

# Treatment of Head and Neck Venous Malformations with Sodium Tetradecyl Sulfate

Ebrahim Karimi, MD<sup>1</sup>, Mehrdad Jafari, MD<sup>2</sup>, Keyvan Aghazadeh, MD<sup>1</sup>,  
Saeed Sohrabpour, MD<sup>1</sup>, and Fatemeh Tavakolnejad, MD<sup>3</sup>

No sponsorships or competing interests have been disclosed for this article.

## Abstract

**Objective.** The purpose of this study was to discuss the clinical outcomes and complications of treating venous malformations with sclerotherapy, with sodium tetradecyl sulfate as the sclerosing agent.

**Study Design.** Case series with planned data collection.

**Setting.** Amiralam Hospital—a referral otolaryngology–head and neck surgery hospital affiliated with Tehran University of Medical Sciences.

**Subjects and Methods.** A total of 345 patients with venous malformations were treated with sclerotherapy with sodium tetradecyl sulfate 3% (1 mL for every 1 cm<sup>3</sup> of the lesion). The venous malformation location, treatments before the current sclerotherapy with sodium tetradecyl sulfate, the number of sclerotherapy sessions, and complications resulting from sclerotherapy were recorded. Follow-up assessments were done for a minimum of 1 year following the procedure. A favorable outcome was defined as a 50% decrease in the lesion size based on clinical and radiologic assessments.

**Results.** A total of 759 injection sessions were documented, ranging from 1 to 6 injections per patient (mean = 3.1). The follow-up duration ranged from 12 to 84 months (mean = 55 months). Based on clinical assessment, a 50% reduction of size was reported for 95.6% of the patients. According to the imaging before and after the procedures, a 50% reduction of size was seen among 67.3% of the patients.

**Conclusion.** The results of the study showed that the use of sodium tetradecyl sulfate as a sclerosing substance can effectively reduce the size of venous malformation lesions.

## Keywords

venous malformation, sclerotherapy, sodium tetradecyl sulfate

Received July 10, 2017; revised January 22, 2018; accepted August 7, 2018.

Venous malformations (VMs) are the most common vascular malformation, and they occur following errors in venous development. About 40% of the VMs are seen in the head and neck region,<sup>1-3</sup> which makes their treatment complex, especially in this anatomically delicate area. These malformations are congenital anomalies that enlarge proportional to the growth of the body and do not shrink spontaneously.<sup>3-8</sup> However, puberty, pregnancy, infections, trauma, and hemorrhage can cause rapid enlargement of such lesions.<sup>4,7-10</sup>

VMs present in a spectrum, ranging from an isolated skin varicosity or localized spongy mass to complex lesions infiltrating various tissue planes. They are soft, compressible, nonpulsatile masses with rapid refilling. VM symptoms depend on their size and location and include blue skin discoloration, pain, swelling, infection, ulcer, bleeding, difficulty in breathing and speech, and dysphagia.<sup>3,7,11-13</sup>

There is a variety of treatment options for VMs, including surgery, sclerotherapy, laser therapy, and cryotherapy.<sup>1-3,14-16</sup> Sclerotherapy is one of the first-line treatments to reduce the size of the lesions.<sup>4,5,7,11-13,17-19</sup>

There are many types of sclerosing substances, including ethanol, sodium tetradecyl sulfate (STS), bleomycin, boiling water, and nitrogen.<sup>2,6</sup> These substances cause injury to the

<sup>1</sup>Otolaryngology Research Center, Amiralam Hospital, Tehran University of Medical Sciences, Tehran, Iran

<sup>2</sup>Otorhinolaryngology Research Center, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran

<sup>3</sup>Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran

## Corresponding Author:

Mehrdad Jafari, MD, Otorhinolaryngology Research Center, Imam Khomeini Hospital, Tehran University of Medical Sciences, Valiasr Hospital, Imam Khomeini Hospital Complex, Bagherkhan St Tehran, 1957944311, Iran.  
Email: mehrdadj82@yahoo.com



vascular endothelium with inflammation and thrombosis, resulting in regression of the lesion.<sup>5,6</sup> In particular, STS causes denudation of the endothelium, inflammatory reaction, and VM thrombosis almost immediately. During the next several weeks, fibrosis develops. The purpose of this study was to evaluate the clinical and radiologic outcomes and complications of treating VMs with sclerotherapy, with STS as the sclerosing agent.

