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SURGICAL OUTCOME OF SPINAL MENINGIOMA, SINGLE INSTITUTE EXPERIENCE

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ABSTRACT

Background: The aim of this study is to review the literature about the spinal meningiomas, their incidence, clinical picture, the best management, and reveal the factors affecting surgical outcome. Methods: This prospective study was carried in Cairo university hospitals on 45 patients suffering from spinal meningioma which were diagnosed by clinical suspicion and radiological investigations. These cases were operated upon by surgical excision through posterior approach and the outcome of these cases and factors affecting the outcome are observed. Conclusion: In our study we have concluded that early diagnosis and early surgical intervention have better results as delay can lead to permanent neurological deficit. Postoperatively, remarkable improvements in neurological deficits were achieved, however risk factor such as age, severe preoperative neurological deficit, and also if the tumor is ventral to the cord and calcified, surgery becomes challenging, and, it has been considered as predicators of a poor surgical outcome.

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Introduction

Meningiomas are the second popular intradural, extramedullary tumors of the spine [1]. The first reported successful resection of a thoracic meningioma was in 1888 by Sir Victor Horsely and Sir William Gowers [2]. Meanwhile they at first described their spinal tumor as a fibromyxoma, and the term "meningioma" that is yet universally utilize was introduced by Harvey Cushing [3]. However, surgical extraction, remains the mainstay of treatment. The clinical administration of spinal meningiomas, involved diagnosis, investigations, surgical and adjunctive treatments, and in addition, the outcomes, follow-up strategies, and future perspectives, are also presented.

Material and Methods

The study was conducted on 45 patients with spinal masses; treated surgically and confirmed histopathologically as spinal meningiomas. There were 30 females and 15 males with average age of 42 years. The mean post-operative follow up period was 12 months. The histopathological variety, locations of the tumors, and clinical results were analyzed. The neurological presentation obtained during the preoperative stage and post-operative follow up were evaluated.

Management:

All selected cases are subjected to:

1) **Preoperative preparation:**

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Fasting of patient eight hours before surgery, antibiotic, shaving of hair at the operation field, and proper sterilization.

2) Surgery:

Technique:

The patient was placed in the prone position under general anesthesia. Anaesthesia was achieved using a combination of propofol and fentanyl infusions without muscle relaxants to allow the assessment of somatosensory (SSEPs) and motor evoked potentials (MEPs). The decrease in amplitude of SSEPs while using propofol is less in comparison to inhalational anaesthetics and it doesn't affect the latency, on the other hand it suppresses MEPs when single pulse stimulation is used but MEPs can be assessed fairly when train of pulse stimulation is used. Opioids including fentanyl have minimal effects on both SSEPs and MEPs. The combination of propofol and opioids in total intravenous anaesthesia (TIVA) results in satisfactory circumstances to monitor evoked potentials. In the present study induction of anaesthesia was accomplished using IV boluses of propofol 2mg/kg and fentanyl 2µcg/kg, morphine 10mg that was given at the beginning of surgery. For maintenance of anaesthesia propofol infusion was titrated between 75-150 µcg/kg/min and fentanyl infusion in a dose of 1µcg/kg/h till the end of the operation [4-6]. Neurophysiological monitoring was used in 20 patients.

A laminectomy or hemilaminectomy with or without facetectomy was performed according to the location and type of the tumor through the posterior approach alone. A longitudinal incision was made in the dura mater and the tumor was detached from the dura mater and removed.

Posterior fixation by lateral mass or by screws may be performed when the tumor is too large to cause posterior instability.

3) Post-operative management:

- Antibiotics: the same intraoperative antibiotic was used for about 10 days.
- Narcotic analgesics.
- Non steroidalantiinflmatory drugs used for analgesia.
- Cortecosteroids are used in all cases.
- Diet rich in protein and calcium is used for rapid healing.
- patient ambulation: immediately post-operative the patient should be ambulant to avoid DVT.

4) Post-operative Evaluation:

The post operative evaluation involved comparison of the neurological findings preoperatively and at the last follow up according to frankel classification.

Also post operative MRI with and without contrast was performed for all cases to assess the extent of surgical excision and sometimes X-ray or CT was performed for cases undergoing fixation.

