Investigating Long-term Outcomes of Surgical Treatment in Spinal Tumors: A 10 years Follow-up Study

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Received: 19 Jan. 2017; Received in revised form: 15 Feb. 2017; Accepted: 25 Mar. 2017

Abstract

Background: Spinal tumors account for 10-15% of total central nervous system neoplasms. This study presents the results of surgical procedures performed on a significant number of patients with spinal tumors.

Methods: The present article presents results of surgery performed on 104 of 204 patients with spinal cord tumors referred to the hospital clinic where they underwent the operation from 2005 to 2015. The studied cases included age, sex, and duration of the disease, and clinical symptoms and their time of occurrence, place of birth, radiological characteristics, surgical results, surgical resection, tumor histology, and complications. In addition, the results are compared with other studies.

Results: A total of 104 studied subjects who underwent the surgery 50% were male. The mean age of patients was 37.1 years. The most common site of the tumor was the thoracic (30.8%) and cervical regions (27.9%). Extramedullary and intramedullary tumors accounted for 74.1% and 25.7% of cases, respectively. Among the extramedullary masses, the most common pathology was nerve plexus tumor (58.4%) and then meningium (18.2%). Astrocytoma (55.6%) and ependymoma (25.9%) were, respectively, the most common types of intramedullary tumors. The total or almost total resection was performed in 78.9 of cases. The average follow-up time was 29 months. The post-operative neurological status of patients was improved in 84.6% of cases.

Conclusions: The factors affecting on the final state of the patients after the operation include the degree of malignancy, the extent of the lesion and the pre-operative severity of the neural defect.

Citation: Tahamtani F, Khoshnevisan A, Jafari M. **Investigating Long-term Outcomes of Surgical Treatment in Spinal Tumors: A 10 years Follow-up Study.** *Acad J Surg*, 2017; 4(2): 48-52.

Keywords: Surgery; Spinal cord tumors; Long-term outcomes

Introduction

Spinal tumors account for 15% of the total neuroplasm of the central nervous system (1). These lesions are divided into extradural and intradural types according to their position relative to the dura and spinal cord. The majority of intradural tumors originates from cells in the spinal cord, nerve roots, or meninges, and is divided into two intramedullary and extramedullary groups. In adults, two-third of spinal cord tumors are extruded ular, most of which are seen in neural sheath, meningioma, and ependymoma of the terminal filum. The other one-third of the spinal cord tumors are intramedullary, of which 80% are primary glial tumors and have benign nature (2). The first successful removal for an extraterrestrial tumor was reported by Horsely in 1887. In 1907, Von Eiselsberg reported the total resection of a neurofibrosarcoma (3). The first large series of spinal tumors was published by Charles Elsberg in 1925 by presenting surgical results in 13 intramedullary tumor cases. He suggested that in cases where there is no significant distinction between the location of the tumor and the healthy tissue, only one posterior myelotomy should be performed first, and then, the surgery must be performed again in the tumor bulging through the myelotomy (4,5). Greenwood then reported much better results its 10^{th} year series in 1963 without mortality and performed a resection of these tumors using a microscope (6). With the advancement in surgical techniques and microsurgical dissociation, more success was achieved in the surgical operation of these tumors (7,8). The basis of treatment for spinal tumors is to obtain a sample for the diagnosis of pathology and decompression of the neural elements and prevent the development of neurological lesions (9,10). In the

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review of articles on spinal tumors, most studies are presented as a case report, and a small number of studies are available in large series studies (11). Our series is one of the largest series published in this case and is the first article to comprehensively examine the status of these tumors and the results of surgical operations. One of the most prominent features of our study is that all surgical procedures were conducted by a surgical team, homogeneity of the treatment of these tumors in all patients, and the long follow-up of the clinical condition of the patients after surgery, and comparing the results with other studies and case series carried out in this area.

Materials and Methods

In this study, 104 patients with a spinal tumor who had undergone surgery in Shariati Hospital from 2005 to 2015 were studied. The studied characteristics included: age, sex, duration of onset of symptoms before surgery, location and number of involved sites in terms of vertebral segments, initial clinical manifestations, tumor location relative to dura and spinal cord tissues, pathology, surgical resection rate, need to use fusion and fixator for skeletal instability, complementary therapies, number and duration of post-operative follow-ups, post-operative results, complications, recurrence and need for re-surgery. In all patients, the facial, profile, and left and right graphs along with dynamic spinal cord graphs before and after the surgery were performed to assess the stability of the spine. Furthermore, for the precise examination of spinal anatomy in case of neural forms involvement, the computed tomography (CT) scan was performed on the involved sites depending on the location of the tumor. According to operation indications, there was a significant evidence of spinal tumor in radiographic studies according to clinical findings and progressive neurodegenerative deficits. The contraindications for surgery in our patients included coagulation disorders and systemic infections, systemic medical disorder (which would lead to anesthesia and surgery with high risk), complete neural impairment for more than 24 hours, and life expectancy lower than 3 months. In cases of severe parasitic quadriplegia, surgery was performed in intramedullary tumors in cases of caudal, rostral, or tumorous cysts. Otherwise, surgery was not performed even in cases of thoracic cystic intramedullary tumors with complete paraplegia.

