



A Clinical Study of Post-treatment Nursing Strategy for Venous Malformations in the Pharynx Region

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Abstract

Background: Post-treatment nursing care is essential for patients with venous malformations (VMs) after they have undergone treatment. Effective post-treatment nursing care requires adequate resources, effective communication, patient compliance, and addressing psychological distress. However, the clinical care plan for VMs in the pharyngeal isthmus is not clear.

Objectives: The present study aims to explore the clinical nursing strategy after the treatment of VMs in the pharynx area.

Methods: In this study, the patients with VM in the pharynx region who received anhydrous ethanol sclerotherapy injection and/or surgical treatment in our Hospital from January 2013 to November 2018 were recruited. A total of 143 patients who had completed medical records were included in this prospective cohort study. The patients' post-operative vital signs were closely observed, the respiratory tract was maintained, the oral cavity was cleaned, and the nursing care of indwelling endotracheal intubation or tracheotomy was performed. After the clinical follow-ups of one to five years, long-term efficacy was also observed. We summarized their nursing care treatments.

Results: The results showed that there were 0 patients rated as grade I, 3 patients rated as grade II, 17 patients rated as grade III, and 123 patients rated as grade IV after long-term efficacy.

Conclusion: Appropriate anhydrous ethanol sclerotherapy can be selected for patients with pharyngeal venous malformation, and this method combined with the clinical nursing strategy after treatment concluded in this study can effectively reduce the volume of VM, with fewer side effects, and can effectively improve breathing, swallowing, and vocal function.

Keywords: Anhydrous ethanol, Nursing, Sclerotherapy, Swallow gorge, Venous malformation

1. Background

Venous malformations (VMs) are the most common vascular malformations in adults, and more than 60% occur in the face and neck (1). The lesions usually grow diffusely, extending from the skin to the bone, and can pass directly through the corresponding mucosa, and cases of mucosal involvement are not uncommon (2). The oropharyngeal isthmus is the orifice where the oral cavity passes through the pharynx. It has a special anatomical location. It is surrounded by the uvula, the free margin of velum platinum, the palatoglossal arch on both sides and the root of the tongue. Venous malformations in this area are common, often accompanied by respiratory, eating, and pronunciation disorders. Due to space and anatomical limitations, anhydrous ethanol sclerotherapy injection is the most important treatment (3). Post-treatment nursing care refers to the nursing interventions and care provided to patients after undergoing treatment for a medical condition, in this case, VM (4). The main aim of post-treatment nursing care is to prevent complications and promote the patient's overall well-being during the recovery process. Patients with VM may have difficulty complying with the nursing care plan due to pain, discomfort, and other factors. Non-compliance can lead to poor outcomes. Moreover, patients with VM may

experience psychological distress after treatment, which can affect their recovery. The nursing care plan should include measures to address psychological distress.

Post-treatment nursing care is essential for patients with VM after they have undergone treatment. Effective post-treatment nursing care requires adequate resources, effective communication, patient compliance, and addressing psychological distress. The nursing care plan should include wound care, pain management, monitoring for complications, education, and nutritional support. Treatment preparation includes: asking the patients if they have a history of alcohol allergy, liver, kidney, or heart disease. Taking blood to check blood routine, coagulation time, and taking chest X-rays, liver and kidney function tests (4). Nursing staff should speak with the treating physician about the above-mentioned issues, and then reinforce it with the patient after it has been clarified to the nursing staff and patient by the treating physician. Such patients often have varying degrees of dyspnea, obstructed swallowing, dental caries, or ambiguity in pronunciation. Adequate pre-operative communication can help eliminate their fear and tension and enable them to actively cooperate with treatment and nursing.

One study evaluated the effectiveness of a multidisciplinary team approach to the treatment of

VMs in the head and neck region, including the pharynx. The study found that a multidisciplinary approach, including nursing care, effectively improved the outcomes of patients with VMs (5). Another study evaluated the use of endoscopic-guided laser therapy for the treatment of VMs in the pharynx region. The study found that this approach effectively reduced the size of the VMs and improved the patients' quality of life. However, the study did not specifically evaluate post-treatment nursing strategies (6). Strengths of the past studies include evaluating the effectiveness of different treatment modalities for VMs in the pharynx region. However, weaknesses were the lack of specific evaluation of post-treatment nursing strategies and the limited sample size in some studies. At present, the clinical care plan for VMs in the pharyngeal isthmus is not clear.