Results

Level of the tumor:

An MRI scan perfected at presented spinal cord pressure in all situations. Concerning the level of the tumor, 27 were found in the thoracic spine (60%), 12 cases in the cervical spine (26.7%) and 6 cases found in the lumbar spine (13.3%).

Table 1: Level of the tumor

Level of tumor	Cases (%)
Thoracic	27 (60%)
Cervical	12 (26.7%)
Lumbar	6 (13.3%)

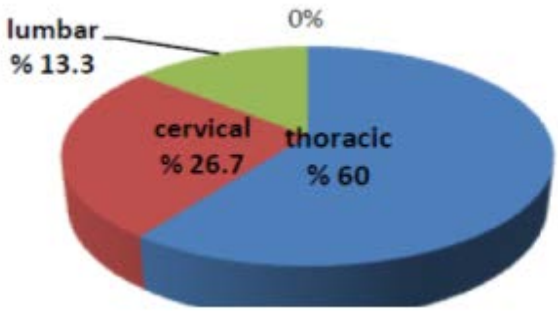

Figure 1: Level of the tumor

Age:

Regarding age distribution of our cases, it ranged between (20 and 65) the youngest was 25 years, while the oldest was 65 years, the largest proportion of cases encountered during 3rd decade of life.

Table 2: Tumor incidence by age group

Age	Cases (%)
20- 40	15 (33.3 %)
40-60	24 (53.4 %)
≥ 60	6 (13.3 %)

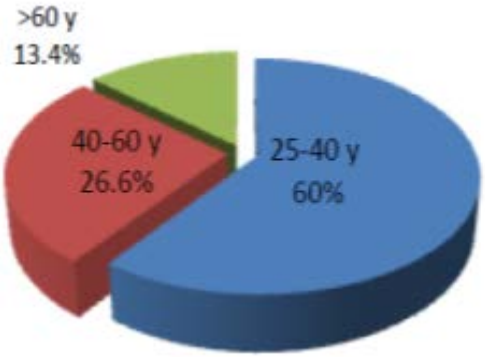

Figure 2: Tumor incidence by aga group

Gender distribution (sex):
Out of the 45 cases 33 cases were females (66.6), and 12 cases were males (33.4).

Table 3: distribution by sex

Sex	Cases
Females	33 (66.6 %)
Males	12 (33.4 %)

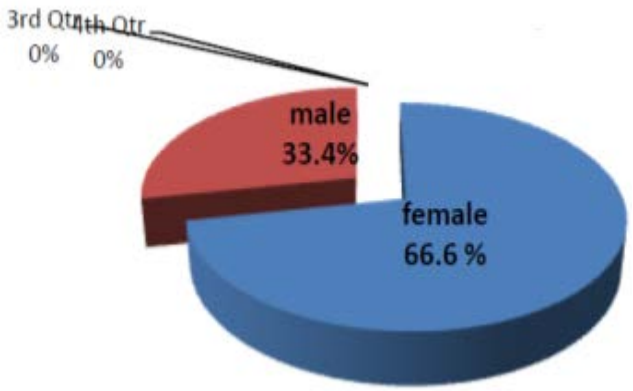

Figure 3: distribution by sex

Between different symptoms, the main ones at the time of acceptance considerable motor weakness of the upper and reduce limb in 12 cases then back pain, upper and lower limbs pain in 9 cases, also Bladder and bowel dysfunction in 9 cases. These symptoms were combined in 18 situations. Noteworthy relationships were found between the symptoms and site of the tumor. Dorsal tumors (27 cases) were related to Paresis of both lower limbs in 9 cases, back pain only in 3 case, also Bladder and bowel dysfunction in 3 cases and combined of these symptoms in 12 cases.
Tumors in the cervical spine (12 cases) were linked with neck pain and radicular pain in 3 cases, motor weakness in the distal upper limbs in 3 case, also Bladder and bowel dysfunction in 3 cases and combined of these symptoms in 3 case.
The major complaints of the patients with conus medullaris and cauda equina tumors had contained low back pain, lower limb painin 3 case and combined with bladder and intestines dysfunction and saddle anesthesia in 3 cases.
Particularly, pain in the lesions of the conus medullaris tended to come before sphincter trouble happen in the late period.

