Prognostic factors of surgery for cervical Epyndymomas

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Abstract:

BACKGROUND AND PURPOSE: Spinal cord tumors represent 10% to 15% of central nervous system (CNS) neoplasms. In adults, Glial tumors account for at least 80% of intramedullary tumors in most series. These tumors are predominantly astrocytomas and ependymomas; the latter are more common. Approximately 36% of tumors were located in the cervical cord. OBJECTIVE: We aimed to outline the prognostic factors that affect the final outcome of cervical cord ependymoma surgeries. PATIENTS METHODS: twenty one patients with cervical epyndymomas underwent surgery between March 2009-march 2014, 13 men and 8 women, Ages are (26-62) years with a mean age of 41 years. The neurological status before surgery, 1 month after the operation and at the most recent examination were assessed based on the grading system of McCormick outcome of the neurological status in the long term follow-up period, estimated comparing the pre-operative neurological status and the most recent status, was classified into “improved”, “unchanged”, “deteriorated” and “death”. The RESULTS: We have 61.9% of patients with total resection, 23.8% subtotal and 14.3% partial resection or biopsy. We had 9 patients Improved (42.9%) , 5 patients with no change (25.8%) , 6 patients deteriorated (28.6%) and 1 died (4.8%). We found a significant correlation between the pre-operative state and the final functional outcome, that, the better the preoperative state the better outcome. There is statistically relevant correlation between the recurrence and the degree of resection. CONCLUSIONS: The spinal cord tumors can be treated safely and effectively by surgery. Total resection must be the essential aim before surgery and must be tried whenever possible. Preoperative neurological state and degree of resection are the most important factors that affected the final outcome. Key words: cervical cord epyndymoma, prognostic factors, outcome

Introduction:

Spinal cord tumors represent 10% to 15% of central nervous system (CNS) neoplasms. These tumors are generally classified by their relationship to the dura mater and spinal cord parenchyma: within the spinal cord parenchyma (intramedullary), outside the spinal cord parenchyma (extramedullary). In adults, two thirds of these tumors are extramedullary and the remaining third are intramedullary. Tumors of the spinal cord encompass a wide variety of histologic types, and their optimal management depends on accurate identification of the pathologic process. Approximately 36% of tumors were located in the cervical cord.

Gliarial tumors account for at least 80% of intramedullary tumors in most series. These tumors are predominantly astrocytomas and ependymomas; the latter are more common. Hemangioblastomas are the third most common type of intramedullary tumors, and the remaining include inclusion tumors and cysts, vascular abnormalities, and metastases.

Pain, weakness, and numbness are the most frequent presenting symptoms. Pain usually localizes to the level of the tumor, and the distribution of the numbness and weakness corresponds to the location within the cord. Bowel and bladder dysfunction may also occur, but these tend to occur later.

Gadolinium-enhanced MRI is the gold standard imaging modality for preoperative evaluation of intramedullary tumors. Not only can such imaging studies help define the location of the tumor within the spinal cord and rule out the presence of multiple lesions, but the tumor’s
appearance on the MR images can give diagnostic clues. The risk of recurrence exists after the resection of any spinal cord tumor, and serial imaging and follow-up must be performed. The likelihood of tumor recurrence depends predominantly on the histology of the tumor and the completeness of the original resection. For benign ependymomas, total resection is often curative without adjuvant therapy.8

Advances in imaging, surgical technique, and intraoperative sensory and motor electrophysiologic monitoring have steadily improved the safety and efficacy of surgery. Most intramedullary tumors are low-grade neoplasms, and most authors agree that surgery now represents the most effective treatment for these benign, well-circumscribed tumors.8

**Patients and methods:**

Twenty one patients with cervical spinal cord ependymomas underwent surgery at the Departments of Neurosurgery, Benha University Medical School, Nasser Institute for research and treatment in Egypt and EGE university medical school –Izmir, Turkey between march 2009-march 2014. There were 13 men and 8 women, age ranged from 26-62 years with a mean age of 41 years.

**Clinical Classification:**

Magnetic resonance imaging (MRI) with gadolinium contrast enhancement was performed as standard radiological investigation before and after surgical treatment. For extra-medullary lesion, signal abnormalities, cerebrospinal fluid capping, and spinal cord displacement identify most extramedullary masses. Gadolinium enhancement markedly increased the sensitivity of magnetic resonance imaging, particularly for small tumors.

