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Intracuff alkalinized lignocaine improves endotracheal tube induced emergence phenomenon

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Abstract
Background Endotracheal intubation for airway management in general anaesthesia is associated with post intubation morbidities due to prolonged inflation of the ETT cuff with air. Lidocaine by instillation in the ETT cuff and its diffusion through semipermeable membrane causes reduction in mucosal irritation and inflammation.
Objectives To compare the endotracheal tube (ETT) cuff pressure inflated with air or alkalinized lignocaine during anaesthesia and evaluate clinical symptoms such as coughing and sore throat (postoperative sore throat [POST]) following tracheal extubation.
Material and Methods: This was a prospective randomized controlled study conducted over a period of 6 months. We included 60 patients in age group of 18–55 years posted for elective laparoscopic operative gynecological surgeries of duration more than 90 min under general anaesthesia with N2O-O2 mixture. Patients were randomized using computer-generated randomization table into air and lignocaine group. The ETT cuff was inflated with air or alkalinized lignocaine (2% lignocaine with 7.5% sodium bicarbonate, in the proportions of 19.0:1.0 ml) to the volume that prevented air leak using cuff pressure manometer. After extubation, an independent observer blinded to study group recorded the presence or absence of coughing and POST at immediately, 1, 6, 12h and 24 h postoperatively.
Results: Demographic data, baseline characteristics (American Society of Anaesthesiologists grade, intracuff volume/cuff pressure at start of surgery), and duration of anaesthesia were comparable among study groups (P>0.05). Cuff pressure and volume achieved in the end of surgery were much noteworthy higher in air group as compared to lignocaine group ($P < 0.0001$). Incidence of coughing and POST at immediately, 1, 6, 12h and 24 h postoperatively was significantly higher in air group compared to lignocaine group.
Conclusion: This study showed the significance of use of alkalinized 2% lignocaine in prevention of rise of cuff pressure and incidence of coughing and POST.

Keywords: air, alkalinized lignocaine, Endotracheal tube intracuff instillation, coughing, postoperative sore throat

Introduction

The postintubation-related emergence phenomenon is a congregate of airway stumbling blocks associated with tracheal intubation or extubation after general anaesthesia [1]. Instrumentation for Laryngoscopy or endotracheal or oral suctioning or endotracheal intubation itself can cause mucosal injury or inflammation and result in symptoms like postoperative sore throat (POST), restlessness, agitation hoarseness and vigorous coughing. POST being the most unpleasant symptom and is very painful to almost 50% of patients [2].
These symptoms can be one of the causes which increases intracranial, intra-thoracic or intra-abdominal pressure, and results in bronchospasm, wound dehiscence, and bleeding. Other laryngeal complication such as hoarseness, dysphonia, or dysphagia was also eminent during the postoperative care [3, 4].
Recently pharmacological approaches have been added to the non - pharmacological strategies (ETT size, cuff pressure or volume control) for prevention of POST. Pharmacological preventive approaches like use of anti-inflammatory drugs, opioids, steroids or local anaesthetic agents are widely used [3].
The most commonly used drug for preventing POST is Lidocaine and its efficacy was evaluated in a Cochrane review in 2009 [4]. The clinical application of the results of this review is still ambiguous, because its route was not adequately cramped, and its effectiveness on other relevant morbidities was questionable [1].

Lidocaine protects the tracheal mucosa through its continuous topical anaesthetic effect, and prevent the diffusion of nitrous oxide into the cuff when it is administered as a cuff inflation medium. Alkalinized form of lidocaine is quicker in onset, and has better duration and quality of the block thus offering extra advantage on non-alkalinized variety. The results still remain inconclusive even after many randomised controlled trials which investigates the efficacy of intracuff lidocaine on the post intubation related emergence phenomenon [1].

Elevated ETT pressure can compromise the blood supply of tracheal mucosa which can result in ciliary loss, inflammation, ulceration, haemorrhage and in extreme cases tracheal stenosis. It is exigent to maintain the ideal cuff pressure during the whole surgery. The factors presiding are anaesthetic gases like N2O, agent filling the cuff and the material and kind of the cuff [1, 5].

As the surgery progresses the most common agent to cause rise in intracuff pressure is N2O concomitantly used with other gases. N2O and O2 easily disperse in air filled cavities like ETT cuff and results in increase volume and cuff pressure of ETT and the genesis of POST rests on this rise in pressure and volume of cuff [1, 5, 6].

