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Clinicoradiological Factors Predicting Functional Outcome and Recurrence in Spinal Meningiomas

Fahri Eryılmaz[1], Muhammad Amir[2]

[1]Department of Neurosurgery, Ministry of Health Hitit University Çorum Erol Olçok Training and Research Hospital, Çorum, Turkey.
[2]Assistant Professor, Department of Neurosurgery, General Hospital, Lahore.

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ABSTRACT

Background: Purpose spinal meningiomas are benign tumors with an extensive range of radiological and clinical characteristics at the time of demonstration. The writers evaluated several clinical-o-radiographic factors to determine functional outcome and disease recurrence in spinal meningiomas. Place and Duration: This Cohort study was held in the Neurosurgery Department of Lahore General Hospital for three years duration from May 2017 to May 2020. **Methods:** We retrospectively analyzed the radiological and clinical details of subjects who were operated on for tumors of the spinal meningiomas confirmed on histopathology. Demographic characteristics such as race, age, gender and its relationship with type II neurofibromatosis were taken into account. Radiological parameters like spinal cord signal changes, tumor size, number of levels of spinal cord, location was observed for tumor attachment, tumor shape and presence of dura mater / calcification were noted. These aspects were investigated to determine functional outcome and recurrence. **Results:** 45 total patients were enrolled in this analysis. Male gender and radiographic features of the dural tail were related with a higher jeopardy of relapse. Ventrolateral or ventral position, T2 cord signal changes, large tumors, and poor functional status preoperatively were related with poor outcomes functionally after one year of follow-up. **Conclusion:** Spine surgeons need to know the risk factors and natural history of spinal meningiomas in order to ensure a better prognosis for their patients.

Keywords: spinal meningioma; reappearance; functional result; dura mater tail.

INTRODUCTION

Spinal meningiomas are communal tumors of slow-growing in nature supposed to be associated with type II neurofibromatosis (NF2).[1,2] They account for approximately two percent of all meningioma's and 27% to 45% of total intra-dural spinal tumors. Though, they may be in the form of extradural, en-plaque type or dumbbells.[3,4] In most cases, a complete and safe resection with a positive result is possible. Although several studies have discussed the predictors of relapse, the literature relatively rarely reports the combined studies of several clinical radiological factors forecasting resection frequency, relapse and functional outcomes in the long-control cohort study.[5,6] In this analysis, we consider numerous radiological and clinical factors that may impact the above-mentioned endpoint.

MATERIALS AND METHODS

This Cohort study was held in the Neurosurgery department of Lahore General Hospital for three years duration from May 2017 to May 2020. We reviewed 45 patients in this retrospective study to examine the images and clinical parameters of patients operated with histological verification. The ethical committee approval was taken. Demographic characteristics such as race, age, gender and its relationship with type II neurofibromatosis were taken into account. Radiological parameters like spinal cord signal changes, tumor size, number of levels of spinal cord, location was observed for tumor attachment, tumor shape and presence of dura mater / calcification were noted. These aspects were investigated to determine functional outcome and recurrence. The spinal meningioma's patients spreading up to the foramen magnum were not included. The extent of resection was assessed according to the operating notes and confirmed by post-operative MRI (if available) and the Simpson classification system was used for classification. Follow-up images were taken 1 year after surgery. Using the modified McCormick classification system; Functional status was applied to assess the functional status of the patient prior to surgery and follow-up at one-year.

Name & Address of Corresponding Author
Dr. Fahri Eryılmaz
Department of Neurosurgery,
Ministry of Health Hitit University Çorum Erol Olçok Training and Research Hospital,
Çorum, Turkey

Statistical analysis

For statistical analysis; SPSS version 22.0 was used. The radiological and clinical factors are divided into two; the relapse rate (relapse and no relapse) and the functional score (satisfactory recovery, ie Modified McCormick Class I or II versus unsatisfactory recovery, ie Modified McCormick Class III-V were investigated. Variables included were age (above fifty vs below fifty years), gender (males and females), preoperative McCormick's modified class

(I-III and IV-V), tumor size (involvement of spinal canal 75% of the anteroposterior and transverse section), cranio-caudal tumor expansion (1-2 levels compared to more than two levels), attachment location (lateral vs ventrolateral or ventral, dorsolateral or dorsal), absence or presence of signal changes at T2 in the spinal cord, dumbbell shape, dural tail, plaque calcification and location. By using the Kaplan-Meier method; survival analysis was performed. To determine the relationship; binomial regression analysis was done. The independent t-test was used for comparison between the two groups.

