Surgical treatment of spinal ependymomas: outcome in Al-Zahraa University Hospital

Gasser H. Al-Shyal, Abd-El-Fatah A. Shehab

Introduction Spinal ependymom as are rare tumors and present mainly around 40 years of age. Total resection is claimed to be the best option for the treatment, but it carries some risk and it needs good evaluation and may be some proper facilities to get satisfactory results.

Aim The aim of this study was to investigate the surgical strategies and outcomes for spinal ependymomas of different lengths and locations. We present our surgical experience in Al-Zahraa University Hospital (Al-Azhar University) for managing spinal cord ependymomas.

Patients and methods We report the results of eight patients over a 2-year period (2016–2018). All cases were managed in Al-Zahraa University Hospital. Surgery was recommended for all patients who have symptoms. Preoperative and postoperative clinical assessments were done for all cases.

Results There were six men and two women. The mean age was 36.4 years (range, 24–60 years). The follow-up period ranged from 1 month to 2 years. Gross total resection was done in six (75%) cases. Near-total resection was done in one case, and partial resection was done in one cervical case. The overall postoperative complications rate was 12%. Seven of the eight cases improved clinically. Pain improved in seven (87.5%) cases. All three cases with weakness improved within the first week of surgery or during the first 6 months (postoperative follow-up period). Sphincters improved in three out four cases that had been presented with sphincters.

Conclusion Most spinal ependymomas can be managed by gross total resection without significant morbidity. Neurological deficit occurred more in tumors that extend more than two spinal levels. Some cases have early postoperative neurological functions declination, but these cases improved during follow-up. It is better to use neurophysiological monitoring, but it is not essential for achieving good outcome.
Sci J Al-Azhar Med Fac, Girls 2019 3:372–377

The Scientific Journal of Al-Azhar Medical Faculty, Girls
2019 3:372–377

Keywords: ependymoma, filum terminal, myxopapillary, spinal tumors

Department of Neurosurgery, Faculty of medicine for girls, Al-Azhar University, Cairo, Egypt

Correspondence to Gasser H. Al-Shyal. MD, PhD, Department of Neurosurgery, Al-Azhar University, Cairo, Egypt.
e-mail: gasserhssn@yahoo.com

Received 15 April 2019 **Accepted** 15 May 2019

Introduction

Spinal ependymomas are rare tumors and present around 40 years of age [1]. They constitute ~15% of spinal cord tumors [1]. Most spinal ependymomas are intramedullary, but intradural extramedullary and extradural ependymomas are known to rarely occur as well [2].

The WHO classifies spinal ependymoma into three different grades: grade I, grade II, and grade III [2]. The WHO classified ependymomas into four distinct subtypes: subependymomas, myxopapillary ependymomas, classic ependymomas, and anaplastic ependymomas [2]. These groups are further divided into cellular (most common), papillary, clear cell, and tanycytic subtypes [3]. Tumors in the classic ependymoma group typically occur in the cervical and sometimes thoracic region, whereas those of the myxopapillary group tend to be in the conus medullaris and cauda equina [4,5]. Anaplastic ependymomas carry the worst prognosis and are extremely rare, occurring most often in the brain [6].

Spinal ependymomas may affect any age group, but they are typically found in adults and comprise the myxopapillary or classic subtypes. Myxopapillary ependymomas are generally encapsulated and reside primarily in the conus medullaris but may extend to the cauda equina. Classic ependymomas generally form in the cervical spine, but occasionally develop in the thoracic region [1].

Most ependymomas are slow growing and tend to compress the adjacent cord parenchyma rather than infiltrating it, thus creates a clear surgical plane. At the time of surgery, most spinal ependymomas are contained within well-defined margins, thus facilitate resection through natural dissection plan and excision of the tumor without injury of cord parenchyma [1].

Despite this grading system, factors affecting recurrence and progression of disease following resections are poorly understood. Whether tumor location along the spinal cord conveys any prognostic value is unknown. However, some evidence suggests that tumor location may be more important than tumor grade in determining prognosis.

For example, spinal ependymomas generally have a better prognosis than intracranial tumors [7]. Regarding location, there are two major types of spinal ependymomas: the first type is the WHO grade I myxopapillary ependymomas, which occur more often in males, primarily at the cauda equina, conus medullaris, and filum terminale [8], and the second type is the WHO grade II classic ependymomas, which occur most frequently in the cervical and thoracic spinal cord segments [9].