**Pathological classification:**

We adopted the pathological classification of WHO regarding pathological types and the 4 tiered classification suggested by Kernohan and Fletcher as a basis to classify the tumors according to their grade of differentiation.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
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</thead>
</table>
| I     | Neurologically normal  
Gait normal  
Normal professional activity |
| II    | Tired after walking several kilometers  
Running is impossible, or moderate sensorimotor deficit does not significantly affect the involved limb  
Moderate discomfort in professional activity |
| III   | Presence of sensorimotor deficit affecting function of involved limb  
Mild to moderate gait difficulty  
Severe pain or dysesthetic syndrome impairs quality of life  
Independent function and ambulation maintained |
| IV    | More severe neurological deficit  
Requires cane and/ or brace for ambulation or maintains significant bilateral upper-extremity impairment  
May or may not function independently |
|       | Severe neurological deficit  
Requires wheelchair or cane and/ or brace with bilateral upper-extremity impairment  
Usually not independent |

The neurological status before surgery, 1 month after the operation and at the most recent examination were assessed based on the grading system of McCormick (figure 1 ). The follow-up periods ranged from 6 months to 38 months with a mean of 12 months, and their neurological status after surgery was assessed and compared to the preoperative status.

**Outcome**

We divided this topic into **surgical outcome** in the form of degree of resection and approach used, and **functional outcome** manifested as the postoperative neurological state measured by McCormick scale and put as follows:

Outcome of the neurological status in the long term follow-up period, estimated comparing the pre-operative neurological status and the most
recent status, was classified into "improved", "unchanged", "deteriorated" and "death".

The extent of tumor resection was evaluated by categorizing into the following 3 grades: total resection, subtotal resection, partial resection or biopsy.

We used the standard definition of **total resection**: removal of 100% of the tumor as evidenced by a microscopically documented clean surgical field at the end of the procedure. When a small tumor fragment was intentionally left in place, the procedure was considered to be a **subtotal resection**. We performed subtotal resection in this series when intraoperative evoked potential monitoring changes heralded impending neurological paralysis. In the same manner, we defined 50–80% resection as **partial resection** and < 50% resection was defined as a **biopsy**.

With cases that operated in EGE University, Izmir, Turkey, intraoperative neurophysiologic monitoring was used. The stimulations are repeatable at a rate of 0.5—2 Hz. This provides practically real-time feedback. A decrease of more than 50% of the baseline amplitude is forced us to stop. We made it a rule to suspend surgery when the waveform becomes aggravated, and we continue when the waveform has improved, but abandon the resection when the waveform becomes multiphasic again or is lost.

### Surgical Technique

The primary goal of surgery was to achieve complete tumor removal and to avoid additional neurological damage. Different surgical techniques were used depending on the tumors’ localization and extension. Generally, osteoplastic laminotomy was the surgical approach of choice, especially for long span lesions. However, in earlier cases and in regions considered biomechanically as stable (cervico-thoracic region) also laminectomy was performed with duraplasty, if necessary.

Just before the Myelotomy, 250 mg of methyl prednisilone was administered intravenously for 10 minutes to decrease spinal cord edema. The myelotomy was advanced deeper until it reached the surface of the tumour. Keeping the plane along the lateral surface of the tumour, the dissection was carried out in a parallel direction. Internal decompression of the tumour was performed. Feeding vessels and arachnoid adhesion were cauterized and divided close to the tumour. In those lesions, which infiltrated normal tissues, the Cavitron ultrasonic surgical aspirator was used to achieve internal decompression.

When the waveform worsened during the procedure (multiple-phase waveform or loss of wave) the manipulation of the spinal cord tumor was suspended and resumed after recovery of the waveform.

After tumor resection, intraoperative ultrasonography was used (in some cases) to confirm whether any residual tumor was present.

### Results

The age range is from 26-62 years with mean age of patients is 41 years with a standard deviation of 9.3 years. There were 13 male and 8 female patients with a percentage of 61.9 and 38.1 respectively. The most common presenting symptoms were motor symptoms in the form of Monoparesis, Paraparesis or Quadriaparesis in (14) patients (66.6%). The second most common were sensory symptoms including pain and paresthesia (brachialgia and neck pain) in 7 patient (33.3%) , the third is sensory loss including lost deep sensations and posterior column symptoms as gait disturbance and instability (7 patients 33%) table 1.

There were 14 total laminectomies, 2 laminotomy or hemilaminectomy, 5 laminoplasties table 2.

In the 21 cases there were 8 events that considered complications. The rate was 38.1%. We had 4 records of recurrence with overall rate (19%).