RESULTS

Table 1: Clinicoradiological features of the patient cohort

Variable	Value*
Total no. of patients	45
Age in yrs.	
Complete cohort	
Median	63
Range	19–99
w/ NF2	
Median	26.5
Range	19–51
w/o NF2	
Median	68
Range	22–99
Sex	
Male	10 (22.22)
Female	35 (77.78)
Tumor location	
Cervical	12 (26.67)
Cervicothoracic	7 (15.56)
Thoracic	26 (57.78)
Craniocaudal tumor extension	
1–2 levels	39 (86.67)
≥3 levels	6 (13.33)
Relation of tumor to spinal cord	
Ventral	3 (6.67)
Ventrolateral	14 (31.11)
Lateral	22 (48.89)
Dorsal/dorsolateral	3 (6.67)
Extraforaminal extension/dumbbell-shaped	3 (6.67)
Tumor occupying ≥75% of spinal canal in AP & transverse directions	23 (51.11)
T2 hyperintense signal changes	12 (26.67)
Dural tail	8 (17.78)
Calcification	2 (4.44)
Preop MMG	
III	27 (60.00)
IV	16 (35.56)
V	2 (4.44)

Table 2: Surgery, complications, and follow-up

Variable	Value*
WHO grade	
I	39 (86.67)
II	6 (13.33)
Complete resection	
Simpson Grade I	4 (8.89)
Simpson Grade II	41 (91.11)
Overall	39 (86.67)
Complications	
CSF leakage	4 (8.89)
Wound complications	5 (11.11)
Follow-up duration in mos	
Mean	58.9 ± 29.6
Range	19–89
Recurrence	5 (11.11)
RFS	
Median	55
Functional outcome (at 1-yr follow-up)	
Satisfactory outcome†	34 (75.56)
Unsatisfactory outcome‡	11 (24.44)

Table 3: Prognostic factors for recurrence

Variable	Stratification	p Value*
Sex	Male vs female	<0.001
Age	<50 vs ≥50 yrs	0.201
Association w/ NF2	NF2 vs non-NF2	0.605
Race	Caucasian vs African American	0.745
Lesion level	Cervical & cervicothoracic vs thoracic	0.099
WHO grade	I vs II	0.189
Lesion plane	Ventral & ventrolateral vs dorsal & dorsolateral	0.112
Craniocaudal tumor extension	1–2 vs ≥3 levels	0.332
Dural tail	Present vs absent	0.04
Tumor size	Occupying ≥75% of spinal canal in AP & transverse directions vs <75%	0.208
T2 signal intensity changes of spinal cord	Present vs absent	0.951

Table 4: Prognostic factors for improvement

Variable	Stratification	p Value*
Sex	Male vs female	0.745
Age	<50 vs ≥50 yrs	0.909
Association w/ NF-2	NF2 vs non-NF2	0.557
Race	Caucasian vs African American	0.606
Level of lesion	Cervical & cervicothoracic vs thoracic	0.6
WHO grade	I vs II	0.432
Plane of the lesion	Ventral & ventrolateral vs dorsal & dorsolateral	0.003
Cranio-caudal extension of the tumor	1–2 vs ≥3 levels	0.201
T2 signal intensity changes of spinal cord	Present vs absent	0.022
Tumor size	Occupying ≥75% of spinal canal in both anteroposterior & transverse direction vs <75%	0.02
Preop MMG	III vs IV & V	0.003
Dural tail	Present vs absent	0.557

Patient demographic and radiological data

The mean age of the examination populace was 56 years (extend 12 to 92 years), and the male to female proportion was 1: 4.42. Patients with NF2 (n = 6) were younger at presentation than patients without NF2 (p <0.0001). Around 66% of the tumors were in the thoracic region. Calcification was reported in images in just 1 patient. The clinical and radiological

highlights are summed up in Table 1. Table 2 sums up patients with essential tumors from a multicenter relative examination.

