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Research Article

A COMPARATIVE STUDY TO DETERMINE THE EFFECTS OF VARIABLE CONCENTRATIONS AND DIFFERENT ROUTES OF ADMINISTRATION OF LIDOCAINE IN SUPPRESSING COUGH AND ON HEMODYNAMIC RESPONSE DURING EXTUBATION IN PEDIATRIC AGE GROUP: AN OBSERVATIONAL PROSPECTIVE STUDY

NIDHA HAFIZ[1], SUMEERA FAYAZ[2], SHOWKAT HUSSAIN TALI[3], SHEIKH IRSHAD[2], MALIK ZAFAR IQBAL[4]*

[1]Department of H&M. [2]Department of Anesthesiology, SKIMS, Srinagar, Jammu and Kashmir, India. [3]Department of Pediatrics, Government Medical College, Anantnag, Jammu and Kashmir, India. [4]Department of Anesthesiology, Government Medical College, Anantnag, Jammu and Kashmir, India. Email: drmalikzafar948@gmail.com

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ABSTRACT

Objectives: The objectives of this study were to compare the effects of different concentrations of lidocaine (2% endotracheal [ET] spray; 10% ET spray; and 2% intravenous [IV]) in suppressing cough and on hemodynamic response during extubation in pediatric age groups; an observational prospective study.

Methods: Ninety patients were enrolled for the study and divided into three groups. In Group A, patients were administered (1 mg/kg) of 2% lidocaine ET spray 5 min before extubation; in Group B, patients were administered (1 mg/kg) of 10% lidocaine ET spray 5 min before extubation; and in Group C patients were administered (1 mg/kg) 2% lidocaine IV 3 min before extubation. The three groups were compared for hemodynamic parameters, incidence of cough, breathing pattern, and need for continuous positive airway pressure (CPAP).

Results: There was significant attenuation of hemodynamic parameters and less incidence of cough and labored breathing in patient receiving either 10% ET or 2% IV lidocaine. As compared to 2% ET lidocaine, requirement of CPAP support was less in patients who received 10% lidocaine. Patients who were administered 2% IV lidocaine did not receive any CPAP support postextubation.

Conclusion: As compared to 2% lidocaine spray postextubation, both 10% lidocaine spray and 2% IV lidocaine postextubation have significantly positive effect on suppression of cough and on hemodynamic parameters.

Keywords: Lidocaine, Extubation, Endotracheal spray, IV lidocaine.

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INTRODUCTION

The appropriate time to remove an endotracheal (ET) tube is part of the art of anesthesia that develops with experience. Both intubation and extubation are associated with rise in heart rate and blood pressure, yet often, there has been less emphasis on avoiding hemodynamic changes at extubation. These cardiovascular changes occur due to release of catecholamines at extubation, in addition to pain from the surgical site and irritation of the tracheal mucosa by the ET tube. All these complications and hemodynamic changes are undesirable. Coughing during emergence from anesthesia even though is a protective physiological effect, causes significant patient discomfort that leads to hemodynamic alterations. The mechanism of cough is presumed to be an irritant or stretch stimuli in the trachea caused by the ET tube and its cuff. Coughing and the hemodynamic response at extubation can result in potentially dangerous patient movements, hypertension, tachycardia, or other arrhythmias, myocardial ischemia, surgical bleeding, bronchospasm, and increase in intracranial pressure and intraocular pressure [1-4].

Awakening and extubation after anesthesia are associated with hemodynamic arousal lasting 10–25 min, partially mediated by elevations in catecholamine levels and partially by nociceptive stimuli. Thus, both anti-sympathetic (beta-blockers) and antinociceptive (narcotics and lignocaine) treatment strategies are appropriate to decrease extubation response [4,5]. The response may be attenuated by pharmacological interventions including: Esmolol (1.5 mg/kg i.v. 2–5 min before extubation), glyceryl trinitrate, magnesium, propofol infusion, remifentanil/alfentanil infusion, i.v. lidocaine (1 mg/kg over 2 min), topical lidocaine 10%, and perioperative oral nimodipine with labetalol. Alternatively, tracheal intubation can be converted to a laryngeal mask before extubation. Each method has its advantages and disadvantages [6].

The use of lignocaine for attenuation of extubation has been widely practiced. Lignocaine has long been used to modulate the unwanted airway and circulatory reflexes seen in response to emergence and extubation. The administration of lignocaine has been through several routes such as intravenous (IV) injection, ET cuff, or intratracheal (IT) instillation [7].

This study was designed to compare the effects of different concentrations of lidocaine (2% ET spray; 10% ET spray; and 2% IV) in suppressing cough and on hemodynamic response during extubation in pediatric age groups.