Spinal ependymomas can be present with symptoms that help to localize the tumor. Limb weakness is very common in patients with thoracic ependymomas. However, patients with conus ependymomas less commonly present with limb weakness, but more frequently, they present with low back pain. Neck pain is more common in tumors at cervical region. Sphincteric disturbances are present with all tumor sites of the cord but are more frequent with dorsolumbar, lumbar, conus and filum ependymomas [2].

The neurological deficit and deterioration are common after excision of spinal cord ependymomas. The preoperative clinical condition is used as a strong predictor of prognosis after surgical excision [10]. Tumors originating in the thoracic region have relatively worse prognosis owing to poor microcirculation of the cord and narrow spinal canal [11]. We present our surgical experience in Al-Zahraa University Hospital (Al-Azhar University) for managing spinal cord ependymomas.

Patients and methods

This study was carried out at Al-zahraa University Hospital, after approval from the local ethical committee, and the Department of Neurosurgery and after written informed consent was obtained from each patient. A total of 8 pateints were managed at Al- Zahraa University Hospital in 2 year interval between 2016 and 2018. Surgery was recommended for all patients who have symptoms. Preoperative and postoperative clinical assessments were done for all cases.

All tumor specimens were sent for histopathological examinations and grading. All tumors were confirmed as ependymomas. Preoperative diagnosis was done with contrast-enhanced MRI. All patients were operated in prone position, and we did not apply the strategy to keep the main arterial blood pressure above 80 mm. Tumor removal was considered near-total resection when at least 80% of the tumor was excised. Partial resection was consistent with a less than 80% resection. There are no standards for postoperative adjuvant radiotherapy at our institute.

We used the surgical microscope in all cases. If the tumor reached to the surface, we open it at this point. If it did not bulge to the surface, we used midline myelotomy without using bipolar coagulation. The midline in a normal cord is identified by the dorsal median sulcus between the elevated posterior columns, midway between the two opposing root entry zones, and also the pattern of transverse arteries and central vein on the dorsum of the cord. We widened the opening by catching the pia on both sides of the cord and separate it with fine-tipped jewel forceps. We started debulking with a tumor forceps without pulling on the tumor via crushing tumor tissue and taking the fragments out. After developing a good cleavage plane between the tumor and cord, we dissected the last rim of the tumor. Hemostasis was achieved with copious saline irrigation avoiding usage of bipolar cautery. In all cases, we did not use neurophysiological monitoring as it is unavailable in our institute. Intraoperative and postoperative prophylactic antibiotics were used routinely in our institute. All cases were examined on the same day after surgery and followed up for at least 6 months.

Results

There were six men and two women. The mean age was 36.4 years (range, 24–60 years). The follow-up period ranged from 1 month to 2 years. The patient characteristics are summarized in Table 1.

Clinical manifestations

The duration of symptoms before diagnosis ranged from 6 months to 2 years. Five cases had spinal cord ependymomas and the remaining three had filum terminal ependymomas. Pain was the most frequent symptom, and it was present in all eight cases. Two filum terminal cases had sciatica. Three (37.5%) patients had weakness. Pyramidal manifestations were present in two (25%) cases, and both were cervical. Sphincteric disturbance was present in four (50%) patients.

MRI findings and resection

MRI scans showed tumors at the cervical regions in three (37.5%) patients. Tumors in the dorsal region were present in two (25%) patients, and three (37.5%) patients had tumors in the lumbar region. Only two cases had tumors that spanned more than two vertebral levels. Gross total resection (GTR) was done in six (75%) cases. Near-total resection was

Table 1 Characteristics of the eight patients with spinal ependymomas

Case number	Sex	Age (years)	Tumor location	Surgery	Tumor grade	Preoperative clinical picture	Postoperative clinical picture	Complications
1	F	24	L2–L3 Filum terminal	GTR	2	Right sciatica and ankle hyporeflexia	Sciatica improved	No
2	M	26	C3–C4	GTR	2	Right upper limb pain and weakness, and pyramidal manifestations	Same with improved pyramidal	Early increase in the weakness Improved during the follow-up period
3	M	60	C2–C7	PR	2	Neck pain, quadriparesis grade 4, pyramidal manifestations, and sphincters	Power slightly improved to grade 2, and sphincters improved	No
4	M	35	C3–C4	GTR	2	Neck pain; no weakness nor pyramidal	Pain improved	No
5	M	32	L1–L2 Filum terminal	GTR	1	Back pain, sciatica weakness in right foot, and sphincters	Improved weakness and sphincters	No
6	M	40	L1–L2 Filum terminal	GTR	2	Back pain; no weakness and no sciatica	Pain improved	No
7	F	36	D12–L1 Conus and filum terminal	NTR	2	Back pain, sciatica, saddle anesthesia, and sphincters with incontinence	Sphincters improved; still has sciatica	No
8	M	38	D6–D12	GTR	2	Low back pain, sensory-level hypoesthesia, and sphincters	Paraplegia	Paraplegia with paralysis of sphincters

