Spinal cord ependymoma case series

Shi et al. analyzed adult and pediatric patients with newly diagnosed or recurrent intracranial ependymoma or spinal ependymomas treated with SRS in Stanford. Following SRS, local failure (LF) was defined as failure within or adjacent to the SRS target volume, while distant failure (DF) was defined as failure outside of the SRS target volume. Time to LF and DF was analyzed using competing risk analysis with death as a competing risk. Overall survival (OS) was calculated from the date of first SRS to the date of death or censored at the date of last follow-up using the Kaplan-Meier method.

Twenty-one patients underwent SRS to 40 intracranial (n = 30) or spinal (n = 10) ependymoma lesions between 2007 and 2018, most commonly with 18 or 20 Gy in 1 fraction. Median follow-up for all patients after first SRS treatment was 54 months (range 2-157). The 1-year, 2-year, and 5-year rates of survival among patients with initial intracranial ependymoma were 86, 74, and 52%, respectively. The 2-year cumulative incidences of LF and DF after SRS among intracranial ependymoma patients were 25% (95% CI 11-43) and 42% (95% CI 22-60), respectively. No spinal ependymoma patient experienced LF, DF, or death within 2 years of SRS. Three patients had adverse radiation effects.

SRS is a viable treatment option for intracranial ependymoma and spinal ependymoma with excellent local control and acceptable toxicity [1].

Ryu et al., compiled spinal ependymoma cases diagnosed between 1973 and 2014 from the Surveillance, Epidemiology, and End Results (SEER) registry. To identify the factors influencing survival, statistical analyses were performed using the Kaplan-Meier method and Cox proportional hazards regression model. In addition, we implemented machine learning algorithms to predict the OS of spinal ependymoma patients.

In the multivariate analysis model, age ≥ 65 years, histological subtype, extraneural metastasis, multiple lesions, surgery, radiation therapy, and gross total resection (GTR) were found to be independent predictors for OS. Our ML model achieved an area under the receiver operating characteristic curve (AUC) of 0.74 (95% confidence interval [CI], 0.72-0.75) for predicting a 5-year OS of spinal ependymoma and an AUC of 0.81 (95% CI, 0.80-0.83) for predicting a 10-year OS. The stepwise logistic regression model showed poorer performance by an AUC of 0.71 (95% CI, 0.70-0.72) for predicting a 5-year OS and an AUC of 0.75 (95% CI, 0.73-0.77) for predicting a 10-year OS.

With SEER data, they reaffirmed that therapeutic factors, such as surgery and GTR, were associated with improved OS. Compared with statistical methods, ML techniques showed satisfactory results in predicting OS although the dataset was heterogeneous and complex with numerous missing values [2].

Moreno et al. studied 14 patients undergoing 5-ALA fluorescence guided surgery for spinal cord ependymomas in the Department of Neurosurgery, University Hospital Complex of Badajoz.

The Modified McCormick scale was used to determine clinical status and the degree of resection was assessed with magnetic resonance imaging.

Of the 14 patients, the tumor showed an intense emission of fluorescence in 12 and the fluorescence

was weak and nonuniform in two. Complete resection was achieved in 11 cases. According to the McCormick classification, 10 patients improved, two remained the same, and two deteriorated.

The results confirm that 5-ALA fluorescence-guided resection is useful in spinal cord ependymoma resection. Although the rate of complete resections is similar to that in published series without 5-ALA, clinical results are better when using 5-ALA with a lower percentage of clinical deterioration [3)].

2017

29 consecutive patients (women - 8, men - 21; mean age - 38 years; range: 18-72) operated for IE were retrospectively analyzed. Mean follow-up was 9 years. Eighteen tumors (62%) were located in the cervical or cervicothoracic spine, and average tumor length was four spinal levels. Twenty patients (69%) presented with neurological deficit.

