

Digital subtraction angiography (DSA) guided sequential sclerotherapy for maxillofacial vein malformation

J. MENG, Q.-W. ZHUANG, Q.-P. GU, J. ZHANG, Z.-P. LI, Y.-M. SI

Department of Stomatology, Xuzhou Central Hospital, Affiliated Xuzhou Hospital, College of Medicine, Southeast University, Xuzhou, China

Abstract. – OBJECTIVES: Venous malformations commonly occur in the head and neck and affect the patient's appearance and also cause pain, ulcers, and bleeding. Current treatment options have many limitations and it is necessary to explore alternate methods to address these malformations. This work was aimed to explore the best method for treating patients with maxillofacial vein malformation.

PATIENTS AND METHODS: Guided by digital subtraction angiography, 43 patients with maxillofacial vein malformation were treated with sequential sclerotherapy intervention.

RESULTS: Patients were followed up for 7 months to 3 years. Lesions completely recessed in 7 cases. Recession rates were greater than 50% in 28 cases, 25-50% in 5 cases, and less than 25% in 3 cases. No severe complications occurred.

CONCLUSIONS: Sclerotherapy with ethanol and pingyangmycin is a safe and effective method of treating maxillofacial vein malformation.

Key Words:

Sclerotherapy, Digital subtraction angiography, Vein malformation, Angiography, Pingyangmycin.

Introduction

Venous malformations (VM) are the most common vascular malformations, and 40% of VM occur in the head and neck, which not only affect the patient's appearance and causes pain, ulcers, and bleeding, but also possibly compress or invade adjacent tissues and organs. VM in the head and neck can cause complications that affect language, swallowing, respiratory function, and that can cause a massive bleeding or a significant aesthetic defect¹ or even threaten life. The treatment options for VM include surgical excision, laser, radiation, freezing, and palliative compression therapy, though all of these interventions have their limitations²⁻⁵. In comparison,

sclerotherapy shows clear efficacy and overcomes the flaws of surgical resection, such as incomplete removal of the malformation, trauma, and excessive bleeding. Sclerotherapy has therefore become the first line of treatment for VM⁶⁻⁸. We treated 43 patients presenting with a wide range of oral and maxillofacial VM using percutaneous digital subtraction angiography (DSA)-guided sequential sclerotherapy intervention and documented the effectiveness of this treatment protocol on recession of lesions.

Patients and Methods

Patient Information

Patients were recruited from the Department of Stomatology, Xuzhou Central Hospital and the studies were approved by the Hospital's Ethics Committee. The cohort study here included a total of 43 patients with large-scale VM in the head and neck. The group characteristics were as follows: 26 males and 17 females, age range of 8-45 years, mean age 20.5 years. The minimum size of tumor was about 4.0 cm × 2.0 cm × 1.5 cm invading the cheek area, and the maximum size was about 16.0 cm × 13.0 cm × 5.0 cm invading the neck, tongue, lips, and pharynx. In this patient group, the tumor diameters were 6-12 cm. Tumor diameters were greater than 10 cm in 12 cases. The anatomical locations of lesions included the ventral tongue area, palate pharynx area, and parotid masseter area. The 3 patients with a case of parapharyngeal VM were also affected with severe sleep apnea hypopnea syndrome.

Methods

Patients underwent preoperative liver and kidney function testing and were checked for any history of alcohol allergies. Sequential sclerotherapy intervention using sclerosing agent in

order to induce thrombosing of veins was applied in addition to general or local anesthesia. Pulmonary artery pressure was intraoperatively monitored. Under DSA, a gauge 7 butterfly piercing needle was placed into the vascular tumor cavity percutaneously. The position of the needle was adjusted according to the condition of back blood. When the blood returned quickly, a 30% diatrizoate solution was then injected. The needle was retained in the entrance to the vein. A bolus of ethanol was injected into the body of tumor at a rate of 0.5 ml/s. Angiography was re-taken 15 min later. The injection pressure was 13.3-26.7 kPa. The volume of each bolus injection was 0.5-1.5 ml over an interval of 2-5 min. Ethanol was then re-injected until the veins showed signs of complete occlusion. For larger lesions, 2 ml ethanol was injected 2-3 days later in another region of the tumor. However, the maximum dose of ethanol administered did not exceed 1ml/kg, and the volume was usually 2/3 of the volume of contrast agent used. During the injection, the venous reflux in the lesion area was compressed mechanically. For large malformations involving multiple anatomical regions, lesions in different areas were injected simultaneously during the treatment process. The operation was carefully carried out under DSA in order to avoid injection of ethanol into normal blood vessels and tissues. Fifteen min following the final ethanol injection, angiography was performed again. If the images indicated that most reflux veins were embolized, then 8 mg pingyangmycin lipiodol was intratumorally injected. The intratumoral injection of pingyangmycin lipiodol emulsion was performed once every 7-10 days. The pingyangmycin emulsion was prepared by dissolving 8 mg pingyangmycin in 2-10 ml of ionic or non-ionic contrast agent, and lipiodol was added at ratios of 1:2 to 1:1. Repeated aspiration was performed to ensure the solution was completely emulsified⁹. To alleviate pain, 2-5 ml of 2% lidocaine was added to the emulsion¹⁰.

