Nidal embolization

Nidal embolization of brain arteriovenous malformations (bAVMs) has become an increasingly important component of bAVM treatment. However, controversy exists as to the relative efficacy and safety of single-stage versus multistage approaches to bAVM embolization, with recent literature favoring multistage strategies.

To assess the sensitivity and specificity of arteriovenous malformation (AVM) nidal component identification and quantification using unsupervised machine learning algorithm, and to evaluate the association between intervening nidal brain parenchyma and radiation-induced changes (RICs) after stereotactic radiosurgery (SRS).

Fully automated segmentation via unsupervised classification with fuzzy c-means clustering was used to analyze AVM nidus on T2-weighted magnetic resonance imaging. The proportions of vasculature, brain parenchyma, and cerebrospinal fluid (CSF) were quantified. This was compared to manual segmentation. Association between brain parenchyma component and RIC development was assessed.

The proposed algorithm was applied to 39 unruptured arteriovenous malformations (AVMs). This included 17 female and 22 male patients with a median age of 27 years. The median percentages of the constituents were as follows: vasculature (31.3%), brain parenchyma (48.4%), and CSF (16.8%). RICs were identified in 17 (43.6%) of 39 patients. Compared to manual segmentation, the automated algorithm was able to achieve a Dice similarity index of 79.5% (sensitivity=73.5% and specificity=85.5%). RICs were associated with higher proportions of intervening nidal brain parenchyma (52.0% vs. 45.3%, p=0.015). Obliteration was not associated with a higher proportions of nidal vasculature (36.0% vs. 31.2%, p=0.152).

The automated segmentation algorithm was able to achieve classification of AVM nidus components with relative accuracy. Higher proportions of intervening nidal brain parenchyma were associated with RICs [1].

Sahlein et al., present a series of consecutive bAVMs embolized at their institution, demonstrating the safety and efficacy of a predominantly single-stage embolization strategy. The safety and efficacy of embolization are reported in the context of predetermined treatment strategies to provide more generalizable insight into treatment outcome.

One hundred thirty consecutive patients with 131 bAVMs underwent endovascular embolization at a single center. Diagnostic angiography with superselective microcatheterizations was performed in all patients. Postembolization angiograms were reviewed by 3 neuroradiologists for degree of occlusion and angiographic evidence of procedural complications. Patients were divided into cohorts based on the prospectively determined treatment strategy, which included the following: global devascularization of the bAVM (Devasc); targeting of a focal angioarchitectural weakness (Target), typically as an adjunct to surgery or Gamma Knife treatment; and primary occlusion of the bAVM by embolization alone (Occlude). Safety and efficacy were evaluated in the context of these treatment groups.

The 131 bAVMs were treated over an average of 1.28 embolization sessions per bAVM; 105 bAVMs (80%) were treated in a single stage. The average percentage devascularization in the Devasc arm was 85.3%, which was statistically significantly greater than the 72% aggregate devascularization reported in 8 modern N-butyl cyanoacrylate and Onyx papers based on 1-sample Wilcoxon rank-sum testing ($p<0.001$). Focal angioarchitectural weaknesses were successfully embolized for all 24 bAVMs in the Target group, directly with the embolic agent in 23 bAVMs and indirectly in 1 bAVM with a venous aneurysm/pseudoaneurysm by reducing arterial inflow and inducing venous thrombosis. Lesions in all patients in the Occlude arm were 100% occluded with embolization alone. Overall, the bAVMs in the Occlude arm were significantly smaller and required embolization of fewer pedicles than those in the Devasc group. One patient (0.8%) experienced significant morbidity following embolization, and 1 patient in the cohort died (0.8%).

This research communicates the authors' experience in developing a largely single-stage strategy for embolization of bAVMs. The results suggest that an aggressive, single-stage embolization may be implemented with a margin of safety and effectiveness similar to the multistage approaches more commonly reported in the literature. This work additionally introduces the importance of prospective assignment to a treatment strategy in assessing procedural outcome in bAVM embolization, thereby improving generalizability of the results and allowing for more rigorous interpretation of efficacy and safety [2)].

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2)
Sahlein DH, Mora P, Becske T, Nelson PK. Nidal embolization of brain arteriovenous malformations: rates of cure, partial embolization, and clinical outcome. J Neurosurg. 2012 Jul;117(1):65-77. doi: 10.3171/2012.3.JNS111405. Epub 2012 Apr 27. PubMed PMID: 22540403.