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Research Article

The Effect of Controlled Hypotensive Anesthesia on Postoperative Sore Throat

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Abstract

Aim: Postoperative sore throat (POST) is a commonly encountered and significant complication following anesthesia, which can adversely affect the quality of a patient's recovery. Many factors contribute to the development of POST. Controlled hypotension (CH) is a surgical technique used to reduce blood flow, improve visibility, and shorten procedure time by safely lowering blood pressure. In this study, we aimed to investigate the effects of CH on POST, coughing, hoarseness, and vomiting in patients undergoing surgery in a supine position with a fixed endotracheal cuff pressure.
Material and Method: A total of 124 patients, aged between 18 and 65 years, classified as American Society of Anesthesiologists (ASA) class I-II and scheduled for elective surgical procedures, were included in the study. The patients were divided into two groups: Group N (n=65), consisting of normotensive individuals, and Group H (n=59), which included patients subjected to CH. In both groups, the endotracheal cuff pressure was manually set to 25 cmH2O using a cuff pressure manometer. CH was achieved in Group H by administering glyceryl trinitrate (nitroglycerin) infusion, maintaining the mean arterial pressure (MAP) within the range of 55-65 mmHg. Patients were assessed for POST, coughing, hoarseness, and vomiting at postoperative 15 minutes, 2, 6, 12, and 24 hours.
Results: Demographic data, smoking status, ASA scores, surgical and anesthesia durations were similar between the groups. Statistically significant differences were observed between the groups in the numeric rate scores (NRS) for throat pain at 15 minutes and 2 hours, as well as hoarseness scores at 2 and 6 hours. The groups were similar regarding vomiting rates and cough scores.
Conclusion: In this study investigating the impact of CH on sore throat, we observed an increased incidence of POST and hoarseness in patients subjected to CH.

Keywords: Sore throat, intubation, hoarseness, controlled hypotension

INTRODUCTION

Postoperative sore throat (POST) is a commonly encountered and significant complication that often disrupts the quality of a patient's recovery following anesthesia. Airway devices such as endotracheal tubes (ETT) and laryngeal masks, which are used to maintain airway patency in patients undergoing general anesthesia, play a crucial role in the development of POST by affecting mucosal blood flow (1,2). The occurrence of POST after endotracheal intubation has been documented to be between 14.5% and 50%, while after laryngeal mask insertion, it ranges from 14.4% to 34% (3,4). Controlled hypotension (CH) is a technique applied during surgery to reduce blood flow within the surgical field, improve visibility and shorten the procedure duration, while safely lowering the patient's blood pressure to a level that does not compromise perfusion indices. It has been widely employed for many years in various surgical procedures, including otolaryngology, ophthalmology, neurosurgery, plastic and reconstructive surgery, among others (5,6).

Under anesthesia, the placement of devices required to maintain airway patency results in prolonged external pressure on the airway structures. When this pressure exceeds capillary-arteriolar blood pressure, it can lead to complications ranging from tissue ischemia, inflammation, ulcer development, granulation, and even stenosis. While the inflation of the cuffs of airway devices is the most significant factor contributing to this condition, it is also

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believed that hypotension may potentially contribute by reducing mucosal blood flow (7,8). However, while the relationship between endotracheal cuff pressure and sore throat under anesthesia is established the clinical impact of CH applied during surgery on this sore throat hasn't been definitively determined. In this study, our objective was to examine the hypothesis that CH administered during surgery affects the incidence of sore throat.

