Intraorbital Vascular Malformations: Treatment with MRI-Guided Sclerotherapy

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Target Audience: Interventional radiologists, interventional MRI scientists, physicians interested in vascular malformation treatment technology and outcomes.

Introduction & Purpose:

Despite their benign histology, many congenital intra-orbital lesions are prognostically aggressive owing to the limited anatomical space and the intimate optic nerve association, resulting in pain, disfigurement, and vision loss. Complete surgical excision while preserving function may not be possible [1]. The use of conventional fluoroscopically-guided interventions has been limited due to inability to visualize soft tissue anatomy. This work aims at evaluating the feasibility of applying interventional MRI technology to access and treat these challenging intraorbital lesions.

Patients & Methods:

9 MRI-guided sclerotherapy procedures were performed on 4 patients (4M,0F,age=3-30y) with retrobulbar(n=2), and orbital margin(n=1) veno-lymphatic malformations, and retrobulbar cystic teratoma(n=1). Patients presented with proptosis (n=3), visual impairment (n=2), diplopia (n=1), ecchymosis (n=2), and/or pain (n=1). 2 lesions were treatment-naïve and the other 2 lesions were post-surgical recurrences. All procedures were exclusively performed within an interventional MRI suite with an in-room monitor used for real-time needle guidance, injection monitoring and bedside scanner operation. A 22g MR-compatible needle was inserted into the targeted lesions under "MR-fluoroscopy" using triorthogonal image plane guidance[2] to interactively monitor the needle on continuously updated sets of true-FISP images (TR/TE, 4.35/2.18; FA, 60°;NSA, 3;TA, 3.11 s/slice). 0.6% gadolinium was mixed with 5% Ethanolamine Oleate (Ethamolin®) (0.15ml:1.0ml vol.) and injected under real-time monitoring using a triorthogonal FLASH sequence (TR/TE,2484/5.4).

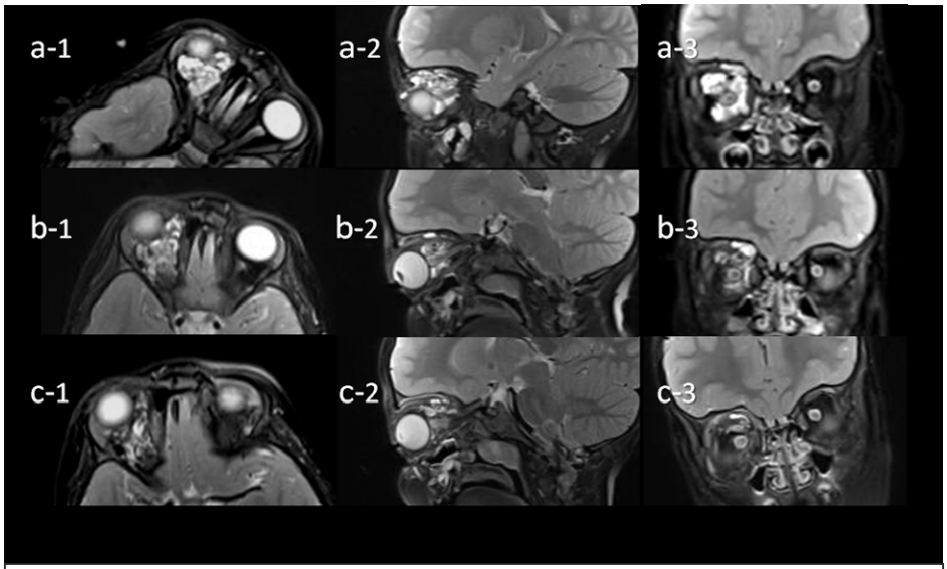

Fig. 1: 3-year-old male with a complex right-sided retrobulbar veno-lymphatic malformation encasing the optic nerve. The patient presented with proptosis, ecchymosis, squint, and visual impairment. He was subjected to 2 prior unsuccessful surgical interventions. (a:1-3) are axial, sagittal, and coronal T2-Wis demonstrating the extent of malformation prior to MRI-guided sclerotherapy. (b:1-3) are the corresponding scans obtained 6 weeks after the first sclerotherapy session. (c:1-3) are the same scans obtained 12 weeks after the first, and 6 weeks after the second session of sclerotherapy. There has been significant shrinkage of the overall dimensions of the malformation and noticeable reduction of proptosis.