Table 4: Clinical symptoms in relation to location of the tumor

Level	Thoracic (27 cases)	Cervical (12 cases)	Lumbar (6 cases)
Pain	**3 case** Back pain only	**3 case** Neck pain and radicular pain (brachialgia)	**3 case** Low back pain and

			radiculopathy
Weakness	**9 cases** Paresis of both lower limbs	**3 cases** Weakness in the distal upper limb	**3 cases**
Bladder and bowel dysfunction	**3 case**	**3 case**	**3 case**
Combined	**12 cases**	**3 case**	**3 case**

Clinical symptoms and signs on initial examination:

In the physical examination, 15 cases of motor weakness; the level of paralysis depends on the position of cord compression and the pattern of weakness is upper motor neuron below the level of the lesion and lower motor neuron at the level of the lesion; cauda equina compression produces lower motor neuron pattern of weakness, 6 cases of sensory disturbance mostly in the form of sensory level, and of sphincter disturbance were observed in the form of urine incontinence. 18 cases of combined symptoms were noticed. The average duration from the beginning of individual symptoms to admission was 9.5 months.

Table 5: Clinical symptoms and signs on intial examination

Symptoms and signs	Cases (%)
Motor weakness	15 (33.4%)
Sensory disturbance	6 (13.3)
Sphincter disturbance	6 (13.3)
Combined	18 (40 %)

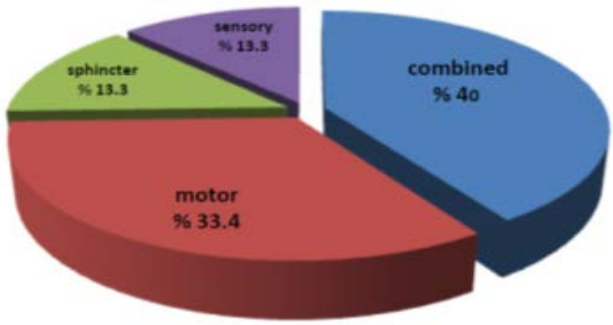

Figure 4: Clinical symptoms and signs on intial examination

Extent of surgical resection:

Total surgical resection was achieved in majority of our cases, 39 cases (86.7%) due to presence of clear plane between the tumor tissue and normal cord tissue, while subtotal resection was achieved in only 6 cases (13.3%) due to attachment to the cord.

Table 6: Extent of surgical resection

Extent of surgical resection	Cases (%)
Total resection	39 (86.7 %)
Subtotal resection	6 (13.3 %)

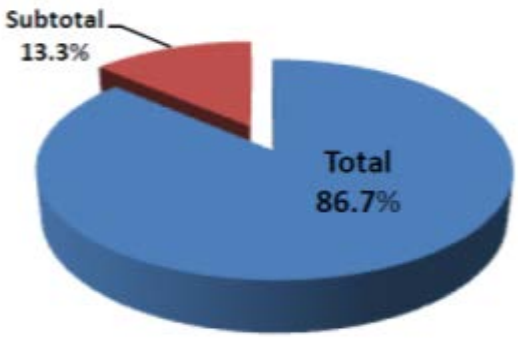

Figure 5: Extent of surgical resection

Functional outcome:

Assessment of motor power done according to the 0-5 Scale or British Medical Research Council (MRC) grading system

which is generally applied:

At average follow up of 8.5 months (range 1.5 to 36 month), the whole of all results become better significantly.

The preoperative motor power grade was 4 in 15 cases, 3 in 12 cases, 2 in 6 cases, and grade 0 in 3 case.

12 cases of sphincteric troubles in the form of urinary incontinence, also 12 cases of back pain and sensory level.

During the post operative follow up period, 30 patients from 33 show improvement in motor power:

15 patients with motor power grade 4 show improvement became full motor power in less than 6 months' post-operative, 6 cases of motor power G 3 show improvement 1 power grade in and 3 case become full motor power in 1 year.

6 cases of grade 2 improved 2 grade in 1 year, 3 case of grade 0 show no change in power.

9 from 12 cases with urinary incontinence show improvement by the end of post operative first year. 3 cases show no improvement.

9 from 12 cases with sensory manifestation show improvement, 3 cases show persistent back pain and no patient *deteriorated.*

With consideration to the post operative complications, it could be noticed that the cerebrospinal fluid leak in 6 patients and paresthesia in other 6 patients.