MATERIAL AND METHOD

This study was carried out on orthopedic patients scheduled for elective surgery in a supine position under general anesthesia in a university hospital, following approval from the Clinical Research Ethics Committee (Approval No: 17-KAEK-049). Patients were informed about the study prior to surgery, and written consent was acquired. A total of 150 patients aged between 18 and 65 years with an American Society of Anesthesiologists (ASA) score of I or II, who consented to participate in the study, were included. Patients who declined to participate, those with ASA scores of III-IV, a history of hypertension, use of antihypertensive, opioid, or steroid medications, preoperative sore throat, known anatomical abnormalities in the airway anatomy, requirements for intubation lasting more than 4 hours, tracheostomy, patients undergoing head-neck or laparoscopic surgery, and pregnant patients were omitted from the study. Patients who underwent multiple laryngoscopy procedures for intubation, those with procedures lasting more than 4 hours, those who developed complications during surgery, those who received steroids, and those who used another airway device for airway management were also excluded. After excluding 26 patients who did not meet the study criteria, the study was completed with 124 patients, who were randomly allocated to Group N (Normotensive) and Group H (Hypotensive) using a sealed envelope method.

After patients were positioned on the operating table and standard monitoring was initiated, preoxygenation was administered. Anesthesia induction for the patients was achieved with intravenous 2 mg/kg of propofol, 1 mcg/kg of fentanyl, and 0.6 mg/kg of rocuronium bromide. Following at least 2 minutes of ventilation with a mask, endotracheal intubation was performed by the same anesthetist using an appropriate endotracheal tube (ETT) (female: 7.0-7.5 mm cylindrical cuff, male: 8.0-8.5 mm cylindrical cuff). Anesthesia maintenance was provided with a flow of 2 liters/min of 50% oxygen, 50% air, and 1 MAC sevoflurane. Throughout the procedure, a moisture and bacteria filter (Altech® Bacterial/Viral Filter) was used between the expiratory limb and the ETT breathing circuit. The intubation duration and the intubation difficulty scale (IDS) scores were measured and documented during the intubation procedure.

Group N (Normotensive) (n: 75): After standard monitoring, patients underwent intubation with an appropriate ETT following anesthesia induction. The ETT cuff pressure was adjusted to 25 cmH2O using a standard cuff pressure gauge and was checked every 5 minutes. If there were any increases or decreases in cuff pressure, it was readjusted to 25 cmH2O.

Group H (Hypotensive) (n:75): After standard monitoring, patients underwent intubation with an appropriate ETT following anesthesia induction. The ETT cuff pressure was adjusted to 25 cmH2O using a standard cuff pressure gauge and was readjusted to 25 cmH2O if there were any changes in cuff pressure. CH was achieved by infusing a solution prepared by diluting glyceryl trinitrate (nitroglycerin) (TRINITY 10mg/10mL I.V infusion solution) with 40 ml of 0.9% sodium chloride to achieve a dose of 0.25-2 µg/kg/min, targeting a mean arterial pressure (MAP) within the range of 55-65 mmHg. If MAP fell below 55 mmHg, the drug infusion was temporarily stopped. In cases of persistent hypotension, intravenous ephedrine (5 mg) was administered in increasing doses. Bradycardia, defined as a heart rate <50 beats/min, was treated with intravenous atropine (0.5-1.0 mg), and the infusion of the drug was discontinued.

All patients received 0.05 mg/kg of morphine and 8 mg of ondansetron intravenously within the case. Following 0.02 mg/kg of atropine administration, decurarization was achieved by administering 0.04 mg/kg of neostigmine or 2 mg/kg of sugammadex.

After the completion of surgery, extubated patients were monitored in the recovery unit at 15 minutes and in the follow-up ward at 2, 6, 12, and 24. hours. If patients experienced pain, 1 mg/kg of tramadol and/or 1 g of intravenous paracetamol were administered.

Postoperative sore throat was assessed using the numeric rating scale (NRS), while vomiting was evaluated as present or absent. Coughing and hoarseness were assessed using 4-point verbal scales.

Cough Score:

0: No cough at all,

1: Mild; only occurred 1 or 2 times or in an annoying manner,

2: Moderate; 3 or 4 times,

3: Severe; 5 or more coughs.

Hoarseness Score:

0: Never present,

1: Mild; not present during conversation but previously experienced and resolved,

2: Moderate; hoarseness present during conversation that the patient can feel,

3: Severe; hoarseness present during conversation.