Gross total resections (GTRs) comprised 87% of cases, subtotal resections (STRs) 10%, and partial resections 3%. The neurological outcome on postoperative day 1 was as follows: modified McCormick scale (mMS) grade I - 6%, grade II - 21%, grade III - 21%, grade IV - 31%, and grade V - 21%; at follow-up, outcomes were mMS grade I - 42%, grade II - 34%, grade III - 10%, and grade V - 14% of patients. Compared to the preoperative period, 69% of patients deteriorated postoperatively; however, 62% improved or remained without deficit in follow-up, and deterioration persisted in 24%. The functional results were significantly worse when the intraoperative monitoring potentials dropped below 50% ($p=0.005$) and if the tumor involved >3 spinal levels ($p=0.039$). Fourteen postoperative complications in 10 patients (34%) included respiratory failure (14%), pneumonia (7%), urinary infection (10%), bed sores (10%), and CSF leak (7%). Two tumors progressed after STR, with progression-free survival times of 5 and 14 years. No recurrence was observed after GTR.

Total tumor resection is the treatment of choice in cases of IEs: no tumor re-growth occurred after total resection, 86% of patients were independent at follow-up, and the 10-year survival rate was 79% [4)].

2016

Seventeen patients were identified: 16 grade II and one grade 3. GTR was 94.12%. Factors that correlated with a decline in MCC were longitudinal extension of the tumour ($p = 0.0238$) and presentation with motor signs and symptoms ($p = 0.0223$). There was no statistical difference between preoperative factors that influence post-operative outcomes in the current study when compared with other published series. There was no statistical difference between preoperative and postoperative MCC scores between our series and other published series.

The current series with a GTR of 94.12% compares favourably with other published series with GTRs of 55.8-84% with no significant difference in functional outcomes. Series with low GTRs should examine their operative strategy or false-positive alarm rates which may lead to higher STRs. This series should be viewed as a unique opportunity to benchmark GTRs of circumscribed intramedullary tumours [5)].

Keil et al., assessed the outcome of 61 consecutive cases of spinal ependymoma in a single centre

over a 20year period using a variety of outcome measures. Sex distribution was equal, with a mean age at surgery of 43.6years (range 5-76years). Overall, most tumours occurred in the lumbosacral region (70.5%), with fewer in the thoracic (27.9%) and cervical regions (18.0%). Myxopapillary features were seen in 41.0% of tumours, and were more common when occurring in the lumbar region (51.2%). Gross total resection was achieved in 52.5%, subtotal resection in 37.7% and biopsy alone in 9.8% of patients and 31.1% received adjuvant radiotherapy. Two-thirds of patients achieved an excellent post-operative neurological outcome (Frankel grade E). Tumour recurrence was rare. Gross total resection and good preoperative neurological condition were most strongly predictive of good outcome. Post-operative radiotherapy did not seem to confer survival benefit in this case series, even in cases of incomplete resection, leading us to question its utility for all cases of spinal cord ependymoma [6].

Farschtschi et al conducted a retrospective review of all patients with NF2 treated with bevacizumab for symptomatic ependymoma at three NF2 specialty centers. Tumor size was evaluated by linear measurements; radiographic response was defined as >20% reduction in tumor size. We also performed immunohistochemical evaluation of NF2-associated symptomatic ependymomas from five patients, including two from this clinical series.

Eight patients with NF2 and symptomatic ependymoma were treated with bevacizumab. All patients had subjective clinical improvement with bevacizumab, although only five of eight patients evaluated had radiographic response. All tumors expressed VEGF-R2. Four of five evaluated ependymomas expressed VEGF-R1; one without VEGF-R1 expression was from a patient who showed clinical but not radiographic response.

Treatment using bevacizumab improved symptoms related to NF2-associated ependymomas, often without concurrent radiographic response. This treatment effect may be related to VEGF-R1 expression in NF2-associated ependymoma [7].

2015

One hundred patients with intramedullary ependymomas underwent 102 operations. Mean age was 44 ± 15 years (range 8-74 years). Patients were followed by outpatient visits and questionnaires, with a mean follow-up of 77 ± 91 months. Short-term results were determined for individual symptoms and the McCormick Scale, whereas tumor recurrence rates were calculated with Kaplan-Meier statistics.

