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Acute Massive Pulmonary Oedema and Myocardial Ischaemia after Adrenaline Intranasal Pack Application

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ABSTRACT

Adrenaline intranasal pack is one of the convenient and efficient vasoconstrictors used for infiltration to limit bleeding and improve the quality and visibility of the surgical field during endoscopic sinus surgery. However, some studies report that adrenaline causes severe side effects in-term of hemodynamic stability and pulmonary edema in some patients. Therefore, this study is designed to explore and compare the efficacy and safety of two different doses of adrenaline intranasal pack. A randomized double-blind study was conducted in the department of Internal Medicine and ENT department of Dr Sulaiman Al Habib Hospital Dubai Healthcare City Dubai United Arab Emirates from January 2020 to Janurary 2021. A total of 20 patients were randomly assigned into 2 groups: group 1 received 1 mg adrenaline and group 2 received 4 mg adrenaline intranasal pack soaked in normal saline after the administration of general anaesthesia. The patients were assessed for hemodynamic parameters and blood loss throughout the surgery. Adrenaline administration remarkably raised the blood pressure and pulse rate in both groups. The hemodynamic parameters were found to be more unstable in group 2 as compared to group 1. The partial pressure of oxygen was decreased more in group 2 as compared to group 1. The requirement of rescue medication to stabilize hemodynamic parameters was more in group 2 than in group 1 but within the recommended range. The blood loss was found to be significantly decreased in group 2 (adrenaline 4 mg) compared to group 1 (adrenaline 1 mg). Group 2 provides a clear surgical field throughout the surgery. In conclusion it is recommended that adrenaline is a potent vasoconstrictor, but the increased levels of adrenaline are responsible for causing cardiac toxicity.

Key words: Pulmonary oedema, Myocardial ischaemia, Adrenaline, Cardiac toxicity

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INTRODUCTION

Bleeding is considered a common complication during and after nasal surgery, and to reduce blood loss, otorhinolaryngologists use homeostatic agents such as vasoconstrictors. Currently used vasoconstrictors for nasal vasoconstriction include adrenaline, vasopressin, noradrenaline, and phenylephrine. However, adrenaline is the most frequently used vasoconstrictor and is installed in the nasal mucosal cavity in pledgets, mucosal infiltration, and nasal drops and is also linked with several side effects because of its agonist activity on both alpha and beta-adrenergic receptors. Side effects of adrenaline include restlessness, headache, hypertension, and tachycardia. It may also be associated with life-threatening conditions, including cerebral hemorrhage, myocardial ischemia, and pulmonary oedema [1].

Adrenalines perform its pharmacological activity by G-protein linked alpha-1 (α1- AR), alpha-2, (α2- AR), beta-1 (β1- AR), and beta-2 (β2- AR), adrenergic receptors. α1-AR regulate arteriolar vasoconstriction having positive ionotropic effects. α2- AR regulate vasoconstriction and are responsible for increasing pulmonary and systemic vasoconstriction while beta 1 and 2 receptors are responsible for increasing myocardial contractility and causing the tachycardia. The dosage of adrenaline should not exceed 4 microgram/kg in patients. Several clinical studies suggested that increase in adrenaline concentration beyond 5 mcg.ml could not result in vasoconstriction but are responsible for causing toxicity in circulatory system. To limit the toxicity of adrenaline it can be used with 2% lidocaine [2].

Acute massive pulmonary oedema is caused by the excess use of adrenaline. Increased systemic resistance and tachycardia is responsible for causing excessive load on the left ventricle, resulting in pulmonary congestion followed by increased pulmonary artery and alveolar pressure and hydrostatic flow of fluid. It is also identified that adrenaline is responsible for changing the endothelial and Clara cells resulting in pathogenesis of lung injury and causing the pulmonary oedema. Treatment approaches for pulmonary oedema include Lasix with 100% oxygen and positive pressure ventilation. Moderate dose of steroids is also recommended for the treatment of pulmonary oedema [1,3].

