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Introduction Vascular malformations of the Head and Neck are lesions that often involve multiple contiguous anatomic spaces and encase critical neurovascular structures, making surgical treatment difficult and often unsuccessful. Percutaneous and transarterial sclerotherapy have been advocated as effective alternatives or adjuncts to surgery. For low-flow malformations, those without a significant arterial component, percutaneous X-ray fluoroscopic injection of the lesion is usually performed. Unfortunately, the lesion itself is only visible after injection during this form of sclerotherapy. This makes accurate needle insertion difficult, especially if there is no palpable component, and hinders complete filling of deep compartments.

The striking concavity of these lesions on MR images, along with the capacity for interactive multiplanar imaging, increased access to the patient, and rapid temporal resolution provided by recently developed MR imaging systems (1,2), suggests that MR-guidance may be optimally suited for sclerotherapy of these lesions.

This pilot study was performed to test the hypothesis that MR-guided percutaneous sclerotherapy of low flow vascular malformations in the head and neck is feasible, will allow monitoring of injection of both superficial and deep vascular components, and can be performed safely.

Methods Imaging system: MR-guided procedures were performed using a clinical 0.2 T C-arm imaging system (Siemens MAGNETOM OPEN, Erlangen, Germany) with the following components:

1) In-room RF-shielded liquid crystal monitor for image viewing at the side of the magnet; 2) MR compatible mouse and foot pedal to control the imager from within the magnet room; 3) Rapid gradient echo sequences (FISP 18/7/1, TR/TE/NEX, 90° FA) to produce images with clinically adequate signal-to-noise and spatial resolution acquired in 1.5 to 3 seconds per slice in a single slice mode, or 4 to 9 seconds in a 3 slice mode (2); and, 4) MR compatible monitoring and surgical lighting.

Procedures: Five MR-guided procedures were performed in 3 patients (age 27, 31, and 45 years) with low flow vascular malformations of the masticator, parotid, parapharyngeal and carotid spaces of the head and neck.

Following target localization on TSE T2W-images, local anesthesia was applied and a 22g MR-compatible needle was advanced under a continuous imaging mode that consisted of the sequential acquisition, reconstruction, and display of multiple sets of three parallel 5 mm slices centered on the predicted needle position to allow rapid detection of needle bending or deflection. Following placement of the needle at the target site, the position was confirmed using T1W or T2W TSE sequences.

Varying amounts (4-10 cc) of a sclerosing agent (Ethanolamine Oleate [Ethamolin®], Cypros Pharmaceutical Corporation, Carlsbad, CA, USA) or Sodium Tetradecyl Sulfate [Sotradecol 3%, Elkins-Sinn, Inc. Cherry Hill, NJ, USA], mixed with 1.25 - 2.5 micromoles gadopentetate dimeglumine [Magnevist®, Schering, Berlin, Germany] per ml of sclerosing agent, were injected into the low flow malformation under continuous gradient echo MR imaging (Figure). The needle was repositioned and injection repeated until all desired compartments of the malformation appeared filled with the sclerosing agent. Due to the large size of the lesions in two of the three patients, sclerosis therapy was planned in a staged manner, and specific portions of the malformation were targeted for treatment in each of multiple settings. Extreme care was taken to prevent subcutaneous or submucosal extravasation of sclerosing agent. The patients were followed up clinically and with MRI.

Discussion Low-flow vascular malformations provide a difficult clinical dilemma, with surgical excision often impossible, and risk of skin or mucosal necrosis or incomplete treatment with current percutaneous treatment options. The rapid continuous monitoring and interactive imaging provided by interventional MR image-guidance makes this option attractive.

The addition of very dilute gadopentetate dimeglumine to the sclerosing agent is safe (personal communication, Dr. Thomas Frenzel, Schering, Berlin, Germany), makes tracking of the injected agent simple during treatment, and along with rapid temporal resolution imaging, allows avoidance of subcutaneous or submucosal injection which can lead to tissue necrosis.

Conclusions Our preliminary results suggest that sclerosing agent injection can be simply monitored, deep vascular components can be easily treated, and that MR guided percutaneous sclerotherapy of low flow vascular malformations in the head and neck is feasible and safe.

References