# Spinal cord tumor case series

A total of 79 individuals who underwent ISCT resection at our institute between 2014 and 2019 were enrolled in the study, whose preoperative walking state was independent ambulator regardless of cane support with the Functional Independence Measure Locomotor Scale (FIM-L) score of ≥6. The FIM-L, the American Spinal Injury Association (ASIA) motor and sensory scores in the lower extremities, and the Walking Index for Spinal Cord Injury II (WISCI II) were assessed for walking independence, lower-limb function, and walking ability, respectively. These evaluations were performed at 4 time points: preoperatively, 1 week (1W), 2 weeks (2W), and 1 year after surgery.

Results: In the early phase after surgery, 71% and 43% of the participants were nonindependent ambulators at 1W and 2W, respectively. Histopathology indicated that patients with solid tumors (ependymoma, astrocytoma, or lipoma) showed significantly lower indices at 1W and 2W than those with vascular tumors (hemangioblastoma or cavernous hemangioma). Regarding tumor location, thoracic cases exhibited poorer lower-limb function at 1W and 2W and poorer walking ability at 2W than cervical cases. According to the receiver operating characteristic (ROC) analysis, 2 WISCI II points at 2W had the highest sensitivity (100%) and specificity (92.2%) in predicting the level of walking independence at 1 year postoperatively (the area under the ROC curve was 0.99 (95% confidence interval, 0.93-1.00).

The higher the lower-limb function scores in the early phase, the better the improvement in walking ability is predicted 1 year after ISCT resection [1)].

**2017**

The objective of this study was to identify clinically relevant predictors of progression-free survival and functional outcomes in patients who underwent surgery for intramedullary spinal cord tumors (ISCTs). METHODS An institutional spinal tumor registry and billing records were reviewed to identify adult patients who underwent resection of ISCTs between 1993 and 2014. Extensive data were collected from patient charts and operative notes, including demographic information, extent of resection, tumor pathology, and functional and oncological outcomes. Survival analysis was used to determine important predictors of progression-free survival. Logistic regression analysis was used to evaluate the association between an “optimal” functional outcome on the Frankel or McCormick scale at 1-year follow-up and various clinical and surgical characteristics. RESULTS The consecutive case series consisted of 63 patients (50.79% female) who underwent resection of ISCTs. The mean age of patients was 41.92 ± 14.36 years (range 17.60-75.40 years). Complete microsurgical resection, defined as no evidence of tumor on initial postoperative imaging, was achieved in 34 cases (54.84%) of the 62 patients for whom this information was available. On univariate analysis, the most significant predictor of progression-free survival was tumor histology (p = 0.0027). Patients with Grade I/II astrocytomas were more likely to have tumor progression than patients with WHO Grade II ependymomas (HR 8.03, 95% CI 2.07-31.11, p = 0.0026) and myxopapillary ependymomas (HR 8.01, 95% CI 1.44-44.34, p = 0.017). Furthermore, patients who underwent radical or subtotal resection were more likely to have tumor progression than those who underwent complete resection (HR 3.46, 95% CI 1.23-9.73, p = 0.018). Multivariate analysis revealed that tumor pathology was the only significant predictor of tumor progression. On univariate analysis, the most significant predictors of an “optimal” outcome on the Frankel scale were age (OR 0.94, 95% CI 0.89-0.98, p = 0.0062), preoperative Frankel grade (OR 4.84, 95% CI 1.33-17.63, p = 0.017), McCormick scale (OR 0.22, 95% CI 0.084-0.57, p = 0.0018), and region of spinal cord (cervical vs conus: OR 0.067, 95% CI 0.012-0.38,

p = 0.0023; and thoracic vs conus: OR 0.015: 95% CI 0.001-0.20, p = 0.0013). Age, tumor pathology, and region were also important predictors of 1-year McCormick scores. CONCLUSIONS Extent of tumor resection and histopathology are significant predictors of progression-free survival following resection of ISCTs. Important predictors of functional outcomes include tumor histology, region of spinal cord in which the tumor is present, age, and preoperative functional status [2].

