CyberKnife Radiosurgery Provides Acceptable Longterm Control with Low Risk of Rebleeding in Arteriovenous Malformations Not Suitable for Surgery

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Objective(s): Cerebral arteriovenous malformations (AVMs) are rare vascular lesions potentially responsible for substantial neurological morbidity and mortality. The treatment of AVMs is complex, often depending on multimodal interventions combining endovascular treatment, microsurgical resection and stereotactic radiosurgery. However, definitive reports on the results of combined treatment of AVM are still lacking. We here report the clinical and radiographic results and rebleeding rates after CyberKnife radiosurgery alone and in combination with embolization in a large multi-institutional AVM cohort.

Methods: We retrospectively analyzed 124 patients with AVMs (Spetzler-Martin (SM) grades 2-5) treated in two institutions (Charité University Hospital Berlin, Germany and Messina, Italy) with single-fraction CyberKnife radiosurgery between 2007 and 2018. All patients underwent multislice computed tomography and 3D-volumetric CT-angiography and well as 3D- digital subtraction angiography and 3D MR angiography for treatment planning. Single-fraction doses between 14 – 22 Gy (median 18 Gy) were applied to the 85% isodose line. Embolization was performed before radiosurgery in 50 cases (40.3%).

Results: Median age of the population was 39.8 yrs (range 9-76 yrs). Median follow-up was 41.5 months (range 6 -123 months). Median volume of the radiated nidus was 3.4 cm^3 (range 0.2 – 27.2 cm^3). Complete or near complete obliteration was achieved in 69 (55.6%), partial remission in 35 cases (28.2%)), while minimal response or no change were observed in 20 cases (16.1%). Obliteration rate in the 25 patients with longer than 4 years follow-up was 76%. Treatment induced toxicity (radiation necrosis and/or edema requiring prolonged steroid treatment) was observed in 18 cases (17.4%), while 91 patients (82.5%) remained symptom-free. Rebleeding occurred in 4 cases (3.2%) and 3 patients died during follow-up (1.51%), with 2 deaths associated to rebleeding from the previously radiated AVM (1.6%).

Conclusion(s): CyberKnife radiosurgery presents a valid therapeutic approach in AVMs not suitable for surgery, with acceptable obliteration rates, low toxicity and rare incidence of rebleeding.