Table 7: British Medical Research Council (MRC) grading system

Grade	Extent of resection
V	Muscle contracts normally against full resistance.
IV	Active movement against resistance. Subdivisions of grade 4 provide further information: • 4- Slight movement against resistance • 4 Moderate movement against resistance • 4+ Strong movement against resistance
III	Active movement against gravity.
II	Active movement with gravity eliminated
I	Only a trace or flicker of movement is seen or felt.
0	No contraction

Table 8: Functional outcome of motor power using British Medical Research Council (MRC) grading system:

Cases	Preoperative	Postoperative	
		6 months	**1 year**
15 cases	**G 4**	**FMP**	
6 cases	**G 3**	**G 4 -**	**G4**
3 Case	**G 3**	**G4**	**FMP**
6 cases	**G2**	**G3**	**G4**
3 Case	**G0**	**G0**	**G0**

Clinical results:

The largest number in our study had an excellent result (30 cases %), followed by 12 cases (%) having a good result, 3 cases (13.4%) had fair results, with no cases had bad results. It is classified according to modified criteria of odom which means **Excellent**: full comfort of pain and other symptoms, return to complete activity; **Good**: fractional comfort of pain, full relief of other symptoms, return to complete activity; **Fair:** being improved with persistent determination of activity; **Poor:** no perfects or further deterioration.

Table 9: Clinical results

Results	Cases (%)
Excellent results	30 (66.6 %)
Good results	9 (20 %)
Fair results	6 (13.4 %)

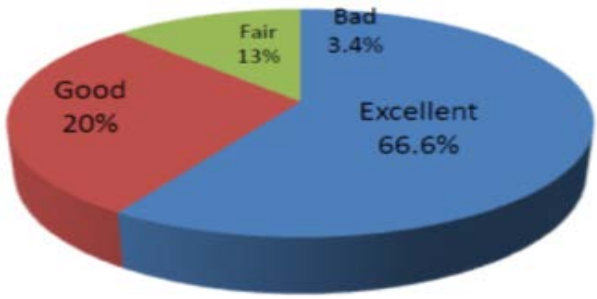

Figure 6: Clinical results

Pathological classification:

WHO G1 (benign meningioma):

39 cases (86.7 %):

15 were Meningotheliomatous , 9 were Psammomatous , 9 were Transitional and 3 case was Fibroblastic **Atypical meningioma WHO G2 :** 6 Cases (13.3%).

Table 10: Pathological classification

NO. Of Cases	Benign Meningioma WHO G1 (86.7 %)				Atypical Meningioma WHO G 2 13.3%
	Meningotheliomatous	Psammomatous	Transitional	Fibroblastic	
	15	9	9	6	6

Postoperative complications:

With regards to postoperative complications, cerebrospinal (CSF) leakage was observed in 6 patients (13.3 %). one was resolved with medical treatment and one needed insertion of temporary lumbar drain, then permanent thecoperitoneal shunt.

Paresthesia was observed in 6 patients (13.3%), and improved with medical treatment within three months postoperative.

Table 11: Postoperative complications

TABLE II. COMPLICATION	TABLE I. CASES (%)
TABLE IV. CSF LEAK	TABLE III. 6 (13.3%)
TABLE VI. PARESTHESIA	TABLE V. 6 (13.3%)

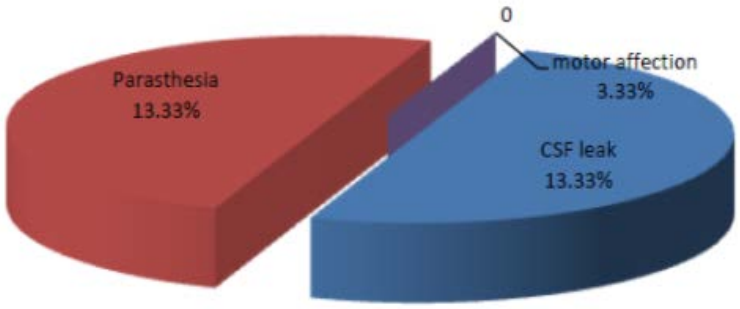

Figure 7: Postoperative complications

Discussion

This study aims at discussing the outcome of surgical management of spinal meningioma and the value of neurophysiological monitoring and somatosensory evoked potentials in the outcome.

Harvey W. Cushing et al. have showed that the incidence of spinal meningioma increases above the age of 40 to 50 [7] as in our study.

