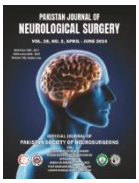

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Original Research

Intracranial Meningioma; Assessment of Tumor Size and Clinical Feature on First Presentation

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ABSTRACT

Objective: To assess the tumor size of intracranial meningioma on first presentation and their clinical features.

Materials & Methods: A prospective review of patients undergoing meningioma resection at the Neurosurgery department, Jinnah Postgraduate Medical Center, Karachi was performed. The clinical records and imaging studies of 43 patients with intracranial meningiomas were analyzed. The data was collected for tumor size, location, first symptom, and clinical features.

Results: There were 31 (72.1%) female and 12 (27.9%) male patients with a mean age of 45.6 years (std: 8.18 years). convexity and Parasagittal meningiomas had the highest frequency (32.6% and 30.2% respectively). The average tumor size was greater than 60mm (44.2%). Skull base tumors presented with a size of more than 60mm (60.0%), followed by convexity meningiomas (57.1%). The most common initial symptom was headache (46.5%) followed by seizures (11.6%). The patients presenting with a duration greater than 24 months (32.6%) had a size greater than 60mm (57.1%). Convexity and skull base meningiomas presented lately greater than 24 months of duration (50%), however, parasagittal meningioma generally presented earlier in less than 6 months of duration 53.8%.

Conclusion: Tumor size location, and clinical features at the first presentation are interlinked**.** Larger tumors were found on the first presentation, with headache and seizure being the most common clinical features. The location also contributed to the early or late presentation of meningioma patients. The association shown between the size and first symptom may be explained by a symptom's tolerance, location, and ongoing medical treatment.

Keywords: Meningioma, Excision, Space Occupying Lesion, Supratentorial, Clinical Features.

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INTRODUCTION

The most frequent benign primary intracranial, extra-axial tumor is meningioma. They are more

prevalent in women, and as people age, so does their prevalence increases.[1] Meningioma usually develops slowly and originates from the meninges, which are the membranes that encircle the brain and spinal cord.[2]

The majority of arachnoidal cap cells, which are the source of meningiomas, are found close to the venous sinuses. This is the area where meningioma production is most common. Certain meningiomas may originate from pial cap cells that move into the brain parenchyma during development along with blood arteries.[3]

Histologically, meningioma cells are generally homogeneous and have a propensity to form whorls and psammoma bodies (calcific concretions laminated on top of one another). Because of this, they are also highly vascularized and have a propensity to calcify.[4]

Excessive radiation exposure, such as that experienced during radiation therapy, familial history of the disorder, and neurofibromatosis type 2 are risk factors.[5,6] Women are diagnosed around twice as frequently as men are (2:1), which is correlated with the production of endogenous hormones like estrogen. Association between menopause and risk of meningioma is also being observed.[7] Obesity is also one of the known risk factors.[8]

Small asymptomatic tumors (e.g., <2.0 cm) usually are incidentally found at autopsy. Large symptomatic tumors may cause symptoms, depending on the size and location.

Tumors overlying the parasagittal/ frontoparietal area may be the source of progressive spastic weakness in the legs and urinary incontinence. Meningioma overlying the cerebrum may be the cause of focal seizures. Sylvian tumors can induce a wide range of motor, sensory, aphasic, and seizure symptoms. Even while it happens less frequently than in gliomas, increased intracranial pressure eventually happens. If associated pressure results in Oculomotor and/ or Abducens nerve palsy, symptoms such as diplopia (double vision) or anisocoria (uneven pupil size) may be present.

Because meningiomas are extra-axial and vascularized, they are easily visible with contrast CT, MRI with gadolinium, and arteriography. When spinal fluid is obtained through lumbar puncture, it is usually observed that CSF protein levels are high. They may have a classic dural tail sign on T1-weighted contrast-enhanced MRI, which is missing in certain uncommon kinds of meningiomas.

Meningiomas included 39% of all brain tumors and 54.5% of non-malignant brain tumors recorded between 2014 and 2018, with a higher frequency of occurrence in females than in males, according to the Central Brain Tumour Registry of the United States (CBTRUS).[9]

Meningiomas are categorized into 3 histopathological grades by the WHO (Benign-1, Atypical-2, Anaplastic/malignant-3, with 70%–95% of meningiomas being classified as WHO grade I).[9]

Symptomatic tumors are treated primarily with surgery and/or radiotherapy.[10] The WHO grade II and III meningiomas are usually more aggressive, with higher rates of mitosis, and have a greater chance of recurrence after surgery, depending on the extent of resection.[11] They may require adjuvant treatment with radiotherapy as well.[12] Chemotherapy has been found of very little role.[13]

Advancements in imaging techniques have allowed for the exact size of a space-occupying lesion to be determined. Tumors at variable locations have variable sizes at initial presentation.

