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Profiles of Meningioma Patients at Dr. Soetomo General Academic Hospital

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ABSTRACT

Introduction: Meningioma is an intracranial extracranial tumor that arises from arachnoid cells. It is reported to be the most common primary brain tumor (39%). Meningioma is diagnosed based on clinical and radiological findings, but a definitive diagnosis requires histopathology examination. However, the clinical, radiological, and histopathological profile of meningioma is rarely studied in Indonesia. **Objective:** This study aimed to identify the clinical, radiological, and histopathological profile of meningioma patients at Dr. Soetomo General Academic Hospital Surabaya from 2017 to 2021. **Methods:** This was a retrospective observational study with a cross-sectional design using secondary data collected from electronic medical records at Dr. Soetomo General Academic Hospital Surabaya in 2017-2021. **Results:** A total of 256 patients were included in this study. The majority of the patients in this study were female (83.98%), aged 40-49 years old (43.36%), and mostly had the clinical symptom of headache (35.94%). Meningiomas were mostly WHO grade I (85.16%), with a transitional subtype (44.92). Based on the Kruskal-Wallis test, there were differences in histopathological grading between male and female patients ($p = 0.000$), as well as between homogenous and heterogenous tumor enhancement ($p = 0.027$). However, there were no differences in histopathological grading between the dural tail findings ($p = 0.181$) and hyperostosis findings ($p = 0.135$). **Conclusion:** Meningioma was found to be more common in females than in males, with the peak occurring in 40-49 years old. The most prevalent clinical symptom was headache, and convexity was the most common location for these tumors, most of which were larger than 3 cm. The majority of meningiomas were WHO grade I with transitional subtype.

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INTRODUCTION

Meningioma is the most common primary central nervous system tumor, accounting for 39% of all primary brain tumor cases. According to data from 2014-2018, the annual incidence of meningioma is 9.12 per 100,000 people. Meningiomas increase with age and are 2.3 times more prevalent in women than men.[1] The five-year survival rate for meningioma patients is 74.3% for benign cases, 58.3% for atypical subtypes, and only 8.3% for malignant meningiomas.[2] The diagnosis of meningioma required clinical, radiological, and histopathological examinations.

The clinical manifestations of meningioma vary depending on the size and location of the tumor. The parasagittal area, sphenoid wing, convexity, and anterior parafalcine are the most frequently found tumor locations.[3] Symptoms that often arise include headaches, seizures, cognitive changes, weakness, ataxia, visual changes, proptosis, syncope, and being asymptomatic.[4]

A radiological examination, such as an MRI or CT scan, is used to further diagnose meningioma, whereas a definite diagnosis requires a histopathological examination, namely a biopsy. Meningioma radiographs usually show intratumoral calcification along with hyperostosis, skull remodeling, central necrosis, and a thickened and contrasting dural tail.[5]

Histopathological examination can be used to determine the meningioma type. The World Health Organization (WHO) classifies meningiomas into 15 subtypes, which are further summarized into three grades, including grade I, grade II, and grade III. According to existing data, more than 80% of meningioma subtypes are typical, consisting of meningothelial, fibrous, or transitional subtypes, while the rest are unusual atypical subtypes.[6]

There were 124 patients diagnosed with meningioma at Dr. Soetomo General Academic Hospital Surabaya in January-December 2018, but only 45 patients had a definitive diagnosis through biopsy or tumor excision.[7] Meningioma patients' clinical features, as well as their radiology and histopathology characteristics, have never been studied. Therefore, we were interested in conducting research on the clinical, radiological, and histopathological profiles of meningioma patients at Dr. Soetomo General Academic Hospital in 2017-2021.

OBJECTIVE

This study aimed to identify the profiles of meningioma based on clinical, radiological, and histopathological characteristics.