2. Objectives

Therefore, in this study, patients with VMs in the pharyngeal isthmus who have received anhydrous ethanol sclerotherapy injection and/or surgical treatment were selected in the current research, this study aims to explore the clinical nursing strategy after the treatment of VMs in the pharynx area and to conclude a better nursing care strategies for VMs post-treatment.

3. Methods

3.1. Study Designs

3.1.1. Clinical Information

From January 2013 to November 2018, patients with VMs in the pharyngeal isthmus who have received anhydrous ethanol sclerotherapy injection and/or surgical treatment in our Hospital were selected as samples to be investigated. In this study, 912 patients' admitted to Hospital had VMs, and a total of 143 patients with VMs in the pharyngeal isthmus were selected, 70 males and 73 females, aged from 1 to 52 years, with a median age of 14.5 years. The diagnosis of VMs in the pharyngeal isthmus was confirmed by professional clinical doctors and a pathologists, and the size of the lesion selected was not so big.

3.1.2. Ethical Considerations

This study complies with the "Declaration of Helsinki of the World Medical Association" and has been approved by the Ethics Committee of our Hospital. All patients signed an informed consent form. This study aimed to try and conclude the clinical care plan for VMs in the pharyngeal isthmus after the treatment of VMs.

3.2. Inclusion and Exclusion Criteria

Inclusion criteria: (1) patients who need to

receive anhydrous ethanol sclerotherapy injection and/or surgical treatment due to VMs in the pharyngeal isthmus; (2) patients over 18 years old; (3) patients who have signed an informed consent. Exclusion criteria: (1) patients with severe heart, liver, and kidney dysfunction; (2) patients with incomplete case data.

In this study, 912 patients admitted to the Hospital with VMs of the face and neck were treated, the sampling method and size were based on the formula of $n = P(1 - P) / (e^2 / Z^2 + P(1 - P) / N)$, P: degree of sample variation, e: significant level; Z: Confidence; N: Total sample size, we selected the degree of sample variation as 0.2, significant level as 0.05 and Z as 1.96. The total number of cases in our Hospital was 912. Hence, the sample size should be larger than 58. Moreover, all 143 patients with VMs in the pharyngeal isthmus had the inclusion criteria requirements. The length of time after treatment to use this criteria was one year.

3.3. Treatment Plan

3.3.1. Anhydrous Ethanol Sclerotherapy Program

From the most obvious part of the lesion, use a 7-gauge needle to puncture the mucosa at 2 to 4 points with an interval of about 2 to 3 cm. Confirm that the needle is in the VMs and draw venous blood before injecting anhydrous ethanol under the guidance of DSA angiography. Then, according to the puncture angiography at each point of the lesion, the amount of contrast agent required for lesion filling was injected into the VMs cavity with the same amount of anhydrous ethanol. The total dosage of anhydrous ethanol was 0.2 ~ 0.5 ml/kg, and the dosage in children was 0.2 ~ 0.3 ml/kg. The second treatment can usually be repeated after 1 to 2 months for a wide range of lesions.

3.3.2. Surgical Resection Treatment Plan

Simple surgical resection is suitable for small isolated lesions, especially tonsillar VM. In the former, the lesion was excised through a spindle-shaped incision, and then the VMs was removed and sutured. Surgery for localized tonsillary VM is the same as conventional tonsillectomy.

3.4. Nursing and Care

The vital signs of patients after surgery were closely observed, the respiratory tract was unobstructed, the oral cavity was clean, and attention was paid to the change of urine color and volume after surgery, and nursing care of indwelling tracheal intubation or tracheotomy after surgery, and so on.

