Online Supplemental Data

Online Table 1. Comparison of MRI findings for meningiomas and malignant dural-based tumors

Variables	Meningiomas (*n*=102)	Malignant dural-based tumors (*n*=31)	P-value
Morphology			
Dural tail			
Absent	2 (2%)	6 (19.4%)	<0.001*
Present	100 (98%)	25 (80.6%)	<0.001*
Osseous destruction			
Absent	20 (19.6%)	3 (9.7%)	0.200
Marrow edema	76 (74.5%)	6 (19.4%)	<0.001*
Cortical disruption	1 (1%)	1 (3.2%)	0.368
Cortical breakthrough	5 (4.9%)	21 (67.7%)	<0.001*
Hyperostosis			
Absent	26 (25.5%)	31 (100%)	<0.001*
Present	76 (74.5%)	0 (0%)	<0.001*
Contrast-enhanced (CE) FLAIR			
Rim-CE			
No rim visible	4 (3.9%)	23 (74.2%)	<0.001*
Rim visible <50%	1 (1%)	6 (19.4%)	<0.001*
Rim visible ≥50%, <100%	6 (5.9%)	0 (0%)	0.167
Complete rim enhancement	91 (89.2%)	2 (6.5%)	<0.001*

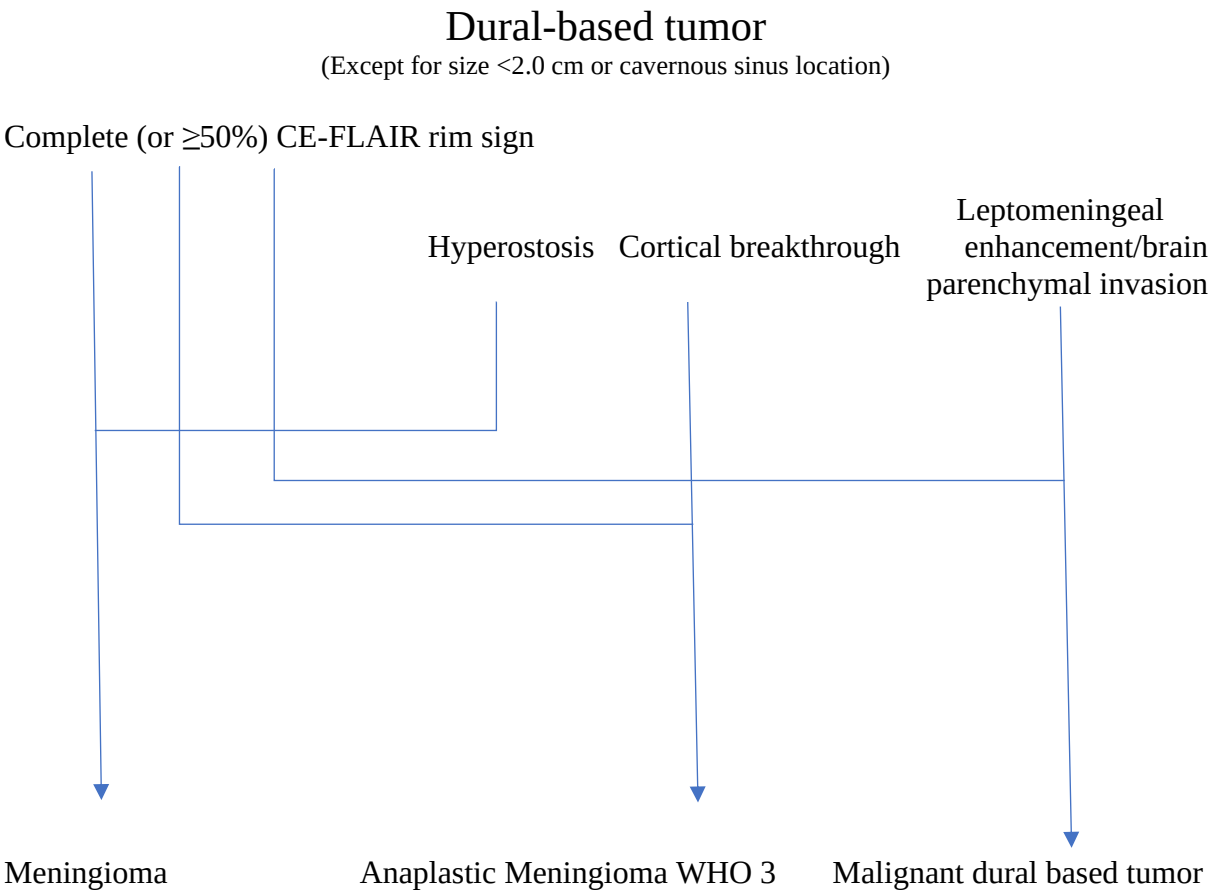
Variables	Meningiomas (*n*=102)	Malignant dural-based tumors (*n*=31)	P-value
Peritumoral edema			
No edema	39 (38.2%)	17 (54.8%)	0.101
Edema <2 cm	37 (36.3%)	3 (9.7%)	0.005
Edema ≥2 cm	26 (25.5%)	11 (35.5%)	0.277
Leptomeningeal enhancement			
Absent	102 (100%)	21 (67.7%)	<0.001*
Present	0 (0%)	10 (32.3%)	<0.001*
T2WI			
Isosignal intensity	25 (24.5%)	7 (22.6%)	0.826
Hyposignal intensity	4 (3.9%)	8 (25.8%)	<0.001*
Hypersignal intensity	73 (71.6%)	16 (51.6%)	0.017
CE-T1WI			
Homogeneous enhancement	75 (73.5%)	9 (29%)	<0.001*
Heterogeneous enhancement	27 (26.5%)	22 (71%)	<0.001*