Results:

Initial intra-orbital needle insertion and subsequent repositioning were feasible in all cases. The flexibility of triorthogonal guidance was most helpful in accessing the retrobulbar intraconal space. Adequate monitoring of sclerosing agent was persistently achieved on 3 planes. Targeted lesions ranged between 1.5 and 4cm. 3 lesions encircled/abutted the optic nerve. 1-5.5 mls of sclerosing material were injected per procedure. The smallest lesion was completely filled with sclerosing material during each of 2 treatment sessions. The remaining 3 lesions were partially filled to avoid excessive intraorbital pressure. Procedures were tolerated by all patients. Noticeable local edema and bruising were a standard finding for 1-2weeks following procedures. Complete resolution of one lymphatic malformation occurred. The 3 other lesions has undergone significant shrinkage without delayed complications.

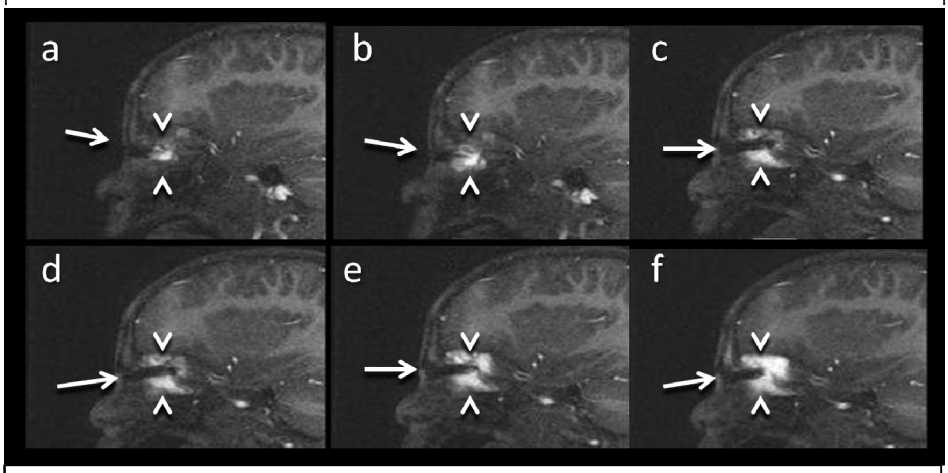

Fig. 2: Sequential image captures from MRI fluoroscopic monitoring of the injected sclerosing agent during treatment of the veno-lymphatic malformation shown in figure 1. Tri-orthogonal plane guidance is being implemented utilizing FLASH sequence (TR/TE,2484/5.4). The shown images are from a sagittal oblique plane obtained along the injecting needle (arrows, a-f). The sclerosing material is mixed with dilute gadolinium to facilitate monitoring of distribution during treatment (arrowheads, a-f). Two additional orthogonal planes (not shown) are routinely acquired to facilitate accurate mapping of the injected volume in relation to the malformation and to critical orbital structures.

Discussion & Conclusion:

This initial report highlights the feasibility of utilizing interventional MRI technology in treating intraorbital congenital lesions. This potential role for interventional MRI may open a new avenue for those patients who are typically deprived of surgical and other conventional interventional options. The initial safety and efficacy reported herein are to be further evaluated on a larger number of procedures and compared to existing surgical data.

References:

[1] Chung EM, et al. Radiographics. 2007;(27):1777-799.
[2] Derakhshan JJ, et al. Proc ISMRM 15: 487 (2007).