European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 06, 2022

Original Research Article

A prospective randomized trial on alkalinized lignocaine preloaded endotracheal tube cuffs to reduce emergence cough following brief surgery

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Abstract

Background and Objectives: Endotracheal intubation is required during general anaesthesia to secure the airway. Presumed mechanisms for emergence cough include irritant or stretching sensations in the trachea brought on by the tube or its cuff. Cough during emergence results in Hypertension, tachycardia, raised Intracranial pressure and intraocular pressure, bronchospasm, wound dehiscence, and surgical bleeding. Our goal is to determine whether alkalinized lignocaine preloaded endotracheal tube cuffs are effective at reducing emergence cough following minor surgery.

Methods: After receiving approval from the institutional ethics committee, this prospective randomised controlled study was carried out on ASA grade I and II patients between the ages of 20 and 50 who were scheduled for a variety of short-duration surgeries under general anaesthesia at Mamata General Hospital for a period of one year. Total of 100 patients, are divided into two groups, Group AL, Group S (50 patients in each Group). Group AL: (study group) these patients received preloaded (alkalinised lignocaine in ET cuff 90 min before intubation) 2% alkalinised lignocaine in the ET cuff, volume decided by minimum occlusion volume technique. Group S: (control group): these patients received normal saline in ET cuff after intubation.

Results: Patients in AL Group had mild cough in 12% of the population, while Patients in S group had mild cough in 14%, moderate cough in 10% and severe cough in 4% of the group population. Emergence cough is significantly less in AL group compared to S Group (p=0.39).

Conclusion: Alkalinized lidocaine in ETTs preloaded with the same solution before surgery appears to significantly lower the incidence of emergence cough during short surgical procedures. Also reduces emergence agitation and provides hemodynamic stability during extubation by avoiding the pressor response.

Keywords: Emergence cough, alkalinized lignocaine, preloaded ET cuff

Introduction

Tracheal intubation with an endotracheal tube is necessary during general anaesthesia. After intubation, inflating a cuff around the endotracheal tube maintains a seal. Irritant or stretch stimuli in trachea caused by tube and its cuff are presumed mechanisms in inducing emergence cough. Smooth emergence from anaesthesia has long been seen as a method of preventing potential respiratory and hemodynamic instability [1, 2]. Smooth emergence from General anaesthesia is frequently complicated by coughing induced by stimuli from ET tube cuff. Coughing during emergence result in Hypertension, tachycardia, increased intraocular pressures, raised Intra cranial pressure, Myocardial infarction, bronchospasm, wound dehiscence [1-5]. Multiple techniques such as deep extubation [1], administration of intravenous opioids before extubation [6], the "no touch emergence" technique [7] and most recently

ISSN 2515-8260 Volume 09, Issue 06, 2022

alkalinized lidocaine in the ETT cuff [8]. Have been described as effective in reducing the cough and cardiovascular response associated with the ETT during emergence. The nociceptive stimuli in trachea caused by cuff can be blocked by topically applied anaesthetics. Multiple techniques such as deep extubation, administration of intravenous opioids before extubation and most recently instilling lignocaine in the ET cuff has been described effective in reducing cough and cardiovascular response associated with ETT during emergence. The use of the ETT cuff as a reservoir for lignocaine to provide local anaesthesia at points of contact with the trachea was first described in 1990. Since then, studies have shown that adding bicarbonate to lignocaine drastically increases its diffusion across the polyvinyl chloride (PVC) cuff membrane and decreases the incidence of cough on emergence after surgery lasting more than 2 hrs [12, 13]. The reduction of emergence cough in surgeries lasting < 2hr is also desirable. A small series suggested that alkalinized lidocaine might be effective for cough reduction during shorter procedures [8]. Conversely, in vitro data suggest that 30-180 minutes are necessary for alkalinized lidocaine to diffuse across the PVC cuff material [10, 11, 14, 15]. In our study, we want to evaluate the efficacy of preloaded alkalinised lignocaine in reducing emergence cough in surgeries of short duration.

