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Case Series

Vascular sclerotherapy: A precision treatment of low flow venous malformations in head and neck regions

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Abstract

The head and neck area is where low flow vascular abnormalities are most prevalent. Treatment is only necessary for abnormalities that exhibit symptoms. This study utilized repeated injections of 3% sodium tetradecyl sulfate to manage low-flow vascular malformations. While combining sclerotherapy with surgical intervention is generally regarded as the most effective approach, it can lead to both aesthetic and functional issues, particularly in the head and neck areas. Treatment is only necessary for abnormalities that exhibit symptoms. In this study, low flow vascular abnormalities were treated with several injections of sclerotherapy using 3% sodium tetradecyl sulphate.

Keyword: Sodium tetradecyl sulphate, Venous malformation (VnM), Vascular malformations (VM), Sclerotherapy

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1. Introduction

Vascular malformations are endothelium-lined vascular channels with narrow walls and a weak muscle layer. Mullikan and Glowacki have distinguished these from hemangiomas or actual vascular tumors. Based on hemodynamics, vascular malformations are clinically classified into high flow and low flow kinds, which can be identified by magnetic resonance imaging (MR) and clinical examination. Arteriovenous malformations represent a form of vascular malformation characterized by high blood flow. Venous, capillary, and lymphatic abnormalities are examples of low flow vascular malformations. Previous literature reports an incidence of 14–65 % of vascular malformations occurring in the head and neck region.[1,2]

Any organ or tissue in the body may be affected by low flow vascular malformations, but the most frequent locations are mucosal and cutaneous surfaces of head and neck especially anterior two-thirds of tongue, palate, gingiva and buccal mucosa.[2-3] Pain, disfigurement, muscular atrophy, impingement on other organs, etc. are among the indications for treatment. Surgery, laser therapy, sclerotherapy, or a combination of surgery and sclerotherapy are among the available therapeutic options. In the current case series, the only treatment for low flow vascular malformations involving the oral cavity is staged sequential sclerotherapy with 3% sodium tetradecyl sulphate (3% STS). Used as the sole treatment in the management of low flow vascular malformations involving oral cavity.

"Sclerotherapy is a primary treatment method that involves injecting a sclerosing agent to trigger inflammation and close off the affected vessels.[5,6] Localized injections can be effective for small skin or mucosal lesions. Intralesional sclerotherapy using liquid agents is often considered a palliative option for many vascular anomalies and tends to yield favourable results in smaller lesions. Sodium tetradecyl sulfate (3% STS), in use since 1946, remains one of the most commonly employed sclerosing agents, particularly for treating venous and lymphatic malformations.

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1.1. Sclerosants

The three types of sclerosants commonly utilized in contemporary therapeutic practice are detergents, osmotic agents, and irritants.[1] Sclerosants damage the endothelial cells of the tunica intima and the luminal 300 μm of the tunica media.[2] While detergents are less cytotoxic yet disrupt intercellular connections, osmotic and irritating sclerosants are directly cytotoxic. Corrosive substances called irritants damage cellular membranes and cause vascular fibrosis.[3]

STS is frequently used to treat venous and lymphatic abnormalities, as well as minor varicose veins in the legs.[3,4] STS works by causing the most endothelium damage and the least amount of thrombus development, which causes the lesion to fibrose[2] and shrink. In our case series, STS was utilized to treat venous malformations (VnM) in the head and neck region. The closure of the vascular lumen may be temporary or long-lasting, depending on the case. Patient satisfaction and an objective assessment of the lesions' size were among our goals.

2. Materials and Methods

Each patient received an intralesional injection of STS 3% solution using an aseptic approach and local anesthetic infiltration around the lesion's center and periphery. The 3% Sotradecol® solution was injected into each lesion using an insulin syringe and a 26-gauge needle. The agent was delivered without radiological guidance. After inserting the needle, the plunger was retracted to check for blood backflow and ensure that the needle was properly inserted into the middle of the vascular space. The sclerosing chemical was then injected until the lesion blanched. Larger lesions were treated with multiple injections.

