%) 0 1 (16.7%) 1 (16.7%) 0	0.38
>4 segments	3 (27.3%)	4 (50%)	0.31	4 (30.8%)	3 (50%)	0.42
Laminectomy	10 (90.9%)	6 (75%)	0.35	12 (92.3%)	4 (66.7%)	0.15
Growth total resection	9 (81.8%)	2 (25%)	0.013*	11 (84.6%)	0	0.001*
Duraplasty	2 (18.2%)	2 (25%)	0.72	2 (15.4%)	2 (33.3%)	0.37
IOM	7 (63.6%)	1 (12.5%)	0.035*	8 (61.5%)	0	0.025*
CUSA	11 (100%)	3 (37.5%)	0.002*	12 (92.3%)	2 (33.3%)	0.007*
Histological type						
Astrocytoma Cavernoma Ependymoma	1 (9.1%) 1 (9.1%) 9 (81.8%)	5 (37.5%) 1 (12.5%) 2 (25%)	0.33	3 (23.1%) 2 (15.4%) 10 (61.5%)	3 (50%) 0 1 (16.7%)	0.11
Grade						
Low High	8 (71%) 2 (18.2%)	5 (67.5%) 2 (25%)	0.68	9 (69.2%) 2 (15.4%)	4 (66.7%) 2 (33.3%)	0.48
Preoperative MMS <3	7 (63.6%)	1 (12.5%)	0.035*	9 (69.2%)	1 (16.7%)	0.032*
Complications						
CSF leak, meningitis Recurrence Weakness, G2 Weakness, G3	1 (9.1%) 1 (9.1%) 0 0	0 0 1 (12.5%) 3(255)	0.17	1 (7.9%) 1 (7.9%) 0 0	0 0 1 (16.7%) 3 (33.3%)	0.13
Postoperative radiotherapy	8 (72.8%)	7 (87.5%)	0.43	9 (69.2%)	6 (100%)	0.92
Postoperative chemotherapy	3 (27.3%)	4 (50%)	0.31	3 (23.1%)	4 (66.7%)	0.067

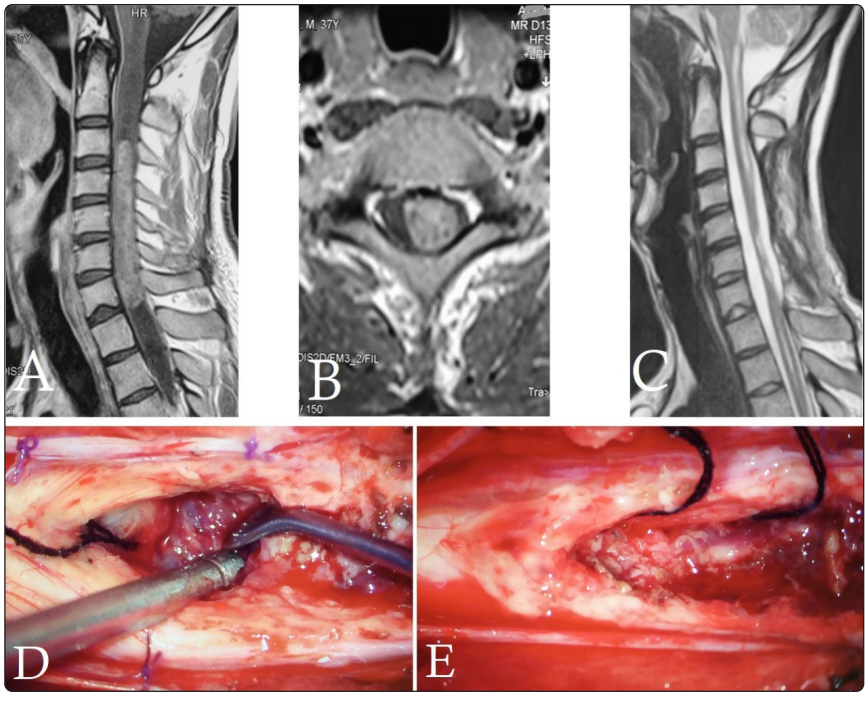

Figure 1. A 37-year-old male with cervical intramedullary ependymoma. Postcontrast enhancement (A) T1 sagittal and (B) T1 axial images showing C3-C7 ependymoma with caudal T1-T2 syrinx. (C) Postoperative T2 sagittal MRI image showing tumor GTR with the disappearance of the syrinx. (D, E) Operative photos showing steps of tumor resection with the plane of cleavage between tumor and spinal cord.

