Section: Anesthesia

Original Research Article

ASSESSING THE EFFICACY OF ENDOTRACHEAL TUBE CUFF LIGNOCAINE IN PREVENTING POST-EXTUBATION COUGH IN CHILD SUBJECTS UNDERGOING ELECTIVE SURGERIES

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ABSTRACT

Background: Airway complications are more common in child subjects compared to adults following extubation. IV (intravenous) lignocaine is efficacious in preventing the response to extubation. However, existing literature data is scarce concerning the use of intracuff lignocaine in micro-cuff endotracheal tubes. **Aim:** The present study aimed to comparatively assess the incidence of cough post-extubation in intracuff air and intracuff lignocaine in pediatric subjects during tracheal extubation. The study was conducted in our institute within a time frame of last 2 years.

Materials and Methods: The study assessed 240 subjects aged 5-12 years who were undergoing surgeries under general anesthesia. They were randomly divided into two groups of 120 subjects each where Group I subjects were given intracuff air and Group II subjects intracuff 2% lignocaine. Following general anesthesia, the airway was secured with age-appropriate microcuff endotracheal tube. This was followed by cuff inflation with air/lignocaine based on the group to reach a cuff pressure of 10cm H2O. In both groups, the incidence of hemodynamic changes, apnea, laryngospasm, desaturation, and cough was assessed following extubation.

Results: The study results showed that post-extubation cough incidence was significantly higher in Group I with our inflation compared to Group II where 2% intracuff lignocaine was used with p=0.03. Two subjects from the air Group (Group I) had laryngospasm compared to no subject depicting laryngospasm from the lignocaine group. In Group I, a significant increase in the heart rate was seen at all times from 1-5 minutes following extubation from baseline, and it was significantly higher compared to the lignocaine group with $p<0.05$.

Conclusion: The present study concludes that post-extubation cough incidence is significantly lower with the use of intracuff lignocaine compared to the use of intracuff air in child subjects undergoing elective surgeries.

Keywords: cuff inflation, pediatric subjects, air inflation, laryngospasm lignocaine inflation, post-extubation.

INTRODUCTION

The pediatric population is at higher risk of developing airway complications following extubation including cough, desaturation, and/or laryngospasm compared to the adult subjects which can be attributed to the hyperreactive airway reflexes and the anatomical variations in children and adults. Cough can lead to a transient rise in the airway pressure which can further lead to an increase in intraocular and intracranial pressures along with an increase in the risk of bleeding from friable surgical sites.[1]

Along with the various pharmacological means used as low-dose propofol, esmolol, and opioids to decrease the adverse post-extubation responses, various other techniques have also been used to reduce the extubation response including the supraglottic airway device replacing the ETT (endotracheal tube) and extubation under deep anesthesia.[2]

IV (intravenous) lignocaine is a widely used agent to prevent the responses of extubation and intubation in adult subjects. Endotracheal tube cuff inflation using lignocaine can allow enough diffusion across the tracheal mucosa to limit the cough response after extubation. However, existing literature data is scarce concerning the use of intracuff lignocaine in micro cuff endotracheal tubes to decrease the incidence of adverse effects post-extubation in pediatric subjects.[1,2]

The present study aimed to assess the efficacy of intracuff lignocaine use for the prevention of hemodynamic responses and cough in child subjects undergoing elective surgery under general anesthesia. The primary study objective was the comparison of post-extubation cough incidence between endotracheal cuff air and endotracheal cuff lignocaine in pediatric subjects during extubation. The study also compared the incidence of hemodynamic response, apnea, desaturation, and laryngospasm in the two study groups.

MATERIALS AND METHODS

The present study aimed to comparatively assess the incidence of cough post-extubation in intracuff air and intracuff lignocaine in pediatric subjects during tracheal extubation. The study was done at Dr. NY Tasgaonkar Institute of Medical Sciences, Karjat, Raigad, Maharashtra after the clearance was given by the concerned Institutional Ethical committee. The study subjects were from the Department of Pediatric Surgery of the Institute. Verbal and written informed consent were taken from all the subjects before study participation.