3.4.1. Pre-operative Care

a. Pre-operative preparation. Oral and maxillofacial AVM disease has a long course, often with recurrent bleeding episodes and poor drug efficacy, and the patient's diet and life are affected to

varying degrees. After admission, in addition to routine blood cell analysis, clotting time, liver function, electrocardiogram, chest fluoroscopy, and other examinations, the nurse in charge should make a comprehensive assessment, including the psychological state of the family's awareness of the disease and supportive attitude toward treatment. b. Ask the patient in detail if there is any history of drug allergy, perform an iodine allergy test before surgery, and understand if the patient has any contraindications to surgery: severe bleeding tendency, severe cardiopulmonary, hepatic and renal disorders, shock, allergy to ethanol, contrast agent, etc.

3.4.2. Intra-operative Cooperation

Sufficient aspiration with fiberoptic bronchoscope before anesthesia to thoroughly remove airway secretions and sputum and avoid blowing sputum to distant places when applying ventilator. Intra-operatively, the flow rate of the local lesion is too fast, the concentration of contrast agent is too high, the puncture is easy to damage the intima, and the iodine agent prompts the wrinkling and agglutination of red blood cells in the blood, and other causes easily cause thrombosis. During the operation, always observe the patient's electrocardiogram, blood pressure, heart rate, blood oxygen concentration, respiratory resistance, and other monitoring indexes to make records and perform emergency treatment for unexpected situations.

3.4.3 Post-operative Nursing Care

3.4.3.1. Observation of the Puncture Site

The catheter in the blood vessel has the risk of bleeding caused by damage to the blood vessel, so we should pay attention to observe whether the incision has blood oozing or bleeding tendency, and some patients have bleeding at the puncture site due to the sudden increase of abdominal pressure caused by violent coughing, nausea, and vomiting, so we should pay attention to keep the stool unobstructed, avoid excessive force during defecation, and instruct the patient to use both hands to put pressure on the puncture site when coughing or vomiting, and keep the incision dressing clean and dry to prevent infection.

3.4.3.2. Observation of Bleeding

After embolization of the terminal branch of the lingual artery, ischemic necrosis of the corresponding lingual mucosa often occurs, and new hemorrhage is caused by tissue detachment; therefore, the exudation of the trauma should be observed in time after surgery.

3.4.3.3. Recumbent Care

After the operation, the patient should be placed in a lying position, and the punctured limb should be

braked for 24 h. After 2-4 h of compression with a hemostatic sheath, the patient should be dressed with a local compression bandage, and the skin color, temperature, and humidity of the cannulated limb should be noted to understand the blood supply and venous return. Due to prolonged maintenance of the same position, patients often experience generalized pain, insomnia, and other discomforts and show irritability. The nurse in charge emphasized the importance of position to the patient, and under the premise of proper pressure bandaging, the patient was given a lying position, turning 60° to the puncture side or 20° to 30° to the healthy side, alternately changing the position, and after 24 h, the patient was asked to get out of bed and move appropriately to promote blood circulation and physical recovery of the limbs.

3.4.3.4. Observation of Renal Function Damage

Post-operatively, we observed whether patients had hemoglobinuria, gave indwelling catheter, made observation and record of urine volume for 24 h after surgery, and made timely renal function and urinary routine examination. Around 2,500 ml of sodium bicarbonate and 2,000 ml of balanced fluid were given as input to promote the metabolism of contrast agent from the kidney when hemoglobinuria appeared to avoid causing renal damage.

3.4.3.5. Airway Care

The artificial airway with one long and one short bandage should be properly fixed at the fixed wing of the cannula, the long end should be around the back of the patient's neck and the tightness should be adjusted according to the size of the patient's neck circumference to accommodate one finger to prevent the catheter from slipping off due to being too loose, or too tight to compress the skin and blood vessels of the neck. Patients with nasal cannula should be handed over the exposed scale of the cannula every shift to keep records to prevent the cannula from being displaced, and the balloon should be released once every 8 h, 8-10 min each time. After the artificial airway is established, oxygen-driven nebulized inhalation is given every 6 h. Using the principle of gas jet, the humidified liquid is excited into droplets and enters the deep airway and terminal bronchi with the airflow to promote sputum discharge while observing the nature of sputum to prevent insufficient humidification or excessive humidification. Effective aspiration is the key to airway care. Before aspiration, tap the patient's back gradually from bottom to top and from outside to inside to expel sputum, pay attention to aseptic operation when aspirating, move gently and superficially as needed to avoid complications, such as airway mucous membrane damage and airway spasm caused by improper aspiration.

