Gamma Knife Radiosurgery for Arteriovenous Malformations in Pediatric Patients

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Learning Objectives

1. Alternative Methods in Management of Pediatric AVMs
2. Results of Gamma Knife Radiosurgical therapy in pediatric AVMs
3. Parameters effecting outcome in pediatric AVM radiotherapy

Introduction

Pediatric AVMs seems to have different clinical, radiological and outcome characteristics when compared to adult counterparts. The risk of rupture of an AVM is 2-4% per year. The cumulative hemorrhage risk of a child is higher than adults and this makes definitive management mandatory whenever possible.

The authors present the results of Gamma Knife stereotactic radiosurgery performed in a series of children with arteriovenous malformations (AVMs) in a single center.

Methods

Evaluation of prospectively recorded data between June 2005 and January 2014 for AVMs revealed a total of 75 pediatric patients treated in our department. Patients requiring fractionated treatment, patient that have a history of previous radiotherapy or radiosurgery and patients with less than 12 months of follow up were excluded leaving a total number of 58 patients.

The median age was 12. There were 24 (41.4%) boys and 34 (58.6%) girls. Diagnosis was established after intracranial hemorrhage in 24 patients (41.4%), after seizures in 17 patients (29.3%), after headaches in 10 (17.2%) and after progressive deficits in 3 (5.2%). The median AVM volume was 3.5 cc

Figure 1 demonstrates a sample patient treated in our clinic.

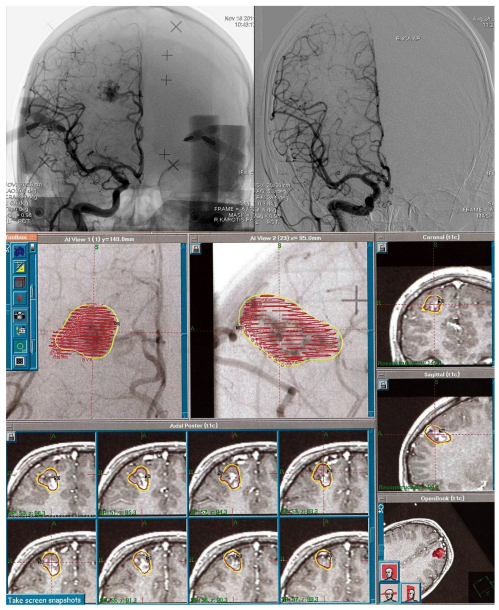
Results

Single session Gamma Knife radiosurgery resulted in complete AVM obliteration in 40 (68.9%) patients after a median follow-up time of 21 months. There were 35 (60.3%) excellent outcome (complete obliteration with no new deficits) in this series. The annual rate of developing new deficits and hemorrhage was calculated as 5.45% and 1.8%, respectively.

The actuarial obliteration rate was calculated as 52% at 24 months, 73.49% at 36 months and 82.54% at 48 months (Figure 2).

Univariate analysis were performed for any association between excellent outcome and the following factors: age, sex, AVM volume, prescription dose, any intervention history, previous embolization, hematoma presentation, Spetzler Martin grade, radiosurgery based AVM score, modified radiosurgery based AVM score, nidus type and pial surface relation. Analyzes revealed sex (p=0.049), AVM volume (p=0.018) radiosurgery based AVM score (p=0.018) and nidus type (p=0.012) was significantly associated with excellent outcome

Figure 1

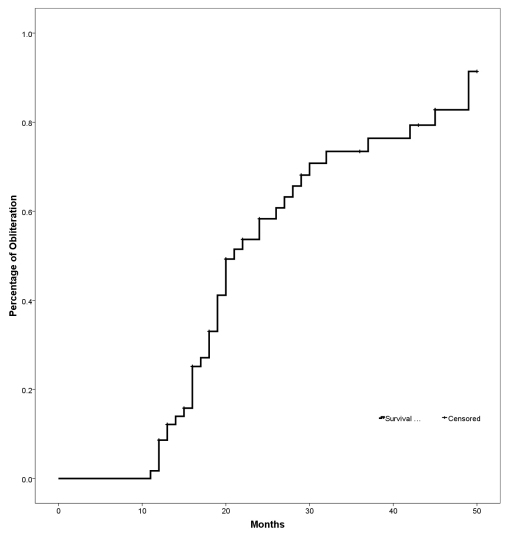


DSA and the treatment plan of a patient treated in our clinic.

Discussion

We would like to emphasis one aspect of our study. The calculated conformity index according to the formulation suggested by Paddick is 79.20% in this series. On the other hand, when we look at how much of the target volume is radiated, we see that 98.59% of the target was irradiated. These two calculations suggest that there is an overtreatment in our series. We think that relatively shorter time to reach obliteration demonstrated in this series may also be the result of this "overtreatment".

Figure 2



Obliteration rates of the patient population throughout the follow-up period.

We speculate, angiographically undetectable immature vessels in the periphery of the nidus may benefit from such a generous treatment. This speculation requires additional studies.

Conclusions

Radiosurgery was successful in majority of patients with minimal morbidity.

Gamma Knife radiosurgery for AVMs can be a safe and successful method in pediatric patients.

Acknowledgement

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