Many studies have demonstrated the association of rise in cuff pressure and cuff volume with use of N2O. Very lately the association of intracuff saline and lignocaine for prevention of POST and coughing is being reviewed

As Lignocaine is liquid state, it impedes the entry of N2O in the cuff as well as it permeates through semipermeable cuff membrane to tracheal mucosa and thus furnishes its direct anaesthetic effect. If lignocaine is alkalinized with sodium bicarbonate (NaHCO3), it increases its nonionized form which greatly increases the diffusion of lignocaine through polyvinyl cuff walls (63 folds) [1, 7]. Thus, small amount of lignocaine can provide rapid and prolonged action over mucosa.

In our study, we studied the effect and safety of use of intracuff alkalinized lignocaine over traditional air and evaluated the incidence endotracheal tube induced emergence phenomenon

Materials and Methods

This was a prospective double blind, randomized controlled study conducted on 60 ASA physical status I and II adult patients of age 18-55 years of either gender posted for elective laparoscopic operative gynecological surgeries under general anaesthesia lasting for more than 90 min after getting approval from Institutional Ethical Committee. The study was undertaken after taking written and informed consent from all the patients.

Patients with laryngeal disease, who has undergone laryngeal surgery, who were tracheostomised, with difficult intubation, pregnant women, emergency cases, belonging to ASA physical status III or IV, with history of Asthma and smoking, history suggestive of gastro oesophageal reflux and recent respiratory infection were excluded. Standard Routine balanced general anaesthesia was given as per the choice of managing Anaesthesiologist but endotracheal tube used was with high residual volume, low pressure cuff with internal diameter 7.0mm for females and 8.5 mm for males.

Patients were allocated into two groups, Group (A) where the endotracheal

tube cuff filled with alkalinized lignocaine (2% lignocaine 19.0 ml alkalinized with 1.0 ml sodium bicarbonate 7.5%) cuff inflated enough to prevent leak around during positive pressure ventilation with starting pressure as approximately 20cm of H_2O.

Group (B) where the endotracheal tube cuff was filled with intracuff air according to computer generated randomization sheet. Volume and cuff pressure of air and lignocaine was noted at the start (after intubation) and end of surgery (at the time of extubation). Duration of surgery was also noted. Presence or absence of coughing immediately after extubation (0hour), 1, 6, 12 and 24 hours postoperatively by independent observer. Coughing and POST was recorded as present or absent.

The study was done in the period of 6 months and patients were randomly divided as per computer generated numbers. 60 patients fulfilling our inclusion criteria were included in the study.

Data analysis was done with the help of SPSS software version 22(IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY, United states.20-Oct-2020).

Results and Analysis

The sociodemographic parameters in terms of age, weight, ASA physical status, duration of surgery and anaesthesia were all comparable in both the groups with p value non - significant i.e., >0.05 (Table 1).

The mean cuff volume at the start of surgery was 3.5 ±0.63 ml in Gp A and 3.7 ± 0.5 in Gp L which was comparable in both the groups with non- significant p values but the mean cuff volume at the end of the surgery was 5.8±0.54 ml in Gp A and 3.58 ± 0.7 ml in Gp L, the difference in both the groups were highly significant p value < 0.0001If the difference of cuff volume is seen in the same group the volume increases by 2.3 ml and is statistically significant p <0.0001 but there is negligible change in volume in Gp L - 0.200ml. (Table 2)

The mean cuff pressure at the start of the surgery were also comparable with non- significant p values. They were 20.48± 0.7 in Gp A and 20.64 ±0.78 in Gp L but at the end of surgery the mean cuff pressure was 39.86 ±7.13 cm of H_2O in Gp A and 19.84 ± 0.68 cm of H_2O in Gp L the difference was statistically highly significant between the groups with p value < 0.0001. If the difference of cuff pressure is seen in the same group the pressure increases by 19.380 cm of H_2O which is statistically significant p <0.0001 but there is negligible change in pressure in Gp L - 0.640 cm of H_2O. (Table 3)

Table 1: Demographic profile and Duration of Anaesthesia

	Gp A n=30	Gp L n=30	95% CI	P value
Age (yrs.) Mean ± SD	32.96 ±10.4	34.4 ± 13.9	- 3.0043 – 5.8843	0.52 (not significant)
Wt. (kgs) Mean ± SD	58 ± 6.99	59.4 ±11.25	-1.9860 - 4.78	0.41 (not significant)
ASA I: II	23: 7	22: 8		0.75 (not significant)
Duration of Anaesthesia	2.67 ±0.72	2.66 ±0.07	-0.19- 0.17	0.915 (not significant)