Gottfried on, Gluf W and Quinones-Hinojosa A, et al. have showed that the intial symptoms were back pain; the most common, followed by sensory disturbance and motor weakness. [8]. In our study, the initial symptoms were back pain but the most common was combined deficit 18 cases (40 %), followed by motor weakness (33.4%), then sensory disturbance (13.4%),then sphincter disturbance (13.4%).

Birch BD, McCormick PC and Resnick DK et al. have showed that 67 to 84% are found in the dorsal spine followed by cervical spine 14 - 27% then lumbosacral spine 2 - 14 %. [9]

In our study, (60%) occurred in the dorsal spine, 26.7 % occurred in the cervical region and 13.3 % occurred in the lumbar region in a similar rate.

Gezen F, Kahraman S and Canakci Z, Beduk A et al. have showed total surgical resection in 95% of cases and subtotal resection was achieved in 5% of cases. [10]. In our study, total resection was achieved in 39 cases (86.6%) while subtotal resection was achieved in 6 cases (13.4%). Subtotal removal of the tumor is a risk factor for tumor recurrence.

In recent times the techniques become perfect surgical outcomes with minimal morbidity and mortality. In our study 30 cases (66.6%) had excellent results, followed by 9 (20%) cases having good results, 6 (13.4%) had fair results, with no case had bad results.

Histopathological diagnosis include: 39 cases (86.7 %) were WHO G1 (benign meningioma), 6 Cases (13.3%) were Atypical meningioma WHO G2.

While suffering is the initial individual symptom, generality patients complained of paresthesia and motor occurrence at same time of acceptance.

The difficulty in making an early diagnosis may be due to the tumor grows slowly and also it may be caused the produces vague symptoms in the early stages and it was found with pain and transmit pain the same to that found in lumbar disease. For these symptoms, there is lateness from the development of individual symptoms to acceptance.

For that reason, it is approved that spinal meningioma will go into careful thought as a conceivable diagnosis when a patient complains of symptoms that are generally in lumbar diseases, such as intervertebral disc herniation and spinal stenosis.

MRI is considered as being a beneficial tool with consideration to tumors in evaluating the general shape and anatomical relations to especially the dura mater and spinal cord, and in definitive basic therapy guidelines and surgical approaches. In our study, spinal meningioma, which is the second common primary spinal cord tumors, is observed in MRI images as well-circumscribed, broad-based dural attachment homogeneous enhancement isointense to slightly hypointense in T1, isointense to slightly hyperintense in T2.

The main spinal meningiomas are benign and natural and treat surgically with surgical excision mat because they can be isolated facilely from the spinal cord may be caused the being developed of diagnostic and surgical instrumentations and also microsurgical and neuroanesthesia techniques.

In this investigation rearward program was applied in the whole cases despite the prevailing circumstances of the site of the tumor and its relation to the spinal cord. Considerable percentage of the tumors is located ventral to the spinal cord and some authors supposed that reaching a high side or in front process was achieved, for elimination of these tumors [11].

In this current study, we also were especially a professional as we had no difficulties in eliminating cervical and thoracic tumors ventral to the spinal cord. Moreover, a posterior approach was used to preserve the bilateral facet joints and accordingly, spinal fusion may be avoided. Meanwhile, extreme lateral approaches require spinal fusion may be due to elimination of the lamina and the facet joint and therefore we thought extreme lateral or anterior approaches were not essential. In addition, anterior approaches are difficult to apply due to epidural venous bleeding, the limited field of view and elimination of many vertebral bodies.

The factors that affect the prediction include the long time preoperative symptoms, the more acute neurological deficit, the more proximal location of the tumor, the more ventral tumor to the spinal cord, and the worse surgical outcome. From the previous studies, it could be noticed that often the neurological symptoms become better postoperatively in most of the cases but partial improvement was also observed in some cases. In this study it could be observed that early diagnosis and appropriate surgical intervention resulted in good clinical outcome. None of our patients presented clinical deterioration and none of them died.

Low back pain and lower limb pain appeared to excess in patients with such stimuli as walking and coughing during the first postoperative month but no neurological deficit occurred as a postoperative complication.

It is noteworthy that, in any percentage of tumor occupying the intradural space, the degree of preoperative symptoms and the duration of symptoms in neurological deficits postoperative was improved. Moreover, with prolonged or severe neurological symptoms surgical intervention is also recommended for spinal meningioma.