METHODS

This was a cross-sectional study with a descriptive retrospective method using secondary data from electronic medical records of meningioma patients at Dr. Soetomo General Academic Hospital, Surabaya, from January 2017 to December 2021. The total sampling technique was used in this study. The study's sample consisted of all meningioma patients at Dr. Soetomo General Academic Hospital from January 2017 to December 2021. The inclusion criteria in this study were meningioma patients with comprehensive medical records, radiological examination, and histopathology test results following biopsy. The exclusion criteria were meningioma patients with incomplete medical records, patients who did not undergo radiology examinations, and patients without histopathology examination results. The variables in this study were age, gender, clinical symptoms, tumor location, tumor size, radiological features (dural tail, hyperostosis, contrast enhancement pattern), and histopathological features. The collected data were processed using the Microsoft Excel 2021 software based on the research variables. The gender, radiological, and histopathological data were then analyzed using the Kruskal-Wallis test in SPSS software.

RESULTS

Out of the 1,192 patients who were diagnosed with meningioma clinico-radiologically at Dr. Soetomo General Academic Hospital in 2017-2021, only 256 had histopathology examination results with complete medical records. Meningiomas were most commonly found in patients aged 40-49 years old (43.36%). Most meningioma patients were female (83.98%), compared to males (16.02%) with a ratio of 5.2:1. The most common clinical symptoms were headache (35.94%), followed by visual disturbances (15.63%), and paresis (12.11%).

Table 1. Demographic and clinical characteristics of meningioma patients

Characteristics	n	Percentage (%)
Age		
0-9	0	0.00
10-19	3	1.17
20-29	8	3.13
30-39	43	16.80
40-49	111	43.36
50-59	61	23.83
60-69	23	8.98
≥70	7	2.73
Gender		
Male	29	83.98

Female	29	16.02
Clinical symptoms		
Headache	92	35.94
Visual impairment	40	15.63
Paresis	31	12.11
Proptosis	20	7.81
Seizure	19	7.42
Syncope	13	5.08
Asymptomatic	12	4.69
Palpable/visible mass	9	3.52
Others	20	7.81

The most common place for meningiomas to be found was in convexity (39.06%), followed by sphenoid (17.19), and falx (7.42%). A few were also found in other places, like the olfactory groove (4.30%), tuberculum sellae (3.13%), cavernous (2.73%), cerebellopontine angle (2.73%), parasagittal (2.34%), petroclival (1.95%), spinal (1.95%), and others (14.06%). Most meningiomas were more than 3 cm (66.41%) in size.

Based on radiological features shown in Table 2, 48.83% of cases showed a dural tail sign, and 30.86% showed hyperostosis. Based on the pattern of tumor enhancement, 43.75% were homogeneous contrast enhancement, 19.92%, heterogeneous contrast enhancement, and the rest were unknown (36.33%).

Table 2. Radiological characteristics of meningioma patients

Characteristics	n	Percentage (%)
Tumor location		
Convexity	100	39.06
Sphenoid	44	17.19
Falx	19	7.42
Olfactory groove	11	4.30
Multiple	8	3.13
Tuberculum sellae	8	3.13
Cavernous	7	2.73
Cerebellopontine angle	7	2.73
Parasagittal	6	2.34
Petroclival	5	1.95
Spinal	5	1.95
Others	36	14.06
Tumor size		
≤ 3 cm	86	33.59
> 3 cm	170	66.41
Dural tail sign		
Yes	125	48.83
No	131	51.17
Hyperostosis		
Yes	79	30.86
No	177	69.14
Contrast enhancement pattern	112	43.75
Homogeneous	51	19.92
Heterogeneous	93	36.33
Unknown		

Table 3 shows histopathological characteristics of meningioma. The majority of meningioma patients were WHO Grade I (84.77%), with the most common type being transitional (44.92% of the total sample). Grade II meningiomas were found in 12.11%, while grade III meningiomas were only found in 3.13%.