We divided the post operative outcome into: Improved, No change, Deteriorated and Dead.
We had 9 patients Improved (42.9%), 5 patients with no change (23.8%), 6 patients deteriorated (28.6%) and 1 died (4.8%). Our study plan was to find any correlation between many factors and outcome, each factor studied separately (table 4).

Table (1) Preoperative Variables of the studied patients

<table>
<thead>
<tr>
<th>Variables</th>
<th>(N=21)</th>
<th>% (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complaint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monoparesis</td>
<td>7</td>
<td>33.3</td>
</tr>
<tr>
<td>Hemiparesis / pararesis</td>
<td>1</td>
<td>4.8</td>
</tr>
<tr>
<td>Sensory dist.</td>
<td>7</td>
<td>33.3</td>
</tr>
<tr>
<td>Quadriparesis</td>
<td>6</td>
<td>28.6</td>
</tr>
<tr>
<td>Duration of complaint</td>
<td>Mean ± SD, median, range 23.6±34.9, 12, 1-120</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>No</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>5</td>
</tr>
<tr>
<td>Spasticity</td>
<td>No</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>8</td>
</tr>
<tr>
<td>Mc Cormic</td>
<td>Grade 1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Grade 2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Grade 3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grade 4</td>
<td>0</td>
</tr>
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</table>

Table (2) Intraoperative Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>No. (N=21)</th>
<th>% (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative monitor</td>
<td>No</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>10</td>
</tr>
<tr>
<td>Approach</td>
<td>Total laminectomy</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Hemilaminectomy or laminotomy</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Laminoplasty</td>
<td>5</td>
</tr>
<tr>
<td>Infiltration</td>
<td>No</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>9</td>
</tr>
<tr>
<td>Resection degree</td>
<td>Total</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Subtotal / biopsies</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Near total</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Median</td>
</tr>
</tbody>
</table>

Table (3) Post-operative variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>No. (N=21)</th>
<th>% (100%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative outcome</td>
<td>No change</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Improved</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Deteriorated</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Died</td>
<td>1</td>
</tr>
<tr>
<td>Post operative Mc - Cormic</td>
<td>Grade 1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Grade 2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Grade 3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grade 4</td>
<td>0</td>
</tr>
<tr>
<td>Complications</td>
<td>No</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>8</td>
</tr>
<tr>
<td>Recurrence</td>
<td>No</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>4</td>
</tr>
<tr>
<td>Need of radiotherapy</td>
<td>No</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>yes</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Median</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>11.5±9.4</td>
<td>8</td>
</tr>
<tr>
<td>Follow up period (months)</td>
<td>15.2±10.8</td>
<td>12</td>
</tr>
</tbody>
</table>

We studied the correlation between the outcome and many factors that may play a role to affect it. We did not find any significance (our p values were 0.37 and 0.48 for age and sex respectively) or correlation between age of presentation or the Gender and final outcome of the patients.

We found a significant correlation between the pre-operative state and the final functional outcome, that, the better the preoperative state the better outcome, as most of patients presented with Gr I and II improved in the immediate post operative time and on follow up, (P = 0.012).

The next factors studied was the usage of intraoperative monitoring the results were not
significant because we found that the percentage of improved cases were nearly similar between the 2 groups (1 of 3 cases 33.3% in the non monitored group and 10 of 18 (44.2%) cases improved in the monitored group. The different approaches did not alter the final outcome of the patients.

We have 62% of patients with total resection, 23.8% Sub total and 14.3% partial resection or biopsy. We found a statistic significance for the correlation between degree of resection and final outcome (P=0.036).

![Figure 1: Preoperative MRI of a patient with Ependymoma](image1)

![Figure 2: Postoperative MRI of a the same patient](image2)

In the 21 cases there were 8 events that considered complications. We studied the relation between complications and other factors and found no correlation with preoperative state, the usage of intraoperative monitoring, the utilized approach, the degree of resection and the development of complications. The only significant variable was the infiltration of the lesion to the surrounding spinal cord tissue (P=0.024).

