



Original Article

Factors influencing outcome in patients with intramedullary spinal cord tumors undergoing resective surgery

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ABSTRACT

Background: We evaluated whether preoperative functional status influenced surgical outcomes for patients with intramedullary spinal cord tumors (IMSCCT).

Methods: We analyzed whether lower preoperative McCormick scores impacted primary outcomes for 78 consecutive patients with IMSCCT of World Health Organization (WHO) grades I and II undergoing tumor resection between 2010 and 2018.

Results: Patients averaged 33.6 years of age, 57.5% were male, and lesions predominantly involved the cervical 23 (29.5%) followed by the thoracic spine 19 (24.3%). Over the average follow-up interval of 69.83 months, IMSCCTs recurred in 11.5% of patients, with 6.4% showing functional deterioration. At follow-up, 73.5% of patients with a preoperative modified McCormick score of two or one showed better functional improvement.

Conclusion: The WHO pathological grades I and II did not significantly influence outcomes for patients with intramedullary spinal cord lesions. However, patients with low preoperative McCormick scores (two or one) demonstrated better functional outcomes.

Keywords: Clinical presentation, Extent of resection, Intramedullary tumor, Malignance, Spinal cord

INTRODUCTION

Intramedullary spinal cord tumors (IMSCCT) account for 20–30% of primary spinal cord tumors in adults and are predominantly found in the thoracic, followed by the cervical and lumbar regions.^[1] Gliomas constitute 80% of all IMSCCTs (i.e., astrocytomas and ependymomas), while hemangioblastomas are the third most frequent lesions (i.e., 2–15% of IMCTs).^[3] Although radical subtotal/total microsurgical tumor resection lowers recurrence rates, improved perioperative neurological status (i.e., %) correlates with better long-term survivals.^[4] Further, outcomes are still significantly dependent on tumor histology.^[6] Here, we asked whether lower World Health Organization (WHO)^[7] pathological grades I and II and/or lower preoperative modified McCormick scores^[5] (i.e., reflecting lesser deficits) significantly influenced outcomes for patients undergoing radical IMSCCT surgery [Tables 1 and 2].

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MATERIALS AND METHODS

This prospective study included 78 consecutive patients with grades I and II IMSCT (i.e., according to the WHO) undergoing tumor resection between 2010 and 2018. Patients averaged 33.60 years of age, 46 (57.5%) were male, and tumors were, respectively, located in the cervical (23 patients = 29.5%), followed by the thoracic (19 = 24.3%) and conus (17 = 21.7%) regions. We were most interested in whether patients with lower preoperative McCormick neurological scores (two or one) or lower grades I and II

Table 1: WHO grading system for tumors of the central nervous system.

WHO grade	Clinical/functional tumor classification
1	Slow-growing, non-malignant long-term survival.
2	Slow-growing sometimes recurs as higher grade tumors can be nonmalignant or malignant.
3	Malignant often recur as higher grade tumors.
4	Reproduce rapidly is very aggressive malignant tumors.

*WHO: World Health Organization

Table 2: McCormick scale.

McCormick score	Clinical/functional classification
I	Neurologically normal, mild focal deficits, normal gait.
II	Sensorimotor deficits affecting function, severe pain, gait difficulties, can still walk.
III	The moderate neurological deficit requires a cane for ambulation, minor involvement of arms, and partially independent.
IV	As grade 3 with arms affected, usually not independent.

WHO pathology had better outcomes at 5 postoperative years [Table 2].

Surgery

Patients underwent routine laminectomies using an operating microscope, intraoperative monitoring, and the Cavitron ultrasonic surgical aspirator to facilitate maximal tumor resections. Adjuvant therapies (routine radiation, cyber knife radiosurgery, or tomo-radiotherapy) were offered to patients with high-grade tumors, progressive disease, and/or for those who had just subtotal tumor resections.

Statistical analysis

The study population was divided into groups based on the WHO grades I and II and recurrence at follow-up. We also used student *t*-tests and Chi-square tests to evaluate categorical variables. $P < 0.05$ was considered significant.