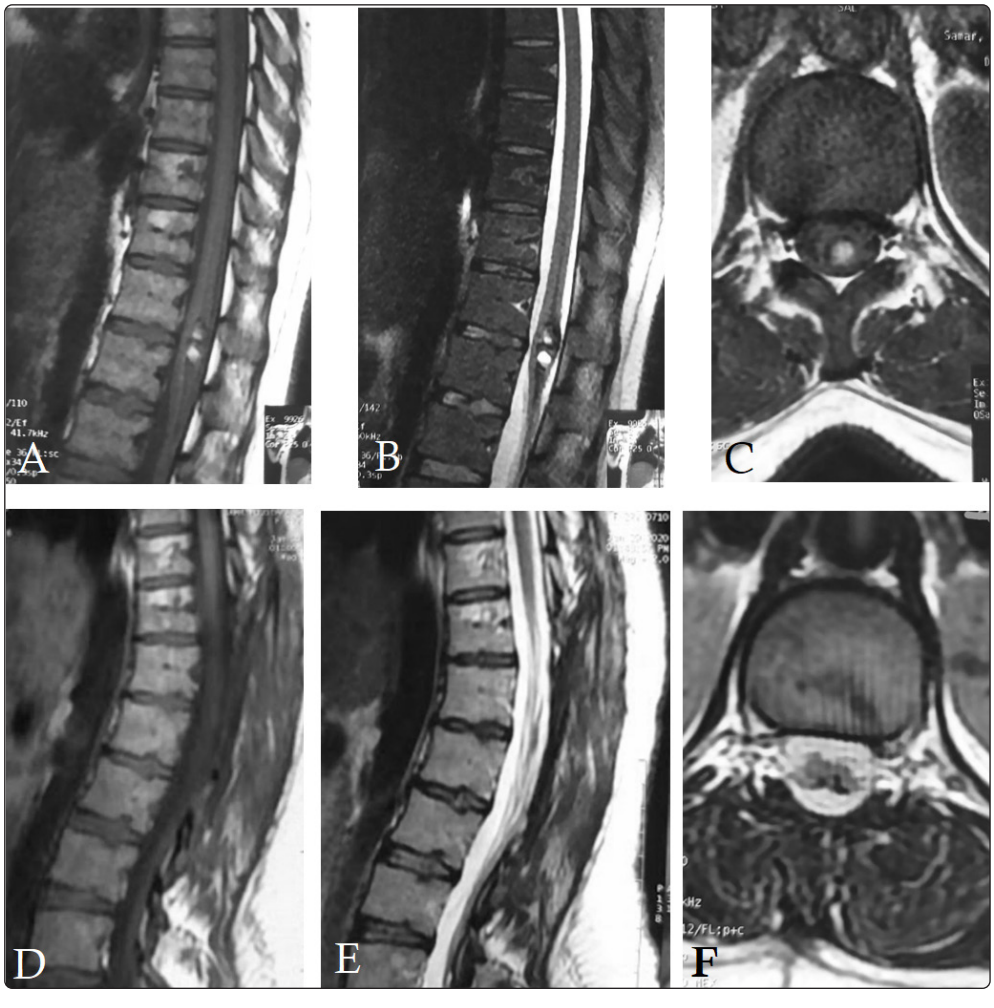

Figure 2. A 26-year-old female with conus medullaris cavernoma. Postcontrast enhancement (A) T1 sagittal, (B) T2 sagittal, (C) and T1 axial MRI images showing conus cavernoma. Postoperative postcontrast enhancement (D) T1 sagittal, (E) T2 sagittal, and T2 axial MRI images showing tumor GTR.