We had 4 records of recurrence with overall rate (19%). We found a statistically relevant correlation between the recurrence and the degree of resection (P= 0.014), in all cases with total resection cases we had only no recurrences while in partial resection group we had 1 of 3 cases recurred within the follow up period. But we couldn't find any correlation between the type of pathology and the rate of recurrence.
Discussion:

Kelkamp and samii reported in their big series that the majority of patients presented a slowly progressive course which started with pain or dysesthesias in 50% of patients. Twenty-two percent noticed gait problems as the first symptom, 16% motor weakness, and 12% sphincter disturbances or sensory deficits.\(^{17}\) Joaquim \textit{et al} reported also that 8 out of his 12 patients 67% had painful dysthesia and the second presenting symptom was long tract symptoms as weakness and lost deep sensory control in 6 of 12 patients 50%.\(^{12}\) While segal \textit{et al} mentioned in their series that the most common presenting symptoms were neurological disturbances (43.5%, \(n = 44\)), back pain (37.6%, \(n = 38\)), and a combination of both (18.8%, \(n = 19\)). 2% (3 patients) suffered from other symptoms as well.\(^{15}\)

For many patients we tried to minimize the amount of bone loss for the issue of post operative instability and curve problems in the cervical vertebrae. Choice of approach based on location of the lesion within the spinal canal weather central or peripheral and the extent of the lesion which may require minimally invasive approaches as laminotomy or hemilaminectomy.

Joaquim \textit{et al}. in most of their patients used open-door laminoplasty exposing one level above and one below the lesion. In spite of that he had 2 patients developed post op kyphosis, which required fusion.\(^{12}\) Nakamura \textit{et al} performed laminoplasty for his all cervical patients (30 patients), as he feels that it will avoid post operative kyphosis and he did not encounter any post operative curve problems.\(^{23}\) Yeo \textit{et al} concluded that unilateral hemilaminectomy combined with microsurgical technique provides sufficient room for the removal of spinal cord tumors. They recommend unilateral hemilaminectomy as a suitable surgical option for the removal of tumors in the spinal canal.\(^{41}\)

In 2006 and 2007, Sala \textit{et al}. by two consecutive works used SSEPs and MEPs, setting the critical point of SSEPs to a 50% reduction of the amplitude or setting an alarm point of MEPs to loss of the waveform; surgery was continued when the D-wave did not decrease over 50% and abandoned when the D-wave decreased by more than 50% with loss of MEP.\(^{29,30}\) Also In 2007 Kothbauer and colleagues\(^{14-16}\) also reported setting the critical point to loss of MEP waveform and a 50% reduction of the D-wave.\(^{15}\)

Sutter \textit{et al} concluded that the multimodal intraoperative monitoring during surgery of the spinal cord tumor proved to be a valid and reliable method to contribute to the improvement of the surgical results allowing gross tumor resections.\(^{38}\)

Sandalicioglu \textit{et al} reported that, In 16 of 30 patients with ependymomas, the Postoperative functional state was unchanged compared to the preoperative condition, and in 11 patients the functional grade deteriorated by one grade. While in his patients with Astrocytomas, In eight of 12 patients (67%) the post-operative state was unchanged compared to the preoperative state, whereas in four patients, the functional state deteriorated by one grade. These results are comparable to ours regarding both tumor types.\(^{34}\)

In all of their 20 patients with Anaplastic ependymomas Liu \textit{et al} reported that Immediately after surgery, 12 patients (60%) had unchanged neurological function; the condition of 8 patients deteriorated, but 3 of these 8 patients (15%) experienced only transient deterioration and later recovered to the preoperative status in follow-up.\(^{19}\) Ohata \textit{et al} presented a study with 18 cases, the final outcome was improved in 1 case, unchanged in 15 cases and deteriorated in 2 cases.\(^{26}\) Others have better results like Nakamura and colleagues as they reported that, functional improvement was obtained in 16 of 33 ependymoma cases (48.5 %) with total tumor resection, and The functional outcomes were poorer in the astrocytoma cases than in the ependymoma cases, and improvement of paralysis was found only in three of the 23 astrocytoma cases.\(^{23}\) In Extramedullary tumors the situation is different with all authors the results were marvelous.

Although we also demonstrated those with grade III and IV tumors to have a poorer prognosis, this was not statistically significant, because of the small number of patients we failed to analyze these grades alone.

Nambiar \textit{et al} concluded that Outcomes are influenced by pre-morbid, pre-operative and post-operative clinical grades, extent of resection, tumour grade and location with respect to the spinal parenchyma. Other significant predictors of good neurological outcome included low tumour grade (\(p = 0.004\)) and extramedullary tumour location (\(p = 0.003\)).\(^{24}\)
Sandalicioğlu wrote that surprisingly, patients with low-grade neuroepithelial tumors and tumor extension of more than three spinal segments showed a good functional outcome only in 52\%.

