

Efficacy of Intracuff Alkalinized 2% Lidocaine in Reducing Cough, Sore Throat And Hoarseness During Emergence in Smokers Undergoing Laparoscopic Surgery

Vikas Gupta^{*}, Poonam Sharma^{**}, Madan^{****}

^{*}Department Of Anaesthesia And Intensive Care Government Medical College, Jammu

Corresponding Author: Vikas Gupta^{*}

Abstract

Background: Cough causes various complications during emergence from general anaesthesia especially in smokers.

Objective of the Study: To assess the efficacy of intracuff alkalinized 2% lidocaine as compared to saline in reducing cough, sore throat and hoarseness during emergence in smokers undergoing laparoscopic surgery.

Materials and Methods: 50 smoking patients undergoing laparoscopic surgery under general anaesthesia including nitrous oxide (N₂O) were enrolled. Patients were randomly allocated to receive either endotracheal tube intracuff 2% lidocaine plus 8.4% sodium bicarbonate (Group I, Study Group), or endotracheal tube intracuff 0.9% saline (Group II, Control Group). The endotracheal tube cuff was inflated to achieve a cuff pressure that prevented air leak during positive pressure ventilation. Incidence of emergence coughing, postoperative sore throat, and hoarseness were analyzed. The volume of inflation solution, the intracuff pressure, the duration of anaesthesia, the time elapsed to extubation after discontinuation of anaesthesia, and the volume of the inflation solution and the air withdrawn from the ETT cuff were also recorded.

Results: Intracuff alkalinized 2% lidocaine was superior to saline in blunting emergence coughing ($p < 0.001$). The incidence of sore throat was significantly lower in Group I at the post-anaesthesia care unit ($p = 0.02$). However, at 24 hours after extubation, sore throat incidence was similar in both the groups ($p = 0.07$). Incidence of hoarseness was similar in both the groups. Intracuff pressure in the saline group increased with time while the intracuff pressure in the lidocaine group remained constant.

Conclusion: Efficacy of intracuff alkalinized 2% lidocaine was superior to saline in reducing incidence of cough during emergence and preventing sore throat during the postoperative period in smokers.

Keywords: Intracuff alkalinized 2% lidocaine, Smoking, Cough, Sore throat, Emergence, Surgery

Date of Submission: 19-09-2017

Date of acceptance: 16-10-2017

I. Introduction

Cigarette smokers are known to have respiratory problems during induction of anaesthesia with increased incidence of laryngospasm and cough during extubation as the integrity of epithelia is lost by smoke irritation (1). Chronic smoking is associated with inflammation of tracheal mucosa secondary to effects of substances in cigarette smoke, leading to increased respiratory problems in perioperative period. These patients have an increased incidence of postoperative sore throat (2). General anaesthesia and tracheal intubation may contribute in exacerbating these respiratory complications. The emergence period may require special attention, since it elicits undesirable and exacerbated airway reflexes (3). One of the principal mechanisms for coughing during emergence is irritation of the respiratory mucosa by the endotracheal tube (ETT) and its cuff (4). Intravenous and topical lidocaine has been in use for many years in blunting the emergence adverse phenomenon after general anaesthesia. Targeted delivery of lidocaine to the mucosa in contact with the ETT cuff can be used as a method for decreasing tracheal stimuli (5).

When lidocaine is injected into the ETT cuff, it spreads through the semi-permeable membrane wall and induces anesthetic action in the trachea (6). This increases tolerance to the placement of tracheal and tracheotomy tubes (5). Hemodynamic alterations after tracheal extubation are thereby minimized, and the incidence of coughing is reduced (7). The aim of this randomized double-blind study was to assess the efficacy of intracuff alkalinized 2% lidocaine as compared to saline in reducing cough, sore throat and hoarseness during emergence in smokers undergoing laparoscopic surgery.