Results

Evaluation by postoperative MRI showed that in 7 cases, lesions had completely disappeared. Lesion regression rates were $\geq 50\%$ in 28 cases, and 25%-50% in 6 cases. The regression rates were less than 25% in 3 cases. Local tumor swelling and pain occurred in 43 cases after treatment with anhydrous ethanol sclerotherapy,

and were relieved by oral analgesics. Preventive tracheotomy was conducted in 2 cases of parapharyngeal VM. Extubation was performed 1 week later. Hemoglobinuria occurred in 1 case, though the condition normalized 3 days later, and urine testing revealed no hemoglobin. Mucosal ulceration occurred in 3 cases, and was healed after symptomatic treatment. Fever up to 39°C occurred in 1 case and was treated with 5 mg dexamethasone. Body temperature normalized without other adverse reactions in 2 days. Face shape and oral function were ameliorated by the treatment procedure in all cases (Figures 1 and 2).

Discussion

The efficacy of sclerosing agents in the treatment of VM has been previously demonstrated, their use leading to reduced trauma, less pain and lowering overall costs. Endovascular injection of pingyangmycin in treating maxillofacial hemangioma has become a non-invasive method of treating vascular tumors¹¹. However, this treatment option is not as effective in achieving lesion recession, especially in cases of VM with rich blood supply or with larger malformations. The reason may be due to the instant dilution of pingyangmycin once injected into the tumor cavity, leading to a loss of any sustained effect on tumor endothelial cells. Ethanol causes damage to endothelial cells in hemangiomas, and triggers he-

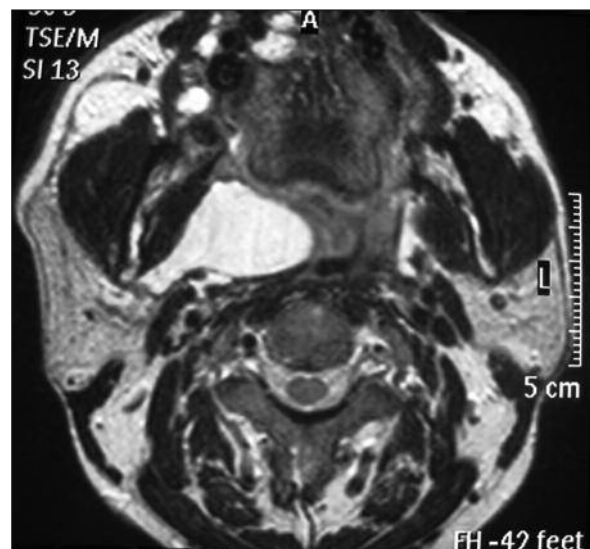


Figure 1. Combined ethanol and pingyangmycin sclerotherapy of VM in the parapharyngeal space: magnetic resonance imaging before treatment.

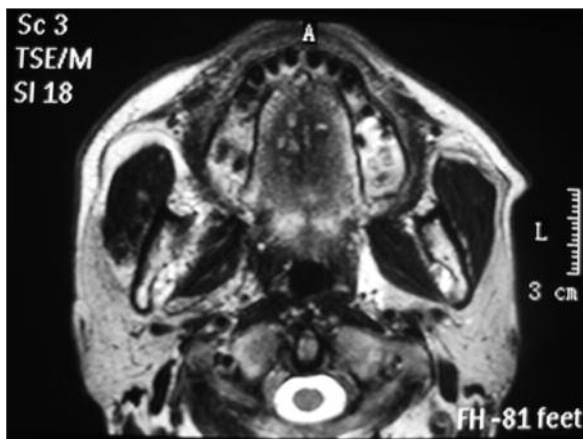


Figure 2. Combined ethanol and pingyangmycin sclerotherapy of VM in the parapharyngeal space: magnetic resonance imaging after treatment reveals the beneficiary effects of sclerotherapy.

moglobin denaturation causing thrombosis inside the veins in the lesion, properties that could be implemented for therapeutic purposes¹². Guided by tumor angiography, we utilized ethanol to induce vein embolization, which leads to slowed reflux flow in the veins. Sequentially, we performed intratumoral injection of a pingyangmycin lipiodol emulsion, which in combination with ethanol treatment allowed for a sustained and more efficient effect. Sclerosing agent sequential therapy has been shown to have several advantages, having fewer associated risks and complications, being a simple operation, causing less trauma, less pain and being relatively low cost¹³.