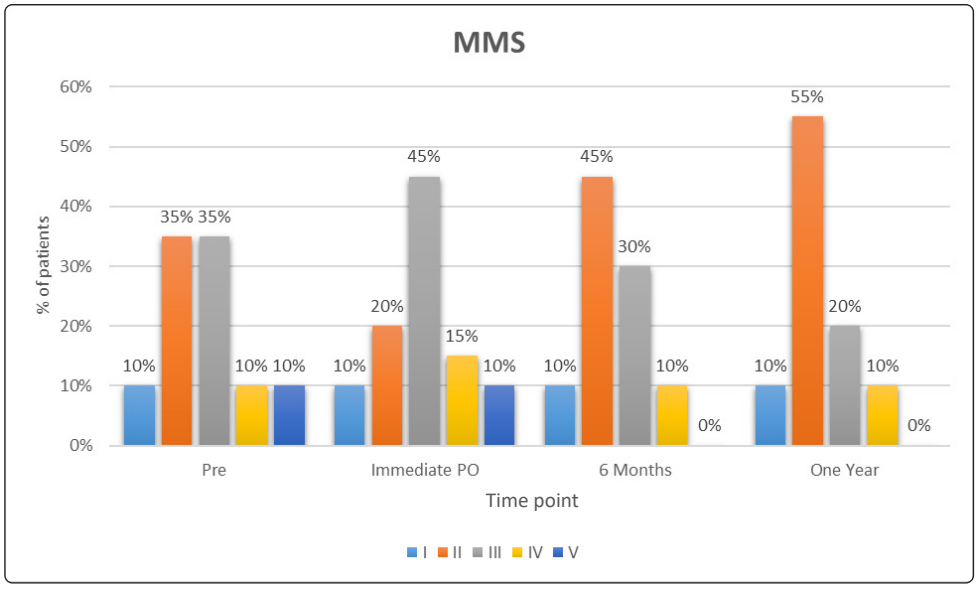

Figure 3. The change in MMS over the study's period.

DISCUSSION

In this prospective study, we highlighted the prognostic factors of IMSCTs surgery in 20 Egyptian patients. Patients with IMSCTs usually present with motor, sensory, or sphincter disturbances.[31] Preoperative assessment of the neurological functions is a key determinant of the surgical outcomes. Many scales were developed, including Cooper–Epstein scale,[9] Klekamp–Samii scoring system,[19] and MMS [23], in order to assess functional outcomes. Due to its common use in the literature and its simplicity and ease of use, many surgeons prefer the MMS. Here, we used the MMS to evaluate our patients pre- and postoperatively.

One-third of our patients presented with pain, motor, and sensory affection and one-third had only sensory and motor involvement. A significantly higher percentage of neurological disturbance was reported by Kane et al.[17] (72%) and Chandy et al.[7] (95.8% motor and 82.5% sensory involvement). Mostly, the sensory disturbance was the first to be mentioned in the previous studies, followed by motor disturbance.[16,36,38] In this study, the reported median of disease duration was 4 (0.13–10) months, which is significantly shorter than that of Constantini et al.[8] (11.6 months), Bansal et al.[3] (3 years), Brotchi et al.[5] (4.5 years), and Cooper et. al.[9] (9.5 years). This substantial variation can be attributed to the histological type of malignancy and its location. In this study, cervical tumors were the most common type (45%), followed by dorsal tumors (20%). Data from 29 studies showed that most of the IMSCTs are in the cervical region (53.0%).[2] Brotchi et al.[5] reported a higher percentage of cervical tumors (55.3%) than ours, whereas Bansal et al.[3] and Kane et al.[17] reported a lower percentage, 25% and 33%, respectively.

At baseline, the median preoperative MMS of our patients was 3 (1–5). Similarly, most of the patients of Bansal et al.[3] had an MMS of 2 and 3 at presentation. Furthermore, the operation resulted in mild complications, most commonly weakness. GTR was achieved successfully in 55% of the reported patients. Patients with MMS <3 were more likely to achieve GTR than those with MMS >3 ($p = 0.001$). IMSCT resection is usually based on the existence or absence of a clear operative dissection plane.[4,22,29] This clear plane of cleavage between the SC and the tumor is usually seen in the ependymomas, unlike the astrocytomas, which tend to be more infiltrative due to the lack of a good dissection plane.[14,39,28] In our study, about 75% underwent ultrasound aspiration, 55% had syrinx, and 20% received duraplasty.

