How to Cite:
Kurniawan, A. L., & Sensusiati, A. D. (2022). Head MRI imaging profile of meningioma according to WHO 2016 grading. *International Journal of Health Sciences*, *6*(S9), 1175–1182.
https://doi.org/10.53730/ijhs.v6nS9.12664

Head MRI imaging profile of meningioma according to WHO 2016 grading

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***Abstract*---**Magnetic resonance imaging (MRI) of meningiomas is essential in predicting their histopathological grade. Meningiomas are the second most common central nervous system neoplasm in adults, usually benign, originating from arachnoid cap cells and categorized according to the WHO classification as benign (grade I), atypical (grade II), and anaplastic (grade III). The study aims to determine the head MRI imaging profile in preoperative meningioma patients confirmed by pathologic results according to WHO 2016 grading. A retrospective study was conducted from January 2017 to March 2022 with 30 samples of meningioma patients who underwent surgery. Preoperative head MRI and pathologic examination were done and tumor location, border, edge, and size were confirmed with pathology results according to WHO 2016 grading. Most patients were 41-50 years old, female (100%), mostly WHO grade I histopathology with transitional type. The most common locations were convexity meningiomas, with the most MRI characteristics of well-defined borders, regular edges, size 0-3 cm, with hypointense T1, hyperintense T2, hyperintense T2 FLAIR, restricted diffusion on DWI, type 2 DCE, homogeneous enhancement pattern, and the most feeding arteries originated from the meningeal artery.

***Keywords*---**Meningioma, histopathological grading, MRI characteristics.

Manuscript submitted: 9 May 2022, Manuscript revised: 18 July 2022, Accepted for publication: 27 August 2022

Introduction

Meningiomas are the most common non-glial tumors of the central nervous system (CNS) which account for between 20-30% of all intracranial tumors (Alyamany et al., 2018). It has an annual incidence of around 6/100,000 population with a prevalence in women twice as much as in men (Watts et al., 2014). Meningiomas are a group of tumors originating from arachnoid cells in the meninges of the brain and spinal cord. This tumor develops slowly and is characteristically attached to the dura mater (Malik et al, 2018). This tumor most often appears in adults with a peak incidence in the 6th and 7th decades. Meningiomas often occur in women with a male-to-female ratio of 1: 1.7 – 2 (Lakshmi, 2015; Khalid et al. 2017; Grigoras et al., 2018).

From the data obtained at Dr. Soetomo Hospital, Surabaya, in 2014 there were 78 patients who had been operated on and diagnosed with meningioma, in 2015 there were 28 cases, in 2016 there were 48 cases and in 2017 there were also 48 cases. In previous studies by Vony (2015) in dr. Soetomo Hospital, with several variables, were used to predict atypical and malignant meningioma, it was stated that they had a sufficient relationship to distinguish between meningioma and its subtypes, and further research with a larger sample size was suggested.

MRI is one of the advanced radiodiagnostic imaging that uses electromagnetic waves, which provide anatomical information and display this information in the form of image slices (multiplanar). The use of MRI with contrast has a broad spectrum in assessing the macrostructure and microstructure of body tissues so that MRI is used as one of the most important modalities in detecting abnormalities in the central nervous system (Tammie et al., 2009). CT Scan and MRI are very important in establishing the diagnosis and describing the characteristics of meningiomas. MRI is known to be more accurate than CT scan in evaluating en plaque meningiomas and meningiomas in the posterior fossa which are often difficult to detect by CT scan including location, dural attachment, the severity of edema, displacement of neurovascular structures which are very important for surgical approach and postoperative effects. et al, 2015; Granata et al, 2015).

The distribution of meningiomas according to WHO is divided into three major groups, namely: benign meningiomas (WHO grade I), atypical meningiomas (WHO grade II), and anaplastic/malignant meningiomas (WHO grade III). The three histologic subtypes that often appear are meningothelial (syncytial), transitional, and fibroblastic meningioma types. Most meningiomas are grade I meningiomas, and about 20% are more aggressive forms, including grades II and III, which are associated with increased morbidity and mortality. In other words, the WHO grading correlates with prognosis, and the grading can only be determined by histopathological examination. Most meningiomas have a good prognosis, frequent surgery and adjuvant radiotherapy are curative. However, complete resection is not always possible because meningiomas can enclose vascular and neural structures, and radiation therapy is limited by neurotoxicity and tumor size. Until now, chemotherapy regimens have minimal effectiveness in the treatment of meningiomas (Choy et al, 2011).

Previous studies at dr. Soetomo Hospital uses several variables to predict atypical and malignant meningiomas, but there are no studies with the aim to determine the image profile MRI of the head of Meningioma related to its pathologic results. With this in mind, the purpose of our study was to determine the profile of MRI images of postoperative meningioma patients that were matched with the pathologic results of patients so that they could assist clinicians and could be used as a reference in identifying meningioma patients in the early stages of treatment. based on the symptoms that appear in meningioma patients.

Material and Methods

The type of research used is a retrospective observational study. The study was conducted by collecting data based on observations of head MRI results. The research design used was observational research using secondary data. The study was conducted by taking medical records of meningioma patients taken from Airlangga University Hospital, Surabaya in the period January 2017 to March 2022 which was carried out from February 9, 2022.

The sample of this study is medical records of meningioma patients who met the inclusion and exclusion criteria. The inclusion criteria consist of meningioma patients or suspected meningioma who underwent an MRI examination of the head prior to surgery, while patients with head MRI results that cannot be interpreted and patients who underwent head MRI of meningioma without pathologic results were excluded. Total sampling was carried out by non-probability sampling from the results of head MRI for the period January 2017 – March 2022. The study uses meningioma as dependent variables, with histopathologic grading and MRI results as independent variables.

