CLINICAL STUDY

Multimodality Image-Guided Sclerotherapy of Low-Flow Orbital Vascular Malformations: Report of Single-Center Experience

Samer Harmoush, MD, Ponraj Chinnadurai, MBBS, MMST, Kamel El Salek, MD, Zeyad Metwalli, MD, Honey Herce, MD, Amit Bhatt, MD, Paul Steinkuller, MD, Timothy Vece, MD, Shakeel Siddiqui, MD, Ashwin Pimpalwar, MD, Douglas Marx, MD, Michel Mawad, MD, and Sheena Pimpalwar, MD, FRCR

ABSTRACT

Purpose: To evaluate the role of multimodality imaging tools for intraprocedural guidance and outcome evaluation during sclerotherapy of low-flow orbital vascular malformations.

Materials and Methods: A retrospective review was performed of 17 consecutive patients with low-flow orbital malformations (14 lymphatic, 2 venous, and 1 venolymphatic) who underwent multimodality image-guided sclerotherapy between November 2012 and May 2015. Sclerotherapy technique, image guidance tools, and complications were recorded. Sclerotherapy outcome was evaluated using clinical response, magnetic resonance (MR) image–based lesion volumetry, and proptosis quantification.

Results: There were 22 sclerotherapy sessions performed. Intraprocedural ultrasound (US), fluoroscopy, cone-beam computed tomography (CT) and MR image fusion were used for image guidance with 100% technical success. Resolution of presenting symptoms was observed in all patients at 1-month follow-up. Four major sclerotherapy complications were successfully managed. Statistically significant reduction in lesion volume ($P = .001$) and proptosis ($P = .0117$) by MR image analysis was achieved in all patients in whom 3-month follow-up MR imaging was available (n = 13/17). There was no lesion recurrence at a median follow-up of 18 months (range, 8–38 mo).

Conclusions: Multimodality imaging tools, including US, fluoroscopy, cone-beam CT, and MR fusion, during sclerotherapy of low-flow orbital malformations provide intraprocedural guidance and quantitative image-based evaluation of treatment outcome.

ABBREVIATIONS

DAP = dose area product, IOP = intraocular pressure, STS = sodium tetradecyl sulfate

From the Departments of Radiology (S.H., K.E.S. Z.M., M.M.), Ophthalmology (H.H., A.B., P.S.), Pediatric Pulmonology (T.V.), Pediatric Anesthesia (S.S.), and Pediatric Oculofacial Surgery (D.M.) and Division of Pediatric Surgery (A.P.), Michael E. DeBakey Department of General Surgery, Baylor College of Medicine, Houston, Texas; Angiography Division (P.C.), Siemens Medical Solutions USA, Inc, Hoffman Estates, Illinois; and Division of Interventional Radiology (S.P.), Department of Radiology, Texas Children's Hospital, 6621 Fannin Street, Houston, TX 77030. Received September 10, 2015; final revision received and accepted February 29, 2016. Address correspondence to S.P.; E-mail: ashwinsheena@hotmail.com

P.C. is a full-time research scientist for and receives a salary from Siemens Medical Solutions USA, Inc (Hoffman Estates, Illinois). None of the other authors have identified a conflict of interest.

Figures E1–E5 and Table E1 and Appendix A are available online at *www.jvir.org*.

J Vasc Interv Radiol 2016; XX:▮▮▮–▮▮▮

http://dx.doi.org/10.1016/j.jvir.2016.02.036

The infiltrative nature of low-flow orbital vascular malformations makes complete surgical resection challenging, with risks of nerve damage, scarring, infection, and incomplete resection (1,2). During long-term follow-up, these malformations have a tendency to recur, as reported in the surgical literature with recurrence rates of 58% and 71% at a mean follow-up of 3.4 years and 7.2 years, respectively (1,2). Sclerotherapy has been increasingly used as a minimally invasive treatment option for the management of these malformations (3–12). The main challenges of sclerotherapy are safe access into retrobulbar lesions, management of orbital compartment syndrome after sclerotherapy, and lack of standardized evaluation of treatment response (13). The purpose of this study was to evaluate the role of multimodality

imaging tools for intraprocedural guidance and outcome evaluation during sclerotherapy of low-flow orbital malformations.

MATERIALS AND METHODS

After obtaining institutional review board approval, a retrospective review was performed of all consecutive patients with low-flow orbital vascular malformations who underwent sclerotherapy between November 2012 and May 2015. During this period, 17 patients (9 male, 8 female) with a median age of 8.5 years (range, 1–42 y) were treated. Nine of 17 patients (53%) had a history of incomplete surgical resection or recurrence after surgery. Patient demographics, clinical presentation, malformation type, and location are summarized in Table 1. All patients were managed using an institutional multidisciplinary management algorithm (Fig 1).