Materials and Methods

The present study was done in Mamata Medical College and Hospital, Khammam, from January 2021 to February 2022 on 100 ASA-1 and ASA-2 patients scheduled for elective surgeries under general anaesthesia after getting approval by the institutional ethical committee and written informed consent from the patients. It was a Randomized prospective study done by lottery method. Patients aged between 20 and 50 years, scheduled for different surgeries for short duration under general anaesthesia were included in this study. Patients who were excluded from the study were Patients who refused to consent, patients with asthma, COPD, respiratory tract infections, patients using preoperative cough suppressants, Patients with anticipated difficult intubation, altered sensorium, documented history of allergy to lignocaine, surgeries on airway. Pre-anaesthetic check-up was carried out preoperatively with a detailed history, general physical examination and systemic examination. Airway assessment was done. Routine investigations were done. Preoperatively, Nil per oral status was confirmed-8 hours. They were premedicated with Tab. Alprazolam 0.5mg on the night before surgery. 100mins Preoperatively, ET cuff was inflated with 2% alkalinised lignocaine (9ml of 2% lignocaine and 1 ml of 8.4% sodium bicarbonate). Age and weight were recorded before shifting the patients to Operation Theatre. Anaesthetic Monitors-Non-invasive BP, Pulse Oximeter and Electrocardiogram were connected and IV access was established with 18 gauge I.V cannula. Baseline values-pulse rate, blood pressure, saturation-SPO2 were noted and patients in both groups were premedicated with inj. Glycopyrrolate 5 mcg/kg, inj. Midazolam .05mg/kg, inj. Ondansetron 0.15mg/kg and inj. Fentanyl 1mcg/kg. Patients were induced with Inj. Propofol 1.5-2.5 mg/kg I.V and intubated after giving inj. Vecuronium 0.12 mg/kg using appropriately sized ET tube. For Group AL: ET cuff was inflated with 2% alkalinised lignocaine (9 ml of 2% lignocaine and 1 ml 7.5% W/V sodium bicarbonate) by minimum occlusion volume technique. The cuff is inflated slowly to prevent damage to tracheal mucosa or cuff rupture. Group S: ET cuff was inflated with normal saline by minimum occlusion volume technique. Maintenance was done with O_2 + N_2O and inj. Dexmedetomidine. Neuromuscular blockade was continued with vecuronium. At the end of surgery, neuromuscular blockade was antagonised with neostigmine and glycopyrrolate. No ET cuff perforations were noted, no airway trauma and laryngospasm noted.

Results

Demographic data were analyzed by using Student's t-test. The incidence of coughing was compared by using the one tailed fisher exact test. Continuous data are presented as means ± SD. P value < 0.05 was statistically significant.

ISSN 2515-8260 Volume 09, Issue 06, 2022

Table 1: This table represents the demographic data of this study

Parameter	Group AL	Group S	P Value
Age	34 (± 8)	35 (± 8)	0.80
Weight (in Kg)	67 (± 7)	68 (± 8)	0.85
Duration of Surgery (min)	91 (±17)	93 (±17)	0.69
Preloading time (min)	100 (± 13)	101 (± 14)	0.56
Volume of Cuff (ml)	6 (± 1)	7 (± 1)	0.32

Table 2: This table shows the presence of emergence cough in Alkalinised lignocaine and Normal saline groups

	Cough	No Cough
Alkalinized Lignocaine	6 (12%)	44
Normal Saline	14 (28%)	36

Table 3: Three category scale for assessing cough on emergence

Mild	Single episode of cough
Moderate	More than 1 episode of unsustained cough for < 5 sec
Severe	Sustained cough for > 5 sec

Table 4: Severity of cough

	Alkalinised Lignocaine Group	Normal Saline Group
Mild	6 (12%)	7 (14%)
Moderate	-	5 (10%)
Severe	-	2 (4%)

