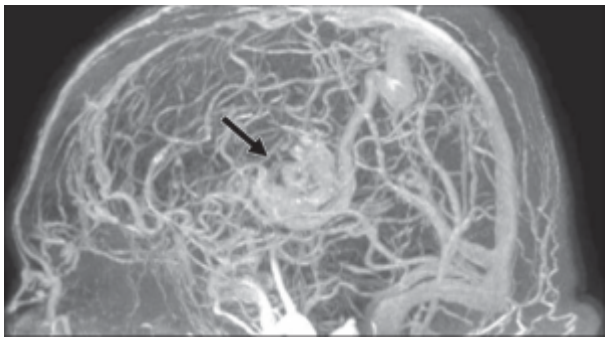
# Ferumoxytol magnetic resonance imaging for intracranial arteriovenous malformation



Central nervous system vascular malformations (VMs) result from abnormal vascular- and/or angiogenesis. Cavernomas and arteriovenous malformations are also sites of active inflammation [1].

Inflammation is increasingly being recognized as contributing to the underlying pathophysiology of cerebral aneurysms and brain arteriovenous malformation. Ferumoxytol is being increasingly used for both its prolonged intravascular imaging characteristics and its utility as an inflammatory marker when imaged in a delayed fashion [2] [3] [4] [5].

Children with intracranial arteriovenous malformations (AVMs) undergo digital DSA for lesion surveillance following their initial diagnosis. However, DSA carries risks of radiation exposure, particularly for the growing pediatric brain and over lifetime. Huang et al. evaluated whether MRI enhanced with a blood pool ferumoxytol (Fe) contrast agent (Fe-MRI) can be used for surveillance of residual or recurrent AVMs.

A retrospective cohort was assembled of children with an established AVM diagnosis who underwent surveillance by both DSA and 3-T Fe-MRI from 2014 to 2016. Two neuroradiologists blinded to the DSA results independently assessed Fe-enhanced T1-weighted spoiled gradient recalled acquisition in steady state (Fe-SPGR) scans and, if available, arterial spin labeling (ASL) perfusion scans for residual or recurrent AVMs. Diagnostic confidence was examined using a Likert scale. Sensitivity, specificity, and intermodality reliability were determined using DSA studies as the gold standard. Radiation exposure related to DSA was calculated as total dose area product (TDAP) and effective dose.

Fifteen patients were included in this study (mean age 10 years, range 3-15 years). The mean time between the first surveillance DSA and Fe-MRI studies was 17 days (SD 47). Intermodality agreement was excellent between Fe-SPGR and DSA ($\kappa = 1.00$) but poor between ASL and DSA ($\kappa = 0.53$; 95% CI 0.18-0.89). The sensitivity and specificity for detecting residual AVMs using Fe-SPGR were 100% and 100%, and using ASL they were 72% and 100%, respectively. Radiologists reported overall high diagnostic confidence using Fe-SPGR. On average, patients received two surveillance DSA studies over the study period, which on average equated to a TDAP of 117.2 Gy×cm2 (95% CI 77.2-157.4 Gy×cm2) and an effective dose of 7.8 mSv (95% CI 4.4-8.8 mSv).

Fe-MRI performed similarly to DSA for the surveillance of residual AVMs. Future multicenter studies could further investigate the efficacy of Fe-MRI as a noninvasive alternative to DSA for monitoring AVMs in children [6].

The purpose of a study was to evaluate the performance of ferumoxytol-enhanced MRA using a high-resolution 3D volumetric sequence (fe-SPGR) for visualizing and grading pediatric brain AVMs in comparison with CTA and DSA, which is the current imaging gold standard. METHODS In this retrospective cohort study, 21 patients with AVMs evaluated by fe-SPGR, CTA, and DSA between April 2014 and August 2017 were included. Two experienced raters graded AVMs using Spetzler-Martin criteria on all imaging studies. Lesion conspicuity (LC) and diagnostic confidence (DC) were assessed using a 5-point Likert scale, and interrater agreement was determined. The Kruskal-Wallis test was performed to assess the raters' grades and scores of LC and DC, with subsequent post hoc pairwise comparisons to assess for statistically significant differences between pairs of groups at $p < 0.05$. RESULTS Assigned Spetzler-Martin grades for AVMs on DSA, fe-SPGR, and CTA were not significantly different ($p = 0.991$). LC and DC scores were higher with fe-SPGR than with CTA ($p < 0.05$). A significant difference in LC scores was found between CTA and fe-SPGR ($p < 0.001$) and CTA and DSA ($p < 0.001$) but not between fe-SPGR and DSA ($p = 0.146$). A significant difference in DC scores was found among DSA, fe-SPGR, and CTA ($p < 0.001$) and between all pairs of the groups ($p < 0.05$). Interrater agreement was good to very good for all image groups ($\kappa = 0.77\text{-}1.0$, $p < 0.001$). CONCLUSIONS Fe-SPGR performed robustly in the diagnostic evaluation of brain AVMs, with improved visual depiction of AVMs compared with CTA and comparable Spetzler-Martin grading relative to CTA and DSA [7].

# References

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