Tumors at different variable locations cause different signs and symptoms accordingly. Small tumors at a variable location might cause severe symptoms while the same histological tumor at a different variable location might cause a lesser degree of signs and symptoms.

The study aims to assess the tumor size on initial presentation and their relationship with variable location and the duration of symptom, i.e. smaller symptomatic and larger size tumors along with the location of the tumor at which they present earliest and lately, the duration of symptom at which the greatest frequency of

patients present and their clinical features on the first presentation leading to better assessment and management of the patients presenting with intracranial meningiomas.

MATERIALS AND METHODS

Study Design & Setting

A prospective cross-sectional descriptive study was carried out at the Department of Neurosurgery, Jinnah Postgraduate Medical Centre Karachi from August 2023 to January 2024. In Total, 43 patients diagnosed with intra-cranial meningioma were admitted and underwent surgical procedures during this duration. Demographic details, location and size of the tumor on imaging, predisposing factors, clinical presentation with duration, and outcomes were all analyzed in the medical data.

Inclusion Criteria

All age patients who were diagnosed with intracranial meningioma were included. Other factors considered for inclusion were the availability of clinical notes, examination, imaging, and histological confirmation of the diagnosis.

Exclusion Criteria

Previously operated patients, recurrent disease, intraspinal meningioma, Patients lost to follow-up, and patients who have life-threatening co-morbidities are excluded from this study.

Pre-op Evaluation

For each case, the demographic information was obtained for gender and age at the time of surgery.

- The variable size was considered as the largest diameter of the lesion in mm in either sagittal, coronal, or axial planes, obtained by direct measurement on the imaging examination films (magnetic resonance). The size was categorized into 4 groups: less than 20mm, 20-40mm, 40-60mm, and greater than 60mm.
- Location of the lesion: Tumor locations were assessed from radiology and operative reports, which included convexity, falx, parasagittal, tentorium, cavernous sinus, clinoid, parasellar, tuberculum sellae, planum sphenoidale, olfactory groove, orbital, middle fossa, sphenoid wing, clivus, cerebellopontine angle, posterior fossa, petroclival, petrous, foramen magnum, jugular foramen, skull base, intraventricular, and multifocal. The location of the tumor was further categorized into 4 groups: (1) **parasagittal/falcine** (2) **convexity** (3) **skull base tumors** and (4) **others**. Skull base location included tumor of cavernous sinus, cerebellopontine angle, clinoid, clivus, foramen magnum, jugular foramen, middle fossa, olfactory groove, orbital, parasellar, petroclival, petrous, planum sphenoidale, posterior fossa, sphenoid wing, and tuberculum sellae. Other locations included tentorial, intraventricular, and multifocal tumors that could not be easily classified into skull base, convexity, or parasagittal/falcine locations.

The first symptom and its duration were evaluated by taking history from the patients. The symptoms included headache, seizures, sensory weakness, motor weakness, aphasia, higher mental function impairments, and others.

The duration of symptoms was noted from the initial complaint till the time of surgery and was categorized into 4 groups (1)**less than 6 months** (2) **6-12 months** (3) **12-24 months** (4) **greater than 24 months**.

Informed written consent was taken from all of the patients.

Statistical Analysis

SPSS version 25 was used to analyze the data and descriptive statistics were used. Mean and standard deviation was calculated for the

quantitative data i.e. demographic data. For qualitative data (i.e., variable size, location, first initial symptom, and duration of the symptoms) frequency and percentages were calculated. The chi-square test was used to see the relationship between the size of the tumor, the location of the tumor, and the duration of the symptom at the first presentation by calculating the p-values between them.

Table 1: Demography and Descriptive Analysis.

Characteristics	Subgroups	Number (n)	Percentage (%)
Gender	Male	12	27.9%
	Female	31	72.1%
Size	<20mm	3	7.0%
	20-40mm	9	20.9%
	40-60mm	12	27.9%
	>60mm	19	44.2%
Location	Parasagittal/Falcine	13	30.2%
	Convexity	14	32.6%
	Skull base	10	23.3%
	Others	6	14.0%
Headache	Present	20	46.5%
	Absent	23	53.5%
Seizures	Present	5	11.6%
	Absent	38	88.4%
Motor weakness	Present	5	11.6%
	Absent	38	88.4%
Sensory weakness	Present	2	4.7%
	Absent	41	95.3%
Vision impairment	Present	3	7.0%
	Absent	40	93.0%
Olfactory impairment	Present	1	2.3%
	Absent	42	97.7%
Speech	Present	1	2.3%
	Absent	42	97.7%
Mental impairment	Present	3	7.0%
	Absent	40	93.0%
Syncope	Present	2	4.7%
	Absent	41	95.3%
Duration of symptom	<6months	17	39.5%
	6-12 months	6	14.0%
	12-24 months	6	14.0%
	>24 months	14	32.6%

RESULTS

Age & Gender Distribution

Out of a total of 43 patients, the majority of patients belonged to the adolescent age group. The mean age of the patients was 45.6 years (standard deviation: 8.18 years) as given in Table 1. The minimum age reported was 29 years and the maximum age was 68 years.