The functional status of patients was surveyed utilizing the modified McCormick evaluating framework. Patients were viewed as palatable in 1-year follow-up when they had no shortages or had negligible (modified McCormick grades I and II). In any case, in patients with unaltered or postoperatively adjusted McCormick III-V reviews, the anticipation was viewed as unacceptable. Albeit one patient encountered a transient disintegration in wellbeing after medical procedure, none of the patients was clinically second rate compared to the underlying introduction at 1-year development. Subtleties of the examination are given in Table 4.

DISCUSSION

Demographic characteristics

There are not many populace reports evaluating the frequency of spinal meningiomas. The hospital depended populace report proposed that the frequency extended from 0.5 to 2 for every 100,000 individuals for every year.[7] Given the moderate progression of these tumors, the frequency gives off an impression of being higher. Spinal meningiomas represent 15% to 47% of all essential spinal cord tumors. They are more uncommon than their cranial counterparts and record for under two percent of all CNS meningiomas.[8,9] Notwithstanding, this rate increments in NF2 patients. In NF2 patients, about ten percent of meningiomas necessitating resection are in the spine. Mautner et al. He discovered spinal meningiomas in 33% of NF2 patients. The tumor is much common in the older populace, with the most usual occurrence between the 6th and eighth decades.[10] Be that, spinal meningiomas may happen prior in patients with NF2. As in the current writing, a solid predominance of females was seen in this examination. The clinical course is normally quiet, despite the fact that the more extended term of indications is an autonomous variable of no improvement. Clinical indications differ with the area of the tumor.[11] The most suitable methodology for spinal meningiomas relies upon the area and size of the tumors. For generally dorsal or dorsolateral tumors, a 1 or 2-level hemi laminectomy or laminectomy is adequate. More exposure of lateral side is required for tumors found ventral or ventrolateral to the spine. A costo- transverseectomy or limited vertebrectomy might be essential to enhance exposure and take into consideration more secure expulsion. In such circumstances, instrumentation might be required, especially at the thoracolumbar or cervico-thoracic intersection level. Misra and Morgan recommended an order of the careful passageway to gauge instrument needs. The aim of the surgery is safe and complete resection.[12,13] Dorsolateral or dorsal lesions are simpler to expel. On account of lesions situated in the central area, dissection and sequential debunking might be useful. By and large, a total resection (Simpson I and II) can be performed.[14] Past reports revealed that total resection was accomplished in 82% to 100% of cases. Nonetheless, the requirement for dural resection is questionable. Most surgeons like to coagulate the attachment at dura, however there is extraordinary inconstancy. It has additionally been proposed to respect the dura mater with a patch graft stitch. Nonetheless, by and large, no endeavor was made to respect the dura mater when the tumor was found ventrally.[15] The dura mater strategy might be helpful in situations where the edge of the tumor is cut in progression with the inward dura mater layer. Protection of the external dura mater layer reduces post resection dural defect, forestalls CSF spillage. Repeat medical procedure is troublesome because of the scarring of the arachnoid and by making an unmistakable planning plane. It has been recommended that the intraoperative ultrasound permits the restriction of the tumor.[16] It likewise permits to survey the helpfulness of the operational passage. We found that intraoperative ultrasound might be particularly helpful for tumors found centrally, yet may not be vital for dorsolateral or dorsal lesions. Uniform hyperechoic echogenicity deprived of cystic changes can recognize meningiomas from neural sheath tumors grounded on intraoperative ultrasound when the preoperative images are suspected. Intraoperative checking (motor evoked potential or somatosensory evoked potential) may likewise be valuable.[17] Whittle et al. proposed that twofold observing of somatosensory evoked potential and motor evoked potential was better than either alone. Nonetheless, in late reports, intraoperative neurophysiology has not been utilized. Complete resection with no neurological disintegration was conceivable even without intraoperative observing. The dreariness and death rates revealed in past reports of spinal meningiomas have been low. The fundamental driver of mortality was pulmonary embolism in the postoperatively.[18] Cerebrospinal liquid spillage and wound difficulties were the greatest widely recognized careful intricacies, happening in 0–5% and 0–7% of patients, separately. Many of spinal meningiomas are allocated WHO grade I and II. The evaluation of meningiomas relapse is lesser in the spine as compared to the skull. Setzer et al. discovered that the histopathological grade was a free indicator of tumor relapse. The WHO classification framework for meningiomas was low before 2000. The rules for distinguishing atypical meningiomas were not uniform. Setzer et al. They testified 1.5%, 52%, and 98% relapse rates for WHO Grade I, II, and III lesions, separately.[19] There was no relationship between the functional outcome and histological subtypes. Maiuri et al. discovered a higher Ki-67