Results

Of the 204 patients diagnosed with spinal cord tumors, 104 patients with a mean age of 37.1 years old (ranging from 4 to 75 years old) were males and the rest were females. The mean duration of the disease was 18.4 months (from 1 to 120 months) and in most cases, the duration of the pre-operative symptoms was 6 months. There was a history of brain tumors in 2 patients (1.9%) (one case of meningioma and the other case of severe choroidal carcinoma) in 68.3% and 27.9% of the patients, the onset of the disease manifestations was associated with axial pain and motor disorders. In 89.8% of the patients (100 patients) suffered from the axial pain with overnight preference and 78 (75%) complained about radicular pain in the organs. Furthermore, sensory symptoms, motor problems, and sphincter disorder were prevalent in 84 (80.8%), 85 (81.7%), and 37 (35.6%) of patients.

The most commonly involved sites were thoracic spine (30.8%) and then cervical region (27.9%). The number of involved sites in terms of vertebrate segments, on average, included three between 1 and 10 segments, and the involvement was observed between two vertebrate segments in majority of cases. In 22 cases (21.2%), diagnosis was done using myelography and CT scan and in 82 cases (78.8%) magnetic resonance imaging was carried out with and without contrast infusion. Extramedullary and intramedullary cases accounted for 77 (74.1%) and 27 cases (25.9%) of spinal tumors, respectively. The most common type of tumors among the extramedullary tumors was neoplastic tumor (45 cases - 58.4%) and then meningium (14 cases - 18.2%) (Table 1).

Table 1. Distribution of extramedullary tumors pathology

Pathology	Number	Percent
Nerve sheath tumor	45	58.4
Meningioma	14	18.2
Ependymoma of the filum	2	2.6
Others	16	20.8

Among intramedullary tumors, astrocytoma was the most common tumor (15 cases - 55.6%), and then epandymium (7 cases - 25.9%) (Table 2).

Table 2. Distribution of Intramedullary tumors pathology

Pathology	Number	Percent
Astrocytoma	15	55.6
Ependymoma	7	25.9
Others	5	18.5

In 4 (3.8%) and 100 cases (96.2%), surgery was performed using anterior and posterior approaches (laminectomy or transpedicular), respectively. Gross total resection, near total, subtotal resections, and biopsy were performed in 63 (60.6%), 19 (18.3%), 18 (17.3%), and 4 cases (3.8%). Radiotherapy and chemotherapy were used as supplemental therapy, respectively, in 35 (33.6%), and 6 cases (5.8%). No surgical complications occurred in 90 cases (86.5%). In 2 cases (1.9%), uterine infection occurred that was recovered using medical treatment, and in 10 cases (9.61%), and the organs weakness was exacerbated. Hydrocephalus was seen (one case in a patient with thoracic astrocytoma and the other in a patient with cervical epandymium) in 2 cases (1.9%). Death caused myocardial infarction only occurred in one case

(0.9%). In 18 cases (17.3%), recurrence occurred, of which six patients underwent surgery (33.3%). The average number and the duration of follow-ups were 5 times (1-20 times) and 29 months, respectively. Among our patients, neurological status improvement, lack of change, exacerbated weakness of organs and death occurred, respectively, in 88 (84.6%), 5 (4.8%), 10 (9.6%), and 1 case (0.9%) (Figure 1). In general, spinal fusion was required in cases of severe instability of the spine in 2 cases (1.9%).

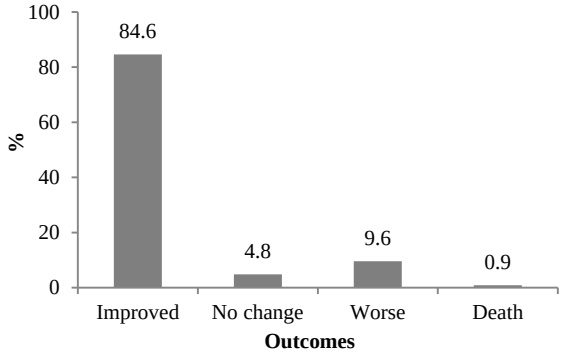

Figure 1. Surgical outcomes in patients with spinal tumors

Discussion

The results of surgeries performed on 104 patients with spinal tumors with 72.1% for the extramedullary type and 27.9% for the intramedullary type were evaluated in a 26-year period in the present study. In other studies, intramedullary and extramedullary tumors accounted for 33.3% and 66.6% of spinal tumors, which is some consistent with our survey results (12-14). In some studies, intramedullary tumors have been reported to be more prevalent in men (13,14), and in some reports, the same prevalence rate has been reported (15,16). No significant difference was observed in this regard in the present study (55.5% in women and 44.5% in men).