Around 27.9% (n=12) were predominantly males while 72.1% (n=31) were females.

Distribution by Size

The distribution of the meningiomas by size is detailed in Table 1, showing the highest percentage 44.2% (n=19) observed with size greater than 60mm of size, followed by 27.9% (n=12) observed in size ranging from 40-60mm. Only 7% (n=3) of patients presented with a size less than 20mm.

Distribution by Location

The distribution according to location is shown in Table 1, showing the greater occurrence of tumors in convexity (32.6%, n=14) and parasagittal location (30.2%, n=13). The skull base tumors occurred in 23.3% (n=10) of the patients.

Initial Symptom

In our studied group, approximately 46.5% (n=20) of the patients presented with the initial first symptom of headache, representing the most common initial clinical feature or symptom. Around 11.6% (n=5) presented with complaints of

seizures as the initial symptom. A few of the patients also had motor or sensory weakness along with higher mental function impairment as the initial clinical feature.

Table 2: cross-tabulation showing the size of meningioma vs location of meningioma.

		Parasagittal/ Falcine	Convexity	Skull Base	Other	Total	P value
Size	<20mm	2 (66.7%)	0 (0.0%)	0 (0.0%)	1 (33.3%)	3	
	20-40mm	3 (33.3%)	2 (22.2%)	2 (22.2%)	2 (22.2%)	9	
	40-60mm	4 (33.3%)	4 (33.3%)	2 (16.7%)	2 (16.7%)	12	0.580
	>60mm	4 (21.1%)	8 (42.1%)	6 (31.6%)	1 (5.3%)	19	
Total		13 (30.2%)	14 (32.6%)	10 (23.3%)	6 (14.0%)	43	

Table 3: cross-tabulation showing the size of meningioma vs duration of symptom.

		DURATION OF SYMPTOMS				Total	P value
		<6 Months	6-12 Months	12-24 Months	>24 Months		
Size	<20mm	2 (66.7%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	3	
	20-40mm	5 (55.6%)	0(0.0%)	1 (11.1%)	3 (33.3%)	9	
	40-60mm	5 (41.7%)	3 (25.0%)	1 (8.3%)	3 (25.0%)	12	0.493
	>60mm	5 (26.3%)	2 (10.5%)	4 (21.1%)	8 (42.1%)	19	
Total		17 (39.5%)	6 (14.0%)	6 (140%)	14 (32.6%)	43	

A greater number of patients presented earlier i.e. less than 6 months of duration were 39.5% (n=17). Another peak was found with a duration greater than 24 months with the presentation of 32.6% (n=14).

When the size of the tumor was compared with the location of the tumor, the correlation was found to be insignificant (P-value: 0.580), as shown in Table 2. It was found that only 7% (n=3) patients presented with size less than 20mm, however, most of the convexity meningiomas (n=8) presented with size more than 60mm, followed by skull base tumors (n=6).

When the size of the tumor was compared with the duration of the symptom as shown in Table 3, it was observed that those patients who presented earlier in less than 6 months of duration, had a trend of equal distribution in the sizes of the tumor (P-value: 0.493). Of the patients who had presented with a size greater than 60mm, most (42.1%, n=8) presented after a duration of symptoms for more than 24 months.

In Table 4, it was observed that parasagittal meningioma generally presented early with less than 6 months of duration 41.2% (n=7). The convexity meningioma presented late with greater than 24 months of duration (50% n=7) but we didn't find any strong relationship between the size of the tumor and the location of the meningioma (p value=0.331).

Table 4: cross-tabulation showing the duration of symptom vs location of meningioma.

		LOCATION				Total	P value
		Parasagittal/Falcine	Convexity	Skull Base	Other		
Duration of Symptom	<6 Months	7 (41.2%)	3 (14.6%)	4 (23.5%)	3 (17.6%)	17	
	6-12 Months	3 (50.0%)	2 (33.3%)	0 (0.0%)	1 (16.7%)	6	
	12-24 Months	2 (33.3%)	2 (33.3%)	1 (16.7%)	1 (16.7%)	6	0.331
	>24 Months	1 (7.1%)	7 (50.0%)	1 (7.1%)	5 (35.7%)	14	
Total		17 (39.5%)	6 (14.0%)	6 (140%)	14 (32.6%)	43	

DISCUSSION

The female predominance of these tumors, also seen in our study, is very well known. A study conducted by Magill et.al included 73.9% females and 26.1 % males with a mean age of 55.7 years ranging from 8 to 90 years old, showing female predominance.[14] In our study, women are more commonly diagnosed with intracranial meningioma as compared to males. However, the hypothesis of larger tumors predominating in females is not supported by our study. According to studies, it has also been shown that tumors lacking progesterone receptors tend to be larger, concerning female sex hormone receptors.[15] There could be additional factors that are associated with the growth of the tumor, which could explain why certain lesions grow to larger sizes while others don't. Another Study has shown that no matter where the tumor is located or whether the patient is male or female, both of which are established risk factors. Larger tumors are linked to a higher chance of a meningioma becoming WHO grade II.[14]

A study conducted on meningioma locations in the United States showed similar findings. Convexity meningiomas were reported in 20.8% of all the patients, this was the most common tumor location.[9] However, our study showed convexity and parasagittal meningioma commonly reported in 32.6% of the patients diagnosed with intracranial meningiomas, with the highest number of patients having a mean size of greater than 60mm.

According to our study, only a few patients are found to have meningiomas less than 20mm suggesting that tumors less than 20mm in size generally get noticed by the patients, causing only fewer clinical symptoms. Mascarenhas et al, reported that patients having meningiomas with a mean size of 29.35 mm had lesser clinical features and fewer or no complications after tumor resection, supporting our study.[16]

Skull base meningiomas are most commonly observed in size greater than 60mm, followed by convexity meningiomas, in our study. These were also known to have a greater duration of symptoms. The hypothesis that a large tumor takes a longer time to develop, therefore appearing in older patients or patients with a long duration of the first symptom is supported by our study, although we didn't find any strong correlation based on the p-value. However, patients having a shorter duration of symptoms are equally distributed among tumors of all sizes.

In another study by Carvi et al, an average volume of 60 cc was observed in anterior skull base tumors, with an average greatest diameter variation of 1.5mm, similar findings are being observed in our study.[17]

Another observation found in our study is parasagittal meningioma and tentorial meningiomas have a trend of presenting earlier usually less than six (6) months in duration. In contrast, skull base tumors along with convexity meningiomas present very late. It could be assumed, the fact that parasagittal meningiomas may get early noticed by the patients by causing symptoms i.e., neurological deficits leading to earlier presentation of the patient to seek medical attention. It could also be due to the reason that the parasagittal region does not admit enough space and causes earlier involvement of the brain parenchyma. Skull base and convexity meningiomas have enough space causing less severe symptoms to the patient, leading to a delay in diagnosis. Although few patients presented with this common trend based on the location the overall relationship between the duration of symptoms and the location of the meningioma was not significant in our study and also not well documented in the literature.

Assuming that the patient who presents to us with a longer duration of the symptom has greater mean size, at a location that easily permits the growth of the tumor in larger volume and the patient only has a sign of headache which patient easily neglects at an early age could be due to

multiple possible factors such as socioeconomic status, non-availability a tertiary care hospital, non-availability of funds to reach medical attention or investigation, self-negligence, seeking nonmedical treatments, lack of educational awareness, etc.

Higher mental function impairment has been linked to greater lesions, according to studies. This specific symptom may not cause much discomfort to the patient and family and may go unrecognized, which delays the diagnosis and gives the tumor more time to spread.

The larger a lesion gets, the more likely it is that it will interfere with functionally important areas and that the nervous system's adaptation and healing processes will eventually wear down. This could account for the association observed between larger lesions and unusual physical test findings.

CONCLUSION

The association shown between the size and kind of first symptom may be explained by a symptom's tolerance, ease of discovery, measurability, and objectivity. This inference lends credence to our contention that, despite Pakistan's designation as an LMIC (low and middle-income country), the disease may not truly be rare there; rather, meningiomas may be going undiagnosed. It is imperative to fortify healthcare systems and raise public knowledge of meningioma symptoms, diagnosis, and treatment.

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Additional Information

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AUTHORS CONTRIBUTION

S. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1	Haris Hamid	Study design and methodology.
2	Iram Bokhari	Literature review and referencing.
3	Arfa Qasim	Final review and approval.
4	Bushra Maqsood	Data collection and calculations.
5	Asra Aslam	Interpretation of results.
6	Farrukh Javeed	Analysis of data.