This observation can be explained by the fact that tumors extending by more than three segments were mostly ependymomas, and as mentioned above, characterized by a clearer-defined plane of dissection compared to astrocytomas.

Our results denote that the better the preoperative state the better outcome as most of patients presented by Gr I and Gr. II showed improvement in the immediate post operative time and on follow up, and the statistical values was of significance ($P = 0.005$). In this topic there is a universal agreement in the literature about the importance of the pre operative state that determines the outcome.

Joaquim et al. presented their work with 12 patients, 8 of them were graded as Gr 2 with 67\%. 6 of 12 patients improved on the follow up period 50\% which is comparable to our results if we included only ependymomas to compare with their work our results will be around 37\%. Ohata et al. also used McCormick scale as a measuring tool to assess the pre and post operative state for the purpose of evaluation and outcome assessment in his 18 patients, and by means of this assessment found results showed that the most important factor determining the long-term functional prognosis is the pre-operative functional status, indicating that surgery must be carried out at an early stage of the disease or at the time of diagnosis.

Balooshi and colleagues from KSA used McCormick scale for 17 patients and concluded that post operative outcome is strongly correlated with preoperative state with significant value. In 1999 Kane et al. reported that the gait status was aggravated and unchanged in 6 (12\%) and 45 (82\%) of 54 patients with intramedullary tumors.

Quigley presented patients with a good preoperative Frankel grade tended to maintain functional status post-operatively though this did not reach statistical significance ($P = 0.090$). But their results were comparable to ours, 88\% were ambulant pre-operatively, and 12\% were non-ambulant. Following treatment, 78\% of their patients who were ambulant pre-operatively, maintained or improved their functional status.

Sandalicioğlu et al. reported that the outcome was aggravated in 27 (34.6\%) and unchanged in 51 (65\%) of 78 cases of intramedullary tumor. McCormick et al. reported that long follow-up evaluation revealed an improvement in clinical grade in 8 patients, no significant change in 12 patients, and deterioration in 3 patients. Epstein et al. reported that during the long follow-up periods, clinical deterioration was observed in 1 of 18 functional grade 1 patients, 4 of 11 grade 2 patients, 4 of 8 grade 3 patients. He concluded that the morbidity of surgery was directly related to the pre-operative neurological condition.

Xu et al. mentioned that, neurologic improvement after surgery is more likely in patients undergoing total resection than partial resection. Jallo et al. reported In their series, the extent of resection gross total (>95\%) or subtotal resection (80-95\%) did not significantly affect the long-term outcome. Only patients who underwent a partial resection (<80\%) fared significantly worse than those with radically removed tumors.

McCormick et al. reported that complete removal was achieved in all of 23 patients and no recurrence was observed during the mean follow-up periods of 62 months. Long follow-up evaluation revealed an improvement in clinical grade in 8 patients, no significant change in 12 patients, and deterioration in 3 patients.

In the series of Epstein et al., total removal was achieved in 37 of 38 intramedullary spinal cord Ependymomas. During the long follow-up periods, clinical deterioration was observed in 1 of 18 functional grade 1 patients, 4 of 11 grade 2 patients, 4 of 8 grade 3 patients.

We compared the percentage of total resection in some series. Total resection rates vary from 58 to 100\% of the cases, in different series.

<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>Total resection</th>
<th>Partial resection</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCormick et al., 1990</td>
<td>23</td>
<td>22 (96%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Yoshii et al., 1999</td>
<td>8</td>
<td>6 (75%)</td>
<td>2 (25%)</td>
</tr>
<tr>
<td>Asazuma et al., 1999</td>
<td>26</td>
<td>15 (58%)</td>
<td>15 (58%)</td>
</tr>
<tr>
<td>Epstein et al., 1993</td>
<td>38</td>
<td>37 (97%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>Hanbali et al., 2002</td>
<td>26</td>
<td>23 (88%)</td>
<td>3 (12%)</td>
</tr>
</tbody>
</table>
Electrophysiological monitoring used in 18 cases and not used in 3 cases, in the monitored cases 8 cases improved in postoperative neurological state (44.4%) and the other 10 cases were either deteriorated or not changed, on the other hand in the non monitored cases 1 of 3 improved (33.3%) and 2 deteriorated or not changed from the preoperative state. We failed to find a statistically significant correlation between usage of monitoring and final outcome of the patient, at the same time we cannot deny that presence of EPM gave us a sense of safety during the operations ensuring that no waves were lost during any of our surgeries but it couldn’t reach the statistically significant levels.

