Surgical Management of Giant Intracranial Arteriovenous Malformations: A Single Center Experience over 32 years

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■ OBJECTIVE: **Treatment of giant intracranial arteriovenous malformations (gAVMs) is a formidable challenge for neurosurgeons and carries significant morbidity and mortality rates for patients compared with smaller AVMs. In this study, we reviewed the treatments, angiographic results, and clinical outcomes in 64 patients with gAVMs who were treated at Henry Ford Hospital between 1980 and 2012.**

■ METHODS: **The arteriovenous malformation (AVM) database at our institution was queried for patients with gAVMs (≥6 cm) and data regarding patient demographics, presentation, AVM angioarchitecture, and treatments were collected. Functional outcomes as well as complications were analyzed.**

■ RESULTS: **Of the 64 patients, 33 (51.6%) were female and 31 (48.4%) were male, with an average age of 45.7 years (SD ± 15.5). The most common symptoms on presentation were headaches (50%), seizures (50%), and hemorrhage (41%). The mean AVM size was 6.65 cm (range, 6–9 cm). Only 6 AVMs (9.4%) were located in the posterior fossa. The most common Spetzler-Martin grade was V, seen in 64% of patients. Of the 64 patients, 42 (66%) underwent surgical excision, 10 (15.5%) declined any treatment, 8 (12.5%) were deemed inoperable and followed conservatively, 2 (3%) had stand-alone embolization, 1 (1.5%) had embolization before stereotactic radiosurgery, and 1 (1.5%) received stereotactic radiosurgery only. Complete obliteration was achieved in 90% of the surgical patients. Mortality rate was 19% in the surgical cohort compared with 22% in the observation cohort ($P = 0.770$).**

■ CONCLUSIONS: **Treatment of gAVMs carries significant morbidity and mortality; however, good outcomes are attainable with a multimodal treatment approach in carefully selected patients.**

INTRODUCTION

Intracranial arteriovenous malformations (AVMs) are one of the most challenging pathologies encountered by cerebrovascular surgeons (38). The management of AVMs is a daunting task, because multiple variables such as patient demographics and presentation, neurologic status, angioarchitecture of the AVM (arterial feeders, nidus size, venous drainage, associated aneurysms or varices), the availability of multimodality resources, expertise of the surgeon or endovascular specialist, and, most importantly, the patient's desires must be taken into consideration for any effective treatment algorithm. The optimal treatment strategy for cerebral AVMs remains controversial (4), especially in light of recent findings from the first randomized trial of unruptured AVMs (i.e., A Randomized trial of Unruptured Brain AVMs [ARUBA]) (34). The results of this trial may change the accepted treatment

Key words
- Embolization
- Giant intracranial arteriovenous malformations (gAVMs)
- Hemorrhage
- Management
- Microsurgery

Abbreviations and Acronyms
ACA: Anterior cerebral artery
ARUBA: A Randomized trial of Unruptured Brain AVMs
AVM: Arteriovenous malformation
gAVM: Giant arteriovenous malformations
HRST: Hypofractionated stereotactic radiotherapy
ICH: Intracerebral hemorrhage
LSt: Lenticulostriate
MCA: Middle cerebral artery
MRC: Medical Research Council
mRS: Modified Rankin score
PCA: Posterior cerebral artery
SM: Spetzler–Martin
SRS: Stereotactic radiosurgery

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Table 1. Patient Demographics and AVM Characteristics