## Materials and Methods

A case series with planned data collection was performed for all patients with VMs who were referred to otolaryngology clinics of Amiralam Hospital (a referral otolaryngology–head and neck surgery hospital affiliated with Tehran University of Medical Sciences) between January 2010 and November 2016. The study protocol was approved by the Board of Ethics of Tehran University of Medical Sciences. Written informed consent was obtained from all patients or their legal guardians prior to enrollment.

Each lesion was evaluated radiologically with magnetic resonance imaging (MRI) and color Doppler ultrasonography to confirm the diagnosis. All patients with any prior management, such as VM surgery or sclerotherapy, were excluded. We used STS 3% direct injections with a 25G needle. After the needle was introduced, the plunger was withdrawn to look for backflow of blood and to confirm appropriate entry into the center of the vascular space. Injections were made by an otolaryngologist. The injection dose was determined per the size of the lesion. One milliliter of the sclerosing substance was injected for every 1 cm<sup>3</sup> of the lesion. The volume of STS injected per patient was 1 to 10 mL at single-injection doses of 1 to 2 mL. The injection was repeated in different sites for large lesions. For deep lesions that were difficult to access, an ultrasound guide was provided by a radiologist, and the otolaryngologist did the injections. All patients were treated as outpatients except for those with laryngeal and soft palate lesions, who were admitted in the otolaryngology ward for 1 to 2 days of observation as a standard protocol. The number of sessions per patient ranged from 1 to 6 (mean = 3.1). Treatments were repeated at intervals of 4 to 6 weeks until the favorable outcome was achieved (>50% decrease in size), the maximum 6 sessions of injection were performed, or no further improvements were observed in 2 consecutive sessions.

The VM location, number of sclerotherapy sessions, and complications resulting from sclerotherapy were recorded. Follow-up assessments were done for a minimum of 1 year following the procedure (range, 12–84 months). MRI was performed 4 to 12 months after apparent clinical improvement (at least 50% decrease in size after injections) or a maximum 6 sets of injection. We reviewed all pre- and posttreatment MRI and determined the efficacy of sclerotherapy radiologically. The favorable outcome was defined as a 50% decrease in the size of the lesion on radiologic assessment. The lesions were assessed clinically by an otolaryngologist before and after each session of injection by

**Table 1.** Distribution of Lesions per Site.

Lesions	n (%)
Mucosal	
Buccal mucosa	67 (26.07)
Tongue	57 (22.17)
Lips	56 (21.78)
Palatine	37 (14.39)
Tonsillar pillars and pharynx	29 (11.28)
Larynx	18 (7)
Hypopharynx	3 (1.16)
Cutaneous	
Parotid	27 (33.75)
Masseter muscle	16 (20)
Neck cutaneous	14 (17.5)
Cheek	13 (16.25)
Auricle	8 (10)
Eyelid	2 (2.5)
Mixed	
Lip and cheek	4 (50)
Temporal scalp and cheek	2 (25)
Neck cutaneous, larynx and pharynx	1 (12.5)
Auricle and parotid	1 (12.5)

estimating the maximum diameter of the lesion and its appearance until the favorable outcome was achieved, a maximum of 6 sets of injections was reached, or no further improvements were observed in 2 consecutive sessions. One radiologist recorded the maximum diameter of the lesion area in 2 perpendicular planes on MRI to assess the radiologic outcome before and after treatment. Furthermore, complications occurring during or after the treatment period were documented. None of the patients withdrew from the study or were lost to follow-up.

