



Gamma Knife Radiosurgery for AVM's in Adults: Ankara Experience

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Introduction

Cerebral arteriovenous malformation (AVM) is a congenital vascular anomaly with vessel tangle which directly shunts blood from arterial to the venous system without an intervening capillary network. The major risk is rupture which has 10% mortality and 30–50% morbidity from each bleed. Stereotactic radiosurgery has proven effect on small and middle size AVM's. We aim to report our experience on cerebral AVM's which were treated by Gamma Knife Radiosurgery.

Methods

Between 2005 and 2015, 756 patients with AVMs were treated with GKS at Gamma Knife Center of Gazi University Hospital Neurosurgery Department. We analyzed 314 adult patients who has at least two year regular follow-up. The rest of the patients are either children or lost in follow-up or have less than 2 years follow-up. Three patients died from other causes. The median follow-up was 75,2 months (48-108months). Total AVM obliteration is determined angiographically. Many factors including the age, sex, AVM volume, the dose, radiosurgery based AVM grading, prior embolization, prior bleed, obliteration rates, complications,

hemorrhage rate after treatment were analysed.

The relation between the variables and obliteration rates were also analysed.

Results

There were 112 women(35.7%) and 202 men(64.3%). The median age was 35 (18-75). The median irradiated nidus volume was 4400 mm³. 87 patients had ruptured AVM'S (27.7%) and 227patients had unruptured AVM's (72.3%). 97 patients had previous embolization (30.9%), 16 patients had embolization and surgery (5.1%) where as 182 patients were treated with only stereotactic radiosurgery. The median dose was 22(14-25) Gy. Median RBAVM was 1.5(0.4-4.4). RBAVM based grade of patients were: grade 1 (RBAVM:0-1) 42 patients(13.4%) , grade 2 (RBAVM:1.01-1.5) 103 patients (32.8%) ,grade 3 (RBAVM:1.51-2) 91 patients(29.0 %), grade 4 (RBAVM:More than 2) 78 patients (24.8%). The obliteration rate is 72.6% (228 of 314 patients). In embolized patients obliteration rate is 70.1% (68 of 97 patients).The obliteration rates in combination of surgical treatment and embolization is 84.2% (16 of 19). The obliteration rate in unembolized patients is 70.7% (128 of 182).

Statistically insignificantly higher rate of obliteration was observed in previously embolized AVM's in this series. RBAVM scores of the patients in embolized and unembolized patients were similar and nearly same obliteration rates were found according to the similar RBAVM scores. The majority of the previously embolized AVM's in this series were grade3 , 4 and 5 AVM's before endovascular treatment.

RBAVM score(p=0.03) , volume (p=0.04) and the dose (p=0.03) were independent predictors of obliteration.The median interval to achieve complete obliteration was 25.5 (9-84) months. At 10 patients(3.2%) intracranial hemorrhage occured during follow up period. The permanent symptomatic complication rate was 1.9%. Transient or asymptomatic radiological complications including edema and ARE (Adverse Reaction Effect) were observed in 5.4% of the patients. Three patients were operated for malignant edema, cyst formation and midline shift (Fig 1,2).

7 patients died from bleeding during the follow up and none of them had obliterated AVM.

Conclusions

Radiosurgery for AVM's provides relatively high rates of obliteration with acceptable complication rates. As the RBAVM score decrease, the rate of obliteration increases. Contrary to many recent series, the obliteration rates were not affected by prior embolization in the presented series. We think that, there is still need for proper endovascular treatment before radiosurgery for selected cases.

Learning Objectives

- The role of radiosurgery in cerebral AVM's

Figure 1: 3 years after radiosurgery, malignant edema, cyst and shift were observed. Right hemiparesis 2/5 and cushing syndrome developed.

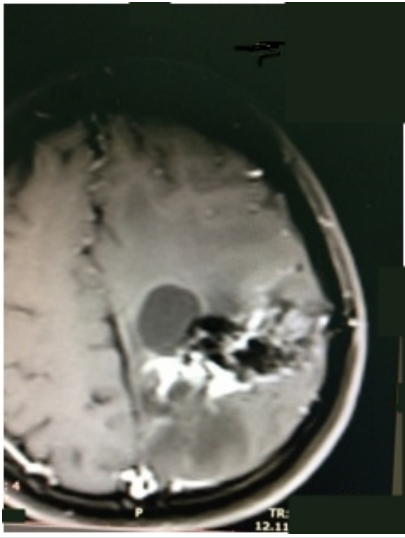
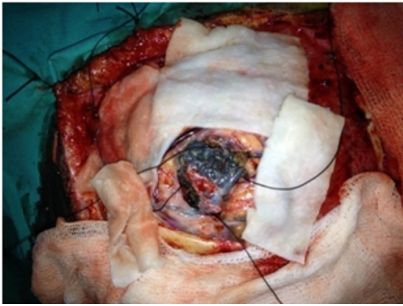


Figure 2: Images during the operation



Characteristics of the patient population ,AVM feature and outcome after treatment

			%
Age	19-29	108	34.4%
	30-44	115	36.6%
	45-59	71	22.6%
	≥60	20	6.4%
	Total	314	100.0%
SEX	Female	112	35.7%
	Male	202	64.3%
	Total	314	100.0%
LOCATION	Superficial	134	42.7%
	Deep	180	57.3%
	Total	314	100.0%
RBAVM	0-1	42	13.4%
	1.01-1.5	103	32.8%
	1.51-2.0	91	29.0%
	≥2	78	24.8%
	Total	314	100.0%
OBLITERATION	No	88	27.4%
	Yes	228	72.6%
	Total	314	100.0%
TRANSIENT OR ASYMPTOMATIC RADIOLOGICAL COMPLICATIONS	No	297	94.5 %
	Yes	17	5.4 %
	Total	314	100.0%
HEMORRHAGE AFTER GKS	No	304	96.8%
	Yes	10	3.2%
	Total	314	100.0%
PERMANENT SYMPTOMATIC COMPLICATION	No	308	98.1%
	Yes	6	1.9%
	Total	314	100.0%
HEMORRHAGE BEFORE GKS	No	227	72.3%
	Yes	87	27.7%
	Total	314	100.0%
Previous Treatment	None	181	57.6%
	Embolization	97	30.9%
	Surgery	19	6.1%
	Gamma Knife	1	.3%
	Embolization+Surgery	16	5.1%
	Total	314	100.0%

$RBAVMs = (0.1) \times Volume + (0.02) \times (Age, year) + 0.5 \times (location; hemispheric/corpus callosum/cerebellar = 1, Basal ganglia/thalamus/brainstem = 2)$