RESULTS

Pathology

The WHO histopathology revealed ependymomas in 28 (35.9%) patients [Figure 1], hemangioblastomas [Figure 2] and epidermoid tumors in 10 (12.8%) patients each, and astrocytomas, cavernomas, and lipomas in 5 patients (6.4%) each. Tumor recurrence was observed in 9 (11.5%) patients, 5 (6.4%) of whom deteriorated functionally. Patients with the WHO grade I and II lesions showed no significant differences in outcomes and/or recurrence rates [Table 3]. Both at discharge from the hospital and at the latest follow-up, patients with lower McCormick scores (two or one) at admission showed better functional improvement [Figures 3, 4 and Tables 3, 4].

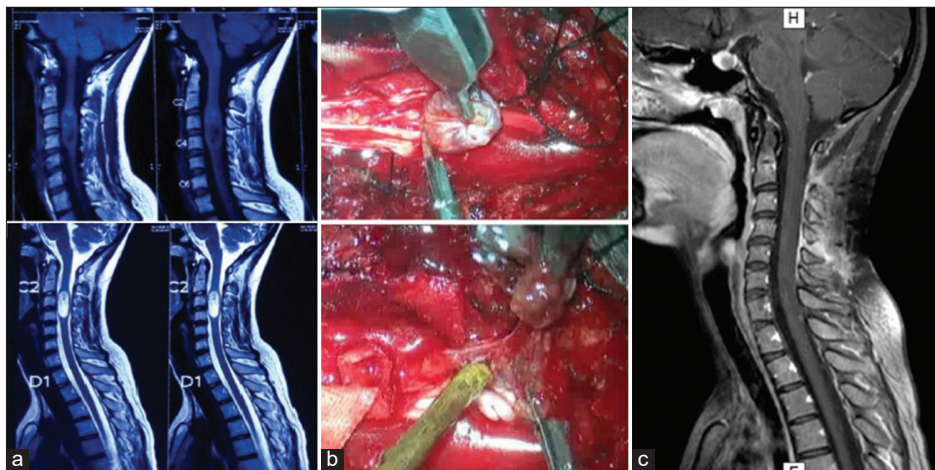


Figure 1: Preoperative magnetic resonance imaging (a) intraoperative (b) 3-month postoperative (c) imaging of a patient with an ependymoma.



Figure 2: Magnetic resonance of hemangioblastoma (a) preoperatively and (b) postoperatively.

Table 3: Comparison between WHO Grade 1 and 2 lesions ($n=78$).

Series number	Variable	Grade 1 ($n=49$)	Grade 2 ($n=29$)	P-value
1	Age (years)	33.55±17.03	33.66±15.25	0.978
2	Men (%)	31 (63.3)	15 (51.7)	0.349
3	Number of spinal levels	2.43±1.08	3.52±1.72	<0.001
4	Spinal level			
	Cervical (%)	12 (24.5)	11 (37.9)	0.01
	Cervicodorsal (%)	2 (4.1)	8 (27.6)	
	Dorsal (%)	16 (32.7)	3 (10.3)	
	Dorsolumbar (%)	5 (10.2)	0 (0.0)	
	Lumbar (%)	4 (8.2)	0 (0.0)	
	Conus (%)	10 (20.4)	7 (24.1)	
5	Preop McCormick score	2.47±0.89	2.21±0.86	0.207
6	Postop McCormick score	2.04±1.07	2.03±1.08	0.980
7	GTR (%)	24 (49.0)	15 (51.7)	1.000
8	Mean follow-up (months)	72.04±34.27	62.79±30.64	0.235
9	Follow-up McCormick score	1.84±1.00	1.72±0.99	0.633
10	Deteriorated (%)	3 (6.1)	2 (6.9)	1.000
11	Recurrence (%)	6 (12.2)	3 (10.7)	1.000
12	Mean recurrent free survival	117.25±4.69	109.24±5.55	0.879

WHO: World Health Organization, GTR: Gross total resection, Preop: Preoperative, Postop: Postoperative

DISCUSSION

In the present study, 78 patients underwent early surgical resection of low WHO grades I and II IMSCT tumors. Notably, all of our patients were either in the WHO grades I or II, and nearly 73.5% had McCormick Functional scores of two or one (i.e., they could walk independently and had mild neurological deficits [Table 2]). Those with low preoperative McCormick scores (two or one) showed improved postoperative functional long-term outcomes. Our

gross total resection rate of 50% was lower than the 62.5% reported by Fathy *et al.*^[2]

Extent of spinal segments involved versus outcome

Neither the number of spinal surgical segments nor the location of IMSCT significantly influenced surgical outcomes and/or recurrence rates for the low WHO grade I and II lesions in our sample; this would likely not be true for higher grade lesions. Patients with minimal preoperative deficits

Table 4: Factors associated with recurrence (n=78).