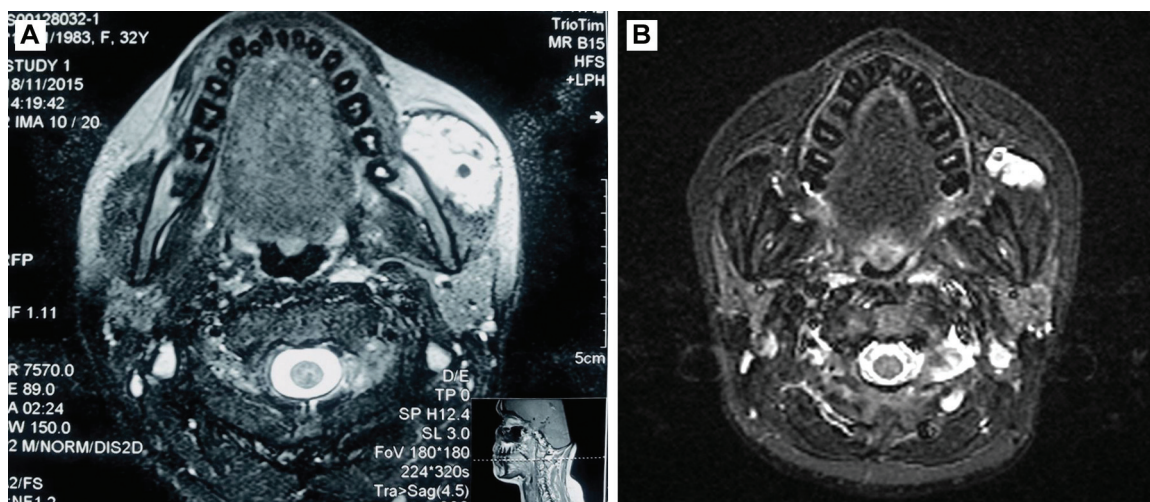
## Results

The clinical data of 345 patients (194 male and 151 female) were included in this study. The mean age was 13.5 years (range, 4–42 years). Moreover, 74.49% (n = 257) had mucosal lesions; 23.18% (n = 80) had cutaneous lesions; and 2.31% (n = 8) had mixed lesions (mucosal and cutaneous). **Table 1** shows the region of each type of lesion.

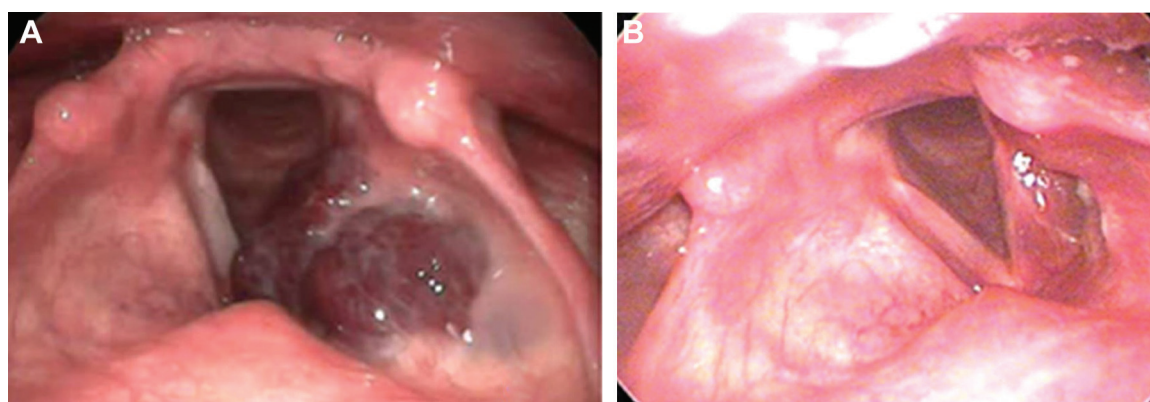
A total of 759 injection sessions were done, ranging from 1 to 6 injections per patient (mean = 3.1). The duration of follow-up ranged from 12 to 84 months, with a mean of 55 months.

The clinical and radiologic favorable outcome was defined as at least a 50% decrease in the lesion size based on clinical assessment and MRI findings. Per clinical assessment, a 50% reduction of size was reported for 95.6% of the patients (**Figure 1**). According to the imaging before and after the procedure, a 50% reduction of size was seen for 67.3% (**Figure 2**).

For 15 patients, of whom 5 had extensive lesions and 5 had deep lesions, the favorable outcome was not reached



**Figure 1.** Clinical improvement of a laryngeal venous malformation (a) before and (b) after 4 sets of sclerotherapy with sodium tetradecyl sulfate.