Online Table 2. Comparison of MRI findings for meningiomas of WHO grades 1, 2, and 3

Variables	WHO 1 (*n*=72)	WHO 2 (*n*=22)	WHO 3 (*n*=8)	P-value
Morphology				
Dural tail				
Absent	1 (1.4%)	0 (0%)	1 (12.5%)	0.075
Present	71 (98.6%)	22 (100%)	7 (87.5%)	
Osseous destruction				
No cortical breakthrough	72 (100%)	21 (95.5%)	4 (50%)	<0.001*
Cortical breakthrough	0 (0%)	1 (4.5%)	4 (50%)	
Hyperostosis				
Absent	14 (19.4%)	8 (36.4%)	4 (50%)	0.071
Present	58 (80.6%)	14 (63.6%)	4 (50%)	
Contrast-enhanced (CE) FLAIR				
Rim-CE				
Rim enhancement <50%	4 (5.6%)	1 (4.5%)	0 (0%)	0.785
Rim enhancement ≥50%, <100%	68 (94.4%)	21 (95.5%)	8 (100%)	
Peritumoral edema				
No edema	31 (43.1%)	8 (36.4%)	0 (0%)	0.001*
Edema <2 cm	30 (41.7%)	5 (22.7%)	2 (25%)	
Edema ≥2 cm	11 (15.3%)	9 (40.9%)	6 (75%)	
Leptomeningeal enhancement				
Absent	72 (100%)	22 (100%)	8 (100%)	N/A
Present	0 (0%)	0 (0%)	0 (0%)	

Variables	WHO 1 (*n*=72)	WHO 2 (*n*=22)	WHO 3 (*n*=8)	P-value
T2WI				0.754
Isosignal intensity	18 (25%)	5 (22.7%)	2 (25%)	
Hyposignal intensity	2 (2.8%)	1 (4.5%)	1 (12.5%)	
Hypersignal intensity	52 (72.2%)	16 (72.7%)	5 (62.5%)	
CE-T1WI				
Homogeneous enhancement	59 (81.9%)	14 (63.6%)	2 (25%)	0.001*
Heterogeneous enhancement	13 (18.1%)	8 (36.4%)	6 (75%)	

Online Figure 1. A diagnostic framework for differentiating between meningioma and malignant dural-based tumor.

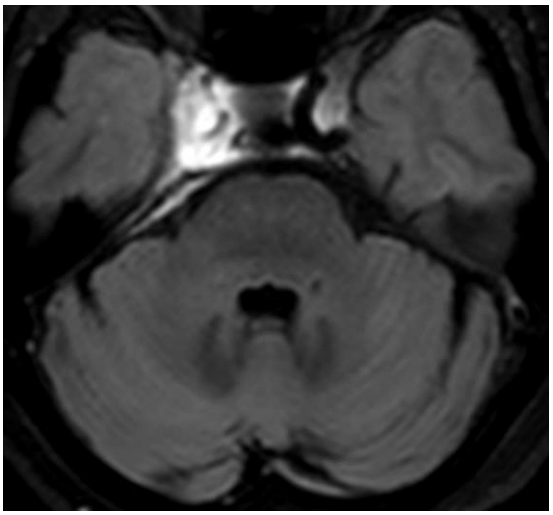


Description: For the dural-based tumor >2.0 cm and except for those at intracavernous locations, our study recommends evaluating the rim enhancement of the tumor-brain interface on the CE-FLAIR sequence (CE-FLAIR rim sign) in the first step.

For the tumor with complete or ≥50% CE-FLAIR rim sign, meningioma is the favored diagnosis. In addition, if associated with hyperostosis, meningioma is highly suggested.

For the tumor with complete or ≥50% CE-FLAIR rim sign and evidence of cortical breakthrough, anaplastic meningioma (WHO 3) is the favored diagnosis.

For the tumor with complete or ≥50% CE-FLAIR rim sign and accompanied by leptomeningeal enhancement and brain parenchymal invasion, the malignant dural-based tumor is the favored diagnosis.



Online Figure 2. Cavernous meningioma. CE-FLAIR sequence demonstrates a homogeneously enhancing mass at the right cavernous sinus without rim enhancement on the tumor-brain interface, pathologically proved meningioma. Four cases (3.9%) of cavernous meningioma in our study demonstrate no rim enhancement on CE-FLAIR sequence according to no pial circulation. This finding shows the limitation of using the CE-FLAIR rim sign to predict meningioma in this location.