II. Materials And Methods

This one-year prospective, randomized double-blind study was conducted in the Department of Anaesthesiology, Government Medical College, Jammu after taking the approval from Institutional Ethical Committee and written informed consent from the patients. All patients were >18 years of age, of both genders with ASA physical status I/II and their Mallampatti classification was equal to 1. All patients were current smokers for a period more than 5 years, inhaling at least five cigarettes per day. Patients undergoing laryngeal surgery with tracheotomy, laryngeal disease or asthma were excluded from the study. Exclusion criteria also included anticipated difficult intubation, intubation attempt >1, need for nasogastric tube, history of respiratory tract infection and contraindication for use of nitrous oxide.

Patients were randomly divided into two groups of 25 each. Group I patients (study group) received 2% alkalinized intracuff lidocaine, Group II patients received 0.9% saline (control group). Before induction, the anesthesia provider was given a 20 mL syringe filled with 0.9% saline or with 2% lidocaine mixed with 8.4% sodium bicarbonate, in a 19:1 mL proportion. At the time of intubation, the study group received intracuff lidocaine and the control group received intracuff saline in a volume sufficient to establish a cuff pressure that would prevent the air from leaking during positive pressure ventilation. The anesthesia provider was blinded to lidocaine or saline administration, since all solutions were colorless in a volume of 20 mL. The ETT cuffs were lubricated with 4 mL of water-soluble gel before tracheal intubation in both groups.

Patients were premedicated with oral midazolam (5 mg) one hour before anesthesia induction. Intravenous line was secured with 20 gauge cannula and lactated Ringers solution was started at a required rate. Patients were induced with injection propofol in the dose of 2–2.5 mg/kg and patients were maintained on nitrous, oxygen, isoflurane and neuromuscular blockade was ensured by injection vecuronium. Routine monitoring included electrocardiogram, pulse oximetry, capnography and non-invasive blood pressure (NIBP). On emergence, the anaesthesia provider assessed and counted the number of coughs before awake extubation. This assessment began at the time when the anaesthetic gases, nitrous oxide and volatile inhalation agents were turned off and the patient was given 100% oxygen. Awake extubation was defined as the ability of patient to breathe spontaneously, follow verbal commands and demonstrate a sustained head lift for more than 5 seconds. In addition, coughing was defined as a sudden, forceful expiration after inspiration. An anaesthesiologist who did not know to which group the patient belonged evaluated the incidence of emergence coughing, sore throat and hoarseness. Sore throat and hoarseness were evaluated at the time of shifting from the post-anaesthesia care unit and 24 hours after extubation.

The data was compiled and analyzed. For anthropometrical variables and duration of anaesthesia, the Student 't' test was used. The incidence of coughing, sore throat and hoarseness were compared by the Chi-square test for multiple variables. The difference in value was considered statistically significant when p value was less than 0.05.

III. Results

With respect to gender, out of 50 patients, 74% of the patients were male and 26% patients female. Genderwise distribution of patients was comparable within the groups. Similarly, patients' characteristics were similar in both the groups. Mean duration (\pm standard deviation) of anaesthesia in Group I (206.6 ± 63.1 minutes) was statistically comparable with that of Group II (223.6 ± 99.3 minutes). Mean time elapsed (\pm standard deviation) from discontinuation of the anaesthesia to extubation was less in Group I (9.2 ± 4.2) when compared with that of Group II (14.1 ± 11.6 minutes), but no statistically significant difference was noted. Initial pressure (T_0) (cm H₂O) required to seal the trachea and avoid air leak during positive pressure ventilation was higher in Group I when compared with that of Group II (17.8 ± 2.1 vs. 15.9 ± 1.3 , respectively; $p < 0.05$). However, the intracuff pressure in Group II increased with time, while in Group I it remained constant. Though initially low, the intracuff pressure in Group II was statistically higher than the pressure in Group I at the end of the study (T_{end} (20.4 ± 9.1 vs. 16.3 ± 5.7 , respectively; $p < 0.05$) (Table 1). In both groups, the intracuff pressure was maintained below the critical tracheal perfusion pressure of 25 cm H₂O.