Statistical Analysis

In calculating the sample size, another study was used as a reference for our primary outcome, which is the

incidence of postoperative sore throat, and it was assumed that hypotensive anesthesia would increase this rate by 50%. Taking into consideration a power of 80% and a significance level of 5%, it was determined that 58 patients per group would be sufficient to detect this change. To account for potential data losses, a total of 150 patients were planned to be included in the study.

The normal distribution of the data was examined using the Kolmogorov-Smirnov test. Categorical data were presented as percentages, while quantitative data were presented as mean±standard deviation (SD) (minimum-maximum). For the comparison of categorical data, the Chi-square test and Fisher's exact test were used. The Mann-Whitney U test was employed to compare numerical data that did not follow a normal distribution, while the Student's t-test was used for numerical data that did follow a normal distribution. All data were analyzed using the Statistical Package for Social Sciences 20.0 (SPSS Inc. Chicago, IL) program. The threshold for statistical significance was set at $p<0.05$.

RESULTS

The study included a total of 150 patients. However, 12 patients could not achieve controlled hypotension with nitroglycerin, 4 patients had multiple laryngoscopy attempts, 8 patients had surgery durations of less than 60 minutes, and 2 patients received steroids, leading to their exclusion from the study. As a result, the study was completed with 124 patients. There were no statistically significant differences between the groups in terms of demographic data of the patients (Table 1).

Table 1. Comparison of demographic data

	Group N (n: 65)	Group H (n: 59)	p value
Age (years); mean±SD	38.89±13.98	36.08±12.80	0.247
Gender (F/M); n (%)	25/40 (38.5/61.5)	31/28 (52.5/47.5)	0.116
BMI (kg/m²); median (min-max)	27.00 (18.52-41.21)	26.95 (18.92-36.89)	0.584
ASA (1/2); n (%)	20/45 (30.8/69.2)	22/37 (37.3/62.7)	0.444
Smoking (yes/no)	28/37	20/39	0.295
Intubation duration (sec); median (min-max)	10.00 (5-15)	8.00 (5-15)	0.350
Mallampati (1/2); n (%)	24/41 (36.9/63.1)	20/39 (33.9/66.1)	0.725
IDS; median (min-max)	1 (0-3)	0 (0-3)	0.341
Anesthesia duration (min); median (min-max)	105.00 (60-240)	105.00 (75-240)	0.972
Paracetamol (gr); median (min-max)	2.00 (0-4)	2.00 (1-4)	0.221
Tramadol (mg); median (min-max)	200 (0-300)	200 (0-400)	0.618
Atropine-neostigmine/sugammadex; n (%)	31/34 (47.7/52.3)	21/38 (35.6/64.4)	0.173

IDS: intubatin difficulty scale, BMI: boddy mass index, SD: standard deviation

There was a statistically significant difference in favor of Group H in terms of throat pain NRS scores at 15 minutes and 2 hours between the groups (p=0.001, p=0.021, respectively).

There was no statistically significant difference between the groups regarding throat pain NRS scores at 6, 12, and 24 hours (p=0.050, p=0.177, p=0.107, respectively) (Table 2).

Table 2. NRS scores for throat pain in the groups

	Group N	Group H	p value
15. min. median (min-max)	0 (0-5)	2 (0-5)	0.001*
2. hr. median (min-max)	0 (0-5)	2 (0-6)	0.021*
6. hr. median (min-max)	0 (0-5)	1 (0-6)	0.050
12. hr. median (min-max)	0 (0-5)	0 (0-7)	0.177
24. hr. median (min-max)	0 (0-2)	0 (0-6)	0.107

*p<0.05

The scores for hoarseness at 2 and 6 hours between the groups showed a statistically significant difference in favor of Group H (p=0.049, p=0.005) (p<0.05).

There was no statistically significant difference in hoarseness scores between the groups at 15 minutes, 12 hours and 24 hours (p=0.398, p=0.071, p=0.017) (Table 3).

