

Long Term Outcomes after Staged Volume Stereotactic Radiosurgery for Large Arteriovenous Malformations

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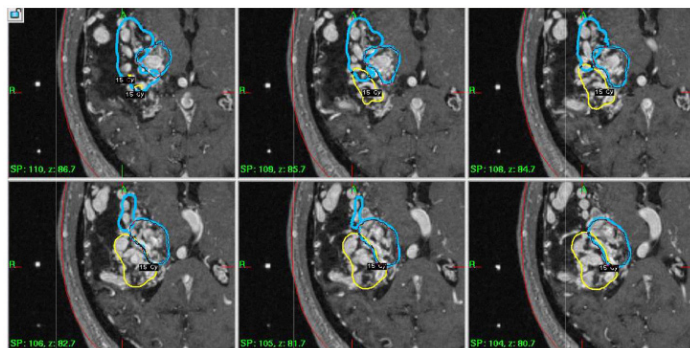
Introduction

Stereotactic radiosurgery is an effective treatment modality for small arteriovenous malformations (AVMs) of the brain. For larger AVMs, the treatment dose is often lowered to reduce potential complications, but this decreases the likelihood of cure. One strategy is to divide large AVMs into smaller anatomic volumes and treat each volume separately.

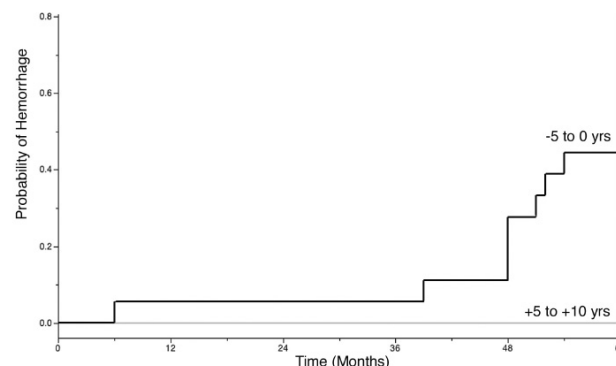
Methods

Eighteen patients with AVMs > 15 ml underwent prospective staged volume radiosurgery over a 13-year period. The median AVM volume was 22.9 ml (range 15.7 - 50 ml). Separate anatomical volumes were irradiated at 3 to 9 month intervals (median volume 10.9 ml, range 5.3 - 13.4 ml; median marginal dose 15 Gy, range 15-17 Gy). The AVM was divided into 2 volumes in 10 patients, 3 volumes in 5 patients, and 4 volumes in 3 patients. Seven patients underwent retreatment for residual disease.

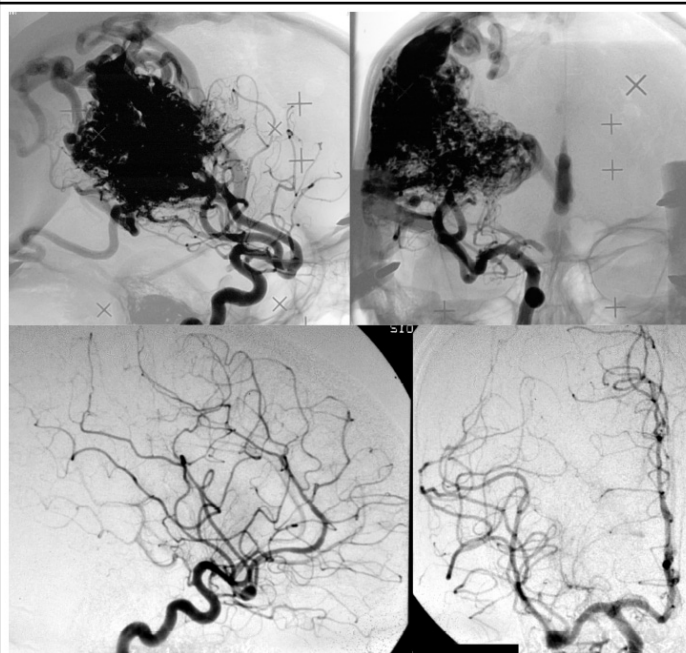
Staged Volume Treatment Plan



The total AVM volume is segmented into smaller volumes for radiosurgical targeting.



Actuarial analysis of hemorrhage rates 5 years prior to treatment vs. 5-10 years after treatment ($p = 0.0341$).



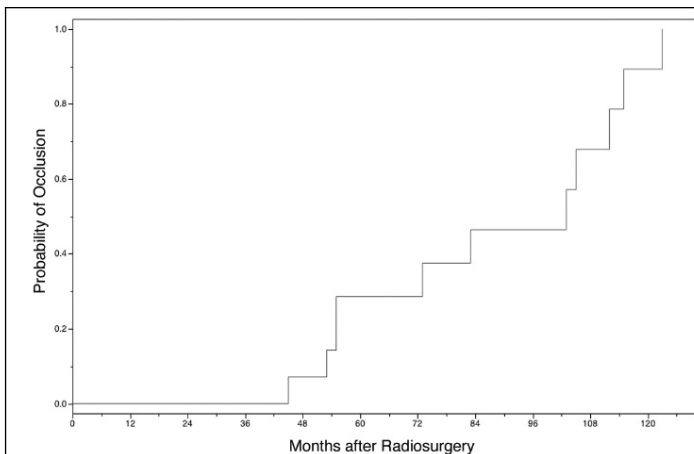
26 y/o female with seizures and a previous hemorrhage. Pre-treatment angiogram shows a large right hemispheric AVM. Follow-up angiogram 5 years after treatment shows angiographic occlusion.

Results

To date, we have achieved angiographic closure in 11 of 18 patients for an overall occlusion rate of 61.1%. Actuarial rates of complete angiographic occlusion were 29% at 5 years and 89% at 10 years. Five patients (27.8%) had a hemorrhage after radiosurgery. The overall hemorrhage rate after treatment was 4.2% per patient years. Four of 18 patients (22%) developed transient new symptoms not related to hemorrhage that subsequently resolved. One patient (5.6%) developed a new permanent deficit not related to hemorrhage. One patient declined further treatment after undergoing 2 of 4 planned treatments and subsequently expired from a hemorrhage (5.6%).

Conclusions

Staged volume radiosurgery for AVMs larger than 15 ml is a viable treatment strategy. The long-term occlusion rate is high while the radiation related complication rate is low. Hemorrhage during the "lag period" remains the greatest source of morbidity and mortality.



Actuarial analysis of angiographic occlusion rates.