Case Series

High-flow nasal cannula (HFNC) oxygenation for sclerotherapy of facial and upper airway vascular malformations in pediatric patients: Case series

Sanjeevani Zadkar, Ranjitha Y. S.[1], Poonam Mishra[2], Rashmi Saraf[3]

Department of Anaesthesiology and Critical Care, [1]Anaesthesiology and Critical Care, [3]Interventional Neuroradiology, Seth GSMC and KEM Hospital, Mumbai, Maharashtra, [2]Department of Anaesthesiology and Critical Care, Jaslok Hospital, Mumbai, Maharashtra, India

Abstract

We report anesthesia management of sclerotherapy for vascular malformations (VMs) of the upper airway and face of pediatric patients conducted under sedation using a high-flow nasal cannula (HFNC) oxygen delivery system. Sclerotherapy procedures were carried out in six patients (five males, one female; age group: 5–12 years). The patients were sedated with midazolam, fentanyl, ketamine, and graded doses of propofol along with continuous oxygen delivery using HFNC. There were no episodes of oxygen desaturation, tongue fall or obstruction of the airway, interruption of procedure for assisted ventilation, and postoperative nausea and vomiting (PONV). Only two patients showed transient apnea for 10 and 15 s but did not require ventilatory assistance. HFNC provides effective oxygenation in pediatric patients undergoing sclerotherapy of VMs of the upper airway and face under sedation.

Keywords: HFNC oxygenation, pediatric patients, sclerotherapy, sedation, upper airway, vascular malformations

Introduction

Vascular malformations (VMs) are lesions of the vascular or lymphatic system most commonly occurring in the head and neck regions, resulting from defective vascular morphogenesis.[1] These can be single or multiple, commonly occurring on the lips, tongue, buccal mucosa, and palate and having the potential to expand.[2] Sclerotherapy being a minimally invasive technique, consists of an injection of a sclerosing agent, most commonly sodium tetradecyl sulfate (STS) into the vascular lesions begetting inflammation, leading to vascular sclerosis, occlusion, and regression of these lesions.[3]

Anesthesia management of these cases is quite challenging and taxing as it requires maintaining airway patency and oxygenation during sedation, meanwhile providing conducive procedural conditions for the interventional radiologist. High-flow nasal cannula (HFNC) oxygenation provides warm, humidified high-flow oxygen (flows up to 70 L/min) through an interface such as nasal cannulae. In this case series, we consolidate our overall experience and observations during the administration of sedation with oxygenation using HFNC for sclerotherapy of VMs in pediatric patients.

Case Reports

We report anesthesia management of six pediatric patients of age group between 5 and 12 years with VMs of the

Address for correspondence: Dr. Ranjitha Y. S.,
H.No-182, Shanta Mandira, 9th Cross, HMT Layout, RT Nagar,
Bengaluru - 560 032, Karnataka, India.
E-mail: ysranjitha@gmail.com

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upper airway and face for sclerotherapy during our 2 months experience of working in the interventional radiology procedural suite. These patients did not have any associated conditions like adenotonsillar hypertrophy, congenital syndromes with an obvious facial deformity, and snoring. MRI did not reveal obliteration of the airway in any of these cases. The presenting feature was in the form of swelling in the diverse regions of the face and upper airway [Figures 1 and 2].

On examination, these were non-tender and non-fluctuant. The Mallampati grades were either I or II. There was no restriction in mouth opening, jaw protrusion, or neck movements. Ultrasonography showed a slow flow of VMs. MRI showed T2 hyperintense homogeneously-enhancing lesion in the concerned region mentioned in Table 1. Infraorbital VM was well-confined without orbital invasion. The baseline hematological, biochemical, and imaging reports were reviewed. Our plan A was sedation with oxygenation using HFNC with backup plans of induction and retromolar intubation with flexometallic tube in tongue lesions, orotracheal intubation with endotracheal tube fixed to the opposite side of the swelling in the submandibular and cheek swellings, and laryngeal mask airway insertion in the infraorbital swelling. Antisialagogue glycopyrrolate 4 mcg/kg was administered intravenously. In the procedural suite, sedation was administered with intravenous midazolam (0.03 mg/kg), fentanyl (1 mcg/kg), ketamine (0.5 mg/kg) along with graded doses of intravenous propofol (1 mg/kg) to all the patients. Oxygenation was ensured throughout the procedure using HFNC at 1 L/kg/min. No complications like desaturation, airway obstruction, interruption of procedure for ventilatory assistance, PONV [Table 1] were noted in any of these cases.