MATERIALS AND METHODS

This research was conducted in the department of Internal Medicine and ENT department of Dr Sulaiman Al Habib Hospital Dubai Healthcare City Dubai United Arab Emirates from January 2020 to Janurary 2021, after getting approval from Institutional Review Committee. A randomly distributed double-blind study was conducted in which 20 patients with age group of 20-50 years were selected for septorhinoplasty. Non-diabetic, non-hypertensive patients and non-pregnant women were selected for this study. Patients with high blood pressure, and previous history of nasal surgery were excluded from this study. The patients were divided into two groups: Group 1 receiving 1 mg of adrenaline and group 2 receiving 4 mg of adrenaline. The informed written consent was taken from the patients or their attendants. The demographic details, clinical and pathophysiological information of the patient were filled in a pre-designed proforma.

General anaesthesia thiopentone 150 mg was given to the patient with nitrous oxide (N_2O) and oxygen. To reduce the blood loss during the surgery, the surgeon infiltrated the nasal cavity using adrenaline injections (adrenaline was diluted with normal saline solution). The inter positive pressure ventilation (IPPV) was maintained using Bain's circuit. Patient's blood pressure, heart rate and partial pressure of oxygen were monitored after the surgery. Blood loss in both the groups were measured meticulously.

All the patients were followed up every 03-04 weeks until 15 days after the surgery for the development of side effects associated with adrenaline. On every visit patient's blood pressure and heart rate were recorded. Finally, the number of patients who developed myocardial ischemia and acute massive pulmonary oedema were determined.

RESULTS

We randomly selected 20 normotensive and non-diabetic patients aged between 20 – 50 years admitted to the ENT department for surgery. There was no significant difference among the patients of both groups with respect to age, sex, body weight, and pre-anesthetic hemodynamic parameters. Patients were randomly assigned into two groups; group 1 received 1 mg of adrenaline and group 2 received 4 mg of adrenaline. All the clinical and pathological parameters of the patients were recorded prior to the selection and allocation in groups. None of the patients was identified with a previous bleeding disorder, myocardial disorder, and any pulmonary infection or disease in both groups.

Prior to the anesthetic procedure, the hemodynamic parameters i.e., systolic, and diastolic blood pressure, pulse rate and partial pressure of oxygen of the patient were monitor carefully. All the hemodynamic parameters were in the normal range in both groups i.e., systolic blood pressure was found to be 100 – 130 mmHg, diastolic blood pressure was 70–90 mmHg, pulse rate was 70 – 90 beats per minute and partial pressure of oxygen was found to be 97 – 100 mmHg. Patients were anesthetized by thiopentone 150 mg with nitrous oxide (N_2O) and oxygen. Following general anaesthesia, adrenaline 1 mg and 4 mg diluted in saline were given to the patients of group 1 and group 2 respectively.

The hemodynamic parameters were monitored throughout the procedure. As the adrenalin was induced, a remarkable change in hemodynamic parameters was observed in both groups. Group 2 showed a significantly high blood pressure, pulse rate, and decreased oxygen level.

After the administration of adrenaline, patients in group 2 show a remarkable increase in hemodynamic parameters i.e., average blood pressure was 200/120 mmHg ± 10 and average pulse rate was found to be 120 beats/min. While in group 1, the average blood pressure was observed as 160/100 mmHg ± 10, and the average pulse rate was found to be 110 beats/min. The PaO2 was declined up to 80 mmHg in group 2 and 90 mmHg in group 1. Few patients in group 2 required a rescue hemodynamic medication to stable their parameters but no severe complication was observed in any patient during the surgery. At the end of the procedure, there is no change in hemodynamic parameters was observed as recorded throughout the surgery. Within 1 hour or of surgery, the hemodynamic parameters were back to their normal range in both groups.

The pain score was recorded by pain scoring. There is significantly reduced pain recorded in group 2 as

compared to group 1. The analgesic effect of both doses of adrenalin was recorded in terms of discomfort during the surgery. The patients in group 2 showed a complete analgesic effect throughout the surgery while patients in group 1 showed a partial analgesic effect during the surgical procedure as few signs of discomfort during the surgery were observed in group 1.