Compared with cervical ependymomas, those of the thoracic spine were associated with more severe motor deficits and gait problems at presentation. A total of 86.3% of patients with intramedullary ependymomas underwent gross-total resection (GTR). A low preoperative McCormick grade and first surgery were the strongest predictors for a GTR. Postoperatively, 67.6% of patients demonstrated a worse neurological state at discharge from the hospital. This deterioration was transient for 40.1% of the patients and permanent for 27.5%. In the long term, the McCormick grade remained unchanged from the preoperative grade in 74.5% of patients, while it was improved in 5.9% of patients and increased after surgery in 19.6% of patients. According to a multivariate analysis, the risk of permanent morbidity increased with a thoracic level of the ependymoma, advanced age, a long clinical history, presence of a tumor hemorrhage, and surgery on a recurrent tumor. In the long term, tumor recurrence rates correlated significantly with the amount of resection (4.2% and 18.5% in 20 years after GTR and partial resections, respectively). Postoperative neuropathic pain syndromes

affected 37.0% of patients, whereas 4% demonstrated a postoperative myelopathy related to cord tethering at the level of surgery.

Intramedullary ependymomas are tumors best treated surgically. A complete resection indicates cure for the overwhelming majority of these patients. Surgery should be performed early by neurosurgeons who deal with these lesions on a regular basis to achieve high GTR rates. Permanent surgical morbidity varies most according to tumor location and patient age [8)].

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53 adult patients over the span of 15years were analyzed for OS, PFS, and the effects of plane of dissection (POD) and gross total resection (GTR) on functional and long term outcomes. The mean age was 45 years and median follow-up was 54 months. The follow-up neurological outcome and modified McCormick scale were used to determine the functional outcome. Kaplan-Meier curves were used to calculate progression and survival. The overall ability to achieve GTR was significantly correlated to identification of an intraoperative POD ($p<0.001$). There was a trend towards increased PFS with the ability to achieve a GTR. There was no significant difference in the pre- and postoperative functional outcome scores. The ability to achieve a GTR is strongly correlated to the identification of a POD in ependymomas. There is a trend towards an increased probability of PFS in intramedullary spinal cord tumors when GTR is achieved. The resection of these tumors is likely to halt, but not reverse, neurological deterioration [9)].

2014

Between 2002 and 2012, 16 patients with regionally metastatic spinal ependymomas were diagnosed and treated. The patients were retrospectively divided into two groups according to tumor grading and histological features. Nine patients were diagnosed with myxopapillary ependymomas (MPE), and seven patients were diagnosed with other low-grade ependymomas.

With a median follow-up of 46.4 months, 13 out of 16 patients had no postsurgical recurrence/progression of the disease. In three patients, the disease recurred/progressed, leading to death in one patient. There was no correlation between gross total removal (GTR) of the main tumor, or resection of the main lesion and the metastatic foci and increased progression free survival in patients of the MPE group. There was an advantage for patients diagnosed with other low-grade ependymomas. Adjuvant radiotherapy did not prove beneficial.

Spinal ependymoma with regional metastases SERMP has a relatively benign course. Achieving GTR of both the main lesion and the metastases is preferable, but should not be achieved at any cost, especially in MPE interfering with the conus medullaris. The benefit of adjuvant radiotherapy remains unproven [10)].

1999

Thirty-six consecutive patients who underwent surgical removal of an intramedullary spinal cord ependymoma between September 1980 and June 1998 were studied retrospectively. This series includes 19 women and 17 men between the age of 12 and 67 years (mean age, 41.2 yr). The location of the tumors was cervical in 24 cases, cervicothoracic in 3 cases, thoracic in 7 cases, and

conus in 2 cases. At surgery, complete removal was achieved in 34 patients and subtotal removal was performed in the remaining 2.

There has been no tumor recurrence in any patient except one who had an anaplastic ependymoma after a mean follow-up period of 56 months. The surgery improved neurological status in 14 of the 36 patients (39%). However, five patients (14%) experienced persistent deteriorations in clinical grade caused by surgery. Four of the five patients harbored benign ependymomas in the thoracic cord and characteristically demonstrated arachnoid scarring and cord atrophy at surgery, indicating that tumors had been present for a long time.

Surgical removal of intramedullary ependymomas is beneficial to patients. However, the thoracic cord may be susceptible to surgical manipulations for intramedullary ependymomas. In addition, intraoperative findings of arachnoid scarring and cord atrophy are ominous for surgical morbidity [11].

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