No difference in the outcome in patients operated with electrophysiological monitoring and those operated without that was observed as long as total excision was achieved. In cases with subtotal excision, also no difference as the surgeon stopped the procedure as he did not find a good plan.

Case presentation

Case1

- ✓ **Thirty-five-year-old, housewife, female patient.**
- ✓ **Complaints:**
  - Back pain for 9 months.
  - Bilateral lower limb heaviness for 1 months.
- ✓ **Examination:**
  - Bilateral lower limb weakness Grade IV.
  - Mild hypertonia in both lower limbs.
  - Mild hyperreflexia in both lower limbs.
  - Sensory level at the umbilicus.
  - Continent.
  - No pathological reflexes.
- ✓ **Operative findings:**
  - Excision was performed through posterior approach
- ✓ **Postoperative**: The patient has excellent result pain and weakness improved.
- ✓ **Post operative MRI** was performed showing mass removal at D11,12 level
- ✓ **pathology**: transitional meningioma WHO G1.

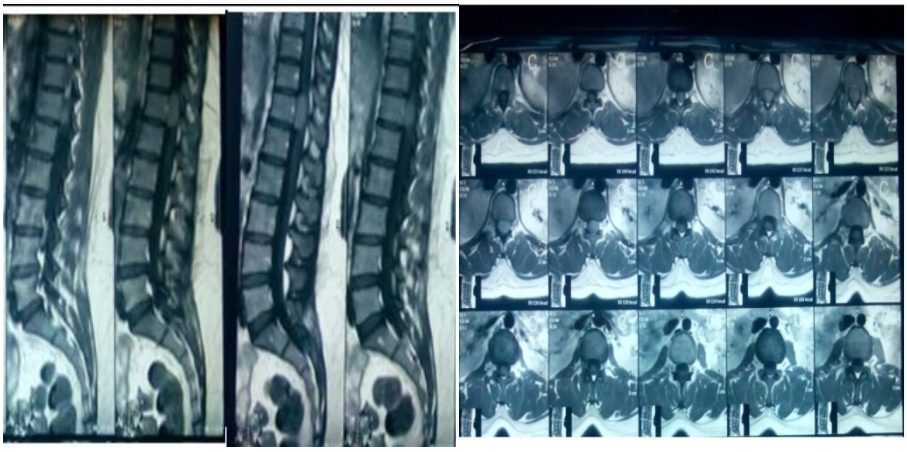

Figure 8: A- preoperative T1-weighted sagittal and axial MRI with contrast showing D12 LESION.

Figure 9: Intra-operative findings of intradural extramedullary mass excision.

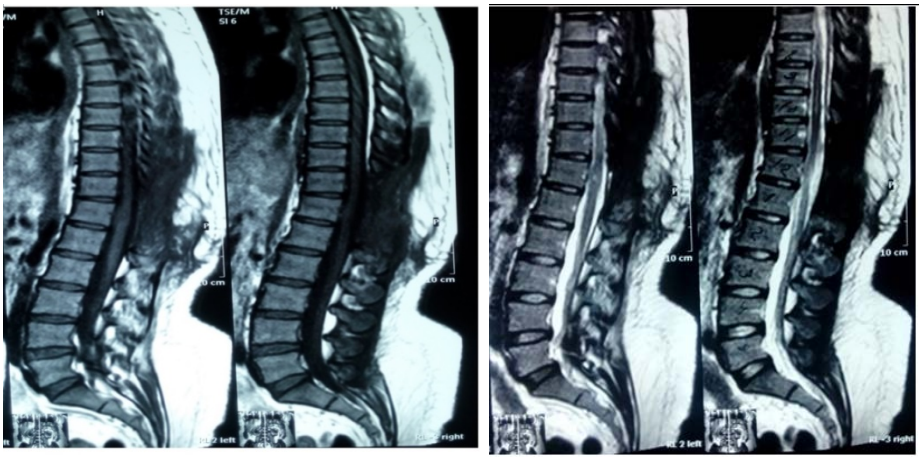

Figure 10 (A): Post-operative T1W AND T2W images MRI showing mass removal at D11-D12 level.