The initial volume needed to inflate the ETT cuff was similar in both groups (Group I, 6.9 ± 2.6 ; Group II, 7.21 ± 2.1 ; $p = 0.77$). There was a decrease in the volume of the solution withdrawn from the cuff at the end of the study, with no statistically significant difference between the groups (10% and 3% decrease in Group I and Group II, respectively; $p = 0.55$). The incidence of coughing at emergence of general anesthesia was considerably lower in Group I ($p < 0.001$), when compared with Group II, demonstrating a beneficial effect of the alkalinized lidocaine in suppressing the irritation stimuli of the ETT cuff on the tracheal mucosa when compared with the ETT cuff inflation with saline (Fig. 1). The incidence of sore throat was significantly lower in Group I than that of Group II at the time of release from the post-anaesthesia care unit ($p = 0.02$). The incidence of sore throat at 24 hours after extubation, however, was similar in both groups ($p = 0.07$). No patient in Group I had sore throat in the postoperative period. The incidence of hoarseness in the postoperative evaluation revealed no

statistically significant differences within the two groups in the post-anaesthesia care unit, as well as at 24 hours after extubation ($p = 0.77$ and $p = 1.0$, respectively) (Fig. 1). The serum concentration of lidocaine in Group I did not vary significantly throughout the study. It was readily detectable 10 minutes after the inflation of the cuff with the local anaesthetic, and remained constant throughout the study period ($T_{10} = 1.52 \pm 0.33$; $T_{60} = 1.60 \pm 0.71$; $T_{120} = 1.60 \pm 0.84$; $T_{\text{end of anaesthesia}} = 1.87 \pm 0.82$).

IV. Discussion

Coughing during emergence from general anesthesia is unwanted reflex that cause various undesirable complication (8). This study observed that when the ETT cuff was inflated with alkalinized 2% lidocaine, there was decrease in coughing incidence during emergence from the general anaesthesia and incidence of sore throat also decreased during the postoperative period in smokers. Moreover, ETT intracuff pressure did not show any significant rise when intracuff lidocaine was infused.

This study included only smokers as smoking exaggerate coughing reflex and chronic smoking affect respiratory epithelia ranging from inflammation to dysplasia and this render respiratory epithelia to be more reactive to ETT insertion which cause stretch stimuli in the trachea (9). Altintas *et al.* demonstrated lower incidence of bucking at the time of extubation with the use of intracuff lidocaine (10). When lidocaine is used to inflate the ETT cuff, a higher tolerance for both tracheal and tracheotomy tubing is well demonstrated (7,10,11). However, a study conducted by Estebe *et al.* failed to demonstrate the effectiveness of intracuff non-alkalinized 4% lidocaine in reducing coughing during emergence from general anesthesia in smokers who underwent anesthesia lasting less than 90 minutes (7). The main reason for this lack of effect may be due to a lower drug diffusion rate through the cuff because of the low drug pH, since lidocaine was not alkalinized (3).

The present study demonstrated lower incidence of coughing in Group I as compared to Group II. The study used proportion of 19 mL of lidocaine and 1 mL of bicarbonate modified solution pH from 6.92 (lidocaine chlorohydrate) to 7.43 (alkalinized lidocaine) which provided for quicker diffusion of lidocaine through the cuff membrane. This allowed for the measurement of a similar significant lidocaine concentration in the analysis of the patients' blood samples just 10 minutes after inflation. The continuous metabolism of lidocaine by the liver may explain the constant serum concentration of the drug found in this study (3). During general anesthesia, the use of intravenous lidocaine has been employed with the intent of suppressing cough reflex. According to studies, to effectively suppress coughing, a high lidocaine serum concentration (12), around 3 mg/mL, is required (13). Such serum concentration may be achieved with an intravenous injection of 1-2 mg/kg (13) of the drug (4). Lidocaine administered intravenously, however, can produce sedation and prolong the process of awakening from anesthesia (14). In the present study, the patients did not experience any prolongation in the awakening from anesthesia time due to the use of intracuff lidocaine. The time elapsed since the discontinuation of the anesthetic drugs until the extubation was shorter in Group I. This may be due to a smoother emergence period experienced by the patients with intracuff lidocaine (3), while in Group II the high incidence of coughing during emergence delayed the extubation.