F, female; GTR, gross total resection; M, male; NTR, near-total resection; PR, partial resection.

done in one case, and partial resection was done in one cervical case.

Complications

The overall postoperative complications rate was 12%. One case was complicated with paraplegia and incontinence. It did not improve during the follow-up period. In this case, the tumor was extended over seven levels of dorsal spines from D6 to D12. Long-segment myelotomy was needed. One more patient experienced slight increase in his weakness (milder weakness was present preoperatively), but this improved and returned to normal function during the follow-up period.

Improvement of neurological functions and pain

Seven out of the eight cases improved clinically. Pain improved in seven (87.5%) cases. All three cases with preoperative weakness improved within the first week of surgery or during the first 6 months (postoperative follow-up period). Sphincters improved in three out of four cases that had been presented with sphincters (Figs 1 and 2).

Analysis of neurological deterioration and complications

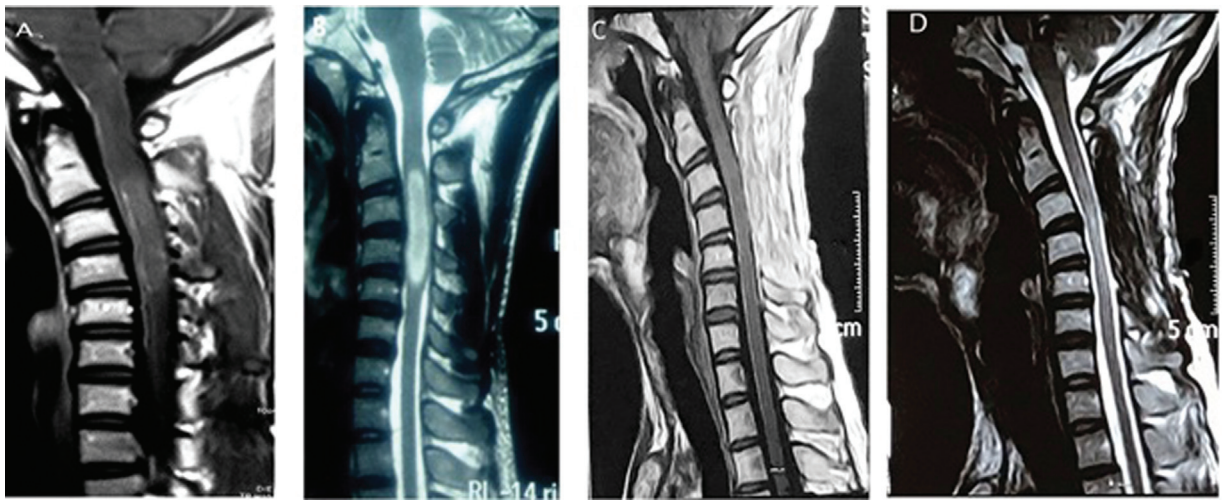
One case was complicated with paraplegia and incontinence. It did not improve during the follow-up period. In this case, the tumor was extended over seven levels of dorsal spines from D6 to D12. Long-segment myelotomy was needed. Severe hypotension was inflicted by the anesthesiologist all throughout the time of surgery. Main arterial blood pressure was around 58 mmHg. Hemostasis was done by saline-soaked gel foam in the tumor bed. All these factors cumulated, and by the end of surgery, the cord became pale whitish (massive ischemia).

Discussion

In the past, complete resection of spinal ependymomas was believed to be impossible and was associated with significant morbidity and mortality [10,11]. The traditional surgical management was biopsy or partial removal, followed by radiotherapy. With advances in the knowledge and surgical equipment's such as operating microscopes, most spinal ependymomas can be managed by GTR, with less complications and improved outcomes. Spinal cord ependymomas are diagnosed most frequently in the fourth decades of life [12–16]. We found this in our series as the main age at surgery was 36.4 years. We found male predominance in our study, and this is comparable to many previous studies [7,17–20].

