A Novel Proposed Grading System for Cerebellar Arteriovenous Malformations

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Introduction

Accurate risk stratification is important when considering surgical therapy, both in terms of patient decision making and treatment strategy. A previous study by Rodriguez-Hernandez et al. (2012) found the most widely used grading system, the SM grading system, did not reliably convey the risk associated with treating these. The objective of this study is to develop a powerful, yet simple and specific grading system to better guide vascular neurosurgeons' decision making and patient counseling for cerebellar AVMs, using the largest patient database reported in the United States, to date.

Methods

Data for cerebellar AVM patients treated microsurgically in two tertiary medical centers were retrospectively reviewed. Patients at institution 1 were collected from September 1999 to February 2013; at Institution 2, from October 2008 to October 2015. Patient outcomes were classified as Good (mRS score 0-2), or Poor (mRS score 3-6) at the time of discharge. Using Chi2 and logistic regression analysis, variables associated with poor outcomes were assigned risk points to design the proposed grading system. It included neurologic status prior to treatment (Poor +2 Points), presurgical hemorrhage (+1 Points), age =60 (+1 Point), and deep venous drainage (+1 Points for Deep).

Results

A total of 125 cerebellar AVMs out of 1328 Brain AVMs (BAVMs) were reviewed in 125 patients, 120 of which were treated microsurgerically and included in the study. With our proposed grading system, we found poor outcomes differed significantly between each grade (p-value=<.001), while the SM and Spetzler-Ponce (SP) grading system did not (p-value=.24 and p-value=.25, respectively). Logistic regression revealed Grade 2 had 3.4x the risk of experiencing a poor outcome (p-value=0.006), while Grade 3 had 8.6x the risk (p-value=<.001). The proposed grading system demonstrated a superior level of predictive accuracy (AUROC of .72) than the SM and SP grading system (AUROC of .61 and .57, respectively).

Table 1

Logistic Regression	Odds Ratio	p-value	95% Confidence Interval
Age (≥60 years)	2.5	0.04	1.04 – 6.03
Gender (Female)	.6	.18	.28 - 1.3
Embolization Prior to Surgery	1.3	.47	0.63 – 2.73
Hemorrhage at Initial Presentation	2	0.09	0.90 - 4.44
Presurgical Hemorrhage	2.2	0.048	1 - 4.7
AVM Size	1.0	.83	.78 – 1.35
AVM Size (≥3 cm)	1.2	0.64	.55 - 2.67
Eloquence (Yes)	1.7	0.40	.49 – 6.07
Associated Aneurysm	1.9	0.12	.85 - 4.07
Venous Drainage (Deep)	2.3	0.03	1.07 - 4.88
Neurologic Status Prior to Treatment	4.6	<.001	2.09 – 9.91

Logistic Regression Analysis of Risk Factors for Poor Outcomes

Figure 1
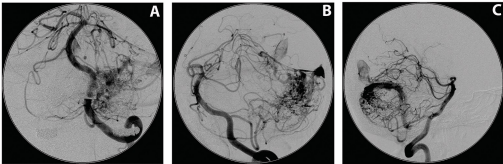
Case Illustration

Table 2

| Predictors	Criteria	Points	Risk Grade	Points	Risk Assessment	Risk for Poor Outcome (number)
Neurologic Status Prior to Treatment	Yes	2	Grade I	0 to 1	Low risk	32.7% (16/49)
	No	0				
Hemorrhage Prior to Surgery	Yes	1	Grade II	2 to 3	Moderate Risk	62.5% (25/40)
	No	0				
Deep Venous Drainage	Yes	1	Grade III	4 to 5	High Risk	80.6% (25/31)
	No	0				
Age ≥ 60	Yes	1				
	No	0				

Proposed Grading System

Figure 2
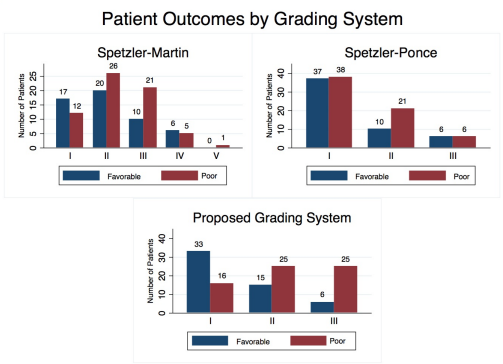
Patient Outcomes by Grading System

Figure 3
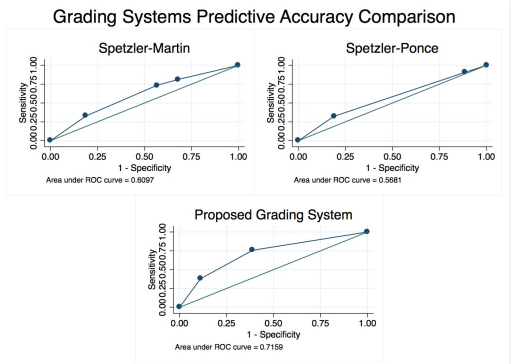
Grading System Predictive Accurary

Conclusions

We propose a novel grading system for cerebellar AVMs based on presurgical hemorrhage, venous drainage, age, and neurologic status prior to treatment. Retrospective and prospective studies with large patient samples are needed to fully establish the accuracy and predictive value of this new, proposed, grading system. Retrospective and prospective studies with large patient samples are needed to fully establish the accuracy and predictive value of this new, proposed, grading system.

Learning Objectives

By the conclusion of this session, participants should be able to 1) describe the prognostic accuracy of the Spetzler-Martin grading system for Cerebellar AVMs, 2) identify factors having the strongest association with patient outcomes, and 3) be able to apply a novel prognostic grading system for surgically resected cerebellar AVMs.