It has been argued that the key to the treatment of VM is to destroy the abnormal vascular group (nidus) rather than the artery or the reflux vein embolizations¹². Long-term clinical experience shows that ethanol can be safely used for arteriovenous malformation embolization, though it is important to identify, guided by angiography, the VM bulk or the micro-leakage of infiltrative lesions, and embolize them without affecting the supply vessels. Using liquid glue or metal rings for embolization can only mitigate and control the disease. In contrast, ethanol embolization can achieve a permanent cure not only by treating tumors, but also by maintaining function. In our study, all VM patients achieved satisfactory results. Among them, 33 cases were patients treated several times using simple pingyangmycin treatment, and these prior attempts had all been ineffective. Having been treated with the sequential sclerotherapy intervention we have described here, all 33 patients were satisfied with the outcomes.

According to earlier work, the complications of ethanol sclerotherapy include facial nerve injury, tissue necrosis, allergies, poisoning, transient hemoglobinuria, pulmonary artery spasm, and pulmonary embolism^{14,15}. During the surgical operation, patient's blood pressure, ECG and blood oxygen saturation were regularly monitored. For large VM cases where a larger dose of ethanol is required, intraoperative pulmonary artery pressure was continuously monitored, and if necessary, nitroglycerin or alprostadil was applied in order to reduce pulmonary artery pressure. Prophylactic tracheotomy was performed for patients with an oropharynx deformity. During the operation, the airway was kept patent and the catheter cautiously placed.

It is suggested that emergency medicine and equipment should be prepared to ensure the safety of patients. The reactions of patients during the operation should also be closely observed. Usually, abnormal signs are a result of a reaction to the contrast agent or from a vascular spasm, which can be treated with antispasmodic agents and antihistamines. During the first 24 hours after surgery, the patient's consciousness, blood pressure, respiration, ECG and blood oxygen saturation need to be continuously and closely monitored. Signs of facial cyanosis, dyspnea and decreased oxygen saturation need to be observed. Meanwhile, first aid items such as tracheotomy kits need to be prepared. In this study, 2 patients showed postoperative transient irritability and chest discomfort symptoms. However, after symptomatic treatment, both patients improved. All other patients were stable and safe during the perioperative period. To prevent accidental embolism and life-threatening events, interventional procedures need to be performed by an experienced physician.

The purpose of using DSA for tumor imaging is mainly to visualize reflux veins, to guide the sites for embolization and determine the dose of sclerosing agent, improving efficacy and preventing complications. The volume of ethanol injected in the entrance of the reflux vein should not be greater than 2/3 of the volume of the contrast agent. Caution should be exercised when injecting ethanol and pingyangmycin in lesions greater than 1/3 of the face surface. In our study, we found 3 VM patients with the reflux vein connecting to the cavernous sinus. These patients were treated with compression of the reflux veins and were placed in a head-down position. When the reflux blood flow decreased in images,

ethanol was be injected. Patients were maintained in a head-down position for 1 hour to prevent accidental cavernous sinus thrombosis and other complications.

Since ethanol is a potent sclerosing agent and its main mechanism is to destroy endothelial cells and lead to hemoglobin denaturation, overdose of ethanol might cause transient hemoglobinuria¹⁶. Urine volume and color should be tightly observed postoperatively. Patients with hemoglobinuria should immediately be treated with intravenous fluid to restore physiological pH, and urine should be alkalized by administering 5% sodium bicarbonate. In our study group, we observed one case of hemoglobinuria that was successfully treated using the aforementioned treatment methods.

Conclusions

We demonstrated the efficacy of DSA guided sequential sclerotherapy intervention in the treatment of maxillofacial vein malformation. Sclerosing agent sequential therapy is a simple operation, causing less trauma, less pain and being relatively low cost. Adverse effects caused by this treatment are well-tolerated and easily controllable. So we conclude that sequential sclerotherapy with ethanol and pingyangmycin is a safe and effective method of treating maxillofacial vein malformation.

Acknowledgements

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Conflict of Interest

The Authors declare that there are no conflicts of interest.

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