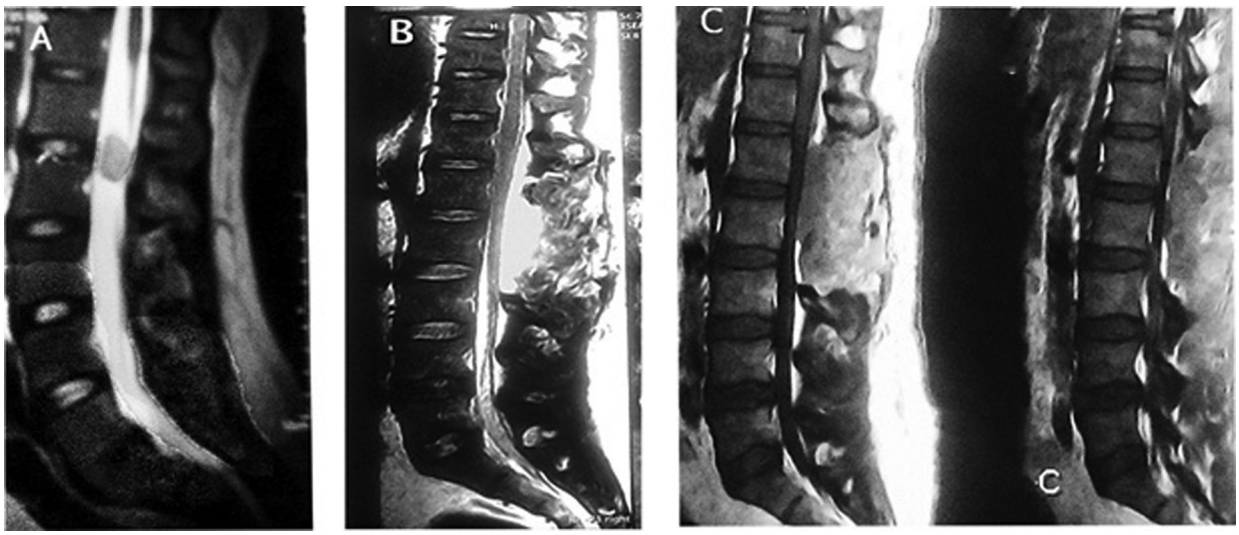
Huang and Lin [21] found the most frequent symptom is weakness of the extremities (76.5% of their patients). Others found that the most common presenting

Figure 1



(a) T1 contrast-enhanced sagittal MRI of a 26-year-old male that was done before surgery. (b) T2 sagittal MRI shows extensive edema. (c) T1 contrast-enhanced MRI 1 month after surgery. It shows complete resection of the lesion and disappearance of the enhancement. (d) T2 MRI shows significant improvement of cord edema 1 month after surgery.

Figure 2



(a) Preoperative T2 sagittal MRI of a 40-year-old male showing filum terminal ependymoma. (b) and (c) Sagittal MRI was done 2 months after excision showing complete removal without any enhancement.

symptom is pain either local or radicular pain, which may delay the diagnosis of spinal cord ependymomas because these symptoms are nonspecific [22]. All cases in our series presented with pain. Sphincter dysfunction ranged from 18 to 40% in many studies [21,23,24], but we found that four cases of our eight cases had sphincteric affection. McCormick and Stein [25] reported that five of 23 patients experienced bowel and bladder dysfunction in the preoperative period. Klekamp [26] found that half of his filum terminal cases had sphincteric affection. We found the same, as half of our filum terminal cases had sphincter dysfunction. Pyramidal manifestations were found in two cases of our eight cases, and they were found only in cervical ependymomas.

Huang and Lin found hyperreflexia in 10 of 17 cases of spinal ependymomas. Oh *et al*. [2] found that spinal ependymomas occur most frequently in cervical (32%) and conus+cauda (26.8%). Wild *et al*. [22] found 29% of their ependymoma cases have cervical ependymomas and 36% of the cases have conus and filum ependymomas. This was confirmed in our series, as seven of our eight cases have ependymomas in one of these locations.

Wild *et al*. [22] found that 65% of their ependymoma cases have WHO grade II, 15% grade I, and 4% grade III. In our series, most of the cases were ependymoma grade II.