All patients received an oral analgesic and a single postoperative dose of intravascular injection of dexamethasone (4 mg) for adults and 0.2 mg/kg for children to reduce inflammation and post-injection pain was noted. Patients were monitored every two weeks, and if there was no or only partial improvement, the treatment was repeated after four weeks. minimum of 0.5–2 ml of the agent was injected into each lesion (at a ratio of 0.5 ml for each 2 cm of lesion size) or a quarter the lesion volume. A compressive dressing was worn for at least 2 hours after injection. The patients in this case series were treated in an outpatient department setting with no radiological guidance.[5-9]

The response to the treatment was graded as follows: no response (no change in size after injection), mild response (25 % decrease in the size after injection), moderate response, partial response was defined as a reduction in lesion size by less than 75%, a good response as a decrease of 75%, and a complete response as total lesion resolution with restoration of normal skin or mucosa appearance. Treatment outcomes were evaluated both clinically and through photographic documentation at each visit, with follow-up periods ranging from 6 to 12 months.

3. Case Presentation

3.1. Case 1

14-year-old female presented to the maxillofacial department with a recurring swelling on the upper labial mucosa, which she had noticed for approximately one year. Clinical examination revealed a painless bluish-red lesion on the right buccal mucosa, characterized by a dome-shaped central area (**Figure 1**). Extraoral evaluation showed moderate swelling of the upper lip. T2-weighted MRI scans demonstrated a well-defined lesion in the upper lip measuring approximately 1.1 × 1.6 × 2.5 cm (AP × TR × CC), appearing hyperintense on T2WI/STIR— findings consistent with a hemangioma. Treatment involved three sessions of sclerotherapy using 1.5 cm^3 of 3% sodium tetradecyl sulfate (STS).[10-12] Following the initial injection, the patient reported experiencing pain and swelling in the upper lip.Two weeks later, the lesion had reduced to 0.75 × 1 × 2 cm. Following the second session, the lesion's size and thickness decreased further. At the third session (4 weeks later), 1.5 cm^3 of 1% STS was administered. Compared to the initial presentation, the lesion had regressed to a 0.5 cm nodule.

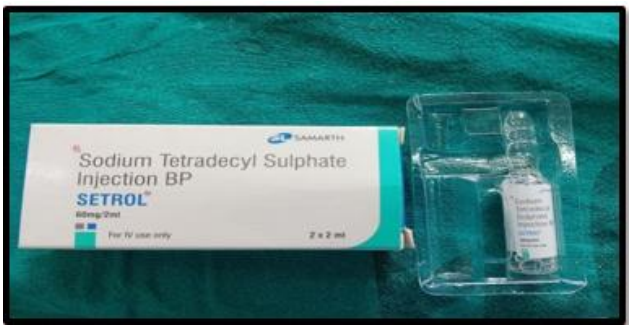

Figure 1:

3.2. Case presentation 1

Case 2

An 8-year-old male reported to the department with a bluish, circular lesion on the left buccal mucosa. The lesion had been present for around three months and was asymptomatic.

Figure 2:

3.3. Case presentation 2

Examination revealed a dome-shaped, localized swelling approximately 1 × 0.6 × 0.8 cm in size (**Figure 2**). There was no tenderness or ulceration on palpation. Based on clinical appearance, a provisional diagnosis of venous malformation was made. The patient underwent two sessions of sclerotherapy using 0.6 cm^3 of 3% STS. Within three weeks, the lesion had faded and its color matched the surrounding mucosa.[13-17]

Case 3

A 13-year-old male presented with a bluish lesion on the lower right buccal mucosa. Unlike the previous cases, the patient reported a history of both pain and ulceration in the affected area. On examination, a dome-shaped swelling measuring approximately 2 × 1.6 × 0.8 cm was observed. The patient had noticed the lesion about one month earlier. Based on clinical findings and radiological findings, a venous malformation was confirmed. Sclerotherapy was administered using 2 cm^3 of 3% STS over three sessions. Two weeks after the first injection, the lesion began to decrease in size, though the patient experienced ulceration at the injection site. After the third treatment session, the lesion had significantly reduced to approximately.