It was reported that operations with syrinx were associated with a higher rate of GTR than those without syrinx (52.7% vs. 36.6%).[1] In patients with syringomyelia, Chandy et al.[7] achieved a successful radical excision in 68%. Patients with hemangioblastoma and ependymoma are mainly linked with syrinx.

MRI was the imaging study of choice in our study, as it has superior soft tissue demarcation, in addition to the capacity of multiplanar imaging and no irradiation exposure. MI studies were also beneficial in detecting the presence of cysts, either intratumoral cysts (commonly seen with high-grade astrocytomas) or syringomyelia. Regarding the relationship of imaging characteristics to pathology, we observed that it was extremely difficult to differentiate ependymomas and astrocytomas on T1WI and T2WI basis. Post-contrast imaging proved that ependymomas tended to be more homogenously and intensely enhancing than astrocytomas; moreover, it helped differentiate between syringomyelia and tumor-related cyst. Klekamp and Samii[19], in their study of 100 intramedullary cases, found that, in general, the presence of an associated syrinx favored the resectability of the tumor because it indicated a displacing rather than an infiltrating tumor. Patients with syringomyelia tended to recover from surgery sooner. However, surgical results and long-term prognosis were not influenced significantly by an associated syrinx. In our study, presence of syringomyelia was not statistically significant for the outcome. The most important factor determining long-term outcome was the preoperative level of neurological function

According to the recent recommendations, primary resection is the first-line treatment in IMSCTs management (Class I), followed by radiation and chemotherapy (Classes IIa and IIb).[35] Primary resection can be replaced with radiation or chemotherapy in contraindicated resection cases or the cases of astrocytoma due to the substantially high incidence of neurological complications postresection in this type.[18]

Almost 65% and 25% of our patients underwent postoperative radiotherapy and chemotherapy, respectively, and 10% underwent both. A recent meta-analysis demonstrated that pooled data of 29 studies revealed that resection is the most commonly performed surgery (76.7%) in patients with IMSCTs. Moreover, the rate of GTR was higher than STR (39.7% vs. 37.0%), respectively. In terms of efficacy, they showed that patients with GTR had better survival outcomes than those with STR.[2] Another study reported that GTR was associated with a good prognosis of surgical outcomes (OR = 0.083, 95% CI: 0.014, 0.51).[37]

According to the traditional treatment method, ependymoma patients should be treated with radiotherapy after surgery to improve their prognosis. However, recent studies have proved that low-grade ependymoma patients treated with whole surgical resection do not need radiotherapy if there is no CSF spread. Ependymoma and anaplastic ependymoma patients who received whole surgical resection can experience an improved survival rate as the short-term survival rate and 10-year survival rates are 70% and 50%, respectively.

Our findings showed that IMSCTs surgeries were associated with improved overall neurological functional status. This improvement exhibits a significant decline in the MMS postoperatively. In addition, lower MMS was shown to be related to better outcomes. Richards et al.[27] indicated that MMS was improved in 16.6% of the cases postoperatively. On the other hand, MMS remained unchanged in 57.1% and worsened in 26.2% of the patients. Tsuji et al.[37] showed that elderly patients (OR = 1.05, p = 0.046) and severe preoperative MMS (OR = 2.10, p = 0.007) are related to poor results of IMSCTs management. Low preoperative MMS score was identified as the strongest predictor of successful GTR by Klekamp et al.[20], who analyzed 100 patients with IMSCTs who underwent surgical treatment. Besides, they found that old age, long disease duration, and thoracic location were risk factors for permanent postoperative neurological complications.

Our review underlines that the most important prognostic factor in determining postoperative neurological status in the long term is the patient's functional status at surgery and highlights the importance of early diagnosis and surgery. An early diagnosis markedly influences patients' functional prognosis and quality of life. According to our experience in treating patients with IMSCTs, we conclude that the determinant predictors of a good outcome after surgery are the histological type of lesion, complete removal of the lesion, and a satisfactory neurological status before surgery.