Vasoconstrictive agents were mainly used in surgical procedures to reduce blood loss and provide a clear surgical area during surgery. Therefore, the blood loss was meticulously observed in both groups. None of the patients in either group required blood transfusion. It was observed that group 2 who received 4mg of adrenaline, show a remarkably reduced blood loss throughout the surgical procedure and found little to no bleeding during surgery. Therefore, a clear surgical site was maintained in group 2 throughout the procedure. While group 1 received 1 mg of adrenaline, showed mild bleeding during the surgical procedure. In this study, adrenaline (4 mg) was found as more effective in terms of vasoconstrictive agent during surgery.

There is no intraoperative complication was observed in both groups. Postoperative complications were also monitored in terms of nasal bleeding. None of the cases report any sign of nasal bleeding. No major complication was not observed in both groups during this study. No major post operative complication was observed in any group.

DISCUSSION

Nasal surgery can result in extreme blood loss and is responsible for promoting the cardiovascular reflex regulated by trigeminal nerve. To promote blood-less field during surgery, adrenaline with vasospastic activity was introduced into nasal mucosal cavity. Adrenaline is sympathomimetic catecholamine and performs its pharmacological activity on both alpha- and beta-adrenergic receptors. In the present study, adrenaline was used for nasal package. The dosage of adrenaline given to the patients were beyond 5 mcg/ml, which resulted in adverse cardiac effects. The use of adrenaline is associated with several complications and can put patient's life at risk. Adrenaline is responsible for activating presynaptic α2- AR, and β1- AR, the activation of β1- AR play a crucial role in initiating the tachycardia also increases the pulmonary systematic resistance. Limited perfusion increases myocardial oxygen requirement and may results in infarction or ischemia. Also, adrenaline linked myocardial vasospasm may also contribute to myocardial infarction and can also cause local tissue necrosis. High blood pressure and headache are also reported by some patients which is also linked with increased levels of adrenaline [4,5].

Several clinical studies have reported side-effects associated with the use of adrenaline during nasal surgery. Ring et al., published a review related to the cardiac complications linked with the use of vasoconstrictors in dental surgeries [6]. The most common contraindication includes myocardial infarction, arrhythmias, angina, and heart failure. However, use of adrenaline may be linked in the development of these contraindications [7].

A study performed by Savino et al., reported that four patients who underwent nasal surgery and are exposed to adrenaline and anaesthesia developed permanent visual defects. The exact mechanism is not identified for adrenaline linked visual impairment, but it is suggested that it is linked with vasospasm of retinal vessels [8].

Different studies have studies that increased concentration of adrenaline above 5 mcg.ml is responsible for causing toxic circulatory side effects. By reducing the concentration of adrenaline, it might be possible to reduce the chances of rapid systemic absorption of adrenaline. Furui et al. [8] and Jayamali et al. [9] recommended that the dose of adrenaline should not be given above 3 mcg/kg to avoid cardiovascular complications. However, some patients can develop extreme sensitivity to adrenaline in recommended dosage [8,9].

To avoid the cardiac complications associated with adrenaline, nasal decongestants for instance oxymetazoline, agonist of α1-AR can be used. The adrenaline linked cardiac toxicity can be managed by early diagnosis and treatment of adverse effects [10].

CONCLUSION

In conclusion, adrenaline is an effective vasoconstrictor and can be combined with local anaesthesia in nasal surgeries. High concentration of adrenaline (i.e., 4mg) used during septorhinoplasty is effective in reducing the blood loss as compared to the low concertation (i.e., 1 mg). However, precautions must be taken when using an excess dose. Other vasoconstrictor agents such as oxymetazoline can be used to the avoid risk associated with adrenaline. Intuitive and fast treatment approaches lead to low risk and significantly negligible mortality rates linked with adrenaline toxicity. The levels of haemodynamic variables should be assessed during the use of any vasopressor.

CONSENT

Informed consent was obtained from participants after explaining the study.

ETHICAL APPROVAL

As per university standard guideline, ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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