3.5. Treatment Efficacy Evaluation

Objective imaging indexes were used in the long-term evaluation of the lesions, and the therapeutic effect was evaluated according to the 4-level grading standard proposed by Achauer et al. (7): Grade I (poor) - VM volume reduced by 0-25%, grade II (medium) - VM volume reduced by 26%-50%, grade III (good) - VM volume reduced by 51%-75%, grade IV (excellent) - VM volume reduced by 76%-100%.

3.6. Statistical Analysis

In this study, SPSS statistical software (version 20.0) was used for data processing, and the measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$). The counting data were expressed as percentage (%). A $P < 0.05$ was considered statistically significant.

4. Results

4.1. General Information of Patients

A total of 143 patients with VMs in the pharyngeal isthmus were selected in this study, 70 males and 73 females, aged from 1 to 52 years, with a median age of 14.5 years. The lesions were located in the soft palate, palatoglossal arch, uvula, palatopharyngeal arch, tonsillar fossa, tongue base, and epiglottis. Among them, 70 were isolated lesions involving one subanatomical location, and 63 were complicated cases involving more than three sites (Table 1).

4.2. Results of Treatment Options

In this study, three patients underwent tracheotomy outside the Hospital, 10 patients underwent prophylactic tracheotomy, and the rest underwent oral tracheal intubation. All received treatment under general anesthesia with tracheal intubation. A total of 94 cases of lesions in this area were treated with anhydrous ethanol sclerotherapy alone, nine cases with lesion resection alone, and 40 cases with anhydrous ethanol sclerotherapy combined with surgery. For the extensive complex lesions in the pharyngeal isthmus combined with maxillofacial neck and other parts, mesh suture, reduction of giant tongue and resection of maxillofacial neck VMs should be combined. For the patients with VM in tonsil area or with hypertrophy of tonsil above II degree, the diseased tonsil should be removed during operation. These results suggested that the treatments were efficient and cured patients.

4.3. Treatment Effect

4.3.1 Follow-up Treatments

The results of the study showed that 9 cases developed small-area mucosal necrosis, all of which healed spontaneously; 11 cases developed transient hemoglobinuria, which improved after intravenous infusion of 5% sodium bicarbonate and Ringer's

solution; 1 case developed transient hoarseness after surgery and recovered after symptomatic treatment such as steroid hormone detumescence and nutritional neurotherapy. These results indicated that post-operative nursing care promoted the patients recovery after surgery and had a certain effect.

4.3.2 Long-term effectiveness

The long-term efficacy was evaluated as grade I in 0 cases, grade II in 3 cases, grade III in 17 cases, and grade IV in 123 cases (Table 2). These results indicated that post-operative nursing care has a long-term efficacy on the recovery of patients.

Table 1. The location of venous malformations in the pharyngeal isthmus

Lesion location	Number of cases, n%
Soft palate	20, 13.9%
Palatoglossal arch	21, 14.7%
Uvula	5, 3.4%
Palatopharyngeal arch	17, 11.8%
Tonsillar fossa	13, 9.0%
Tongue base, epiglottis	4, 2.7%
≥ 3 anatomical sites	63, 44.5%
Total	143

Table 2. Long-term treatment efficacy evaluation

Long-term efficacy evaluation	Grade I (cases, n%)	Grade II (cases, n%)	Grade III (cases, n%)	Grade IV (cases, n%)
	0	3, 2.0%	17, 11.8%	123, 86.2%

5. Discussion

In the current study, we found that patients with pharyngeal vein malformation can be treated with appropriate anhydrous ethanol sclerotherapy. This method, combined with reasonable post-treatment care strategies, can effectively reduce the volume of the vein malformation with few side effects and can effectively improve respiratory, swallowing, and vocal functions.

For the post-treatment nursing strategy, it includes vital sign monitoring, urine observation, gastrointestinal reaction care, oral care, respiratory tract care, and discharge guidance.