**Figure 2.** Improvement of a buccal venous malformation (a) before and (b) after 2 sets of sclerotherapy with sodium tetradecyl sulfate per magnetic resonance imaging.

(there was <50% reduction after 6 sets of injection or no further improvements were observed in 2 consecutive sets of injection). In addition, fibrosis following our previous injections was observed among the remaining 5 patients.

Complications were reported for 23 cases (6.6%): anaphylaxis in 1, mucosal ulcers in 15, cutaneous ulcers in 2, temporary facial nerve paralysis in 1, auricle necrosis in 1, and airway edema in 3 (requiring tracheostomy in 1).

## Discussion

Sclerotherapy is one of the best treatments to reduce the size of VM lesions and to minimize the symptoms.<sup>1,18,19</sup> In this study, we reported the outcomes of the treatment of VM lesions with sclerotherapy with STS 3%. A 50% reduction in size was observed for 95.6% and 67.3% of clinical and radiologic (MRI) assessments.

Different types of substances, including ethanol, STS, and bleomycin, have been used as sclerosing agents.<sup>2,6</sup> Absolute ethanol is documented to be the most potent sclerosing substance.<sup>12</sup> According to Ali et al, treatment with ethanol 100% remains the basis for treatment of deeper lesions.<sup>4</sup> However, other studies showed that absolute

ethanol may lead to a variety of side effects, including tissue necrosis, hypertension, pulmonary embolisms, and hemolysis. However, STS 3% is currently used in the treatment of VMs and is associated with fewer side effects, less recurrence of the lesions, and fewer complications.<sup>12</sup> In addition, based on future studies, STS may be suggested for treatment of lesions for which a large volume of coverage is necessary, especially in pediatric cases that can receive limited amounts of ethanol. STS has also been documented as a safer substance with less neurotoxicity and less swelling following the procedure.

Previous studies reported an efficacy of 75% to 95% for sclerotherapy,<sup>1,18</sup> which is consistent with our findings. However, previous studies suffered from inconsistency in outcome measures due to subjective assessment of the outcomes. According to review studies by Horbach et al and Johnson et al, MRI provides useful information for radiologic evaluation of the treatment success.<sup>4,5,11</sup> We also used MRI to objectively assess the outcome of the procedure. The difference between the reported clinical and radiologic improvements can be explained by the fact that (1) the sclerotic effect of sclerosing substances may decrease in



deeper zones of the lesions and (2) changes in these areas cannot be discovered by clinical assessment. Therefore, inconsistency between clinical and radiologic assessment is mainly seen in deep and extensive lesions. It is also noteworthy that no previous study found a correlation between the reduction of the lesion size and improvement of clinical symptoms.<sup>13</sup>

Complications were seen among 6.66% of our patients, which was significantly lower than the complication rate reported in cases treated with absolute ethanol. The complication rate of absolute ethanol was 27% in a study by Lee and Chen<sup>18</sup> and 24% in a study by Vogelzang.<sup>20</sup>

Our study showed that the use of STS as a sclerosing substance may reduce the size of VM lesions. With a mean 3.1 injections per patient and a low rate of major complications, sclerotherapy with STS is a safe procedure to replace the previous methods for the treatment of VM lesions. However, the major limitation of this study was the lack of a control group. Another limitation was the lack of tools or modalities for precise sizing of the lesion for assessment of clinical improvement. Although the lesions were observed and assessed by 1 otolaryngologist before and after treatment, there may always be some possible errors (eg, lesion depth may affect the difference between clinical and radiologic assessment).

## Conclusion

In conclusion, sclerotherapy with STS 3% seems to be an effective and reliable choice for treatment of VMs in the head and neck region. We hope that further studies would compare the efficacy of different sclerosing agents and their complication rates.

## Author Contributions

**Ebrahim Karimi**, designed study, collected data, revised the article; **Mehrdad Jafari**, collected data, revised article; **Keyvan Aghazadeh**, collected data, revised the article; **Saeed Sohrabpour**, analyzed the data, drafted the article; **Fatemeh Tavakolnejad**, contributed to study design, drafted the article.