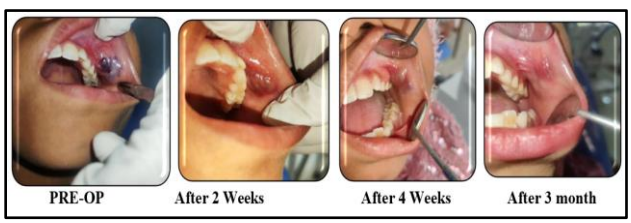

Figure 3:

3.3. Case presentation 3

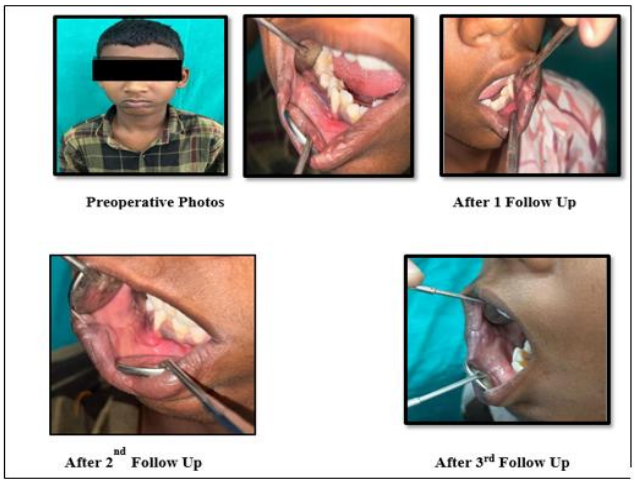

Figure 4:

4. Discussion

The International Society for the Study of Vascular Anomalies categorizes vascular anomalies into two main types based on their biological characteristics: (1) Vasoproliferative lesions, which are vascular neoplasms, and (2) Venous malformations (VM). Vascular malformations are congenital defects that arise from abnormal development of the vascular system during embryogenesis. These anomalies are present at birth, although they may not always be clinically detectable. VMs are estimated to occur in about 1% of live births, though many affected individuals do not seek medical treatment. When found in the oral cavity, vascular malformations can cause significant discomfort and lead to more severe clinical challenges.

While clinical evaluation and patient history are primarily used for diagnosis, imaging techniques such as MRI and digital subtraction angiography are often employed to confirm the condition in certain cases.

Percutaneous sclerotherapy is now considered the primary treatment option for venous malformations. Numerous treatment approaches, including radiation therapy, electrocoagulation, the use of intravascular needles, and various sclerosants, have been reported in the literature. Surgical excision, however, remains difficult and often unfeasible. In cases with larger or deeper lesions, embolization may be used, which involves blocking the blood vessels feeding the malformation. Despite the challenges, surgical excision is generally considered the most effective treatment for benign vascular lesions located in the head and neck region, as other methods may result in permanent tissue damage and progressive scarring. Nonetheless, surgical resection has its limitations, particularly in cases where complete removal is not possible, where there is a risk of heavy bleeding, or when vital structures may be endangered. Extensive oral

surgeries can also impair chewing functionality. In these cases, sclerotherapy offers a viable alternative, especially for smaller lesions or those in aesthetic areas. Sclerotherapy is effective for alleviating symptoms and can lead to partial or complete regression of lesions. The procedure is minimally invasive, cost-effective, and can be performed on an outpatient basis using sclerosants. Sodium Tetradecyl Sulfate (STS) is one of the most commonly used sclerosing agents.

Sclerosants are chemical agents that are injected into veins to cause their closure, a process known as sclerosis. These agents are widely used in the treatment of conditions like varicose veins and other low-flow vascular malformations.