labelling index in recurrent spinal meningiomas (p = 0.00012). The importance of adjuvant spinal meningioma treatment is disputable. While early reports propose that CyberKnife frameless stereotactic radiosurgery is a reasonable and viable choice, it is just utilized in a couple of focuses. The spinal meningiomas chemotherapy reports are constrained and the result is unsuitable. In the current associate, no patients got stereostatic radiosurgery or chemotherapy.[20] The spinal meningiomas recurrence ratio is low. Be that as it may, while thinking about relapse of spinal meningiomas, the term of development and histological assessment of the tumors ought to be painstakingly evaluated. When all is said in done, spinal meningiomas reoccur less regularly than intracranial meningiomas.[21] Mirimanoff et al. detailed that the five-year and ten-year ratio of progression recurrence of spinal meningiomas were 0.5% and 12.8%, individually. This frequency was lesser as compared of parasagittal (18% and 24%), convexity meningiomas (3% and 25%) and the sphenoid ridge (35% and 56%). In the 78 spinal meningiomas report by King et al. Just recorded 1 relapse 13 years later to the primary surgery.[22] Duty et al. what's more, Solero et al. It worked out that the recurrence rates were 3.1% and 6.4%, separately. Klekamp and Samii announced fundamentally advanced relapse: 22% following 1 year and 41.03% following five years, unmistakably not quite the same as the remainder of the reports. Numerous clinical radiological components are related with higher relapse rates. Cohen-Gadol et al. more young patients (<50 years) have been accounted for with cervical meningioma; Epidural spread and plaque expansion were related with a higher recurrence than in old patients. Maiuri et al. They additionally announced more recurrence in the more youthful populace. Klekamp and Samii announced that atherosclerotic plaque or arachnoid scarring, penetrating meningiomas and incomplete resection were altogether connected with more relapse.[23] Nakamura et al. It worked out that the relapse ratio was lower with Simpson I resection than with Simpson II resection. Conversely, King et al. Detailed a low repeat rate even without tire resection. Various reports show a higher occurrence of atypical and anaplastic meningiomas in men. The recurrence rate was characterized as higher in men considering all histopathological evaluations of intracranial meningiomas. The tail of a dura mater can be found in up to half of spinal meningioma cases.[24] Nonetheless, its relationship with recurrence has once in a while been surveyed. At last, long follow-up is fundamental for these patients as late backslide is the standard instead of the special case.

Functional Outcome

Given that various sizes of useful scores have been portrayed in the writing, an immediate examination is beyond the realm of imagination. Different creators have utilized the Frankel grade, Nurick or the modified Japanese Orthopedic Society score.[25] In spite of the fact that the McCormick grade (or modified McCormick grade) was initially used to evaluate intramedullary tumors, numerous surgeons have utilized it to assess functional results. Setzer et al. Arachnoid invasion and McCormick's grades are autonomous indicators of a poor long-haul outcome. Different reports recommend an expanded frequency of ventral meningiomas, plaque and intra-tumor calcification.[26] Be that as it may, in a large portion of these reports, the investigation of radiological operators isn't finished. The size of the tumor didn't influence the functional outcome in the Schaller report.

CONCLUSION

Spinal meningiomas can have diverse radiographic signs. Young patients with spinal meningioma ought to be assessed for NF2. Though, uncommon in men, relapse ratio is more usual. The dural tail presence ought to be deliberately examined to anticipate recurrence. Patients with a dural tail on imaging ought to experience long haul follow-up as late relapsing rate is usual. Huge tumors with attachment at ventral side that because signal changes in the spinal cord are related with poor practical results. Complete meningioma resection may bring about recuperation; however the guarded prognosis is saved for those with serious preoperative neurological issues.

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