Table 3. Histopathological characteristics of meningioma patients

Characteristics	n	Percentage (%)
WHO Grade I	**218**	**84.77**
Transitional	115	44.92
Fibroblastic	22	8.59
Meningothelial	21	8.20
Microcytic	19	7.42
Fibroblastic + Microcytic	10	3.91
Angiomatous	7	2.73
Psammomatous	6	2.34
Meningothelial + microcytic	5	1.95
Microcytic + Angiomatous	3	1.17
Transitional + microcytic	3	1.17
Secretory	2	0.78
Fibroblastic + Angiomatous	1	0.39
Lymphoplasmacyte-rich	1	0.39
Meningothelial + Angiomatous	1	0.39
Metaplastic	1	0.39
Transitional + Secretory	1	0.39
WHO Grade II	**31**	**12.11**
Atypical	29	11.33
Chordoid	1	0.39
Clear cell	1	0.39
WHO Grade III	**7**	**3.13**
Anaplastic	4	1.56
Rhabdoid	2	0.78
Papillary	1	0.39

Table 4 shows the Kruskal-Wallis test and crosstabulation between histopathology grades with gender and each radiological feature. The distribution showed that grade I and grade II meningiomas were more common in women, while grade III meningiomas were more common in men, and the results showed a significant difference ($p = 0.000$). The majority of patients with grade I and grade II meningioma had homogeneous contrast enhancement, whereas all of those with grade III meningioma had heterogeneous contrast enhancement, and the statistics showed a significant difference ($p = 0.027$). There were no significant differences in histopathological grading between patients with/without dural tail sign ($p = 0.181$), or patients with/without hyperostosis ($p = 0.135$).

Table 4. Crosstabulation and the result of the Kruskal-Wallis test between histopathological grading with gender and radiological characteristics

Characteristics	Histopathological Grading			P
	Grade I	Grade II	Grade III	
Gender				
Female	194 (90.23%)	19 (8,84%)	2 (0,93%)	0,000
Male	24 (58,54%)	12 (29,27%)	5 (12,20%)	
Dural tail				
Yes	110 (88,0%)	14 (11,2%)	1 (0,8%)	0,181
No	108 (82,4%)	17 (13,0%)	6 (4,6%)	
Hyperostosis				
Yes	71 (89,9%)	8 (10,1%)	0 (0%)	0,135
No	147 (83,1%)	23 (13,0%)	7 (3,9)	
Contrast enhancement				
Homogenous	98 (87,5%)	14 (12,5%)	0 (0%)	0,027
Heterogenous	38 (74,5%)	9 (17,7%)	4 (7,8%)	

DISCUSSION

In this study, the incidence of meningioma increased with age until it reached a peak in the fifth decade of life, or 40–49 years old (43.36%), but then decreased after the age of 50 years old. This result is similar to a study by Goyal *et al*., where most patients aged 41–50 years old.[8] Meningioma was more common in females, accounting for 215 patients (83.98%), with a ratio of 5.2:1 between females and males. Similar results were shown in a study by Sidabutar *et al.*, which reported that meningioma patients were dominated by women at 88%.[9] The high incidence of meningiomas in women is linked to sexual hormones. This was proven by several studies, such as the discovery of progesterone and estrogen hormone expression in meningiomas, as well as the reports of an increased risk of meningioma in women with hormone replacement therapy (HRT) and women who have experienced menopause or have given birth.[10]

The most frequent clinical symptoms found in this study were headache (35.94%), followed by visual impairment (15.63%), and paresis (12.11%). Talawo *et al*. also found a similar result in their study, where headaches were found in 31.1% of patients.[11] Headaches in brain tumors are often caused by pressure or traction on the structures outside and inside the cranium that are responsive to pain. This traction is caused by tumor tissue growth, swelling, and/or secondary bleeding.[12]

Convexity was the most frequently found meningioma location in this study (39.06%), which is similar to research by Goyal *et al.* with a number of convexity meningiomas reaching 40.54%.[8] Most of the meningioma patients in this study had a tumor size >3 cm (66.41%), while the remainder had a tumor size ≤3 cm (33.59%). Research by Raharjanti *et al*. also found a similar thing where most meningiomas were sized 3-6 cm (33%) and >6 cm (12.8%).[13]