In many series, GTR ranged from 52 to 86.3% [22–24,27]. In our case series, we are in this range, as we did GTR in six (75%) of our eight patients. Keil *et al*. [24] confirmed that GTR is preferable in de-novo cases, and it is the most important factor for desirable outcome. Huang and Lin [21] suggested that it is reasonable to estimate that total resection is possible in 80–90% of the patients with spinal ependymomas. In our series, GTR was achieved in all filum terminal cases except one case that had invaded the conus. In a study done by Klekamp [26] on 29 patients with filum terminal ependymomas, he found that GTR was feasible in 77% of these cases.

Complications are not uncommon with spinal cord ependymoma surgeries. Early complications rate was 23.5% in a study done by Huang and Lin. These includes two patients in whom postoperative extubation was unsuccessful. Another patient developed wound infection and CSF leak and two patients with urinary tract infection [21]. In another study done by Keil *et al*. [24], short-term complication rate was 24.6% [24]. We did not encounter any of these short-term nonneurological complications in our study. Regarding postoperative neurological deterioration, Huang and Lin [21] found the incidence of neurological deterioration after primary resection of spinal ependymomas was 29.4%. Aghakhani *et al*. [12] observed that 88% of the patients showed improvement or stabilization by the operation at the end of the follow-up period. In our series, one case showed neurological deterioration and the other seven cases showed improvement in their neurological status.Some reports have failed to identify a statistically significant increase in prognosis with the utilization of neurophysiological monitoring techniques [1]. Alkhani *et al*. [28] reported that patients did well regardless of monitoring status. We do not have these monitoring facilities at our institute, and all cases were operated without monitoring. Despite that, we got results similar to the surgeons who had used this technique. Although this modality cannot independently provide a holistic evaluation of spinal cord and root integrity, its use can allow surgeons to proceed with enhanced precision and confidence that the risks of neurological damage have been minimized [29].

Conclusion

Most spinal ependymomas can be managed by GTR without significant morbidity.

In our study, permanent neurological deficit occurred in one case out of eight cases. Neurological deficits occurred more in tumors that extend more than two spinal levels. Some cases presented with declination in neurological functions in the early postoperative period, but these cases improved in the follow-up period. It is better to use neurophysiological monitoring, but it is not essential for achieving good outcome.

Financial support and sponsorship

Nil.

Conflicts of interest

None declared.

References

1 Nagasawa DT, Smith ZA, Creamer N, Fong C, Lu DC, Yang I. Complications associated with the treatment for spinal ependymomas. *Neurosurg Focus* 2011; **31**:E13.

2 Oh MC, Kim JM, Kaur G, Safaee M, Sun MZ, Singh A, *et al*. Prognosis by tumor location in adults with spinal ependymomas. *J Neurosurg Spine* 2013; **18**:226–235.

3 Louis DN, Ohgaki H, Wiestler OD, Cavenee WK, Burger PC, Jouvet A, *et al*. The 2007 WHO classification of tumors of the central nervous system. *Acta Neuropathol* 2007; **114**:97–109.

4 Rudà R, Gilbert M, Soffietti R. Ependymomas of the adult: molecular biology and treatment. *Curr Opin Neurol* 2008; **21**:754–761.

5 Schiffer D, Chiò A, Giordana MT, Migheli A, Palma L, Pollo B, *et al*. Histologic prognostic factors in ependymoma. *Childs Nerv Syst* 1991; **7**:177–182.

6 Chi JH, Cachola K, Parsa AT. Genetics and molecular biology of intramedullaryspinal cord tumors. *Neurosurg Clin* 2006; **17**:1–5.

7 Armstrong TS, Vera-Bolanos E, Bekele BN, Aldape K, Gilbert MR. Adult ependymal tumors: prognosis and the M. D. Anderson Cancer Center experience. *Neuro Oncol* 2010; **12**:862–870.

8 Sonneland PR, Scheithauer BW, Onofrio BM. Myxopapillary ependymoma. A clinicopathologic and immunocytochemical study of 77 cases. *Cancer* 1985; **56**:883–893.

9 McCormick PC, Torres R, Post KD, Stein BM. Intramedullary ependymoma of the spinal cord. *J Neurosurg* 1990; **72**:523–532.

10 Yanni DS, Ulkatan S, Deletis V, Barrenechea IJ, Sen C, Perin NI. Utility of neurophysiological monitoring using dorsal column mapping in intramedullary spinal cord surgery. Clinical article. *J Neurosurg Spine* 2010; **12**:623–628.