The present study included pediatric subjects who were undergoing elective surgeries at the institute under general anesthesia and needed an endotracheal tube for administration of general anesthesia. The exclusion criteria for the study were subjects undergoing airway, head and neck, neuro, and cardiac surgeries, allergic to local anesthesia, history of tracheal or laryngeal surgery, congenital heart disease, bronchial asthma, and active upper respiratory tract infections.

All the subjects were comprehensively evaluated by the anesthesiologists one day before surgery. Nil per oral instructions were given following Institution protocol along with age-appropriate medications. Subjects were transferred to the operating room monitoring was done with non-invasive blood pressure, pulse oximeter, and electrocardiogram recordings assessment at baseline. Based on the choice of anesthesiologist, induction anesthesia was done with either IV sevoflurane or propofol in 100% oxygen.

After administration of 0.5mg/kg atracurium or 0.1 mg/kg IV vecuronium, endotracheal intubation was done with an age-appropriate microcuff tube by an anesthesiologist expert in the field. Insertion depth was assessed following confirming the correct tracheal placement of the endotracheal tube. Subjects who needed multiple attempts for tracheal intubation more than 2 or had tracheal intubation that was traumatic were excluded from the study. All subjects were given 1 µg/kg IV fentanyl as an analgesic.

They were randomly divided into two groups of 120 subjects each where Group I subjects were given intracuff air and Group II subjects intracuff 2% lignocaine. Following general anesthesia, the airway was secured with age-appropriate microcuff endotracheal tube. Initially, micro cuff in both groups were inflated with air as incremental air volume. A manometer was used to measure the cuff pressure. Air volume needed to cuff pressure of 10 cm H2O and to eliminate leak around cuff was taken as the desired volume. Micro cuff deflation and reinflation were done in Group II with an equal volume of 2% lignocaine solution. Anesthesia maintenance was done using 2% sevoflurane in oxygen and air mixture as a fraction of inspired oxygen 35%–40% using fresh gas flow at a rate of 2L/ min via a closed circuit. Tidal volume of 6-8ml/kg was maintained and adjustment was made in respiratory rate to maintain end-tidal CO2 in 32-34 mmHg.

At the surgery end, in Group II, cuff pressure was assessed and a difference was noted from the baseline values. The micro cuff was reinflated with air for restoration of cuff pressure to baseline and the volume was recorded. The residual neuromuscular blockade antagonist used was 0.01 mg/kg of glycopyrrolate and 0.05 mg/kg of neostigmine. Tracheal extubation was done after adequate residual neuromuscular blockade reversal which was confirmed by the anesthesiologist.

Following tracheal extubation, parameters were assessed for 5 minutes in both groups including blood pressure and heart rate at every minute, apnea is taken as cessation of breathing for more than 20 s, laryngospasm (graded according to the 4-point scale of Tsui BCH et al3 Grade 0 = no laryngospasm, Grade 1 = stridor during laryngospasm, Grade 2 = complete closure of vocal cords, Grade 3 = cyanosis, oxygen desaturation SpO2 <95% for more than 30 s, and cough as two or more episodes of violent coughing or a SpO2 value that fell below 95% during the cough episode. Subjects with hemodynamic disturbances, apnea, laryngospasm, and desaturation were managed following the discretion of the attending anesthesiologists.

The data gathered were analyzed statistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY,

USA) for assessment of descriptive measures, one-way ANOVA (analysis of variance), Pearson correlation, and chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered statistically significant.