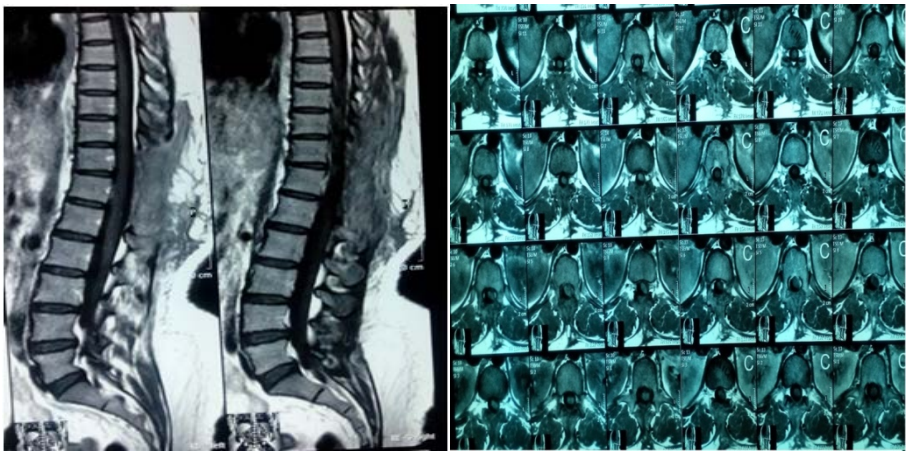

Figure 11- (C) Post-operative sagittal and axial T1W MRI with T1W with contrast showing total resection of the lesion.

Case 2

- ✓ **A female patient, 46 years old, housewife.**
- ✓ **Complaints:**
  - Dull aching neck pain for 4 years.
  - Right upper and lower limb heaviness for 5 years.
- ✓ **Examination:**
  - RT upper and lower limb weakness grade 4.
  - Rt lower limb hypertonia.
  - Rt lower limb hyperreflexia.
  - RT lower limb hypothesia.
  - LT side full motor power.
  - +Ve adductor reflex.
  - +Ve patellar reflex.
  - Rt lower limb hypothesia.
  - Preciptancy of micturition.
- ✓ **Operative:** Excision was performed through posterior approach
- ✓ **Postoperative**: The patient has good result for pain and weakness improved.
- ✓ **Postoperative complication: CSF Leak** occur day 4 postoperative managed by lumbar drain for 5 days and removed after stoppage of leak.
- ✓ **Post operative MRI** was performed showing mass removal at D1,2,3 level
- ✓ **pathology**: WHO G1 meningiothalmutous meningioma.

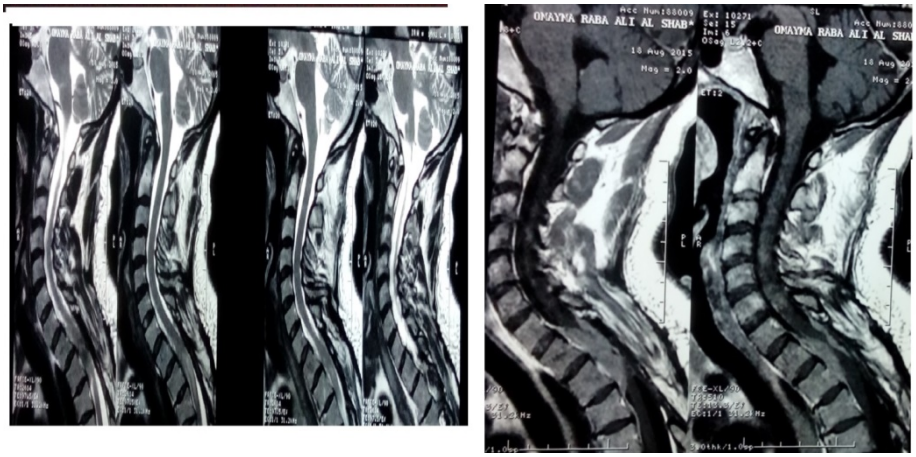

Figure (12): (A): Pre-operative sagittal T1W and T2W Images MRI with contrast.
D1,2,3 meningioma .