Pt.	Age, years	Sex	Presentation	Size, cm	Location	SM	Arterial Feeders	Treatment	Initial mRS	F/U mRS Early	F/U mRS Late	F/U, months	AVM Obliteration	Complications
1	64	M	HA, ICH	6	R, P-O	4	A/M/PCA	Sx	1	3	2	177	Complete	Field cut*
2	56	F	ICH, Sz	7	R, F-P	4	ACh, MCA, ThP	NR	3	3	6	36	—	Death 2/2ICH
3	50	M	Diplopia	6	R, P-O	4	M/PCA	E + Sx	1	1	1	62	Complete	Chronic HA
4	48	F	HA, ICH	7	Vermis	5	A/PICA, SCA	Sx	3	5	6	0	Complete	PVS and WD
5	20	M	ICH	7	L, F-P	5	A/MCA	E + Sx	3	3	3	82	Complete	Aphasia, paresis*
6	54	F	HA, ICH	6	R Sylvian	4	MCA	Sx	1	4	Lost	2	Complete	Field cut, plegia*
7	35	M	Sz	6	L, T-P	5	AChA, MCA	Dec.	2	2	2	89	—	Chronic Sz
8	49	F	HA, ICH	6	L, P-O	5	A/M/PCA	Dec.	3	3	6	480	—	Death 2/2 ICH
9	41	M	Sz	6	L, T	5	ACh, M/PCA	Sx	2	5	Lost	3	Complete	Aphasia, plegia
10	50	M	Sz	7	R, PO, CC	5	M/PCA	NR	2	2	2	268	—	Chronic Sz
11	13	M	Sz	7	L, P, CC	5	A/M/PCA	E + Sx	3	3	3	78	Complete	Paresis
12	64	M	Sz	6	R, F	5	A/MCA	Dec.	1	1	0	126	—	None
13	28	M	ICH, Sz	6	R, BG	5	A/M/PCA	NR	3	3	3	3	—	Paresis
14	41	F	HA	6	L/R, P-O	5	A/M/PCA	NR	1	3	5	312	—	PVS
15	49	M	HA, ICH	7	Vermis	4	SCA	Sx	1	3	3	25	Complete	Truncal ataxia
16	50	M	HA, ICH	8	R, P	4	A/M/P	E + Sx	1	4	3	171	Complete	Paresis
17	17	F	HA, Tin.	9	Cerebell.	5	SCA, PCA	E + Sx	1	6	—	0	Complete	Death 2/2 ICH
18	35	M	HA	6	R, P-O	4	M/PCA	Sx	1	4	3	65	Complete	Field cut, paresis
19	65	F	Sz	6	R, F-P	4	A/MCA	Sx	2	3	3	32	Complete	Paresis
20	23	M	ICH, Sz	7	R, T-O	5	M/PCA	E + Sx	2	2	1	40	Complete	Field cut
21	22	F	Sz	6	L, O	5	A/MCA	SRS	1	2	Lost	3	Partial	Field cut, Sz
22	53	F	HA, ICH	6	R, T-P	5	A/M/PCA	Sx	1	4	3	12	Complete	Field cut, paresis
23	34	M	HA, ICH	6	L, P-T	5	M/PCA	E+ SRS	2	2	2	98	Partial	Sz
24	33	M	HA	6	L, F-P	5	A/MCA, LStr	Dec.	3	2	2	96	—	HA, paresis
25	59	F	HA, Sz	8	R T-P-O	5	A/M/PCA	E + Sx	2	4	3	30	Complete	Paresis
26	30	F	HA	9	R, F-T	4	A/M/PCA	Sx	1	6	—	0	—	Death 2/2 ICH
27	38	F	Ataxia	6	Cerebell.	5	A/PICA, SCA	Sx	2	5	5	7	Partial	PVS 2/2 ICH
28	58	M	Sz	7	L Sylvian	5	M/PCA	Dec.	2	2	2	184	—	Sz
29	20	M	HA, ICH	6	L, F-P	5	A/M/PCA	Sx	1	3	2	16	Complete	Sz
30	27	F	AMS	7	Vermis	4	A/PICA, SCA	NR	1	1	Lost	13	—	Hydrocephalus
31	64	M	ICH, Sz	6	L, T-P	4	A/M/PCA	Sx	2	6	—	0	—	Death 2/2 ICH
32	44	F	SZ	6	L, T-P	4	A/MCA, PChA	E + Sx	1	3	1	181	Complete	HA