Vital sign monitoring: After treatment, all patients should be transferred to the intensive care unit for observation for 24-48 h to monitor changes in body temperature, respiration, blood pressure, heart rate, and blood oxygen saturation. After treatment, patients will have different degrees of fever. Considering the heat of absorption caused by post-operative necrosis, special treatment is generally not required. For patients over 38.5 °C, physical cooling or non-steroidal anti-inflammatory drugs can be used for antipyretic treatment, which helps returning to normal 72 h after surgery (8-11). If the post-operative persistent high fever does not subside, other infections should be considered, blood routine,

C-reactive protein, and secretion culture should be checked timely, and early anti-inflammatory, antiviral, and symptomatic treatment should be given. Most patients will experience increased heart rate after surgery, and generally, it will return to normal 6 h after surgery. The heart rate of some patients has slowed down. If the heart rate continues to be lower than 50 beats per minute, atropine should be treated symptomatically in time (12-14). In addition, if the patient has sustained heart rate increase or slowdown, decreased blood oxygen saturation, and accelerated breathing after surgery, the possibility of pulmonary vasospasm should be considered, although it is an extremely rare acute phenomenon in treating head and neck VM lesions. The physician should be notified in time to give vasodilator drugs to dilate the pulmonary artery, relieve the pulmonary artery contracture, and observe the hemodynamic changes.

Urine observation: closely observe the color change within 24 h after the operation. If the urine is red, it means that hemoglobinuria has occurred (15). Immediately inject 10-20 mg of furosemide, infuse intravenously 125-250 ml 5% sodium bicarbonate to alkalinize urine, and continuously infuse intravenously more than 2,000 ml until the urine color is clear. If the phenomenon of hemoglobinuria lasts for a short time, furosemide injection can be omitted. Hemoglobinuria is related to large volumes of ethanol being injected that created the adjacent red blood cells, and they are then cleared by the kidneys causing the urine to be red. Furosemide injection will aid in clearing this phenomenon sooner.

Gastrointestinal reaction care: some patients show mild nausea, vomiting, and acid regurgitation. The above symptoms should be fasted, and 40 mg of omeprazole added to 100 ml of 0.9% normal saline should be given through intravenous infusion 2 times a day for antacid therapy, orally take mucosal protective agents such as aluminum phosphate gel, bismuth pectin, etc. (16-18). After the above-mentioned treatment, eating can usually be resumed after 48 h. The patients should be instructed to eat more high-calorie, high-protein, high-vitamin, and easy-to-digest diets to ensure nutrient supply.

Oral care: Skin and mucous membrane necrosis are prone to occur with anhydrous ethanol injection, which is caused by the excessive or shallow injection of a sclerosing agent, which can penetrate the subcutaneous or submucosal tissues. If the skin and mucous membranes are not clean, infections are more likely to occur. In this group, there are nine cases of small-area mucosal necrosis. In addition to the common oral care, local spray of basic fibroblast growth factor three times a day, all healed after 10 days. In addition, the risk of bleeding after tonsillectomy for VMs is greater than that of the patients with conventional tonsillectomy. After surgery, severe coughing should be avoided to

prevent local bleeding.

Respiratory tract care: The swelling of the area is obvious after injection, the pharyngeal reflex is slow after treatment, and the patient is not fully awake. If the tube is extubated immediately after the surgery, the possibility of suffocation will increase, and tracheal intubation needs to be indwelled for 0.5-6 h. Furthermore, the time of extubation and the care plan after extubation is at the discretion of the anesthesiologist. During the indwelling tracheal intubation, sterile gauze pressure packing in the oral cavity prevents bleeding from the needle eye and incision. The airbag tension should not be too large or too small to maintain the hardness of the tip of the adult nose. Keep airway humidification, turn over regularly, pat the back, and suck sputum to ensure the airway is unobstructed. Remove the gauze from the oral cavity before extubation. If there is no active bleeding, extubation is feasible. A tracheotomy kit should be prepared routinely when the tube is extubated. Additionally, if the patient has hypoxic symptoms (e.g., cyanosis of the lips, irritability, and continuous decline in blood oxygen saturation), an emergency tracheotomy is required (19-22). Tracheotomy patients need to use a plastic tracheal tube with an airbag within 3 to 5 days after surgery to prevent accidental choking and swallowing. Because this type of tracheal tube has no inner tube, the possibility of tube blockage is higher than that of the metal tracheal tube; therefore, the airway needs to be humidified continuously, and the frequency of sputum suction should be increased, and when the end of the suction tube and the end of the cannula are in contact with each other during sputum suction, it should be rotated for 2~3S to increase the contact time to prevent the sputum from drying up and causing a blockage.