Based on the pathology of the spinal tumors, the incidence of meningium (71.4% in women) and astrocytoma (60% in women) was more common in women, but there was no significant difference between two genders in neural sheath tumors (55.6% women) and epandymium (55.6% in men). Rewiring other studies showed higher incidence rate of meningium in women (12,17-23). In our patients, the most common site for the incidence of intramedullary tumors was thoracic region (48.2%), cerdvical region (33.3%), and lumbar region (48.2%), respectively, and such pattern was confirmed in other studies (1,24). With regard to the spinal meningium cases, the most common occurrence site included the thoracic region (64.3%) and then the cervical area (35.7%). This rate and pattern are consistent with the results of other surveys (12,21,22). Furthermore, the most common site of neoplastic tumors in the lumbar region was (48.9%). This ratio has also been confirmed in other relevant studies (12,20). The number of involved segments in intramedullary tumors in our study was 4 on average and varied between 5 and 6 in other studies (15,25). In our study, one case of metastatic cerebellar plexus carcinoma occurred and similar lesion was referred to in an article issued by Tun and Kaptanoglu in 2007. It seems that cerebrospinal fluid dissemination is responsible for the metastasis of the lesion to the cervical cord. In our study among intramedullary tumors, the most common cause of referral was an axial pain (62.9%) and then motor disorder (29.6%). In other studies, including the study conducted by Epstein et al., the incidence of axial pain and motor disorder was reported in 70% and 30% of cases, which was consistent with our study. Among the extramedullary tumors in our study, the most common tumor was nerve sheath tumors (58.4%) and then meningium (18.2%). According to other studies, nerve sheath tumors only account for 25% of intradural tumors, and meningium had a similar prevalence rate, which is different from our study results (1,2). In intramedullary tumors in our patients, the prevalence of astrocytoma was much higher than that of epandymium (astrocytoma 55.6% and 25.9% epandymium), but in other studies, the prevalence of astrocytoma and epandymium was approximately the same (17-19).

In our study, total or almost total tumor resection was performed in 40.8% of cases of intramedullary tumors, and subtotal resection or biopsy was performed in 59.2% of cases; while in Constantini (25) and Valesquz (15), total resection and subtotal resection were performed in about 70% and 30% of cases of intramedullary tumors. The lower total resection rate in our study, compared to other studies, maybe attributed to the greater relative prevalence of astrocytoma compared to epandymium in our study compared to those studies. In the cases of intramedullary tumors in our study, the patient's post-surgery condition was improved, remained unchanged and was exacerbated in 70.3%, 11.2%, and 18.5% of cases. The factors affecting the treatment outcomes (based on improvement of neurological status) included: female gender ($P = 0.050$), age over 40 years ($P = 0.010$), lower number of involvement segments ($P = 0.009$), and benign pathology ($P = 0.010$), but the extent of surgical resection did not have a significant effect ($P = 0.100$), which may be attributed to more astrocytoma cases than to epandymium. Furthermore, in cases where the patient's neurological impairment was more severe, the treatment outcomes were worse than those without a neurological defect or mild impairment ($P = 0.020$). In a study, Constantini et al. showed that there was a relationship between the age, number of involvement segments and the extent of the resection with the treatment outcome and degree of

tumor malignancy was the only significant factor in this regard (25). In our patients, tumor recurrence occurred in 17.3%. Researchers have also reported recurrence rates of between 20% and 30%, correlated with tumor malignancy grade (15,25). The complications of the incision site in our study occurred in 2 cases (1.9%) in the form of localized infection and were fully recovered. In a study, Epstein reported wound healing rate of 5% among patients (26,27). Overall, our patients experienced a 9.6% increase in post-operative limb weakness. The results of reviewing other articles showed that in case of absence of neurodegenerative defects, the risk of worse motor activity up to 5% was reported (27-29). Furthermore, 1.9% (2 cases) of our patients suffered from hydrocephalus. The incidence of hydrocephalus was reported in 15% and 8% of malignant and benign spinal tumors, respectively (30).

Based on the results of this study and comparison with other articles, it seems that the pre-operative neurological status of the patients, the type and location of the tumor play a significant role in the outcome of the treatment. In cases of severe neurodegenerative defects, the results of total resection are better than subtotal resection and radiotherapy of lesion. For a long time, radiotherapy and chemotherapy as complementary therapy have been routinely used in the treatment of intramedullary tumors, but its real value is questioned. Since radiation tolerance in the spinal cord is 10-15% less than that of the brain, it should be avoided in low-grade malignancy, especially as its risk increases with increasing dosage and extent of the therapeutic field. The value of radiotherapy is more common in cases of malignant gastrostomy or in the massive subarachnoid involvement or in the development of neuraxis dissemination, and in these cases, the use of chemotherapy is recommended. The incidence of hydrocephalus along with caudal intramedullary astrocytoma of the craniocervical region is in favor of malignant behavior and secondary dissemination and spinal cord fluid blockage, which can help predict tumor behavior.

However, all efforts have been made to understand the clinical and biologic behavior of spinal tumors to provide practical solutions to the treatment of these lesions. Although the results of this study are helpful in this regard, to generalize these results to other patients and provide definite results, future multicenter studies should be considered, considering the underlying and interventional factors. The final point is that as long as cellular and molecular methods or gene therapy can be used in the treatment of these lesions, the best method to treat these lesions is to carry out total surgical resections to the extent possible.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

We would like to acknowledge hospital's staff for their helps.

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