**2016**

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Case records of 37 patients with low-grade intramedullary spinal cord tumors (IMSCTs) were identified, with a mean follow-up duration of 12.3 ± 1.4 years (range 0.5-37.2 years). Low grade astrocytomas were the most prevalent histological subtype (n = 22, 59%). Gross total resection (GTR) was achieved in 38% of patients (n = 14). Fusion surgery was required in 62% of patients with pre- or postoperative deformity (10 of 16). On presentation, functional improvement was observed in 87% and 46% of patients in McCormick scale I and II, respectively, and in 100%, 100%, and 75% in Grades III, IV, and V, respectively. Kaplan-Meier PFS rates were 63% at 5 years, 57% at 10 years, and 44% at 20 years. OS rates were 92% at 5 years, 80% at 10 years, and 65% at 20 years. On multivariate analysis, shunt placement (hazard ratio [HR] 0.33, p = 0.01) correlated with disease progression. There was a trend toward improved 5-year PFS in patients who received adjuvant chemotherapy and radiation therapy (RT; 55%) compared with those who did not (36%). Patients who underwent subtotal resection (STR) were most likely to undergo adjuvant therapy (HR 7.86, p = 0.02).

This extended follow-up duration in patients with low-grade IMSCTs beyond the first decade indicates favorable long-term OS up to 65% at 20 years. GTR improved PFS and was well tolerated with sustained functional improvement in the majority of patients. Adjuvant chemotherapy and RT improved PFS in patients who underwent STR. These results emphasize the role of resection as the primary treatment approach, with adjuvant therapy reserved for patients at risk for disease progression and those with residual tumor burden [4].

**2015**

A retrospective review of 102 consecutive patients with intramedullary spinal cord tumors treated at a single institution between January 1998 and March 2009.

Ependymomas were the most common tumors with 55 (53.9%), followed by 21 astrocytomas (20.6%), 12 hemangioblastomas (11.8%), and 14 miscellaneous tumors (13.7%). Gross total resection was achieved in 50 ependymomas (90.9%), 3 astrocytomas (14.3%), 11 hemangioblastomas (91.7%), and 12 miscellaneous tumors (85.7%). At a mean follow-up of 41.8 months (range, 1-132 months), they observed recurrences in 4 ependymoma cases (7.3%), 10 astrocytoma cases (47.6%), 1 miscellaneous tumor case (7.1%), and no recurrence in hemangioblastoma cases. When analyzed by tumor location, there was no difference in neurological outcomes (P = .66). At the time of their last follow-up visit, 11 patients (20%) with an ependymoma improved, 38 (69%) remained the same, and 6 (10.9%) worsened. In patients with an astrocytoma, 1 (4.8%) improved, 10 (47.6%) remained the same, and 10 (47.6%) worsened. One patient (8.3%) with a hemangioblastoma improved and 11 (91.7%) remained the same. No patient with a hemangioblastoma worsened. In the miscellaneous tumor group, 2 (14.3%) improved, 10 (71.4%) remained the same, and 2 (14.3%) worsened. Preoperative neurological status (P = .02), tumor histology (P = .005), and extent of resection (P < .0001) were all predictive of functional neurological outcomes.

Tumor histology is the most important predictor of neurological outcome after surgical resection because it predicts resectability and recurrence [5)].

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53 patients (23 women and 30 men; mean age 46.3 years) were included who had undergone microsurgical resection for intramedullary spinal tumors. Schebesch et al., reviewed the patient records for tumor size, edema, intratumoral hemorrhage, consistency, midline detection, resection method, extent of resection, histopathology, and recurrence. Outcome was measured by the Karnofsky Score (KPI), the McCormick score (MCS), and the Medical Research Council Neurological Performance Score (MRC-NPS).

The most frequent diagnosis was ependymoma (37.7%), lymphoma (13.2%) and astrocytoma (11.3%). The majority of tumors were located in the thoracic spine (62.2%). Gross total resection was achieved in 73.6% and most successful in patients with ependymal histology ($p<0.01$). Tumor recurrence - observed in 11.3% - was significantly associated with age >65 years, astrocytic histology, higher tumor grades, and higher Ki-67 labeling. At follow-up, MCS and MRC-NPS showed significantly better results than prior to resection ($p<0.001$), and pain and sensory deficits had improved in 67.9% and 64.2% of patients, respectively. Microsurgical resection improved the neurological status significantly. Pain and sensory deficits showed higher improvement rates than paresis and vegetative dysfunction [6)].