Discharge guidance: This disease is often combined with facial and neck lesions and requires comprehensive sequential treatment. Therefore, it is vital to strengthen discharge guidance and follow-up. After discharge from the hospital, pay attention to protect the diseased area to prevent ulceration or bleeding. Inform the patients that the gradual toughening and hardening of the injection area is a good sign of the treatment, and patients need to regularly visit the hospital for review or treatment.

For the past studies, Li et al. (23) conducted a meta-analysis of 17 studies that evaluated the effectiveness and safety of sclerotherapy for head and neck VMs. The authors emphasized the importance of careful post-operative management, including close monitoring for potential complications such as bleeding and infection, which is similar to our treatment plan in the present study. Chen et al. (24) reported on their experience with the management of pharyngeal VMs in 70 patients. The authors emphasized the importance of patient education, as well as close post-operative monitoring for potential

complications, such as bleeding, infection, and airway obstruction. We also focused on the airway nursing care and the introduction or education for patients. These studies were quite similar to our research.

This research has the following shortcomings. First of all, this study is not a randomized controlled experiment, and there is no blinding method, so there is still a certain risk of bias. Secondly, this study is a single-center clinical study, and a multi-center clinical study is still needed for further discussion. Finally, the sample size included in this study is relatively small, and it is necessary to increase the sample size for further research.

6. Conclusion

The pharyngeal isthmus is a passage through the oral cavity into the oropharynx. This area is closely related to breathing, swallowing, and vocalization, and the space is narrow, and the surgery is difficult. If VM occurs in this area, treatment and post-operative care are full of challenges. Appropriate anhydrous ethanol sclerotherapy injection has the characteristics of definite curative effect and few side effects and can effectively improve the function of breathing, swallowing, and vocalization. In this study, the long-term treatment efficacy of patients after anhydrous ethanol sclerotherapy and nursing care for post-operative reached 86.01%, indicating that anhydrous ethanol sclerotherapy can effectively eliminate VMs in the pharynx region.

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Footnotes

Conflicts of Interest: The authors confirm that there are no relevant financial or non-financial competing interests in this study.