## Disclosures

**Competing interests:** None.

**Sponsorships:** None.

**Funding source:** None.

## References

1. Wang X, Meng J, Zhang J, et al. Curative effects of RF combined with DSA-guided ethanol sclerotherapy in venous malformations. *Exp Ther Med*. 2016;12:3670-3674.
2. Morgan P, Keller R, Patel K. Evidence-based management of vascular malformations. *Facial Plast Surg*. 2016;32:162-176.
3. Zheng JW, Mai HM, Zhang L, et al. Guidelines for the treatment of head and neck venous malformations. *Int J Clin Exp Med*. 2013;6:377-389.
4. Ali S, Weiss CR, Sinha A, Eng J, Mitchell SE. The treatment of venous malformations with percutaneous sclerotherapy at a single academic medical center. *Phlebology*. 2016;31:603-609.
5. Horbach SE, Lokhorst MM, Saeed P, de Gouyon Matignon de Pontouraude CM, Rothová A, van der Horst CM. Sclerotherapy for low-flow vascular malformations of the head and neck: a systematic review of sclerosing agents. *J Plast Reconstr Aesthet Surg*. 2016;69:295-304.
6. Deepa V, David CM, Lidiya A. Management of arterio venous vascular malformation masquerading as a mucocoele using sclerotherapy—review of literature and a case report. *Int J Pharm Sci Invent*. 2013;2:1-6.
7. Heit JJ, Do HM, Prestigiacomo CJ, et al. Guidelines and parameters: percutaneous sclerotherapy for the treatment of head and neck venous and lymphatic malformations. *J Neurointervent Surg*. 2017;9:611-617.
8. Gemmete JJ, Pandey AS, Kasten SJ, Chaudhary N. Endovascular methods for the treatment of vascular anomalies. *Neuroimag Clin N Am*. 2013;23:703-728.
9. Hyder SM, Huang J-C, Nawaz Z, et al. Regulation of vascular endothelial growth factor expression by estrogens and progestins. *Environ Health Persp*. 2000;108(suppl 5):785-790.
10. Dubois J, Garel L. Imaging and therapeutic approach of hemangiomas and vascular malformations in the pediatric age group. *Pediatr Radiol*. 1999;29:879-893.
11. Johnson PL, Eckard DA, Brecheisen MA, Girod DA, Tsue TT. Percutaneous ethanol sclerotherapy of venous malformations of the tongue. *Am J Neuroradiol*. 2002;23:779-782.
12. Wohlgemuth WA, Müller-Wille R, Teusch V, Hammer S, Wildgruber M, Uller W. Ethanolgel sclerotherapy of venous malformations improves health-related quality-of-life in adults and children—results of a prospective study. *Eur Radiol*. 2017;27:2482-2488.
13. Spence J, Krings T, Da Costa L, Agid R. Percutaneous sclerotherapy for facial venous malformations: subjective clinical and objective MR imaging follow-up results. *Am J Neuroradiol*. 2010;31:955-960.
14. Lewin JS, Merkle EM, Duerk JL, Tarr RW. Low-flow vascular malformations in the head and neck: safety and feasibility of MR imaging-guided percutaneous sclerotherapy—preliminary experience with 14 procedures in three patients. *Radiology*. 1999;211:566-570.
15. Ogawa Y, Inoue K. Electrothrombosis as a treatment of cirroid angioma in the face and scalp and varicosis of the leg. *Plast Reconstr Surg*. 1982;70:310-318.
16. Li ZP. Therapeutic coagulation induced in cavernous hemangioma by use of percutaneous copper needles. *Plast Reconstr Surg*. 1992;89:613-622.
17. Guevara CJ, Gonzalez-Araiza G, Kim SK, Sheybani E, Darcy MD. Sclerotherapy of diffuse and infiltrative venous malformations of the hand and distal forearm. *Cardiovasc Intervent Radiol*. 2016;39:705-710.
18. Lee C-H, Chen S-G. Direct percutaneous ethanol instillation for treatment of venous malformation in the face and neck. *Brit J Plast Surg*. 2005;58:1073-1078.
19. Hoff SR, Rastatter JC, Richter GT. Head and neck vascular lesions. *Otolaryngol Clin North Am*. 2015;48:29-45.
20. Vogelzang RL. Vascular malformations: effective treatment with absolute ethanol. *China Journal of Oral and Maxillofacial Surgery*. 2007;5:7.