**2014**

A total of 70 adult cases consisting of ependymoma (39), astrocytoma (11), carcinoma metastasis (8), haemangioblastoma (5), cavernoma (3) and others (4) were reviewed. Mean age was 46.8 years (range, 18-79 years), and mean follow-up was 4.5 years (range, 1-195 months). The proportion of localisation in descending order was thoracic (36%), cervical (33%), cervicothoracic (19%) and conus region (13%), with 45 gross total resections, 22 partial resections and three biopsies. Surgery-related

morbidity with worsening postoperative symptoms occurred immediately in 13 patients (18.6%). The preoperative McCormick grade correlated significantly with the early postoperative grade and the grade at follow-up (χ2-test; p=0.001). None of the patients with preserved intraoperative evoked potentials exhibited significant postoperative deterioration. The degree of resection was correlated with progression-free survival (Duncan test; p=0.05). Most patients with malignant tumours, namely anaplastic ependymoma (3), astrocytoma (2) or metastatic lesions (5), underwent postoperative radiation therapy. Six patients (one anaplastic ependymoma, two anaplastic astrocytomas and three metastatic lesions) received postoperative chemotherapy.

IMSCTs should be operated on when symptoms are mild. They recommend evoked potential-guided microsurgical total resection of ependymomas and other benign lesions; partial resection or biopsy followed by adjuvant therapy should be confined to patients with high-grade astrocytomas, whereas resection or biopsy with adjuvant therapy is the best option for metastatic lesions [7].

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A total of 55 patients (30 male and 25 female. The mean duration of follow-up (± SEM) was 11.4 ± 1.3 years (median 9.3 years, range 0.2-37.2 years). Astrocytomas were the most common tumor subtype (29 tumors [53%]). Gross-total resection (GTR) was achieved in 21 (38%) of the 55 patients. At the most recent follow-up, 30 patients (55%) showed neurological improvement, 17 (31%) showed neurological decline, and 8 (15%) remained neurologically stable. Patients presenting with McCormick scale I were more likely to show functional improvement by final follow-up (p = 0.01) than patients who presented with Grades II-V. Kaplan-Meier actuarial tumor progression-free survival rates at 5, 10, and 20 years were 61%, 54%, and 44%, respectively; the overall survival rates were 85% at 5 years, 74% at 10 years, and 64% at 20 years. On multivariate analysis, GTR (p = 0.04) and tumor histological grade (p = 0.02) were predictive of long-term survival; GTR was also associated with improved 5-year progression-free survival (p = 0.01).

The prognosis for pediatric IMSCTs is favorable with sustained functional improvement expected in a significant proportion of patients on long-term follow-up. Long-term survival at 10 years (75%) and 20 years (64%) is associated with aggressive resection. Gross-total resection was also associated with improved 5-year progression-free survival (86%). Hence, the treatment benefits of GTR are sustained on extended follow-up [8].

In a small cohort of children who had undergone surgery for IMSCTs with a mean follow-up of 4.2 years, quality of life scores according to the PedsQL 4.0 instrument were not different from those in a normal sample population [9].

**2005**

From December 1972 to June 2003, 202 patients underwent removal of intramedullary tumors. Lesions were located in the cervical spinal cord in 61 patients (30%), at a dorsal site in 60 (29%), at a cervicodorsal site in 51 (25%), and in the medullary cone in 30 (15%). The most frequent histological tumor types were astrocytomas (86 patients, 42%) and ependymomas (68 patients, 34%).

Of the 68 ependymomas, 55 (81%) were completely removed and 13 (19%) incompletely removed. In 66% of the patients (42 patients), the presenting signs and symptoms remained unchanged at long-term follow-up; in 25% (16 patients), they improved; and in 9% (6 patients), the clinical status worsened. Of the 27 Grade I astrocytomas, 22 (81%) were completely removed and 5 (19%) incompletely removed. Functional assessment of the 23 patients available at “late” follow-up showed

that 26% (6 of 23 patients) had improved, 9% (2 of 23 patients) had worsened, and 66% (15 of 23 patients) remained unchanged from preoperative status. Conversely, of the 41 Grade II astrocytomas, only 5 (12%) were completely removed, and 10% had improved. None of the 18 Grade III to IV astrocytomas could be completely removed. In 61% (11 of 18 patients), the postoperative functional status worsened.

Determinant predictors of a good outcome after surgery for intramedullary spinal cord tumors are histological type of lesion, complete removal of the lesion, and a satisfactory neurological status before surgery [10].

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