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Treatment outcomes of pediatric patients with brain arteriovenous malformations

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Introduction

Brain arteriovenous malformations (AVMs) are a common cause of intracranial hemorrhage in children. The 2-4% annual risk of AVM hemorrhage creates a greater lifetime risk compared to adults. Few series describe the management and outcomes of pediatric AVMs treated with multimodality therapy.

Methods

47 (18%) consecutive pediatric patients were identified from a retrospective review of 264 AVMs treated over an 8-year period. The World Federation of Neurosurgical Societies (WFNS) score was used for status at presentation. The modified Rankin scale (mRS) was used to assess functional outcome at last follow-up.

Results

Baseline patient characteristics and treatment modalities are detailed in Tables 1 & 2. 96% patients completed treatment with a mean follow-up of 1.7 years. 68% presented with hemorrhage, and 32% presented unruptured. 56% of ruptured patients underwent surgery -/+ preoperative embolization compared to 40% of unruptured patients. The mean Spetzler-Martin grade in surgical patients was 2.3 compared to 3.2 in radiosurgical patients (p = .009). Radiosurgery was performed after surgery for cases of recurrence (1/27 patients, 4%) and residual (2/27 patients, 7%) – all in Grade 4 AVMs. The overall surgical cure rate was 89%, and 100% for grades 1-3 (21 patients). In radiosurgical patients with more than 2 years follow-up, 11/13 (85%) patients obtained a radiographic cure, and 100% for Grades 1-3 (7 patients). 78% surgical patients and 75% radiosurgical patients were mRS 0-2 at last follow-up. For ruptured patients, 88% were mRS 0-2 compared to 69%, if presenting with WFNS 1-3 and 4-5, respectively. For unruptured patients, 73% were mRS 0-2 (88% of Grades 1-3; 57% of Grades 4-5).

Table 1: Baseline patient characteristics

	Overall
N	47
Age (years)	12 (SD 3.5)
Female	17 (36%)
Clinical presentation	
Hemorrhage	32 (68%)
Non-hemorrhage	15 (32%)
World Federation of Neurosurgical societies score (WFNS, ruptured patients)[1]	
1	14 (44%)
2	2 (6%)
3	0 (0%)
4	8 (25%)
5	8 (25%)
Modified Rankin score (mRS, non-hemorrhage patients)	
0	7 (47%)
1	8 (53%)
Spetzler-Martin grade (45 patients)	
1	9 (19%)
2	8 (17%)
3	17 (36%)
4	9 (19%)
5	2 (4%)
AVM morphology	
Maximum size, mean (cm)	3.0 (1.7)
AVM size < 3 cm	22/45 (49%)
Lobar location	35 (75%)
Infratentorial location	5 (11%)
Eloquent AVM location	28/45 (62%)
Associated aneurysm	5/45 (11%)
Venous drainage pattern	
Superficial only	21 (47%)
Any deep drainage	24 (53%)

[1]All unruptured patients were WFNS 1.

Table 2: Treatment modalities

	Overall
Surgery alone	10 (21%)
Embolization alone	1 (2%)
Radiosurgery alone	16 (34%)
Preoperative embolization + surgery	14 (30%)
Preoperative embolization + radiosurgery	3 (6%)
Radiosurgery + surgery	1 (2%)
All modalities	2 (4%)

Conclusions

Surgical resection and stereotactic radiosurgery may offer similar clinical and radiographic outcomes in pediatric patients. For unruptured pediatric AVMs, treatment likely has greater risk with high grade AVMs, and prospective, multicenter data may help stratify the risk and benefits of treatment in that subset of patients.