This study had some limitations as follows: 1) there is a potential selection bias as it is a single-center study; 2) the sample size is relatively small, which may hinder our ability to generalize our findings; 3) the studied surgeries were conducted by more than one surgeon, leading to a variation in the surgical outcomes based on the experience and learning curve; 4) we did not compare between the GTR and STR to show the difference in prognostic factors; 5) the analysis was limited to the total population without conducting a subgroup analysis according to the tumor histology or grade. A better balance between tumor control and functional preservation may be achieved not only by the surgical technique or expertise but also by intraoperative monitoring (SSEP, MEP), vascular image guidance, ultrasonic aspiration, and postoperative supportive care, including rehabilitation. Further studies with a longer follow-up period and larger sample size are required to evaluate the prognostic factors of IMSCTs management.

CONCLUSION

The findings of the current study showed that patients with GTR, good preoperative MMS, intraoperative monitoring, and ultrasonic aspirator usage might be associated with better functional outcomes.

REFERENCES

1. Ardeshiri A, Chen B, Hütter BO, Oezkan N, Wanke I, Sure U, et al: Intramedullary spinal cord astrocytomas: The influence of localization and tumor extension on resectability and functional outcome. Acta Neurochir (Wien), 2013
2. Azad TD, Pendharkar AV, Pan J, Huang Y, Li A, Esparza R, et al: Surgical outcomes of pediatric spinal cord astrocytomas: systematic review and meta-analysis. J Neurosurg Pediatr 22(4):404–410, 2018
3. Bansal S, Ailawadhi P, Suri A, Kale SS, Sarat Chandra P, Singh M, et al: Ten years' experience in the management of spinal intramedullary tumors in a single institution. J Clin Neurosci 20(2):292–298, 2013
4. Behmanesh B, Setzer M, Konczalla J, Harter P, Quick-Weller J, Imoehl L, et al: Management of patients with primary intramedullary spinal cord glioblastoma. World Neurosurg 98:198–202, 2017
5. Brotchi J, Noterman J, Baleriaux D: Surgery of intramedullary spinal cord tumours. Acta Neurochir (Wien), 1992
6. Chamberlain MC, Tredway TL: Adult primary intradural spinal cord tumors: A review. Current Neurology and Neuroscience Reports11(3):320–328, 2011
7. Chandy MJ, Babu S: Management of intramedullary spinal cord tumours: Review of 68 patients. Neurol India 47(3):224–228, 1999
8. Constantini S, Houten J, Miller DC, Freed D, Ozek MM, Rorke LB, et al: Intramedullary spinal cord tumors in children under the age of 3 years. J Neurosurg 85(6):1036–1043, 1996
9. Cooper PR, Epstein F: Radical resection of intramedullary spinal cord tumors in adults. Recent experience in 29 patients. J Neurosurg 63(4):492–499, 1985