Discussion

Low-flow VMs occur in the lymphatic or vascular systems. They mostly involve the anterior two-thirds of the tongue, palate, gingiva, and buccal mucosa.[4] These manifest as swellings which bring about cosmetic disfigurement, difficulty in eating, speech, and seldom causing pain with bleeding. Sclerotherapy followed by surgical resection is considered the treatment of choice.[5]

A comprehensive approach is required in the anesthetic management of pediatric patients with VMs of the airway and face. It encompasses multitude of concerns like an

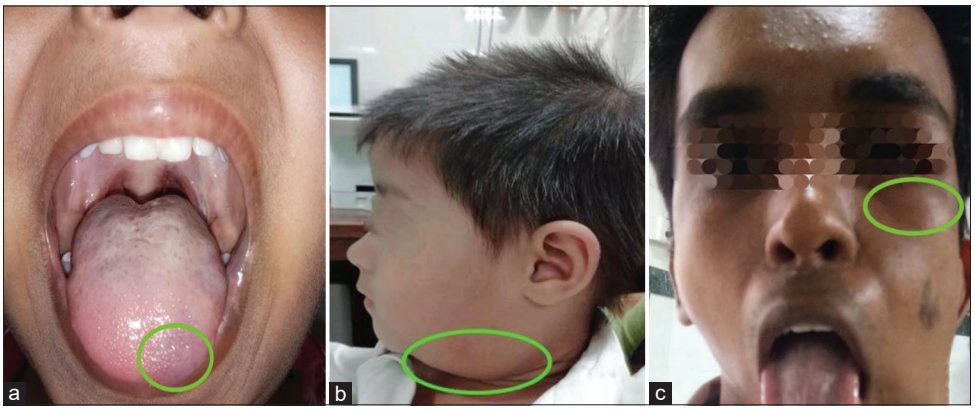

Figure 1: Vascular malformations in various locations. (a) Tip of the tongue (b) Submandibular region (c) Infraorbital region

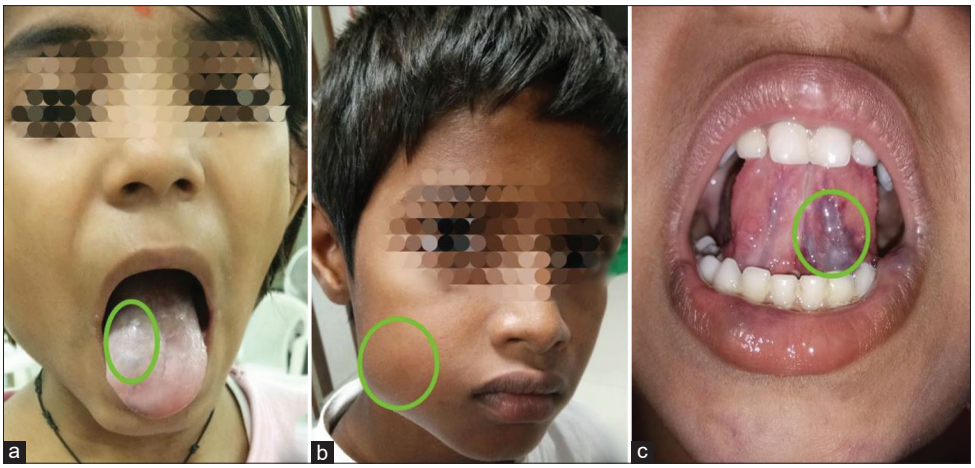

Figure 2: Vascular malformations in various locations (a) Tongue (b) Cheek (c) Ventral surface of the tongue