Table 3. Hoarseness scores between groups			
Median (min-max)	**Group N**	**Group H**	**p value**
15. min.	0 (0-2)	0 (0-2)	0.398
2. hr.	0 (0-2)	0 (0-3)	0.049*
6. hr.	0 (0-1)	0 (0-2)	0.005*
12. hr.	0 (0-1)	0 (0-2)	0.071
24. hr.	0 (0-0)	0 (0-2)	0.017
*p<0.05			

There was no statistically significant difference between the groups in terms of cough scores of patients at 15 minutes, 2, 6, and 12 hours (p=0.311, p=0.109, p=0.823, p=0.888, p=0.945).

The total number of patients who had vomiting at least once within 24 hours was similar between the groups (p=0.847).

DISCUSSION

In our study examining the effect of CH anesthesia on POST, we observed an increased incidence of POST and higher hoarseness scores.

POST is a significant side effect that affects the quality of postoperative recovery in patients undergoing general anesthesia. Studies have reported a high incidence of POST, ranging from 14.5% to 50% after endotracheal intubation and from 14.4% to 34% after the use of a laryngeal mask (3,4). The mechanism behind the development of POST is primarily associated with local trauma-induced inflammation, resulting in edema and congestion of the pharyngeal mucosa (9-11). While cuff pressure is considered one of the major factors contributing to POST, the impact of impaired mucosal blood flow on throat pain has not been clearly elucidated (12-16).

CH anesthesia is widely used in many surgical procedures, but it carries certain risks, especially when prolonged hypotension is applied. Prolonged hypotension can lead to organ damage, tissue perfusion disorders, cognitive changes due to cerebral hypoperfusion, myocardial ischemia due to decreased coronary circulation, and even conditions like postoperative oliguria or anuria in cases of reduced kidney blood flow. Extended periods of hypotension may result in hemiplegia, acute tubular necrosis, cerebral thrombosis, myocardial infarction, blindness, and even death. Therefore, while CH anesthesia is safely employed in many surgeries, its reliability is a subject of debate in some procedures (17,18). Recent studies have found an association between CH anesthesia and postoperative neurological deficits in arteriovenous malformation surgeries (19). To minimize complications, it is essential to carefully select patients for CH anesthesia, pay attention to the duration of hypotension, and closely monitor patients during and after the procedure.

Hypotension has adverse effects on cellular damage, ischemia, and tissue perfusion. In a study (20), induced hypotension in normotensive rats using L-arginine resulted in mild arteriolar obstruction in glomeruli and mild ischemic damage in tubular areas of kidney tissue. Another study (21) demonstrated that hypotension induced by isoflurane significantly caused neuronal damage in the hippocampal CA1 region. Severe hypotension can lead to neuronal endoplasmic reticulum stress and apoptosis (22). Prolonged hypotension due to trauma-related hemorrhage has been shown to significantly affect mitochondrial function, endoplasmic reticulum stress markers, and free iron levels (23). O'Meara et al. (24) reported a significantly higher percentage of iron-laden histiocytes in tracheobronchial secretions of patients who underwent CH, suggesting an association with decreased tissue perfusion. Although our study did not investigate cellular-level effects, we believe that CH may have increased the sensitivity of pharyngeal structures to the accepted safe levels of intracuff pressure. This could have led to more cellular ischemia, edema, and damage in this area, ultimately resulting in an increased incidence of sore throat and hoarseness.

To our most current knowledge, this is the first study to investigate the effect of CH on sore throat. However, our study has several limitations. First, the relatively small sample size, and second, the lack of confirmation of ETT cuff placement using fiberoptic visualization. The ETT tube was placed based on a standard size of 21 cm for females and 23 cm for males, and its position was verified by feeling the cuff at the suprasternal notch and listening to breath sounds in 5 quadrants.

CONCLUSION

In conclusion, we found that CH increased the incidence of POST and hoarseness. Anesthesiologists should prioritize patient monitoring, effectively regulate intraoperative cuff pressure, and develop strategies to reduce POST occurrence in patients undergoing CH anesthesia.

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