10. Cushing H: The Special Field of Neurological Surgery. Neurosurgery 57(6):1075–1075, 2015
11. Duong LM, McCarthy BJ, McLendon RE, Dolecek TA, Kruchko C, Douglas LL, et al: Descriptive epidemiology of malignant and nonmalignant primary spinal cord, spinal meninges, and cauda equina tumors, United States, 2004-2007. Cancer 118(17):4220-4227, 2012
12. Eiselsberg A, Ranzi E: Ueber die chirurgische Behandlung der Hirn- und Rückenmarkstumoren. Vol. 44. August Hirschwald, 1907
13. Elm E Von, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al: The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement : Guidelines for reporting observational studies *. Int J Surg 12(12):1495–1499, 2014
14. Epstein FJ, Farmer JP, Freed D: Adult intramedullary spinal cord ependymomas: The result of surgery in 38 patients. J Neurosurg 79(2):204–209, 1993
15. Garcés-Ambrossi GL, McGirt MJ, Mehta VA, Sciubba DM, Witham TF, Bydon A, et al: Factors associated with progression-free survival and long-term neurological outcome after resection of intramedullary spinal cord tumors: Analysis of 101 consecutive cases. J Neurosurg Spine 11(5):591–599, 2009
16. Hsu W, Jallo GI: Pediatric spinal tumors. In: Handbook of Clinical Neurology, 2013
17. Kane PJ, El-Mahdy W, Singh A, Powell MP, Crockard HA: Spinal intradural tumours: Part II - Intramedullary. Br J Neurosurg 13(6):558–563, 1999
18. Karikari IO, Nimjee SM, Hodges TR, Cutrell E, Hughes BD, Powers CJ, et al: Impact of tumor histology on resectability and neurological outcome in primary intramedullary spinal cord tumors: A single-center experience with 102 patients. Neurosurgery 68(1):188–197, 2011
19. Klekamp J, Samii M: Introduction of a score system for the clinical evaluation of patients with spinal processes. Acta Neurochirurgica 123(3-4):221–223, 1993
20. Klekamp J: Spinal ependymomas. Part 1: Intramedullary ependymomas. Neurosurg Focus 39(2):E6, 2015
21. Kucia EJ, Bambakidis NC, Chang SW, Spetzler RF: Surgical technique and outcomes in the treatment of spinal cord ependymomas, Part 1: Intramedullary ependymomas. Oper Neurosurg 68(1 Suppl Operative):57–63, 2011
22. McGirt MJ, Chaichana KL, Atiba A, Attenello F, Woodworth GF, Jallo GI: Neurological outcome after resection of intramedullary spinal cord tumors in children. Child's Nervous System 24(1):93–97, 2008
23. McCormick PC, Torres R, Post KD, Stein BM: Intramedullary ependymoma of the spinal cord. J Neurosurg 72(4):523–532,1990
24. Merchant TE, Pollack IF, Loeffler JS: Brain tumors across the age spectrum: Biology, therapy, and late effects. Seminars in Radiation Oncology 20(1):58–66, 2010
25. Mitha AP, Turner JD, Spetzler RF: Surgical approaches to intramedullary cavernous malformations of the spinal cord. Oper Neurosurg 68(2 Suppl Operative):317–324 , 2011
26. Narayan P, Barrow DL: Intramedullary spinal cavernous malformation following spinal irradiation case report and review of the literature. J Neurosurg 98(1 Suppl):68–72, 2003
27. Richards O, Goacher E, Pal D, Tyagi A, Chumas P, Derham C: Intramedullary spinal cord tumours – a single Centre, 10-year review of clinical and pathological outcomes. Br J Neurosurg 35(2):125–128, 2021

28. Rodriguez D, Nadig A, Harte T, Leach J: Surgical outcomes in adult intramedullary spinal cord tumors: Our experience. Eur Spine J 5(4):243–250, 2013

29. Schneider C, Hidalgo ET, Schmitt-Mechelke T, Kothbauer KF: Quality of life after surgical treatment of primary intramedullary spinal cord tumors in children. J Neurosurg Pediatr 13(2):170–177, 2014

30. Schwartz TH, McCormick PC: Intramedullary ependymomas: Clinical presentation, surgical treatment strategies and prognosis. Journal of Neuro-Oncology 47(3):211–218, 2000

31. Shrivastava RK, Epstein FJ, Perin NI, Post KD, Jallo GI: Intramedullary spinal cord tumors in patients older than 50 years of age: management and outcome analysis. J Neurosurg Spine 2(3):249–255, 2005

32. Takami T, Naito K, Yamagata T, Kawahara S, Ohata K: Surgical outcomes of posterolateral sulcus approach for spinal intramedullary tumors: Tumor resection and functional preservation. World Neurosurg 108:15–23, 2017

33. Takami T, Naito K, Yamagata T, Ohata K: Surgical management of spinal intramedullary tumors: Radical and safe strategy for benign tumors. Neurol Med Chir (Tokyo) 55(4):317–327, 2015

34. Takami T, Yamagata T, Naito K, Arima H, Ohata K: Intraoperative assessment of spinal vascular flow in the surgery of spinal intramedullary tumors using indocyanine green videoangiography. Surg Neurol Int 4(1):135, 2013

35. Tobin MK, Geraghty JR, Engelhard HH, Linninger AA, Mehta AI: Intramedullary spinal cord tumors: a review of current and future treatment strategies. Neurosurg Focus 39(2):E14, 2015