Table 1. Patient Demographics, Malformation Type, Anatomic Distribution, and Clinical Presentation

	No. Patients	%
Demographics		
Male	9	52.9
Female	8	47.1
Median age, y (range)	8.5 (1–42)	
Malformation type		
Lymphatic	14	82.4
Microcystic	12	70.6
Macrocystic	2	11.8
Venous	2	11.8
Mixed	1	5.9
Anatomic distribution		
Preseptal	13	76.5
Extraconal	12	70.6
Intraconal	13	76.5
Clinical presentation		
Intralesional hemorrhage with acute/subacute orbital compartment syndrome	8	47.1
Chronic intermittent pain and periorbital swelling	5	29.4
Deprivational amblyopia	3	17.6
Migraine and seizures	1	5.9
History of previous surgical resection		
Yes	9	52.9
No	8	47.1
Associated findings		
Developmental venous anomalies	7	41.2
Dural arteriovenous fistula	1	5.9
Multiple pial arteriovenous fistulae	1	5.9
Extraorbital involvement	10	58.8

Multimodality Image Guidance

Magnetic resonance (MR) imaging was performed using a Philips Achieva 1.5 Tesla MR Scanner (Philips Healthcare, Best, Netherlands) with and without contrast with emphasis on fat-suppressed T2-weighted imaging in sagittal, axial, and coronal planes. Intraprocedural ultrasound (US) imaging was performed using a linear 8- to 18-MHz transducer (LOGIQ E9; GE Medical Systems, Milwaukee, Wisconsin). Cone-beam computed tomography (CT) imaging (*syngo* DynaCT; Siemens AG,

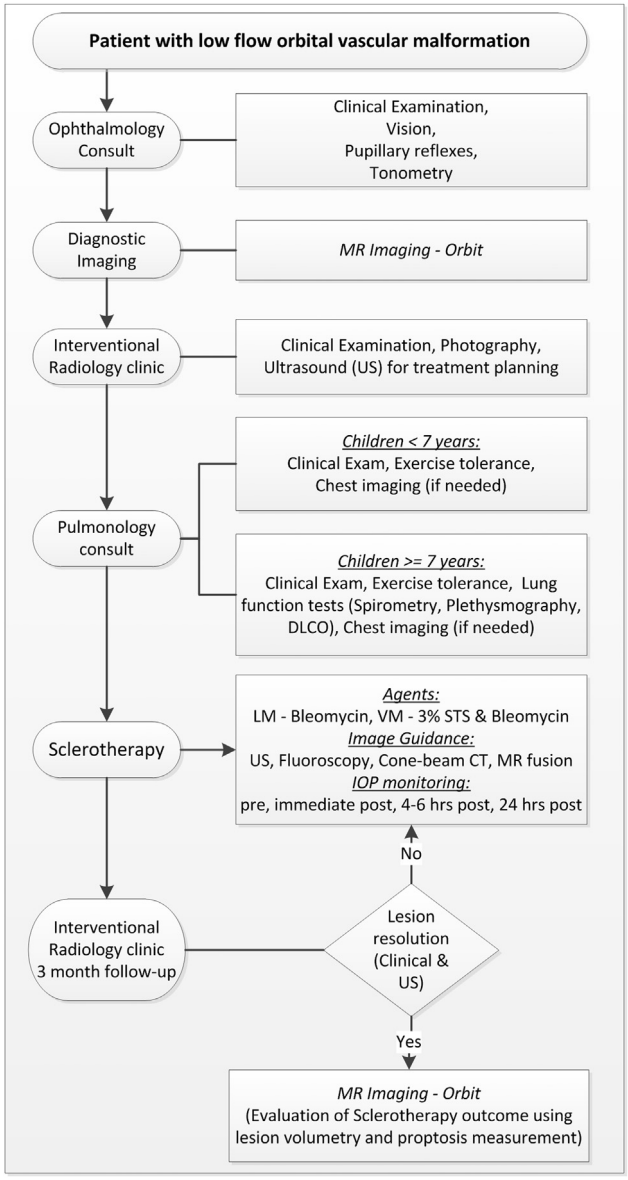

Figure 1. Institutional algorithm for management of low-flow orbital vascular malformations. DLCO = diffusion capacity of lung for carbon monoxide; LM = lymphatic malformation; VM = venous malformation.