

The Meningioma Vascular Index: A Volumetric Analysis of Flow Voids Predicts Successful Embolization Carlito Lagman MD; Vera Ong; Thien Phuc Nguyen BS; Yasmine Alkhalid BS; John Patrick Sheppard; Prasanth Romiyo BA, BS; Daniel Azzam; Giyarpuram Prashant MD; Joel S Beckett MD; MHS; Isaac Yang MD Department of Neurosurgery, Radiation Oncology, Radiological Sciences, Head and Neck Surgery, and the Jonsson Comprehensive Cancer Center, David Geffen School of Medicine at the University of California, Los

Introduction

Meningiomas that appear hypervascular on neuroimaging may be amenable to preoperative embolization. However, methods for measuring hypervascularity have not been described nor has the predictive value of hypervascularity been assessed.

Methods

We performed volumetric analyses of 51 intracranial meningiomas (21 preoperatively embolized) resected at our institution. Through the use of an image segmentation software and voxel-based segmentation method, we measured volumes of flow voids on T2-weighted magnetic resonance images. We named this the meningioma vascularity index (MVI). The primary outcome was a successful embolization procedure. We also analyzed operative time, intraoperative blood loss, Simpson grade, and the need for blood

Results

The MVI was correlated with successful embolization (rpb = 0.35, P = .01), intraoperative blood loss (r = 0.29, P = .04), and perioperative blood transfusion (rpb = 0.36, P =.009). An MVI greater than or equal to 2.5 cc was a significant predictor of successful embolization (odds ratio [OR] 4.00. 95% confidence interval [CI] 1.01-15.78) and subtotal resection (OR 7.64, 95% CI 1.74-33.58), and these remained significant after controlling for tumor volume (OR 12.85, 95% CI 1.47-112.31 and OR 7.64, 95% CI 1.74-33.58, respectively).

Conclusions

We report a method of predicting successful embolization using volumetric analysis of flow voids on standard magnetic resonance imaging sequences. This information could help neurosurgeons and interventional radiologists better understand the likelihood Meningioma vascularity index (MVI) measured on axial T2-weighted magnetic resonance images using the ITK-SNAP software



A) MVI less than 2.5 cc and unsuccessful embolization, B) MVI less than 2.5 cc and successful embolization, C) MVI greater than 2.5 cc and unsuccessful embolization,
D) MVI greater than 2.5 cc and successful embolization.

Learning Objectives

To investigate flow void volume as a predictor of a successful embolization.

TABLE 1. Summary of Patients						
Age, yrs						
Mean \pm SD	58 ± 13					
Range	31-81					
Sex, n (%)						
Male	14 (27)					
Female	37 (73)					
Volumes, cc						
MVI	1.83 ± 1.95					
Tumor	73 ± 102					
Preoperative embolization	21 (41)					
Surgery	51 (100)					
Operative time, hrs	11 ± 7					
EBL, cc	239 ± 176					
Simpson						
Grade 1	27 (53)					
Grade 2	4 (8)					
Grade 3	4 (8)					
Grade 4	15 (29)					
Grade 5	1 (2)					
WHO						
Grade 1	36 (71)					
Grade 2	14 (27)					
RBCT	6 (12)					
MVI, Meningioma Vascular	r Index (flow					
void volume); EBL, estimat	ed blood					
loss; WHO, World Health C	Organization;					
RBCT, red blood cell transf	usion					

Patient	Meningioma	MVI	Artery	Material	OR	EBL	Simpson	WHO	RBC
43F	Anterior clinoid	1.97	MMA	Coil	14	400	4	2	No
48F	Petroclival	3.76	MMA	Coil	11	200	4	1	No
44F	Parietal, parasagittal	0.38	MMA	n-BCA	8	250	1	2	No
53M	Frontal-parietal	0.19	MMA	n-BCA	13	200	1	1	No
33M	Middle fossa	0.79	MMA	n-BCA	22	200	2	1	No
73F	Sphenoid wing	0.74	MMA, IMAX	PVA	4	400	4	1	No
60M	Bifrontal	7.68	MMA, STA (bilateral)	PVA	10	300	1	2	No
79F	Parietal-occipital	3.30	MMA, STA	PVA	10	50	4	1	No
60F	Temporal-occipital	8.99	MMA	PVA, coil	3	100	1	1	No
66F	Frontal	0.42	MMA, IMAX	PVA, coil	2	100	1	1	No
46M	Parafalcine	3.28	MMA (bilateral)	PVA, coil	21	350	3	1	No
58F	Parafalcine	0.57	MMA	PVA, coil	8	200	1	1	No
65F	Frontal	1.06	IMAX, MMA	PVA, coils	10	200	1	1	No
74F	Sphenoid wing	5.13	MMA (bilateral)	PVA, coils	< 1	900	4	1	Yes
46M	Anterior skull base	5.05	MMA, AMA, IMAX	PVA, coils	5.6	250	4	1	No
81F	Frontal	1.45	MMA	PVA, coils	< 1	150	3	4	No
79F	Cerebellar	0.29	Occipital	PVA, n-BCA	4	200	3	1	No
33M	Frontal	1.68	MMA	PVA, n-BCA	6	300	1	1	No
45F	Temporal	0.04	MMA, MDTA, ADTA	PVA, n-BCA	8	300	2	1	No
53F	Frontal-orbital	2.29	MMA (bilateral)	PVA, n-BCA	12	500	1	1	Yes
74F	Sphenoid wing	6.15	MDTA, MMA	PVA, n-BCA, coil	54	250	4	1	Yes
MVI, M tempora alcohol; Organiz	eningioma Vascular Inc l artery; AMA; accessor n-BCA, n-Butyl Cyano ation: RBCT, red blood	dex; MN ry menii acrylate cell tra	MA, middle meningeal art ngeal artery; M/A, middle ; OR, operative time (hrs nsfusion	ery; IMAX, internal a e/anterior; DTA, deep .); EBL, estimated blo	naxill temp od los	ary arte oral art s (cc);	ry; STA, su ery; PVA, j WHO; Woi	perficia olyviny rld Healt	l l h