4.1. Sclerosants can also be classified as

1. **Detergents**—Disrupt vein cellular membrane (protein theft denaturation) • Sodium tetradecyl sulfate • Polidocanol • Sodium morrhuate • Ethanolamine oleate

2. **Osmotic agents**— These agents cause cell damage by altering the water balance through osmotic pressure, leading to dehydration of the cell and denaturation of the cell membrane.

Examples of osmotic agents include hypertonic sodium chloride solutions and sodium chloride solutions mixed with dextrose.

3. **Chemical irritants**— sclerosing agents work by causing direct damage to the endothelial cells of blood vessels, which leads to the closure of the vessel. Examples of such agents include chromated glycerin, polyiodinated iodine, and sodium tetradecyl sulfate (STS), which is commonly used in treatments for venous malformations (VM). Another frequently used agent is polidocanol, but in our practice, we prefer the foam preparation of STS due to its fewer side effects and more efficient application. STS is particularly effective in treating larger VMs because its sclerosing action depends on the blood flow and the size of the feeding vessels. At lower concentrations, STS is capable of stripping the endothelial lining of vessels over a significant distance. It also has the ability to induce a hypercoagulable state, possibly by inhibiting protein C, and can promote platelet aggregation.

While sclerotherapy is generally effective, it carries potential risks such as pulmonary embolism, allergic reactions, nerve damage, discomfort, disseminated intravascular coagulation, tissue necrosis, and sloughing, with some reports of airway impairment. These complications are rare and can generally be minimized with careful administration of the treatment. In some cases, anaphylaxis and pulmonary embolism have been reported, particularly following intravenous injection of STS.

In a study by Minkow et al., the use of intralesional 3% STS injections for intraoral hemangiomas showed positive outcomes with minimal side effects. A similar study on venous malformations treated with 3% STS also observed satisfactory results with complications comparable to those encountered in our case.

Karimi et al. showed that sodium tetradecyl sulfate was effective in reducing the size of venous malformations. In another study, Alfred Inbaraj et al. concluded that sclerotherapy with 3% STS is both safe and effective for treating tongue venous malformations, with minimal complications. He studied studied, 83% demonstrated clinical improvement, with significant reductions in lesion size.

A study by Xena Alakailly, Raja Kummoona, Faisal A. Quereshy, Dale A. Baur, and Ariadn E. González further confirmed that sclerotherapy with 3% STS is a simple, safe, and effective method for treating venous malformations. Among the 13 patients treated, 28.57% had complete resolution, 35.7% had a good response, and 14.28% had moderate or mild improvements. Pain and swelling post-injection were common side effects, which were managed with oral analgesics and dexamethasone. Superficial ulcers and ecchymosis were also observed in a few patients, but these healed without any complications.

In our own study, we selected 3% STS due to its proven high effectiveness and minimal complications. Some patients experienced minor side effects, such as small skin ulcers or superficial breakdowns, which were successfully treated by conservative measures. The concentration of STS used was directly related to the severity and size of the lesions. Patients were monitored for six months after treatment, and no recurrences were observed during this period. The results showed a satisfactory reduction in lesion size, and further research with a larger sample size and a broader range of lesion sizes is recommended to determine the full effectiveness of STS injections for slow-flow vascular malformations.

5. Conclusion

Intralesional sclerotherapy with 3% Sodium Tetradecyl Sulphate has proven to be an effective treatment, with most patients showing significant lesion reduction or complete resolution. While some local inflammatory reactions and minor complications were noted, severe side effects were rare and could largely be avoided with proper technique. These findings suggest that, when appropriately administered, sclerotherapy is a safe and effective treatment for a wide range of patients with suitable lesions.

6. Ethical Consideration

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee. Written informed consent was obtained from all patients (or guardians, where applicable), including permission for use of anonymized data and images. Patient confidentiality was strictly maintained. Participants were informed about the procedure, possible risks, benefits, and their right to withdraw at any stage. All outcomes, including complications, were reported transparently, with no conflicts of interest or undue influence.

7. Source of Funding

None.

8. Conflict of Interest

None.

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