The pressure in the ETT pilot balloon, an indirect measure of the pressure exerted by the cuff on the tracheal mucosa, is not routinely determined by the anesthesiologist (15). Several methods have been proposed to minimize the elevation of cuff pressure during N₂O anesthesia. These include the use of an ETT with regulatory pressure valves (16), the inflation of the cuff with a mixture of N₂O/O₂ in proportions identical to those used in the anesthesia (17), the use of a tracheal tube with a cuff impermeable to N₂O (18), and filling the cuff with 0.9% saline (19). A reliable and alternative method of reducing high cuff pressure is filling the cuff with lidocaine. Others have used lidocaine in the form of chlorohydrate to fill the cuff in concentrations of 2%, 4% and 10% (200-500 mg) (6,10). Lidocaine alkalinization increases the rate of diffusion through the cuff wall, allowing a reduction of the lidocaine dose while achieving the same results (11). The ETT cuff serves as a reservoir to release local anesthetic to the subjacent tracheal tissues (20). Our results demonstrated that intracuff lidocaine prevents a significant rise in the cuff pressure during N₂O anesthesia, secondary to continuous drug diffusion. On the other hand, there was a time-dependent increase in the cuff pressure in Group II. The reason for the rise in intracuff pressure is likely due to the increased gas by absorption of N₂O (8). Gas was also removed from the cuffs filled with lidocaine. The increased cuff gas in Group I at extubation was counter-balanced by a decrease in the liquid volume due to diffusion of alkalinized lidocaine through the cuff wall. This balance maintained adequate cuff pressure and protected the airway against air leak or aspiration of gastric content.

Cuff lubrication with lidocaine gel or spray has been associated with increased morbidity during emergence from anesthesia due to adherence of the ETT to the tracheal mucosa (21), and may promote cuff rupture (22). Contrarily, cuff lubrication with a water soluble gel in association with alkalinized lidocaine increases tracheal tube tolerance and reduces the incidence of postoperative sore throat (21). It has been suggested that sore throat is caused by the activation of tracheal pain receptors (14). The proposal of a continuous application of local anesthetic to block these nociceptive receptors would therefore seem logical, in

an attempt to reduce the incidence of sore throat (3). After tracheal extubation, sore throat has been reported in 15% to 80% of cases (10). In our study, the incidence of sore throat was 20% and 12% in Group II at the time of discharge from the post-anaesthesia care unit and at 24 hours after extubation, respectively. In Group I, no patient presented with sore throat. This may be related with the combination of three different techniques recognized as protective against sore throat: use of low ETT cuff pressure, use of intracuff alkalinized lidocaine, and use of water-soluble lubricant (3). However, despite all techniques applied for preventing tracheal morbidity, the incidence of hoarseness was similar in both groups, suggesting that this symptom is unlikely related to the cuff pressure or to the cuff inflation solution.

The toxicity of local anesthetic must be considered. The mean volume of lidocaine used in the study was 6.9 ± 2.6 mL (138 ± 52 mg). This dose is lower than the toxic systemic level. If a cuff rupture occurs, a relatively high dose of lidocaine can be delivered into the trachea and bronchium leading to toxicity. However, lidocaine induced cuff rupture has never been reported previously. In this study, all patients were extubated without any complications, and no evidence of cuff damage was observed. Bicarbonate is another drug that can lead to tracheal wall damage if a cuff rupture occurs. The small dose used in the present study (1 mL of 8.4% bicarbonate in 20 mL of solution) was enough to increase the pH of the lidocaine solution, and facilitate its diffusion, but is unlikely to produce damage on the trachea if any cuff damage occurs.

V. Conclusion

In conclusion, efficacy of intracuff alkalinized 2% lidocaine was superior to saline in reducing incidence of cough during emergence and preventing sore throat during the postoperative period in smokers. Therefore, the study recommends use of an ETT cuff filled with alkalinized lidocaine in smokers undergoing general anesthesia.

