Stereotactic Radiosurgery for Intracranial Arteriovenous Malformations: Past, Present and Future

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EDITORIAL

Stereotactic Radiosurgery (SRS) is a minimally invasive and effective therapeutic modality for appropriately selected patients harboring intracranial arteriovenous malformations (AVMs). For patients with Spetzler-Martin grade I or II AVMs, microsurgery often offers safe and effective treatment [1,2]. However, treatment of Grade IV or V AVMs remains challenging and involves significant risks with lower success rates regardless of treatment modality [3,4]. In a recent retrospective review of 110 patients with high-grade AVMs treated with SRS, we found low obliteration rates of 10% and 23% at 3 and 5 years, respectively [3]. In the same study, symptomatic radiation-induced changes (RIC) were observed in 12% of patients, with permanent post-SRS clinical deterioration occurring in 10% of patients. For patients with large (>10 cm³) AVMs unsuitable for surgery a volume-staged SRS approach has endorsed by certain groups. Kano et al. reported cumulative obliteration rates of 28% and 35% at 5 and 10 years, respectively, for these patients following two-stage SRS [4]. No mortality was observed in the study, but 13% of patients suffered from symptomatic adverse radiation effects. Although SRS may be used to treat large AVMs with moderate efficacy, the optimal management strategy, including the risks versus benefits of surveillance compared to multimodality therapy, for these lesions is still unclear.

Spetzler-Martin grade III AVMs represents a heterogeneous cohort of AVMs which straddles the dividing line between high-grade and low-grade lesions. In a large study comprising 398 patients treated for grade III AVMs using SRS with at least 2 years of follow-up, we recently reported obliteration rates of 38% and 60% at 3 and 5 years, respectively [5]. Grade III AVMs with <3 cm diameter, deep venous drainage, and eloquent cortex localization were found to have significantly higher obliteration rates compared to other subtypes. In the same study, permanent RIC was observed in 4% of patients, with pre-SRS rupture and presence of a single draining vein serving as independent predictors of RIC. A similar study was performed by the University of Pittsburgh group; 474 patients with grade III AVMs treated with SRS were reviewed, and comparable obliteration rates of 48% and 72% at 3 and 5 years, respectively, were observed [6]. This study also found significantly higher obliteration rates for small (diameter <3 cm) grade III AVMs than for larger ones. In the same study, permanent symptomatic adverse radiation effects were observed in 2.7% of patients, and no difference in complication rates was found between the various grades III AVM subtypes. Therefore, for patients with Grade III AVMs, SRS demonstrates relatively high rates of obliteration with acceptably low complication rates. Specifically, patients with small lesions located in eloquent cortical areas may have the most benefit, and thus should be selected for SRS rather than microsurgery.

Recent publication of the results from A Randomized Trial of Unruptured Brain Arteriovenous Malformations (ARUBA) has challenged the traditionally aggressive stance toward the management of AVMs [7]. ARUBA compared the risk of symptomatic stroke or death (primary endpoint) in patients harboring unruptured AVMs who were allocated to either medical management or intervention with surgery, SRS, or embolization alone or in combination. The trial was prematurely halted due to the significantly higher rate of the primary endpoint in the intervention cohort. However, the study has been criticized for its wide variability in treatment approaches, imbalance in randomization of AVM grades, and short duration of follow-up. Length of follow-up for patients treated with SRS is critical for assessment of treatment efficacy; SRS does not produce immediate angiographic results and has a latency period of 2 to 3 years that is associated with a risk of hemorrhage. Hence, the trial’s relatively limited follow-up duration of 33 months is inadequate to evaluate the efficacy of SRS for AVM treatment. We reviewed 444 patients with unruptured AVMs treated using SRS with radiologic and clinical follow-up intervals of 76 and 86 months, respectively, thus representing a better assessment of this treatment modality [8]. The overall obliteration rate was 62%, the risk of latency period hemorrhage was 1.6% annually, the rates of symptomatic and permanent RIC were 14% and 2%, respectively, and the incidence of clinical deterioration was 7%.

In summary, SRS affords a favorable risk to benefit profile for carefully selected AVM patients. It should be utilized judiciously to treat low grade AVMs in eloquent locations and small grade III AVMs. Low grade AVMs in non-eloquent areas should be considered for microsurgical resection prior to SRS. High-grade AVMs may be conservatively managed if they are asymptomatic or minimally symptomatic. Should they become progressively

symptomatic or rupture, multimodality approaches including pre-SRS embolization and volume-staged SRS, may be considered. The consideration of an AVM for SRS should always be undertaken by a multidisciplinary team at an experienced cerebrovascular center which has the capability to offer all potential treatment alternatives.

REFERENCES