Radiological examination can show that meningiomas are different from other brain tumors by showing a dural tail appearance, hyperostosis, and a contrast enhancement pattern that is commonly homogeneous. Dural tail sign is a specific feature of meningioma, which indicates thickening of the dura due to tumor invasion of the meninges.[14] In this study, the dural tail sign appeared in 125 patients (48.83%). In other studies, the dural tail sign can be seen in 60–72% of cases.[14] In people with meningiomas, hyperostosis can also be caused by disruption of osteoblast or osteoclast activities due to excessive expression of osteogenic molecules.[15] In this study, 79 patients (30.86%) showed the features of hyperostosis. This is in line with previous research, which stated that hyperostosis in meningioma can occur in 4.5–44% of cases.[16] In this study, it was found that 112 people (43.75%) showed a homogeneous contrast enhancement, 51 people (19.92%) had a heterogeneous contrast enhancement, and the other 93 people (36.33%) had no information about enhancement pattern. This result is in accordance with findings by Yu *et al.*, who reported that homogeneous tumor enhancement (82–86%) was more frequently found in meningioma cases compared to heterogeneous tumor enhancement (13-18%).[17]

According to histopathology examination, the majority of meningiomas were WHO grade I, amounting to 85.16% (218 patients), with the most common type being transitional (44.92%). A total of 31 patients (12.11%) in this study had WHO grade II meningioma, with the most common type being atypical (11.33%). Meanwhile, the remaining 7 people (2.73%) had WHO grade III meningioma, with the largest type being anaplastic (1.56%). A retrospective study conducted by Malik *et al.* in India also showed similar results, where grade I meningiomas were found in 85.7% of patients, with the transitional type being the most frequently encountered type.[18]

The Kruskal-Wallis test showed a significant difference in the distribution of histopathological grading between female and male patients (p = 0.000). There were 194 female patients with WHO grade I, 19 with WHO grade II, and 2 with WHO grade III. Meanwhile, in male patients, there were 24 patients with WHO grade I, 12 patients with WHO grade II, and 5 patients with WHO grade III. Although men have a lower overall incidence of meningiomas than women, they have a higher incidence of grade III

meningioma. These results are in line with research by Mubeen *et al*., which stated that higher-grade meningiomas are more often found in men.[19] The malignancy of meningioma in men is thought to be due to differences in molecular levels genetic and hormonal between male and female meningioma patients.[20]

There was no significant difference in histopathological grading between patients with and without the dural tail sign (p = 0.181). Previous research stated, however, that the presence of dural tails is more common in benign meningiomas, and the difference is significant between the three WHO grades.[17] There was also no significant difference found in histopathological grading between patients with and without hyperostosis (p = 0.135). A study by Janah *et al*. showed a different result, which shows that hyperostosis is more often found in WHO grade III.[21] This discrepancy in results may be due to differences in patient characteristics and sample size. There was a significant difference in the distribution of histopathological grading between patients with homogeneous and heterogeneous tumor enhancement patterns (p = 0.027). This study revealed that in grade I and grade II meningiomas, there was more of a homogeneous tumor enhancement, while in grade III meningiomas, all of them showed heterogeneous tumor enhancement. This is in accordance with research by Yu *et al.*, which revealed that the proportion of homogeneous and heterogeneous enhancement patterns had a significant difference between WHO grade I, grade II, and grade III (p < 0.001). Higher tumor grades are linked to heterogeneous enhancement patterns, which are common in atypical and anaplastic types of meningiomas.[17]

CONCLUSION

Meningiomas can show distinctive characteristics on clinical, radiological, and histopathological examinations. In this research, the majority of meningioma patients were women aged 40–49, most of whom exhibited the clinical symptom of headache, commonly located in a convexity with a size of more than 3 cm, and the majority were WHO grade I with transitional subtype. These findings suggest that further research needs to be done regarding the risk factors of meningioma, such as hormonal profile in meningioma patients.

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Conflict of Interest
The authors have no conflicts of interest.

Ethic Consideration
This research was conducted after receiving approval from Ethical Committee of Dr. Soetomo General Academic Hospital with ethical clearance number 1303/LOE/301.4.2/V/2023.

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Author Contributions
NV, DA, JS, and SAU contributed to the study design and drafting the manuscript. NV helped with data collection and analysis. DA, JS, and SAU supervised the results and discussion. All authors reviewed and approved the final version of the manuscript

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