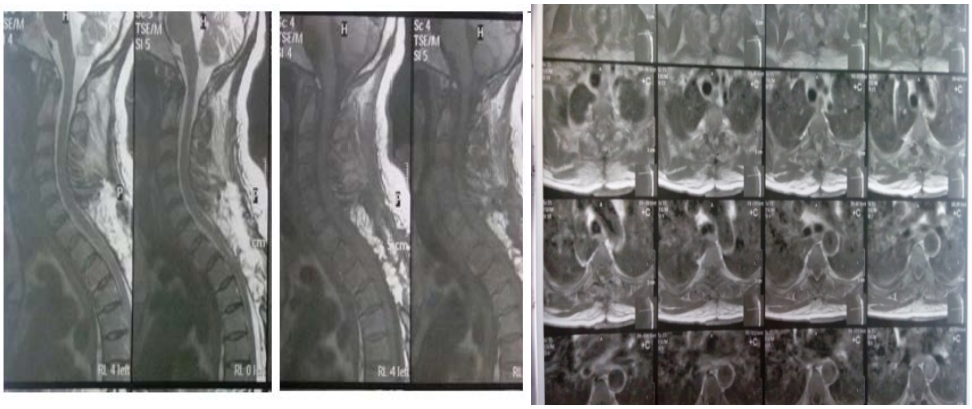

Figure 13 (A): POST-operativa saggital and axial T1 and T2 MRI .

Conclusion

Spinal meningiomas are the second common spinal tumor; 25 : 46% of primary spinal cord tumors they represent 7.5 : 12.7% of all meningiomas of the body, more frequently in females, 67% was females while 33% was males patients with average age of 44 years, frequently present in dorsal spine (60%) followed by cervical (26.7 %) then lumbosacral spine (13.3 %). They are slowly growing, well circumscribed tumors mostly benign in nature in 86.7 % of cases were WHO G1 (benign meningioma) while 13.3% were atypical meningioma WHO G2.

The analysis of early clinical symptoms shows that, the initial symptoms was pain which may be local or radicular in nature but the most common is combined deficit in 40%, followed by motor weakness (33.4%), then sensory disturbance (13.4%), and sphincter disturbance (13.4%).

In our study we concluded that, Postoperatively, remarkable improvements in neurological deficits were achieved as total resection was achieved in 39 cases (86.6%) while subtotal resection was achieved in 6 cases (13.4%), clinically 30 cases (66.6%) had excellent results, followed by 9 (20%) cases having good results, 6 cases (13.4%) had fair results, and no case had bad results. Also no neurological deficit occurred as a postoperative complication for this reason, surgical process of intervention is highly recommended for symptomatic spinal meningioma especially with prolonged or acute neurological symptoms.

However, risk factor as delay in surgical removal can lead to permanent neurological deficit, also age, severe preoperative neurological deficit and if the tumor is ventral to the cord and calcified, surgery becomes hazardous and may damage the cord, and they have been considered as predicators of a poor surgical outcome.

Also we found no difference in outcome between the patients operated with neurophysiological monitoring or not as long as total excision was achieved.

Summary:

In our study, we have discussed the outcome of surgical management of 45 patients with spinal meningiomas. The neurological were evaluated presentation which obtained through the preoperative stage and post-operative continuation, mean post-operative follow up period was 12 months, and factors affecting surgical outcome were revealed.

The analysis of early clinical symptoms shows that, the initial symptom was pain which may be local or radicular in nature, but the most common was combined deficit of motor weakness, sensory disturbance and sphincter disturbance.

Moreover, more advanced therapy guide at preserving and further enhancing the neurological function have been advanced over the past 30 years. For may be caused great strides have been made recently in the prognosis of surgery may be due to the being advanced of diagnostic tools, such as CT and MRI, an understanding the precise anatomical structures, and the advancement of surgical instrumentation and techniques. Postoperatively, remarkable improvements in neurological deficits were achieved as total resection was achieved in majority (86.6%) also clinically, 86.6% had excellent to good results, and no neurological deficit occurred as a postoperative complication. Therefore, surgical intervention is highly recommended for symptomatic spinal meningioma especially with prolonged or severe neurological symptoms, as delay in surgical removal and treatment can lead to permanent neurological deficit. Also risk factor as age, severe preoperative neurological deficit if the tumor is ventral to the cord and calcified, have been considered as predicators of a poor surgical outcome.

Surgery offers the potential for “cure” without the need for further treatment so neurologists and doctors of general practice must pay great attention to complaints of patients and course of illness. When spinal meningiomas was suspected, they must consult a neurosurgeon for surgical removal.

Neurophysiological monitoring did not improve outcome in our study.

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