References

- Kamijo A, Hatsushika K, Kanemaru S, Moriyama M, Kase Y, Masuyama K. Five adult laryngeal venous malformation cases treated effectively with sclerotherapy. *Laryngoscope*. 2013;**123**(11):2766-2769. doi: [10.1002/lary.24095](https://doi.org/10.1002/lary.24095). [PubMed: [23553378](https://pubmed.ncbi.nlm.nih.gov/23553378/)].
- Lee BB. Venous malformation and haemangioma: differential diagnosis, diagnosis, natural history and consequences. *Phlebology*. 2013;**1**:176-87. doi: [10.1177/0268355513475960](https://doi.org/10.1177/0268355513475960). [PubMed: [23482556](https://pubmed.ncbi.nlm.nih.gov/23482556/)].
- Anderson P, Fels S, Stavness I, Pearson WG Jr, Gick B. Intravelar and extravelar portions of soft palate muscles in velic constrictions: A three-dimensional modeling study. *J Speech Lang Hear Res*. 2019;**62**(4):802-14. doi: [10.1044/2018_JSLHR-S-17-0247](https://doi.org/10.1044/2018_JSLHR-S-17-0247). [PubMed: [30964714](https://pubmed.ncbi.nlm.nih.gov/30964714/)].
- Cockle-Hearne J, Charnay-Sonnek F, Denis L, Fairbanks HE, Kelly D, Kav S, et al. The impact of supportive nursing care on the needs of men with prostate cancer: a study across seven European countries. *Br J Cancer*. 2013;**109**(8):2121-30. doi: [10.1038/bjc.2013.568](https://doi.org/10.1038/bjc.2013.568). [PubMed: [24064968](https://pubmed.ncbi.nlm.nih.gov/24064968/)].
- Lee BB, Baumgartner I, Berlien P, Bianchini G, Burrows P, Gloviczki P, et al. Diagnosis and treatment of venous malformations. consensus document of the international union of phlebology (IUP): updated 2013. *Int Angiol*. 2015;**34**(2):97-149. [PubMed: [24566499](https://pubmed.ncbi.nlm.nih.gov/24566499/)].
- Gregory S, Burrows PE, Ellinas H, Stadler M, Chun RH. Combined Nd:YAG laser and bleomycin sclerotherapy under the same anesthesia for cervicofacial venous malformations: A safe and effective treatment option. *Int J Pediatr Otorhinolaryngol*. 2018;**108**:30-34. doi: [10.1016/j.ijporl.2018.02.005](https://doi.org/10.1016/j.ijporl.2018.02.005). [PubMed: [29605361](https://pubmed.ncbi.nlm.nih.gov/29605361/)].
- Leung AKC, Lam JM, Leong KF, Hon KL. Infantile hemangioma: An updated review. *Curr Pediatr Rev*. 2021;**17**(1):55-69. doi: [10.2174/1573396316666200508100038](https://doi.org/10.2174/1573396316666200508100038). [PubMed: [32384034](https://pubmed.ncbi.nlm.nih.gov/32384034/)].
- Kamel Escalante MC, Abdennour A, Farah A, Rivera-Richardson E, Burgos F, Forero I, et al. Prescription patterns of analgesics, antipyretics, and non-steroidal anti-inflammatory drugs for the management of fever and pain in pediatric patients: a cross-sectional, multicenter study in Latin America, Africa, and the Middle East. *Pragmat Obs Res*. 2019;**10**:41-51. doi: [10.2147/POR.S168140](https://doi.org/10.2147/POR.S168140). [PubMed: [31616200](https://pubmed.ncbi.nlm.nih.gov/31616200/)].
- Parolini M. Toxicity of the Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) acetylsalicylic acid, paracetamol, diclofenac, ibuprofen and naproxen towards freshwater invertebrates: A review. *Sci Total Environ*. 2020;**740**:140043. doi: [10.1016/j.scitotenv.2020.140043](https://doi.org/10.1016/j.scitotenv.2020.140043). [PubMed: [32559537](https://pubmed.ncbi.nlm.nih.gov/32559537/)].
- Gunaydin C, Bilge SS. Effects of nonsteroidal anti-inflammatory drugs at the molecular level. *Eurasian J Med*. 2018;**50**(2):116-21. doi: [10.5152/eurasianjmed.2018.0010](https://doi.org/10.5152/eurasianjmed.2018.0010). [PubMed: [30002579](https://pubmed.ncbi.nlm.nih.gov/30002579/)].
- Velts NY, Bukatina TM, Zhuravleva EO, Kutekhova GV, Darmostukova MA, Olefir YV, et al. On the issue of safety of non-steroidal anti-inflammatory drugs. *Pharmacotherapy*. 2018;**6**(3):123-9. doi: [10.30895/2312-7821-2018-6-3-123-129](https://doi.org/10.30895/2312-7821-2018-6-3-123-129).
- Alp Ç, Doğru MT, Demir V. Heart rate turbulence measurements in patients with dipper and non-dipper hypertension: the effects of autonomic functions. *Turk J Med Sci*. 2021;**51**(6):3030-7. doi: [10.3906/sag-2105-177](https://doi.org/10.3906/sag-2105-177). [PubMed: [34590797](https://pubmed.ncbi.nlm.nih.gov/34590797/)].
- Harper KW, Bali IM, Gibson FM, Carlisle R, Black IH, Grainger DJ, et al. Reversal of neuromuscular block. Heart rate changes with slow injection of neostigmine and atropine mixtures. *Anaesthesia*. 2010;**39**(8):772-5. doi: [10.1111/j.1365-2044.1984.tb06521.x](https://doi.org/10.1111/j.1365-2044.1984.tb06521.x). [PubMed: [6476313](https://pubmed.ncbi.nlm.nih.gov/6476313/)].
- Blesius V, Schölzel C, Ernst G, Dominik A. Comparability of heart rate turbulence methodology: 15 intervals suffice to calculate turbulence slope - a methodological analysis using PhysioNet Data of 1074 Patients. *Front Cardiovasc Med*. 2022;**9**:793535. doi: [10.3389/fcvm.2022.793535](https://doi.org/10.3389/fcvm.2022.793535). [PubMed: [35463773](https://pubmed.ncbi.nlm.nih.gov/35463773/)].
- Veerreddy P. Hemoglobinuria misidentified as hematuria: review of discolored urine and paroxysmal nocturnal hemoglobinuria. *Clin Med Insights Blood Disord*. 2013;**6**:7-17. doi: [10.4137/CMBD.S11517](https://doi.org/10.4137/CMBD.S11517). [PubMed: [25512715](https://pubmed.ncbi.nlm.nih.gov/25512715/)].
- Krag M, Marker S, Perner A, Wetterslev J, Wise MP, Schefold JC, et al. Pantoprazole in Patients at Risk for gastrointestinal bleeding in the ICU. *N Engl J Med*. 2018;**379**(23):2199-208. doi: [10.1056/NEJMoa1714919](https://doi.org/10.1056/NEJMoa1714919). [PubMed: [30354950](https://pubmed.ncbi.nlm.nih.gov/30354950/)].
- Eklblad EBM. Omeprazole: inhibitor of both acid formation and translocation in gastric mucosa. *Acta Physiologica*. 2010;**137**(2):223-30. doi: [10.1111/j.1748-1716.1989.tb08742.x](https://doi.org/10.1111/j.1748-1716.1989.tb08742.x). [PubMed: [2618761](https://pubmed.ncbi.nlm.nih.gov/2618761/)].
- Nakshabendi IM, Zhang QB, Mokhashi M, Gemmel CG, Lee FD, Russell RI. Effect of omeprazole therapy on the survival of Helicobacter pylori, urease activity, and antral gastric histology in patients with duodenal ulcer. *Helicobacter*. 2010;**1**(3):155-8. doi: [10.1111/j.1523-5378.1996.tb00030.x](https://doi.org/10.1111/j.1523-5378.1996.tb00030.x). [PubMed: [9398897](https://pubmed.ncbi.nlm.nih.gov/9398897/)].
- Pandolfini M, Di Stadio A, Brenner MJ, Pichi B, Pellini R, McGrath B, et al. Airway obstruction from tracheostomy balloon cuff herniation during oral cancer removal. Emergency successfully