References

- [1]. Schwilk B, Bothner U, Schraag S, Georgieff M. Perioperative respiratory events in smokers and non-smokers undergoing general anaesthesia. *Acta Anaesthesiol Scand* 1997; 41: 348-55.
- [2]. Myles PS, Iacono GA, Hunt JO, Fletcher H, Morris J, McIlroy D, Fritschi L. Risk of respiratory complications and wound infection in patients undergoing ambulatory surgery: Smokers versus nonsmokers. *Anesthesiology* 2002; 97: 842-7.
- [3]. Navarro LHC, e Lima RM, Aguiar AS, Braz JRC, Carness JM, Modolo NSP. The effect of intracuff alkalinized 20% lidocaine on emergence coughing, sore throat and hoarseness in smokers. *Rev Assoc Med Bras Mar/Apr* 2012; 58(2).
- [4]. Suzuki N, Kooguchi K, Mizobe T, Hirose M, Takano Y, Tanaka Y. Postoperative hoarseness and sore throat after tracheal intubation: effect of a low intracuff pressure of endotracheal tube and usefulness of cuff pressure indicator. *Masui* 1999; 48: 1091-5.
- [5]. Shroff PP, Patil V. Efficacy of cuff inflation media to prevent postintubationrelated emergence phenomenon: air, saline, and alkalinized lignocaine. *Eur J Anaesthesiol* 2009; 26: 458-62.
- [6]. Tanaka Y, Nishimori M, Sato Y, Furuya H. Lidocaine for preventing postoperative sore throat. *Cochrane Database Syst Rev* 2009;8: CD004081.
- [7]. Estebe JP, Dollo G, Le Corre P, Le Naoures A, Chevanne F, Le Verge R, *et al.* Alkalinization of intracuff lidocaine improves endotracheal tube-induced emergence phenomena. *Anesth Analg* 2002; 94: 227-30.
- [8]. Gonzalez RM, Bjerke RJ, Drobycki T, Stap elfeldt WH, Green JM, *et al.* Prevention of endotracheal tube-induced coughing during emergence from general anesthesia. *Anesth Analg* 1994; 79: 792-5.
- [9]. Jawad M, Alsaady MA. Effect of endotracheal tube lidocaine instillation in prevention of smokers emergence coughing: sample of Iraqi patients undergoing emergency appendectomy. *J Intensive Crit Care* 2016, 2: 2.
- [10]. Altintas F, Bozkurt P, Kaya G, Akkan G. Lidocaine 10% in the endotracheal tube cuff: blood concentrations, haemodynamic and clinical effects. *Eur J Anaesthesiol* 2000; 17: 436-42.
- [11]. Huang CJ, Hsu YW, Chen CC, Ko YP, Rau RH, Wu KH, *et al.* Prevention of coughing induced by endotracheal tube during emergence from general anesthesia a comparison between three different regimens of lidocaine filled in the endotracheal tube cuff. *Acta Anaesthesiol Sin* 1998; 36: 81-6.
- [12]. Caranza R, Raphael JH, Nandwani N, Langton JA. Effect of nebulized lidocaine on the quality of induction of anaesthesia in cigarette smokers. *Anaesthesia* 1997; 52: 849-52.
- [13]. Beckers S, Camu F. The anesthetic risk of tobacco smoking. *Acta Anaesth Belg* 1991; 42: 45-56.
- [14]. Yukioka H, Yoshimoto N, Nishimura K, Fujimori M. Intravenous lidocaine as a suppressant of coughing during tracheal intubation. *Anesth Analg* 1985; 64: 1189-92.
- [15]. Braz JR, Navarro LH, Takata IH, Nascimento Junior P. Endotracheal tube cuff pressure: Need for precise measurement. *Sao Paulo Med J* 1999; 117: 243-7.
- [16]. Spittle CSN, Beavis SE. Do you measure cuff pressure? A survey of clinical practice. *Br J Anaesth* 2001; 87: 344-5.
- [17]. Navarro LHC, Braz JRC, Pletsch AK, Amorim RB, MÓdolo NSP. Comparative study of thacheal tube cuff pressure with or without Lanzo pressure regulation system. *Braz J Anesthesiol* 2001; 51: 17-27.
- [18]. Karasawa F, Mori T, Kawatani Y, Oshima T, Satoh T. Deflationary phenomenon of the nitrous oxide-filled endotracheal tube cuff after cessation of nitrous oxide administration. *Anesth Analg* 2001; 92: 145-8.
- [19]. Fujiwara M, Mizoguchi H, Kawamura J, Hayashi I, Takakuwa R, Morinaga N, *et al.* A new endotracheal tube with a cuff impervious to nitrous oxide: constancy of cuff pressure and volume. *Anesth Analg* 1995; 81: 1084-6.
- [20]. Navarro LHC, Braz JRC, Nakamura G, Lima RM, Silva FP, MÓdolo NSP. Effectiveness and safety of endotracheal tube cuffs filled air versus filled alkalinized lidocaine: A randomized clinical trial. *São Paulo Med J* 2007; 125: 1390-6.
- [21]. Walmsley AJ, Burville LM, Davis TP. Cuff failure in polyvinyl chloride tracheal tubes sprayed with lignocaine. *Anaesthesia* 1988; 43: 399-401.
- [22]. Stanley TH, Kawamura R, Graves C. Effects of nitrous oxide on volume and pressure of endotracheal tube cuff. *Anesthesiology* 1974; 41: 256-62.