Series Number	Variable	Non – recurrence (n=69)	Recurrence (n=9)	P-value
1	Age (years)	33.99±16.63	30.56±13.88	0.556
2	Men (%)	40 (58.0)	6 (66.7)	0.730
3	Spinal levels involved	2.88±1.47	2.44±1.36	0.394
4	Spinal levels			
	Cervical (%)	21 (30.4)	2 (22.2)	0.339
	Cervicodorsal (%)	10 (14.5)	0 (0.0)	
	Dorsal (%)	18 (26.1)	1 (11.1)	
	Dorsolumbar (%)	4 (5.8)	1 (11.1)	
	Lumbar (%)	3 (4.3)	1 (11.1)	
	Conus (%)	13 (18.8)	4 (44.4)	
5	Preop McCormick score	2.39±0.87	2.22±0.97	0.593
6	Postop McCormick score	2.07±1.10	1.78±0.83	0.443
7	GTR (%)	36 (52.2)	3 (33.3)	0.481
8	Mean follow-up (months)	68.23±34.18	71.44±24.27	0.786
9	Follow-up McCormick score	1.68±0.96	2.67±0.88	0.005
10	Deteriorated (%)	1 (1.4)	4 (44.4)	<0.001

GTR: Gross total resection, Preop: Preoperative, Postop: Postoperative

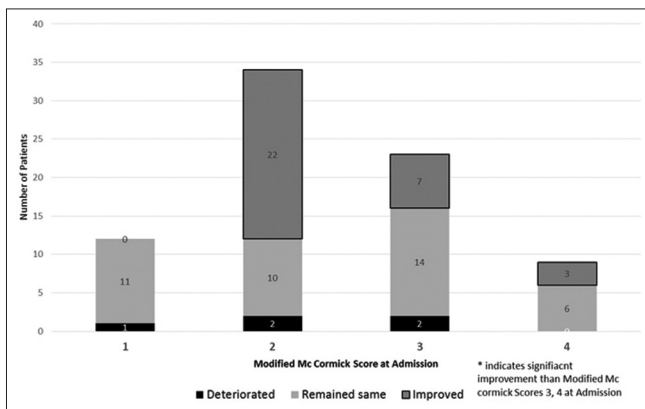


Figure 3: Functional status of the study population at discharge from hospital.

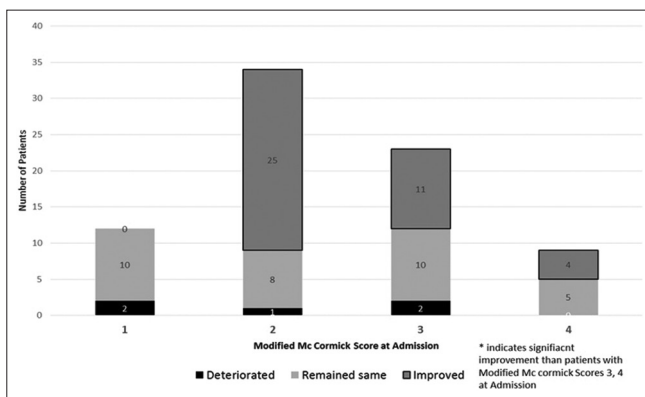


Figure 4: Functional status of the study population at the latest follow-up.

(McCormick scores of two or one) were more likely to remain functionally independent at the latest follow-up.

CONCLUSION

Patients with low preoperative McCormick scores (i.e., of one or two) demonstrated better functional outcomes after IMSCT surgery, while WHO grades of I or II did not significantly impact results.

Ethical approval

The study was approved by Institutional Ethics Committee - KFRC/EC/APR/0013/2010.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation:

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the

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