METHODS

This prospective and observational study was conducted in the Postgraduate Department of Anesthesiology and Critical Care, SKIMS, Srinagar from 2019 to 2021, after approval by the Institutional Ethical Committee. The study was conducted on 90 patients divided into three groups of 30 patients each.

Inclusion criteria

Children of either sex, aged 2–18 years having ASA physical status I and II were included in the study.

Table 1: Comparison of different groups in terms of age, weight, and duration of surgery

n (30)	Age (years)				Weight (kg)				Duration of surgery (minutes)			
Group	Mean	SD	Range	p-value	Mean	SD	Range	p-value	Mean	SD	Range	p-value
A	7.2	4.36	2.17	0.9	27.8	11.4	12.5	0.9	106.2	30.8	60.1	0.8
B	7.1	4.37	2.17		27.3	11	11.5		105.7	26.6	65.1	
C	6.3	4.09	2.16		26.6	12.4	12.4		102.2	25.7	60.1	

Exclusion criteria

Anticipated difficulty in tracheal intubation, resistance during intubation, hepatic, cardiac or neuromuscular disease, hypersensitivity reaction to lidocaine, asthma, or other respiratory diseases were exclude from the study.

The patients were visited on the evening before the surgery and the study was explained in detail to the patients/guardians. Written informed consent was taken. Anesthesia was induced with propofol (1–2 mg/kg), fentanyl (2 µg/kg), atracurium (0.5 mg/kg), sevoflurane, and oxygen. Patients were intubated with appropriate ET tube by an experienced anesthesiologist. Anesthesia was maintained with oxygen (50%), nitrous oxide (50%), is oflurane, and muscle relaxation, using mechanical ventilation. Minute ventilation and respiratory rate were adjusted to maintain the end expiratory carbon dioxide tension at 30–40 mmHg and airway pressure at 15–20 cm H2O. After completing surgery, the oropharynx was gently suctioned. 5 min before extubation, drugs corresponding to Group A (2% lidocaine ET spray) and Group B (10% of lidocaine ET spray) were sprayed through ET tube using mucous membrane sprayer, whereas 3 min before extubation, drugs corresponding to Group C (2% lidocaine IV) were given intravenously. Isoflurane and nitrous oxide (N2O) were discontinued and manual ventilation was applied with 100% oxygen. After the spontaneous respiratory efforts resumed, neuromuscular blockade was reversed with neostigmine (60 µg/kg) and glycopyrrolate (10 µg/kg). Extubation was done after patients resumed regular spontaneous respiration and followed verbal commands. Various parameters were measured after extubation at regular intervals including hemodynamics, oxygen saturation, breathing pattern, cough reflex, and requirement of PEEP with mask ventilation.

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences version 21 for Windows 11.0. The data were presented using descriptive statistics such as mean and standard deviation for continuous variables and frequency and percentage for categorical variables. Association between categorical variables was assessed using Chi-square tests with Yates continuity correction. Comparison of continuous outcomes among groups was performed by Analyses of Variance. Continuous outcomes that are not normally distributed or ordered observations are analyzed using Kruskal–Wallis test. $p<0.05$ was considered statistically significant.

RESULTS

Average age and weight of study population and duration of surgery is shown in Table 1. The three groups were comparable with regarding to the age, weight, sex distribution, and duration of surgery.

Postextubation comparison of variation in heart rate in in three groups is depicted in Table 2. In Table 3, intergroup comparison has been depicted. Heart rate was found to be higher in Group A and least in Group C postextubation at 1 min, 3 min, and 5-min time intervals which were found to be statistically significant. However, there was no statistically significant difference between Group A and Group B at any point of time in intergroup comparison.

Table 4 depicts incidence of cough in three groups at various intervals of time for duration of 10 min postextubation. Group A had maximum number of patient having cough, while Group C has the least number of such patients and the difference was found to be statistically significant. In intragroup comparison, there was no significant difference between Group A and Group B at any time interval postextubation.

Table 2: Comparison based on heart rate (beats/min) in three groups at various intervals of time

Time interval	Group A		Group B		Group C		p-value
	Mean	SD	Mean	SD	Mean	SD	
Baseline	101.73	11.44	101.80	9.42	102.43	10.60	0.961
1 min	115.37	9.64	112.50	10.73	106.13	9.72	<0.001*
3 min	113.67	9.11	109.30	9.62	104.07	8.83	<0.001*
5 min	110.50	10.09	107.87	8.62	103.13	8.79	0.039*
10 min	104.83	11.29	103.17	11.63	101.80	9.75	0.619

Table 3: Intergroup comparison based on heart rate (beats/min) at various intervals of time