Table 1. Intracuff pressure (cm H₂O) during anaesthesia procedure

Time points (minutes after tracheal intubation)	Group I (Study Group)	Group II (Control Group)
T ₀	17.8 ± 2.1	15.9 ± 1.3
T ₃₀	17.2 ± 7.0	16.8 ± 6.4
T ₆₀	17.9 ± 6.5	17.1 ± 6.7
T ₉₀	17.5 ± 7.2	18.2 ± 8.4
T ₁₂₀	16.3 ± 6.8	19.1 ± 9.0
T _{end of anaesthesia}	16.3 ± 5.7	20.4 ± 9.1

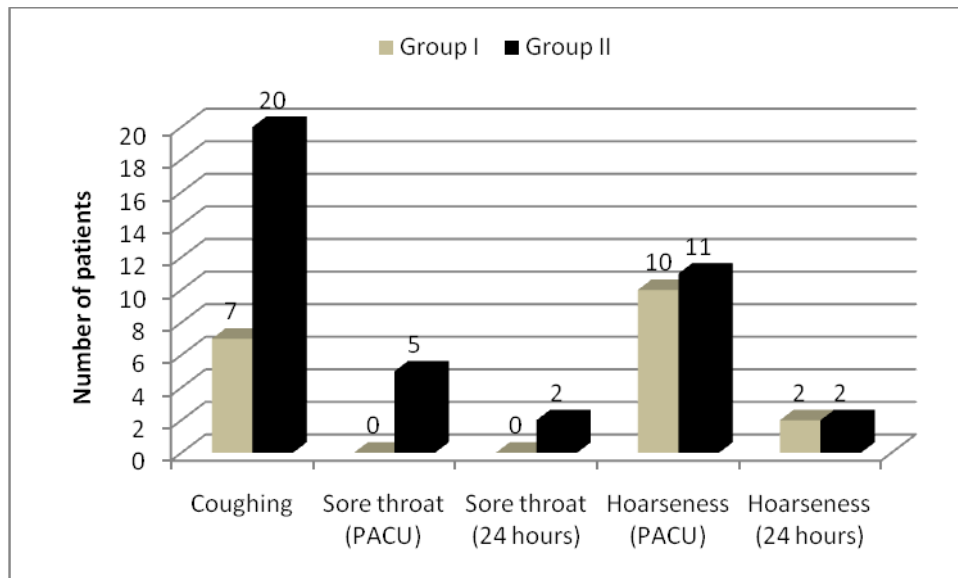


Fig. 1. Incidence of emergence incidence of cough and tracheal morbidity present during post anaesthesia care unit (PACU) and 24 hours after extubation.

Vikas Gupta*. "Efficacy of Intracuff Alkalinized 2% Lidocaine in Reducing Cough, Sore Throat And Hoarseness During Emergence in Smokers Undergoing Laparoscopic Surgery." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) , vol. 16, no. 10, 2017, pp. 01–05.