11 Nakamura M, Ishii K, Watanabe K, Tsuji T, Takaishi H, Matsumoto M, *et al*. Surgical treatment of intramedullary spinal cord tumors: prognosis and complications. *Spinal Cord* 2008; **46**:282–286.

12 Aghakhani N, David P, Parker F, Lacroix C, Benoudiba F, Tadie M. Intramedullary spinal ependymomas: analysis of a consecutive series of 82 adult cases with attention to patients with no preoperative neurological deficit. *Neurosurgery* 2008; **62**:1279–1285.

13 Chang UK, Choe WJ, Chung SK, Chung CK, Kim HJ. Surgical outcome and prognostic factors of spinal intramedullary ependymomas in adults. *J Neurooncol* 2002; **57**:133–139.

14 Ferrante L, Mastronardi L, Celli P, Lunardi P, Acqui M, Fortuna A. Intramedullary spinal cord ependymomas : a study of 45 cases with long-term follow-up. *Acta Neurochir (Wien)* 1992; **119**:74–79.

15 Halvorsen CM, Kolstad F, Hald J, Johannesen TB, Langmoen IA, Helseth E, *et al*. Long-term outcome after resection of intraspinal ependymomas: report of 86 consecutive cases. *Neurosurgery* 2010; **67**:1622–1631.

16 Hoshimaru M, Koyama T, Hashimoto N, Kikuchi H. Results of microsurgical treatment for intramedullary spinal cord ependymomas: analysis of 36 cases. *Neurosurgery* 1999; **44**:264–269.

17 Lee SH, Chung CK, Kim CH, Yoon SH, Hyun SJ, Kim HJ, *et al*. Long-term outcomes of surgical resection with or without adjuvant radiation therapy for treatment of spinal ependymoma: a retrospective multicenter study by the Korea Spinal Oncology Research Group. *Neuro Oncol* 2013; **15**:921–929.

18 Lin YH, Huang CI, Wong TT, Chen MH, Shiau CY, Yen SH, *et al*. Treatment of spinal cord ependymomas by surgery with or without postoperative radiotherapy. *J Neurooncol* 2005; **71**:205–210.

19 Oh MC, Tarapore PE, Kim JM, Sun MZ, Safaee M, Parsa AT, *et al*. Spinal ependymomas: benefits of extent of resection for different histological grades. *J Clin Neurosci* 2013; **20**:1390–1397.

20 Tarapore PE, Modera P, Naujokas A, Oh MC, Amin B, Weinstein PR, *et al.* Pathology of spinal ependymomas: an institutional experience over 25 years in 134 patients. *Neurosurgery* 2013; **73**:247–255.

21 Huang YH, Lin JW. Management and outcome of primary spinal ependymomas: a single center experience in Taiwan. *Clin Neurol Neurosurg* 2013; **115**:2130–2135.

22 Wild F, Hartmann C, Heissler HE, Hong B, Krauss JK, Nakamura M. Surgical treatment of spinal ependymomas: experience in 49 patients. *World Neurosurg* 2018; **111**:e703–e709.

23 Klekamp J. Spinal ependymomas. Part 1: Intramedullary ependymomas. *Neurosurg Focus* 2015; **39**:E6.

24 Keil VC, Schmitt AJ, Martin SC, Cadoux-Hudson TA, Pereira EA. Optimizing treatment strategies in spinal ependymoma based on 20 years of experience at a single center. *J Clin Neurosci* 2016; **29**:52–58.

25 McCormick PC, Stein BM. Intramedullary tumors in adults. *Neurosurg Clin Am* 1990; **1**:609–630.

26 Klekamp J. Spinal ependymomas. Part 2: ependymomas of the filum terminale. *Neurosurg Focus* 2015; **39**:E7.

27 Li TY, Chu JS, Xu YL, Yang J, Wang J, Huang YH, *et al.* Surgical strategies and outcomes of spinal ependymomas of different lengths: analysis of 210 patients. *J Neurosurg Spine* 2014; **21**:249–259.

28 Alkhani A, Blooshi M, Hassounah M. Outcome of surgery for intramedullary spinal ependymoma. *Ann Saudi Med* 2008; **28**:109–113.

29 Kelleher MO, Tan G, Sarjeant R, Fehlings MG. Predictive value of intraoperative neurophysiological monitoring during cervical spine surgery: a prospective analysis of 1055 consecutive patients. *J Neurosurg Spine* 2008; **8**:215–221.