Kothbauer et al reported that monitoring is a predictive of functional motor outcome for intrinsic spinal cord tumor surgery. Jallo et al reported that the intraoperative monitoring has significantly improved the safety of complete resection of intramedullary neoplasms. In particular, the electrophysiological monitoring of motor pathways is extremely helpful to achieve a radical resection for these intramedullary tumors. Kelleher et al recommended intraoperative monitoring in all operations with neurological risk despite the low incidence of neurological complications. He also mentioned that, a limitation of neurophysiological monitoring is the inherent inability to accurately record data from the spinal cord with severe preoperative dysfunction seen in patients with myelopathy, trauma, or intramedullary tumors. This limitation in our opinion is the factor that may prevent the use of Neurophysiological monitoring to reach the threshold to be statistically evident. Another factor is lack of prospective comparative studies that may analyze usage versus non usage of Monitoring due to ethical issues and legal regulations.

Nagasawa et al agreed with us in that, the presence of neurological deficits and deterioration is not uncommon complications associated with spinal cord surgery. Such complications may be particularly incapacitating and slow the patient’s progress toward rehabilitation, he added that such complications are believed to result from a disruption of adjacent microvasculature and edema caused by surgical manipulation of surrounding tissue.

Yanni et al reported that, occasionally, resection may become complicated by cord edema, arachnoid fibrosis, or capillary neovascularization, resulting in cord rotation, asymmetrical enlargement.

Lu et al mentioned that Postoperative kyphosis is of particular concern for tumors of the cervical and lumbar spine, as these regions lack a rib cage that can function as an internal brace providing biomechanical support for the thoracic levels.

Joaquim et al reported that Cervical kyphosis was observed in two cases (both on cervico-thoracic junction with more than 3 level laminoplasty), that required posterior instrumentation and fusion, but with no additional neurological deterioration.

In the series by Karikari et al, the patients with ependymomas, the more common and less aggressive tumor, had a tumor recurrence rate of 7%. Patients with astrocytoma, the more aggressive and less common tumor type, had a recurrence rate of 48%. McCormick et al reported that complete removal was achieved in all of 23 patients and no recurrence was observed during the mean follow-up periods of 62 months.

Kucia et al reported three recurrences 4.5% followed definitive treatment (average time to, 3.9 years; range, 2.2 to 5.6 years). 2 of these patients underwent GTR at presentation. 1 patient had a recurrence at the original site; the other had a recurrence above the original site. Both underwent GTR at the time of recurrence. Nambiar et al and Jenkinson et al have nearly the same overall recurrence rate 11.0% and 10.4% respectively which is near to ours.

We found a statistically relevant correlation between the recurrence and the degree of resection (P= 0.014), in all cases with total resection cases we had no recurrences while in subtotal or partial resection group we had 4 of 8 cases recurred within the follow up period, this is coincidental with most of the results in the literature.

We couldn’t find any correlation between recurrence and Intraoperative monitoring or the approach used, when reviewing the literature we did not find (up to our knowledge) specific works that could find a direct relation between recurrence and intra-operative monitoring, but you can take an indirect impression from our discussion about IOM and its relation to resectability and final outcome.
Conclusions:

The spinal cord tumors can be treated safely and effectively by surgery as a main method with or without any adjuvant method in the form of radiotherapy or chemotherapy.

Total resection must be the essential aim before surgery and must be tried whenever possible. The surgery must be carried out at the time of the diagnosis, as the pre-operative and postoperative neurological conditions are closely related.

Preoperative neurological state and degree of resection are the most important factors that affected the final outcome of our patients

The most important predicting factor for postoperative outcome is the preoperative neurological condition. This observation suggests that operative treatment should be performed in an early stage of the disease.

Age, sex, primary complaint, approach used and neuromonitoring did not appear significantly enough to affect the final outcome of patients as appears from the statistical analysis

Intraoperative neurophysiology of the spinal cord has become a critical part of neurosurgery and orthopedics surgery, as well as a part of clinical neurophysiology.

Complications are encountered mainly with high grade and infiltrative masses that were hard to be removed without any post operative neurological deficit

We think that this favorable long term outcome is rather a result of radical tumor resection than of adjuvant postoperative radiation and that the crucial factor for tumor recurrence is the extent of surgical tumor resection.

Recurrence is an important issue and is directly correlated with the degree of tumor resection and infiltrative nature of the tumor. Once the tumor is removed completely, close clinical and radiological examination is necessary to detect tumor re-growth at an early stage.

References:

