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Profile of Meningioma based on Imaging and Histopathology at Dr. Saiful Anwar Hospital, Malang

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ABSTRACT

Introduction: Meningiomas are common central nervous system tumors originating from meningothelial cells. Imaging examinations are widely used to characterize lesion features, while histopathological evaluation remains essential for definitive diagnosis and grading.

Material and Methods: This study was a retrospective descriptive study conducted using secondary data from medical records of patients diagnosed with meningioma at RSUD Dr. Saiful Anwar Malang between 2020 and 2023. Data included demographic characteristics, imaging findings from CT and MRI examinations, and histopathological grading.

Results: Most meningioma cases occurred in female patients (85%), with the highest proportion observed in the 40–60-year age group (65%). According to the WHO classification, grade I meningiomas were the most common (69%). The frontal region was the most common tumor location (25%), followed by involvement of multiple regions (35%). Solitary meningiomas accounted for 87% of cases. Most tumors had a maximum diameter of 4–6 cm (67%). Imaging findings commonly included dural tail (51%), hyperostosis (53%), and peritumoral vasogenic edema, which was qualitatively identified in all cases.

Conclusion: This retrospective descriptive study demonstrates the demographic distribution, imaging characteristics, and histopathological grading of meningioma cases at a tertiary referral center. Imaging features such as dural tail, hyperostosis, and peritumoral edema were frequently observed; however, histopathological examination remains the gold standard for definitive diagnosis and grading of meningioma.

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INTRODUCTION

Meningiomas are primary central nervous system tumors arising from meningothelial cells and represent one of the most frequently diagnosed intracranial neoplasms [1,2]. According to the World Health Organization (WHO) 2021 classification, meningiomas are categorized into three grades: grade I (benign), grade II (atypical), and grade III (anaplastic), based on histopathological and molecular characteristics [1,3–5].

Although meningiomas account for a substantial proportion of primary brain tumors worldwide, many cases are discovered incidentally during neuroimaging examinations due to the absence of pathognomonic clinical manifestations. Clinical presentation is often nonspecific and may

include headache related to increased intracranial pressure, focal neurological deficits, or seizures secondary to mass effect [1,4–11].

Imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) play an important role in the initial evaluation of intracranial lesions by providing information regarding tumor location, size, and associated features. However, imaging findings alone are insufficient for definitive diagnosis and grading, and histopathological examination remains essential to guide appropriate management [1,11].

Therefore, this study aimed to describe the demographic characteristics, imaging findings, and histopathological grading of meningioma cases at RSUD Dr. Saiful Anwar Malang during the period 2020–2023.

MATERIAL AND METHODS

Study Design and Setting

This study was a retrospective descriptive study conducted at Dr. Saiful Anwar General Hospital, Malang, East Java, Indonesia. The study aimed to describe the demographic, radiological, and histopathological characteristics of meningioma cases based on medical record data collected between January 2020 and December 2023.

Study Population and Sampling

The study population comprised all patients diagnosed with meningioma registered at Dr. Saiful Anwar General Hospital during the study period. A total sampling technique was applied using a non-probability sampling method.

Inclusion criteria were patients with a confirmed diagnosis of meningioma who had undergone brain imaging examinations (CT and/or MRI) and histopathological evaluation. Patients with incomplete medical records or missing imaging or histopathological data were excluded from the study. As this study was retrospective and descriptive, no prior sample size calculation was performed.

Imaging Evaluation

Imaging data were obtained from contrast-enhanced computed tomography (CT) scans and/or magnetic resonance imaging (MRI) examinations performed as part of routine clinical care, in accordance with standard institutional protocols. MRI examinations included standard sequences, namely T1-weighted, T2-weighted, and post-contrast T1-weighted images. Contrast-enhanced CT scans were used to assess tumor characteristics, including location, size, presence of calcification or hyperostosis, and bone involvement.

Radiological variables evaluated in this study included tumor location, number of lesions (solitary or multiple), maximum tumor diameter, presence of dural tail sign, presence of hyperostosis, and presence of peritumoral edema. Tumor size was defined as the maximum diameter of the lesion measured on axial, coronal, or sagittal planes, based on the largest dimension reported in the radiological examination.

Assessment of Peritumoral Edema

Peritumoral edema was assessed qualitatively based on imaging findings documented in the official radiology reports available in the medical records. Edema was recorded as either present or absent. Quantitative measurement or grading of edema severity was not performed.

Histopathological Evaluation

Histopathological data were obtained from anatomical pathology reports. Tumors were classified according to the World Health Organization (WHO) grading system into grade I, grade II, or grade III meningioma based on histopathological findings.

Statistical Analysis

Data were analyzed using descriptive statistical methods. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented using descriptive statistics. No inferential statistical analysis was performed, as the study was designed as a retrospective descriptive study. Data analysis was performed using standard spreadsheet-based descriptive analysis.

Ethical Approval

This study was approved by the Health Research Ethics Committee of Dr. Saiful Anwar General Hospital, Malang (Approval No. 400/215/K.3/102.7/2024). Patient confidentiality was maintained throughout the study, and all data were anonymized before analysis.

RESULTS

Female patients accounted for the majority of cases (85%), with a marked predominance in the 41–60-year age group. Detailed demographic characteristics, histopathological grading of Meningioma (WHO grade), and tumor location analysis showed that the frontal region was the most common single location, while involvement of multiple regions accounted for the largest proportion of cases. Study subjects are presented in Table 1.

Table 1. Demographic Characteristics of Study Subjects, histopathological grading of Meningioma (WHO grade), and tumor location

Variable	n	%
Gender		
Male	8	15
Female	47	85
Age (years)		
20-40	9	16
41-60	36	65
>60	10	18
WHO Grade		
Grade I	38	69
Grade II	16	29
Grade III	1	2
Location		
Frontal	14	25
Temporal	8	15
Occipital	3	5
Parietal	1	2
Suprasellar	3	5
Sphenoid wing	3	5
Olfactory groove	2	4
Convexity	1	2
CPA	1	2
Multiple regions	19	35

Most meningiomas presented as solitary lesions, with multiple tumors observed in a smaller proportion of cases (Table 2).

Table 2. Distribution of Tumor Quantity

Quantity	n	%
Single	48	87
Multiple	7	13

Most tumors had a maximum diameter of 4–6 cm. Peritumoral edema was observed in all cases. The dural tail sign and hyperostosis were present in approximately half of the cases (Table 3).

Table 3. Radiological Characteristics of Meningioma Cases

Imaging Characteristics	n	%
Tumor size (maximum diameter)		
< 3 cm	7	13
4-6 cm	37	67
> 7	11	20
Peritumoral edema		
Present	55	100
Not present	0	0
Dural Tail		
Present	28	51
Not present	27	49
Hyperostosis		
Present	29	53
Not present	26	47

DISCUSSION

Demographic Profile

This study demonstrated a predominance of meningioma cases in female patients (85%), which is consistent with previous reports indicating a higher incidence of meningioma among women, particularly during the third to sixth decades of life [1,5,6]. Hormonal factors have been widely proposed as a contributing mechanism, especially during reproductive age, when exposure to endogenous and exogenous hormones is higher. Studies by Custer et al. and Wahyuhadi et al. have reported an association between exogenous hormone exposure, including hormonal contraceptive use, and an increased risk of meningioma in female patients [12,13].

A meta-analysis by Qi Zhen-Yu et al. further supports this association, demonstrating that prolonged exposure to exogenous hormones increases the risk of meningioma development. Estrogen is known to modulate cellular proliferation and accelerate the cell cycle through transcriptional mechanisms, potentially promoting tumor growth and inhibiting apoptosis [12,14]. Consistent with these findings, Korhonen et al. reported that 80.6% of meningioma cases occurred in female patients, while studies from India similarly reported female predominance ranging from 68% to over 80% [15,16].

Regarding age distribution, the highest frequency of meningioma cases in this study was observed in patients aged 41–60 years. This finding aligns with national data from Indonesia and international studies reporting an increasing incidence of meningioma with advancing age [17]. Hormonal fluctuations during the perimenopausal period, followed by a decline in hormone levels after menopause, have been proposed as contributing factors influencing the age-related distribution of meningioma cases [14,18,19].

Imaging-Histopathology Correlation

Histopathological evaluation showed that WHO grade I meningioma was the most common subtype in this study, followed by grade II and grade III tumors. These findings are consistent with previous institutional and population-based studies reporting WHO grade I meningioma as the predominant subtype [2,4,20,21]. The predominance of WHO grade I tumors has been attributed to higher expression of progesterone and estrogen receptors, which are more frequently observed in benign meningioma subtypes compared to higher-grade tumors [16].

This hormonal receptor expression may also explain the higher proportion of WHO grade I tumors observed among female patients compared to male patients, who tend to present more frequently with higher-grade meningiomas [5,22]. However, due to the descriptive nature of this study, no statistical association between imaging features and WHO grade was assessed.

Comparison with the Regional and Global Data

Regarding tumor location, the frontal region and involvement of multiple regions were the most commonly observed sites in this study. These findings are generally consistent with previous literature reporting frequent involvement of the frontal, temporal, convexity, and parasagittal regions, reflecting the tendency of meningiomas to arise along the dural venous sinuses and the convex surfaces of the brain [15,23,24]. Differences may influence variations in tumor location distribution across studies, populations, and institutional referral patterns [25].

Most meningiomas in this study presented as solitary lesions (87%), consistent with prior reports indicating that meningiomas are predominantly solitary tumors, with multiple meningiomas being relatively uncommon [25,26].

Clinical Implications

Peritumoral edema was observed in all cases included in this study. Vasogenic edema is a well-recognized imaging feature of meningiomas and has been reported in a substantial proportion of supratentorial meningioma cases [27]. The development of peritumoral edema has been associated with vascular endothelial growth factor secretion by tumor cells, leading to increased vascular permeability and subsequent edema formation in the adjacent brain parenchyma [28]. In this study, edema assessment was qualitative and based on radiology reports, which may have contributed to the high observed prevalence. This finding should therefore be interpreted with caution.

Tumor size analysis showed that most lesions had a maximum diameter of 4–6 cm. Larger tumor size has been associated with an increased incidence and severity of peritumoral edema, which in turn has been linked to higher rates of postoperative complications and recurrence in previous studies [28].

The dural tail sign was identified in approximately half of the cases. Although considered a characteristic imaging feature of meningioma, the dural tail sign is not universally present. It may also be observed in other intracranial pathologies, such as lymphoma and pituitary adenoma [29–31]. MRI is superior to contrast-enhanced CT in detecting dural tail thickening [29,30].

Hyperostosis was observed in more than half of the cases in this study. Hyperostosis is a common

osseous manifestation of meningioma and typically appears as focal or diffuse bone thickening on CT or MRI imaging. The reported prevalence of hyperostosis in meningioma varies widely across studies, while bone destruction remains relatively rare [9,32,33].

Limitations

This study has several limitations. First, the retrospective design limits control over data completeness and standardization of imaging protocols. Second, this study was conducted at a single tertiary referral center, which may limit the generalizability of the findings. Third, the relatively small sample size restricts the ability to perform inferential statistical analysis. Finally, survival outcomes and tumor recurrence data were not available and therefore could not be evaluated.

CONCLUSION

This study provides descriptive data on the demographic, radiological, and histopathological characteristics of meningioma cases in a tertiary referral center. The findings demonstrate a predominance of cases in female patients, with WHO grade I being the most frequently identified grade.

Although several imaging features, such as dural tail, hyperostosis, and peritumoral edema, were frequently observed, these findings are suggestive rather than diagnostic. Therefore, histopathological evaluation remains essential for the definitive diagnosis and grading of meningioma.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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