Time interval	p-value		
	A versus B	A versus C	B versus C
Baseline	0.978	0.799	0.821
1 min	0.281	<0.001*	0.019
3 min	0.076	<0.001*	0.32
5 min	0.282	0.002	0.039
10 min	0.577	0.275	0.623

Table 4: Incidence of cough in three groups at various intervals of time

Time interval	Group A		Group B		Group C		p-value
	No.	%age	No.	%age	No.	%age	
1 min	11	36.7	8	26.7	2	6.7	0.021*
3 min	8	26.7	6	20.0	1	3.3	0.044*
5 min	7	23.3	4	13.3	0	0.0	0.022*
10 min	3	10.0	2	6.7	0	0.0	0.227

Table 5 depicts the intergroup comparison of breathing at different time points. The difference is statistically significantly between Groups B and C at 1 min and 3 min of time. The difference is statistically significant between Groups A and C at 1 min, 3 min, and 5 min of time. There is no statistically significant difference between Groups A and B.

Table 6 depicts the requirement of continuous positive airway pressure (CPAP) in three groups at various intervals of time. In Group A, four patients needed CPAP at 1 min and 1 patient at 3 min postextubation, while as in Group B, one patient needed CPAP at 1 min postextubation and no patients required CPAP in Group C. The difference was not statistically significant between the three groups.

DISCUSSION

The use of lidocaine has been widely practiced for attenuation of extubation. Lidocaine has long been used to modulate the unwanted airway and circulatory reflexes seen in response to emergence and extubation. The administration of lidocaine has been through several routes such as IV injection, ET cuff, or IT instillation. In this study, we have compared the efficacy of lidocaine administered through the ET tube to lidocaine administered intravenously, in suppressing the extubation response as smooth extubation at the end of surgery is vital for a good outcome [8].

Table 5: Breathing pattern in three groups at various intervals of time

Time interval	Breathing pattern	Group A		Group B		Group C		p-value
		No.	%age	No.	%age	No.	%age	
1 min	Normal	21	70.0	23	76.7	29	96.7	0.023*
	Labored	9	30.0	7	23.3	1	3.3	
3 min	Normal	23	76.7	25	83.3	30	100	0.024*
	Labored	7	23.3	5	16.7	0	0.0	
5 min	Normal	24	80.0	27	90.0	30	100	0.036*
	Labored	6	20.0	3	10.0	0	0.0	
10 min	Normal	27	90.0	29	96.7	30	100	0.161
	Labored	3	10.0	1	3.3	0	0.0	

Table 6: Requirement of peep CPAP in three groups at various intervals of time

Time interval	Group A		Group B		Group C		p-value
	No.	%age	No.	%age	No.	%age	
1 min	4	13.3	1	3.3	0	0.0	0.063
3 min	1	3.3	0	0.0	0	0.0	0.364
5 min	0	0.0	0	0.0	0	0.0	-
10 min	0	0.0	0	0.0	0	0.0	-

Coughing during emergence from general anesthesia is a physiological response to tracheal extubation which can result in potentially dangerous patient movements, hypertension, tachycardia, or other arrhythmias, surgical bleeding and bronchospasm, which is very detrimental. Lidocaine blood levels of 3–6 μg/mL are known to potentiate the effects of nitrous oxide anesthesia in humans [9].

In our study, there was a statistically significant difference between heart rate at 1 min and 3 min postextubation among three groups ($p<0.05$). The difference was statistically significant between Group A and Group C at 1 min, 3 min and 5 min postextubation ($p<0.05$). The results are in concordance with the other studies [10,11]. Similar to our study, Qureshi [12] and Manjunath and Ravi [13] reported that 10% lignocaine spray was a simple and probably one of the most effective methods in attenuating hemodynamic response to laryngoscopy and extubation.

There was no statistically significant difference between the oxygen concentration of two groups at different intervals of time. The results are in concordance with the other researchers [14,15].

In our study, there was statistically significant difference in the incidence of cough at 1 min, 3 min and 5 min postextubation between the three groups. The Group A has maximum incidence of cough at all the intervals of time. The difference was statistically significant between Group B and Group C at 1 min and 3 min postextubation. The difference was statistically significant between Group A and C at 1 min, 3 min, and 5 min. The results are in concordance with the studies of other researchers [16,17].

The requirement of CPAP postextubation was found to be statistically insignificant ($p>0.05$) between three Groups. In Group A, four patients required CPAP at 1 min and one patient required CPAP at 3 min postextubation, while as in Group B, one patient required PEEP at 1 min postextubation and no patient required PEEP in Group C.

CONCLUSION

As compared to 2% lidocaine spray postextubation, both 10% lidocaine spray and 2% IV lidocaine postextubation have significantly positive effect on suppression of cough and on hemodynamic parameters.

ETHICAL CLEARANCE

Obtained.

CONFLICTS OF INTEREST

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