36. Tredway TL: Minimally invasive approaches for the treatment of intramedullary spinal tumors. Neurosurgery Clinics of North America 25(2):327–336, 2014

37. Tsuji O, Nagoshi N, Ishii R, Nori S, Suzuki S, Okada E, et al: Poor prognostic factors for surgical treatment of spinal intramedullary ependymoma (World Health Organization Grade II). Asian Spine J 14(6):821–828, 2020

38. Vaillant B, Loghin M: Treatment of spinal cord tumors. Curr Treat Options Neurol 11(4):315–324, 2009

39. Wu J, Wu Y, Xu WL, Li GY: The surgical treatment of intramedullary spinal cord tumors: A retrospective analysis of 76 patients. CNS neuroscience & therapeutics 24(6):575, 2018

الملخص العربي

العوامل المؤثرة في النتيجة الجراحية لأورام العمود الفقرى داخل النخاع الشوكى: دراسة متابعة مستقبلية لمدة عام

البيانات الخلفية: تحديد العوامل النذير للنتائج الجراحية لأورام النخاع الشوكى أمر ضروري. أثبتت العديد من الدراسات أن التدخل الجراحي المبكر لاورام النخاع الشوكى كان مرتبطًا بنتائج أفضل ومعدلات بقاء معززة.

الغرض: حققت هذه الدراسة في العوامل الإنذارية لنتائج سنة واحدة للمرضى الذين يعانون من اورام النخاع الشوكى و يخضعون لعملية جراحية.

تصميم الدراسة: عينة المريض ، مقاييس النتائج: تم إجراء دراسة مستقبلية على 20 مريضًا مصابًا باورام النخاع الشوكى ، والذين خضعوا لعملية جراحية في مستشفيات جامعة الإسكندرية الرئيسية. تمت متابعة المرضى لمدة عام واحد لفحص تأثير المعلمات قبل الجراحة على النتائج الوظيفية بعد العملية الجراحية ، والتي تم تقييمها بواسطة مقياس ماكورميك المعدل.(MMS)

المرضى والطرق: لا توجد قيود على عمر المريض أو جنسه أو خصائص الورم. استبعدنا المرضى الذين ليس لديهم بيانات موثوقة لحساب النتائج الوظيفية بعد الجراحة ، وآفات الخيط الانتهائى ، و الاورام المرتجعة.

النتائج. كان وسيط رسائل الوسائط المتعددة قبل الجراحة 3 (1-5). أثناء العملية الجراحية ، خضع 85٪ لعملية استئصال الصفيحة الفقرية و 55٪ حصلوا على استئصال كلي. بالإضافة إلى ذلك ، خضع 55٪ من المرضى للمراقبة أثناء العملية ، وخضع 75٪ من المرضى للشفط بالموجات فوق الصوتية . تغير الوسيط MMS بشكل ملحوظ ليصل إلى 2 (1-4) في نهاية الشهر السادس وسنة واحدة من المتابعة. كان لدى 11 مريضًا (55٪) و 13 مريضًا (65٪) رسائل MMS أقل من 3 في نهاية الشهر السادس وسنة واحدة من المتابعة ، على التوالي (.(0.005> Pكان المرضى الذين يعانون من 3≤ MMS أكثر عرضة للخضوع للاستئصال الجزئي من المرضى الذين يعانون من 3> MSS في نهاية الشهر السادس وسنة واحدة من المتابعة (0.013 =p و= 0.002 ، على التوالي). لم يكن هناك ارتباط معنوي بين MSS في الشهر السادس والمتغيرات المدروسة الأخرى. أظهر تحليل الانحدار أن أيا من المتغيرات المشتركة المدروسة لم تكن تنبؤات مستقلة للشهر السادس والرسائل المتعددة الوسائط لمدة عام.

الخلاصة: في الختام ، أظهرت نتائج الدراسة الحالية أن المرضى الذين يعانون من الاستئصال الكامل مع حالة سريرية جيدة قبل الجراحة والشفط بالموجات فوق الصوتية قد يرتبطون بنتائج وظيفية أفضل. لم نتمكن من تحديد أي تنبؤات مستقلة لرسائل الوسائط المتعددة قصيرة أو طويلة المدى.