Discussion

The present study, using a simple preloading technique for alkalinized lidocaine in the ETT cuff, demonstrated a significant reduction in cough on emergence from general anaesthesia after short surgical procedures. There was a case report done previously on this topic, but scant articles on this topic [21, 22, 23, 25]. Rizvanović, *et al*., proved that Cuff inflation media has a significant effect on postoperative throat mucosal injuries and emergence phenomenon [19, 24, 26]. It was proved that with lidocaine alone, rate of diffusion through the cuff was low (<8% over 24h), whereas the L-B solution had a high diffusion (>90% over 24h) [19]. The effectiveness of alkalinized lidocaine in longer procedures has long been established [12], its use in shorter surgeries had previously been reported in only one small series of patients [8]. The 12% incidence of cough in group AL in the present study is slightly more than the 5% cough obtained by Estebe *et al*. [8] in their alkalinized lidocaine group. However, in this study, patients in the saline control group coughed considerably less than previously reported: 28% vs 70% [8]. It was proved by Estebe *et al*., that use of a small dose of alkalinized lidocaine (40 mg) instead of air is a relatively easy and safe practice that avoids the use of large doses of lidocaine [18]. The pH of a commercially available local anaesthetic solution must be acidic to maximise stability in solution and shelf-life. The reasons include: solubility-local anaesthetic solutions are aqueous solutions and if provided at a pH close to 7.4 the lipid soluble uncharged form could precipitate out due to its lower water solubility; stability-the uncharged base form is more unstable at physiological pH, so degradation is minimised at a low pH where the drug is predominantly in the charged form [17]. Preloading of ETT tube cuffs before the use of alkalinized lidocaine during short surgical procedures required a minor change in preoperative anaesthesia procedures and very little preparation time. Though the exact time of intubation for each case in an operating room schedule is not possible to predict, the requirement of at least 90 minutes prefilling is easy to integrate into clinical practice. Relatively few patients were excluded from the present study and several different procedures including gynaecological, otolaryngological (not involving the airway), plastic and general surgery were included, improving generalizability. Nonetheless, certain limitations apply to

ISSN 2515-8260 Volume 09, Issue 06, 2022

our findings. First, knowing that the anesthetized patient was enrolled in our study, the medical team might have modified cough-inducing behaviours (Hawthorne effect), though this limitation applies to both study groups. Second, the study was designed to evaluate the prevention of cough at deeper levels of anaesthesia where laryngospasm more often occurs if extubation is attempted [16]. Third, the usefulness of alkalinized lidocaine in the ETT cuff for very short (<30 minute) procedures cannot be ascertained from this study. Fourth, our results are statistically fragile: if only one more patient had coughed in the study group, the resulting differences would not have been judged significant, even with the 1-sided testing this study was designed for, based on the results of previous studies. This fragility was also reflected in the wide confidence intervals of the 1-tailed risk ratio for cough and is the result of the study design using numbers of patients just sufficient to demonstrate statistical differences greater than the admittedly arbitrary limit of "significance", usually defined as $p<.05$. When defining the number of patients necessary in each group in this way, P values very close to .05 will be always be generated when the actual difference is similar to the expected difference, as was the case in this study. Finally, this study shows that prefilling ETT cuffs with alkalinized lidocaine before using alkalinized lidocaine in the ETT cuff for short procedures is effective in preventing emergence cough but was not designed to show whether prefilling is necessary. 2% alkalinized lignocaine placed in the cuff of an endotracheal tube, diffused across the cuff membrane. The cuff could act as a potential reservoir for a local anaesthetic, allowing diffusion and subsequent anaesthesia of the underlying mucosa. The simple preloading technique for alkalinized lignocaine ET cuff demonstrated a significant reduction in emergence cough. The basis of our study was that lignocaine instilled into the endotracheal cuff might cause anaesthesia of the trachea by diffusing across the polyvinyl chloride membrane of which the cuff is composed of. Though in vitro studies argue against the effectiveness of alkalinized lidocaine in the ETT cuff without prefilling [10, 11]. The local anaesthetic effect should be confined to the mucosa in contact with the cuff and the protective cough reflexes above the tube cuff and of the vocal cords should remain intact. Mean volume which was inflated into ET tube cuff was 6.6±2 ml, but no signs of lignocaine toxicity was observed during intra operative & post-operative period in our study. There is risk of cuff damage and leakage, in our study, all tubes were intact post extubation. By alkalinising lignocaine with sodium bicarbonate allowed better diffusion as the hydrophobic neutral base is able to diffuse better than plain lignocaine and the dose of lignocaine can be reduced. The dose of lignocaine used to produce clinical effect is also reduced by alkalinisation. There by reducing the plasma concentration and toxicity.

Conclusion

Alkalinized lidocaine in ETTs preloaded with the same solution before surgery appears to significantly lower (p= 0.38) the incidence of emergence cough during short surgical procedures. Also reduces emergence agitation and provides hemodynamic stability during extubation by avoiding the pressor response.

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