

Ferumoxytol-based MR Versus Digital Subtraction Angiography for Surveillance of Residual Brain Arteriovenous Malformations in Children: A Single-Institution Analysis of Inter-Modality Reliability

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Introduction

Pediatric patients with Brain Arteriovenous Malformations (AVMs) typically undergo a Digital Subtraction Angiography (DSA) study at diagnosis and for surveillance following surgical intervention. To limit risk exposure from DSA, including radiation, we evaluated the sensitivity, specificity, and inter-modality agreement of DSA versus Magnetic Resonance with ferumoxytol contrast (Feraheme®, AMAG Pharmaceuticals Inc., Cambridge, MA, USA) using Arterial Spin Labeling (ASL) and Spoiled Gradient Recalled Acquisition (SPGR) series for surveillance of residual AVM.

Methods

A retrospective, single-institution cohort of children treated for AVM from 2014 to 2016 who underwent surveillance by ASL, SPGR, and DSA was assembled. Comparing modalities, blinded raters assessed residual AVM, lesion evolution, and their diagnostic confidence using a Likert scale. Sensitivity, specificity, and inter-modality reliability were determined with DSA as the gold standard. Acute radiation exposure was compared to a safety threshold of 2Gy.

Results

Fifteen patients met criteria (11 years, 3 to 17). Average time between MR and DSA was 17 days (SD=98). Cohen's Kappa for ASL plus SPGR was 0.848 ($p = <0.001$), ASL only was 0.393 ($p = 0.0139$), and SPGR only was 0.848 ($p = <0.001$). Sensitivity and specificity of ASL plus SPGR and ASL and SPGR only were 92% and 100%, 72% and 100%, and 92% and 100% respectively. Raters reported greater diagnostic confidence with ferumoxytol MR series versus standard MR. On average, patients received two DSA studies for surveillance. Per study, radiation for Total Dose Area Product, Total Air Kerma, and Peak Air Kerma was 58,102 mGy cm² (95% CI: 36,253, 79,951), 537 mGy (95% CI: 428, 646), and 304 mGy (95% CI: 109, 498). Two surveillance DSA studies constitute 54% (95% CI: 43-65%) of the 2Gy safety threshold.

Conclusions

Ferumoxytol-based MR performed excellently for AVM surveillance in children and should be considered to supplant Digital Subtraction Angiography.

Learning Objectives

Determination of clinical reliability, sensitivity, and specificity of non-invasive, non-radiation surveillance imaging for residual AVM utilizing MR series with ferumoxytol contrast versus Digital Subtraction Angiography.