

Comparison of Predictive Grading Systems for Procedural Risk in Endovascular Treatment of Brain Arteriovenous Malformations – Analysis of 104 Consecutive Patients

Benjamin Pulli MD; Christopher J Stapleton MD; Matthew Koch MD; Aman B. Patel MD

Massachusetts General Hospital

Harvard Medical School

Introduction

Endovascular embolization of brain arteriovenous malformations (AVMs) is widely utilized, often used in conjunction with microand/or radiosurgery. Grading systems to assess procedural risks of endovascular embolization have been proposed, but none has been independently validated. We sought to validate and compare these grading systems in 104 consecutive patients with brain AVMs who underwent endovascular embolization between 2003 and 2016 at our tertiary academic referral center.

Methods

Clinical and demographic data were obtained from the medical records. Cerebral angiograms were reviewed and Buffalo [1], AVM Neuroendovascular (AVMN) [2], and Spetzler-Martin (SM) grades determined. Clinical outcomes and complications were collected. Receiver operating characteristics (ROC) curve analysis was performed.

Results

Forty-five(43.3%) patients were females, with an average age at presentation of 43.2 ± 16.2 years. Forty-nine patients (47.1%) presented with hemorrhage. Fifty-five (52.9%) AVMs were located on the left side, 40 (38.5%) were in an eloquent brain region, and mean AVM size was 3.4 ± 1.4 cm. There were 10 major and 17 minor complications in

25 patients (vessel rupture: 9; retained/fractured microcatheter: 5; off-target embolization: 4; extension of embolic cast into venous outflow: 2; artery dissection: 1; ischemic stroke presumed to be related to embolization: 6). Arterial pedicle size (p=0.002) and number of arterial pedicles (p=0.04) were predictors of complications, while AVM side, location in/near an eloquent brain region, patient age, AVM size, or venous drainage pattern were not. The Buffalo score was predictive of complications (p=0.004), but AVMN (p=0.23) and SM grades (p=0.35) were not (table). ROC curve analysis revealed an area under the curve (AUC) of 0.68±0.05 for the Buffalo score, significantly better than AVMN (AUC 0.58 ± 0.06 , p=0.04) and SM grades (AUC 0.56 ± 0.06 , p=0.05, figure).

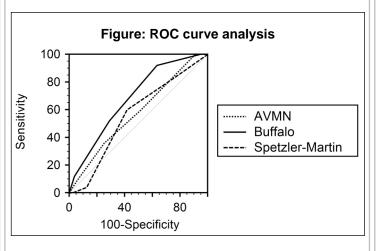


Table			
	Complications (N=25)	No complications (N=79)	P-value
Age ± SD	46.0 ± 16.9	42.3 ± 15.9	0.33 *
Female gender, N (%)	7 (28)	38 (48)	0.12 #
Left side, N (%)	14 (56)	41 (52)	0.90 #
AVM in eloquent region, N (%)	7 (28)	33 (42)	0.32 #
AVM size, cm ± SD	2.8±1.3	2.8±1.4	0.88 *
Deep venous drainage, N (%)	17 (68)	38 (48)	0.17 #
Spetzler-Martin grade, median (IQR)	3 (2 - 3)	2 (2 - 3)	0.35 [†]
Number of arterial pedicles, N ± SD	4.8 ± 1.6	4.0 ± 1.8	0.04 *
Arterial pedicle size < 1 mm, N (%)	18 (72)	27 (34)	0.002 #
Buffalo score, median (IQR)	4 (3 - 4)	3 (2 - 4)	0.004 [†]
Fistulous component, N (%)	11 (44)	22 (28)	0.21 #
AVMN grade, median (IQR)	3 (2 - 4)	3 (2 - 3.5)	0.23 †
Embolization agent, N (%) Onyx NBCA Other	19 (76) 3 (12) 3 (12)	48 (61) 28 (35) 3 (4)	0.61 ‡
Flow reduction achieved, N (%) 75 - 100% 50 - 74% 0 - 49%	7 (28) 8 (32) 10 (40)	36 (46) 13 (17) 30 (38)	0.34 ‡
* Student's T test. # χ^2 test. † Mann Whitney-U test. ‡ One-way ANOVA.			

Conclusions

Our independent analysis of 104 patients with brain AVMs treated with endovascular embolization validates the predictive capacity of the Buffalo score, but not AVMN or SM grades, for endovascular embolization procedural risk.

References

- [1] Dumont TM et al. A proposed grading system for endovascular treatment of cerebral arteriovenous malformations: Buffalo score. Surgical Neurology International 2015, 6:3.
- [2] Feliciano CE et al. A Proposal for a New Arteriovenous Malformation Grading Scale for Neuroendovascular Procedures and Literature Review. P R Health Sci J. 2010, 29:2.