Histopathological examination and grouping of meningiomas can provide prognostic information. Histological assessment of meningioma is currently used based on 2016 WHO classification. After surgery, the tumor tissue was examined histopathologically through tissue biopsy and examined under a microscope as the gold standard examination. The results of the histopathological examination were classified according to WHO criteria, namely benign (WHO grade I) and high grade (WHO grade II and III). The MRI characteristic such as tumor location, borders, margins, T1WI, T2WI, T2 FLAIR, DWI, DCE, and MRA was obtained. Data collected were arranged using Microsoft Office Excel, analyzed, and described as frequency and respondent percentage.

Result and Discussion

This study obtained 30 samples aged between 20-75 years. The highest sample age group was 41-50 years with 18 people then followed by the age group 51-60 years with 8 people, all of which are female patients as shown in tables 1 and 2.

Table 1
Sample distribution based on age

Age (year)	Frequency	Percentage (%)
21-30	2	7
31-40	1	3
41-50	18	60
51-60	8	27
>60	1	3
Total	30	100

Table 2
Sample distribution based on gender

Gender	Frequency	Percentage (%)
Laki-laki	0	0 %
Perempuan	30	100 %
Jumlah	30	100 %

MRI characteristics based on location and histopathologic subtype are shown in Tables 3 and 4. Based on the description of the results of the head MRI examination, 30 samples showed that the most common locations were convexity meningioma as many as 13 people, followed by sphenoid wing meningioma as many as 7 people. Based on the histopathologic type, the meningioma found was mostly grade I as much as 97% and grade II as much as 3%. The histologic type was mostly grade I transitional type as many as 14 patients (47%), microcystic as many as 7 patients (24%). The results in this study are in accordance with the research statistics of Watts, J. et. al., 2014 which found 90% grade I meningioma cases, 5-7% grade 2, and about 1-3% grade III cases.

Table 3
Sample distribution based on location

Tumor location	Frequency	Percentage (%)
Falx cerebri meningioma	2	7
Convexity meningioma	13	43
Sphenoid wing meningioma	7	24
Olfactory groove meningioma	5	10
Sella tubercle meningioma	5	16

Table 4
Histopathologic subtype of meningioma

Grading Histopatologi		Frekuensi	Persentase (%)
WHO GRADE I	Transitional	14	47
	Microcystic	7	24
	Meningothelial	5	17

	Psammomatous	1	3
	Secretory	1	3
	Fibroblastic	1	3
	Atypical	1	3
	Angiomatous	-	0
	Lymphoplasmacyte-rich	-	0
WHO GRADE II	Atypical	1	3
	Choroid	-	0
	Clear Cell	-	0
WHO GRADE III	Rhabdoid	-	0
	Papillary Meningioma	-	0
Total		30	100

Based on MRI characteristics, 30 patients (100%) had well-defined borders, with regular margins 28 (93%), 2 patients with irregular margins (7%), with the largest size of 0-3 cm in 14 patients (47%) followed by with 4-6 cm in 11 patients (37%), and 7-9 cm in 5 patients (16%). Based on the MRI characteristics, there were 18 patients (60%), T1 was isointense in 12 patients (40%), T2 hyperintense in 13 patients (43%), hypointense in 12 patients (40%), and isointense in 5 patients (17 %). The T2 FLAIR was hypointense in 3 patients (11%), isointense in 2 patients (6%), and hyperintense in 25 patients (83%). The DWI shows restricted diffusion in as many as 19 patients (63%), and unrestricted diffusion in 11 patients (37%). The DCE curve mostly types 2 with 19 patients (63%), followed by type 3 with 7 patients (24%). A homogeneous enhancement pattern was found in 26 patients (87%) and heterogeneous in 4 patients (13%). Most of the feeding arteries came from meningeal of 17 patients (58%). These results are shown in table 5.

Table 5
MRI Characteristics

MRI Characteristic		Frequency	Percentage (%)
Border	Well-defined	30	100
	Ill-defined	0	0
	Total	30	100
Margin	Regular	28	93
	Irregular	12	7
	Total	30	100
Size	0-3 cm	14	47
	4-6 cm	11	37
	7-9 cm	5	16
	>10 cm	0	0
	Total	30	100
T1	Isointense	12	40
	Hypointense	18	60
	Hyperintense	0	0
	Total	30	100
T2	Isointense	5	17
	Hypointense	12	40
	Hyperintense	13	43

	Total	30	100
T2 FLAIR	Isointense	2	6
	Hypointense	3	11
	Hyperintense	25	83
	Total	30	100
DWI	Restricted	19	63
	Unrestricted	11	37
	Total	30	100
DCE	Type 1	4	13
	Type 2	19	63
	Type 3	7	24
	Type 4	0	0
	Type 5	0	0
	Total	30	100
Enhancement Pattern	Homogenous	26	87
	Heterogenous	4	13
	Total	30	100
Feeding Artery	Meningeal	17	58
	Dural	6	20
	MCA	3	10
	ACA	2	6
	ICA	2	6
	Total	30	100

Conclusion

From the results obtained, it can be concluded that epidemiologically, the majority of meningioma patients are women with a percentage of 100% who are in the 40-49 year age group, with the most common location being convexity meningioma and the most histopathologic type with transitional type.

Acknowledgement

We would like to thank all patients, staff of the Radiology Department of Dr. Soetomo East Java Province General Hospital, Surabaya, Indonesia, and staff of the Airlangga University Hospital, Surabaya, for their good participation and cooperation during the research.

Conflict Of Interest
There is no conflict of interest.

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