RESULTS

The primary study objective was the comparison of post-extubation cough incidence between endotracheal cuff air and endotracheal cuff lignocaine in pediatric subjects during extubation. The study also compared the incidence of hemodynamic response, apnea, desaturation, and laryngospasm in the two study groups. The study assessed 240 subjects aged 5-12 years who were undergoing surgeries under general anesthesia. They were randomly divided into two groups of 120 subjects each where Group I subjects were given intracuff air and Group II subjects intracuff 2% lignocaine. All the parameters at baseline in the two study groups were statistically comparable. The mean age of the study subjects in Group I and II was 64 (25-118) and 58 (22-112) months, mean height was 102 (82.3-129) and 99 (83.3-122) cm, and weight was 15 (10-28.1) and 15.1 (11-22.3) respectively. The mean cough ETT dimension was 3-3.5mm was 0.5 (0.3-0.5) and 0.5 (0.5-0.5), in 4-4.5mm in 1(0.6-1.0) and 1 (0.5-1.0), and 5-5.5mm in 1.5 (1.2-2.0) and 1.3 (1.0-1.6) in Groups I and II. [Table 1]

The success rate in the first attempt was 90% and 87% in lignocaine and air groups respectively which was statistically comparable with p=0.82. No subject needed more than two attempts for intubation. Two groups were also comparable concerning the surgery duration with a mean duration of 142.3 (118-213) and 156.3 (102.3-262.3) minutes respectively. Time from cuff inflation to extubation and time from the last muscle relaxant to extubation were also statistically comparable in the two groups.

Post-extubation cough incidence was significantly higher in Group I with 28.3% (n=34) subjects in comparison to 13.3% (n=16) subjects from Group II (lignocaine) with p=0.03. The incidence of desaturation and laryngospasm was comparable in the two study groups. In Group II, the volume of lignocaine/air needed for restoration of cuff pressure to baseline 10cm H2) in different micro cuff size endotracheal tubes was 0.1ml (0-0.3). No subject in Group I (air) had a fall in intracuff pressure.

In Group I (air), a significant increase was seen in heart rate at all the assessment time from 1 to 5 minutes after extubation from baseline which was significantly higher in comparison to Group II (lignocaine) at all the assessment time with p<0.05. However, this increase in MAP (mean arterial pressure) was statistically comparable in Group I and II with p>0.05. Heart rate showed no significant increase following extubation in Group II compared to Group I.

It was seen that for subgroup assessment of Group II subjects so assess the relationship of end operative cuff pressure to surgery duration and cough occurrence. For surgery duration of >12 minutes, it was seen in 85.71% (n=60) study subjects from End-operative cuff pressure <10 cm H2O compared to 40% (n=20) subjects from End-operative cuff pressure =10 cm H2O which was significantly higher in End-operative cuff pressure <10 cm H2O with p<0.001. Cough occurrence was 5.7% (n=4) in End-operative cuff pressure <10 cm H2O which was significantly lesser compared to 24% (n=12) subjects from End-operative cuff pressure=10 cm H2O with p=0.03. [Table 2]

Table 1: Demographic and disease data in study subjects

S. No	Characteristics	Group I (n=120)	Group II (n=120)
1.	**Mean age (months)**	64 (25-118)	58 (22-112)
2.	**Mean height (cm)**	102 (82.3-129)	99 (83.3-122)
3.	**Mean weight (kg)**	15 (10-28.1)	15.1 (11-22.3)
4.	**Micro cuff ETT (mm)**		
a)	3-3.5	0.5 (0.3-0.5)	0.5 (0.5-0.5)
b)	4-4.5	1(0.6-1.0)	1 (0.5-1.0)
c)	5-5.5	1 (1.0-2.0)	1 (0.6-1.1)
d)	6-6.5	1.5 (1.2-2.0)	1.3 (1.0-1.6)

Table 2: Subgroup assessment of Group II subjects to assess the relationship of end-operative cuff pressure to surgery duration and cough occurrence

S. No	Parameters	End-operative cuff pressure <10 cm H2O (n=70)	End-operative cuff pressure=10 cm H2O (n=50)	p-value
1.	**Surgery duration >120 minutes**	60 (85.71%)	20 (40%)	**<0.001**
	95% CI	68.21-96.50	27.74-56.36	
2.	**Cough occurrence**	4 (5.7%)	12 (24%)	**0.03**
	95% CI	1.40-12.62	14.54-40.20	