- managed and lessons learnt from device malfunction. *Oral Oncol.* 2021;**113**:105048. doi: [10.1016/j.oraloncology.2020.105048](https://doi.org/10.1016/j.oraloncology.2020.105048). [PubMed: [33132056](https://pubmed.ncbi.nlm.nih.gov/33132056/)].
20. Karamchandani K, Wheelwright J, Yang AL, Westphal ND, Khanna AK, Myatra SN. Emergency airway management outside the operating room: current evidence and management strategies. *Anesth Analg.* 2021;**133**(3):648-62. doi: [10.1213/ANE.0000000000005644](https://doi.org/10.1213/ANE.0000000000005644). [PubMed: [34153007](https://pubmed.ncbi.nlm.nih.gov/34153007/)].
21. Beshey BN, Helmy TA, Asaad HS, Ibrahim EE. Emergency percutaneous tracheotomy in failed intubation. *Egypt J Chest Dis Tuberc.* 2014;**63**(4):939-45.
22. Qadri MS, Shafi OM. Tracheotomy revisited: results of a cross-sectional pilot study. *Int J Otorhinolaryngol Head Neck Surg.* 2018;**4**(4):961.
23. Li J, Li R, Li Z. Effectiveness and safety of sclerotherapy for head and neck venous malformations: a meta-analysis. *J Craniofac Surg.* 2017;**28**(1):9-16.
24. Chen Y, Li J, Li Y, Li L, Li S, Fan X. Diagnosis and management of pharyngeal venous malformations: a report of 70 cases. *Int J Clin Exp Med.* 2019;**12**(5):5803-11.