Table 1: CASE REPORTS

Case number	Age (years)	Sex	Weight (kg)	Site and size (of vascular malformation) (cm)	Duration of sclerotherapy (min)	Oxygen flow used (liters/min)	Complications
1	7	Male	16	Tip of tongue, 1.5×0.8	10	16	Nil
2	5	Male	15	Left submandibular region, 3.5×2	10	15	Nil
3	12	Male	30	Left infraorbital region, 2.5×2	20	30	Nil
4	9	Female	20	Right half of the tongue including right border, 2×0.8	15	20	Nil
5	10	Male	25	Right cheek, 3×3	15	25	Nil
6	7	Male	15	Ventral surface of the tongue, 0.5×0.8	10	15	Nil

overlapping procedural and anesthetic field, risk of airway obstruction due to tongue fall, interruption of procedure for ventilatory assistance, and post-sclerotherapy airway edema. Large lesions involving contiguous anatomic spaces, encasing critical neuro-vascular structures require a well-equipped anesthetic team with a difficult intubation cart set ready. Flexible fiberoptic intubation with a flexometallic tube with a backup plan of tracheostomy would be apt in such cases.

In our case series, we included pediatric patients above 5 years of age with small VMs without airway obliteration on MRI and clinical signs of obstruction. In view of the small lesions with anticipated short procedural time, we administered sedation with continuous nasal oxygenation using HFNC. We used midazolam, fentanyl, and ketamine in combination with graded doses of propofol. The coadministration of opioids, benzodiazepines, and ketamine results in a marked reduction in the propofol requirement.[6] Opioids reduce the propofol dose required to produce loss of consciousness, obtund movement and hemodynamic responses to noxious stimuli.[6] Thus, reduced propofol requirements in our cases reduced the incidence of ventilatory depression. Besides its use in acute respiratory failure, there is a place for HFNC in emergency and elective airway management.[7] The prime advantage of HFNC is to provide an upper airway distending pressure of 3.2–7.4 cm H_2O which maintains the upper airway patency during sedation. This is transmitted to the lower airways to generate PEEP (positive end-expiratory pressure).[8] HFNC has several advantages compared to the conventional oxygen therapy through nasal prongs, such as creating a positive pressure effect, delivery of a predictable, constant FIO_2, and reduction of the upper airway resistance and airway irritability.[8] Thus, it is preferred over nasal prongs even during a short procedure under sedation. Also, high oxygen flow use ensures nitrogen and CO_2 washout, and a higher fraction of inspired oxygen (FIO_2) providing an oxygen reservoir which aids in apneic oxygenation as well.[9] Provision of warm and humidified oxygen increases a patient's compliance, prevents bronchial irritation, and atelectasis under anesthesia. Due to these collective advantages, HFNC oxygenation enables sedation with adequate oxygenation eliminating the need for interruption of procedure for ventilatory assistance in the form of bag and mask ventilation or intubation. Circumventing the need for a bag and mask ventilation, HFNC also aided in maintaining a safe distance between the fluoroscopy table and the anesthetist, decreasing radiation exposure. The amount of radiation exposure is inversely proportional to the square of the distance.[10] We avoided general anesthesia with endotracheal intubation as sclerotherapy is a short procedure to provide optimal procedural field especially in the cases of tongue lesions and to shorten recovery times.

Conclusion

Sclerotherapy is a minimally invasive short procedure. Thus, sedation with continuous nasal oxygenation using HFNC demonstrated an array of benefits in the form of optimal oxygenation, uninterrupted conducive procedural conditions maintaining airway patency, uneventful and rapid postoperative recovery proving to be an appropriate approach of anesthetic management for sclerotherapy of small VMs of the airway. Further studies on similar lines with large numbers would be required to substantiate this technique of anesthesia management in these cases.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for his/her images and other clinical information to be reported in the journal. The patient understands that the name and initials will not be published and due efforts will be made to conceal the identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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