DISCUSSIONS

The present study assessed 240 subjects aged 5-12 years who were undergoing surgeries under general anesthesia. They were randomly divided into two groups of 120 subjects each where Group I subjects were given intracuff air and Group II subjects intracuff 2% lignocaine. All the parameters at baseline in the two study groups were statistically comparable. The mean age of the study subjects in Group I and II was 64 (25-118) and 58 (22-112) months, mean height was 102 (82.3-129) and 99 (83.3-122) cm, and weight was 15 (10-28.1) and 15.1 (11-22.3) respectively. The mean cough ETT dimension was 3-3.5mm was 0.5 (0.3-0.5) and 0.5 (0.5-0.5), in 4-4.5mm in 1(0.6-1.0) and 1 (0.5-1.0), and 5-5.5mm in 1.5 (1.2-2.0) and 1.3 (1.0-1.6) in Groups I and II. These data were in line with the previous studies of Tsui BCH et al4 in 2004 and Egbuta C5 in 2022 where authors assessed subjects with demographic data comparable to the present study.

The study results showed that for the success rate in the first attempt was 90% and 87% in lignocaine and air groups respectively which was statistically comparable with p=0.82. No subject needed more than two attempts for intubation. Two groups were also comparable concerning the surgery duration with a mean duration of 142.3 (118-213) and 156.3 (102.3-262.3) minutes respectively. Time from cuff inflation to extubation and time from the last muscle relaxant to extubation were also statistically comparable in the two groups. These results were consistent with the findings of Thakore S et al,[6] in 2021 and Assefa B et al,[7] in 2022 where surgery, duration, and attempts seen in the results of the present study were comparable to the results of the mentioned studies.

It was seen that post-extubation cough incidence was significantly higher in Group I with 28.3% (n=34) subjects in comparison to 13.3% (n=16) subjects from Group II (lignocaine) with p=0.03. The incidence of desaturation and laryngospasm was comparable in the two study groups. In Group II, the volume of lignocaine/air needed for restoration of cuff pressure to baseline 10cm H2) in different micro cuff size endotracheal tubes was 0.1ml (0-0.3). No subject in Group I (air) had a fall in intracuff pressure. These findings were in agreement with the results of Wetzel LE et al,[8] in 2008 and Mhamane R et al,[9] in 2015 where post-extubation, cough, desaturation, and laryngospasm reported by the authors in their respective studies were comparable to the present study.

The study also showed that in Group I (air), a significant increase was seen in heart rate at all the assessment times from 1 to 5 minutes after extubation from baseline which was significantly higher in comparison to Group II (lignocaine) at all the assessment time with p<0.05. However, this increase in MAP (mean arterial pressure) was statistically comparable in Group I and II with p>0.05. Heart rate showed no significant increase following extubation in Group II compared to Group I. These results were in line with the studies of Nigussie E et al,[10] in 2021 and Hirota W et al,[11] in 2000 where a significant increase was seen in heart rate at all the assessment times from 1 to 5 minutes after extubation from baseline which was significantly higher in comparison to lignocaine compared to air use similar to the present study was reported by the authors in their respective studies.

Concerning the subgroup assessment of Group II subjects so assess the relationship of end-operative cuff pressure to surgery duration and cough occurrence. For surgery duration of >12 minutes, it was seen in 85.71% (n=60) study subjects from End-operative cuff pressure <10 cm H2O compared to 40% (n=20) subjects from End-operative cuff pressure =10 cm H2O which was significantly higher in End-operative cuff pressure <10 cm H2O with p<0.001. Cough occurrence was 5.7% (n=4) in End-operative cuff pressure <10 cm H2O which was significantly lesser compared to 24% (n=12) subjects from End-operative cuff pressure=10 cm H2O with p=0.03. These findings were in line with the results of Fagan C et al,[12] in 2000 and Soares SMF et al,[13] in 2017 where the relationship of end-operative cuff pressure to surgery duration and cough occurrence results reported by the authors in their studies were comparable to the results of the present study.

CONCLUSION

Considering its limitations, the present study concludes that post-extubation cough incidence is significantly lower with the use of intracuff lignocaine compared to the use of intracuff air in child subjects undergoing elective surgeries. In the future, further multi-institutional studies in larger child populations from different geographical backgrounds can help reach definitive conclusions.

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