Table 2a: Intra cuff volume association between two groups

	Gp A n=30	Gp L n=30	Difference	Standard Error	95% of CI	P value
Start (Inflated with)	3.5 ± 0.63	3.7 ± 0.5	0.200	0.104	0.0056-0.4056	0.056 (Not significant)
End (deflated with)	5.8 ± 0.54	3.58 ± 0.7	-2.2	0.114	-2.44- 1.99	< 0.0001 (highly significant)

Table 2b: Intra cuff volume association in same group

	Gp A n=30	Gp L n=30
Start (inflated with)	3.5 ± 0.63	3.7 ± 0.5
Endm (Deflated with)	5.8 ± 0.54	3.58 ± 0.7
Difference	2.3	-.200
P value	< 0.0001 (highly significant)	0.2079 (not significant)

Table 3: Intra cuff Pressure association between two groups

	Gp A n=30	Gp L n=30	Difference	Standard Error	95% of CI	P value
Start (after inflation)	20.48 ± 0.7	20.64 ± **0.78**	0.160	0.134	- 0.1060-0.4260	0.2361 (not significant)
End (before deflation)	39.86 ± **7.13**	19.84 ± **0.68**	-20.02	0.925	-21.85-18.1889	< 0.0001 (highly significant)

Table 3b: Intra cuff Pressure association in same group

	Gp A n=30	Gp L n=30
Start (after inflation)	20.48 ± 0.7	20.64 ± 0.78
End (before deflation)	39.86 ± 7.13	19.84 ± 0.68
Difference	19.380	-0.640
P value	< 0.0001 (highly significant)	=0.0001 (highly significant)

Table 4: Association between post operative period and coughing

	Gp A n=30		Gp L n=30		Chi square statistics	P value
Coughing	Yes	No	Yes	No		
0 hour	16	14	5	25	8.865	0.0029 (significant p <.05)
1 hr	9	21	2	28	5.45	0.0195 (significant p <.05)
6 hr	8	22	2	28	4.32	0.0376 (significant p <.05)
12 hr	7	23	1	29	5.19	0.0226 (significant p <.05)
24hr	7	23	1	29	5.19	0.0226 (significant p <.05)

Table 5: Association between post operative period and POST

	Gp A n=30		Gp L n=30		Chi square statistics	P value
POST	Yes	No	Yes	No		
0 hour	8	22	2	28	4.32	0.376 (not significant)
1 hr	12	18	2	28	9.3	0.0022 (significant p <.05)
6 hr	12	18	2	28	9.3	0.0022 (significant p <.05)
12 hr	12	18	2	28	9.3	0.0022 (significant p <.05)
24hr	12	18	2	28	9.3	0.0022(significant p <.05)

POST: post operative sore throat

Discussion

Sore throat is a common postoperative complaint, occurring most often following endotracheal intubation. Main causative factors include tracheal-tube size and cuff design. Routine tracheal intubation for elective surgical procedures can result in pathological changes, trauma and nerve damage which may also account for postoperative throat symptoms. However, high intracuff pressure is associated with nerve palsies due to neuropraxia and nerve compression [7]. Careful insertion techniques for the tracheal tube are of great importance in the prevention of airway trauma and postoperative sore throat, so it was made sure that intubation was done by Anaesthesiologists who had an experience of minimum of 50 intubation in past.

Other factors that are found to be implicated were surgeries involving the head and neck region because of movement of the tube and cuff within the trachea and the presence of a nasogastric tube, such surgeries were excluded from our study.

Endotracheal cuff provides suitable security to airways to prevent aspiration due to under inflation during positive pressure ventilation. Navarro *et al.* [1, 8] and Manissery *et al.* [7] stated that if the endotracheal cuff pressure was more than 30 cm of H2O with prolonged duration it can damage tracheal mucosal perfusion. Many endoscopic studies demonstrated that when the intracuff pressure exceeded or equal to 50 cm of H2O it is termed as critical perfusion pressure [9].

N_2O anaesthetic is the chief factor, which increases the intracuff pressure by easily diffusing into the cuff. [1,6,7,10] Fill *et al.* [6] and Manissery *et al.* [7] stated that inflation-deflation techniques, use of O_2 and N_20 mixture, polyurethane cuffs and liquid cuff medias can reduce this cuff pressures.

The basis of our study was that intracuff lignocaine not only prevents the diffusion of N2O intracuff but also permeates through semipermeable membrane of polyvinyl chloride cuff to provide soothing effect on tracheal mucosa and helps in reducing pressure induced necrosis, cough reflex.[1,4,11] POST syndrome which is a combination of sore throat for

scratchy throat and hoarseness which endures after surgery is over and has a significant impact on post operative outcome and patient satisfaction score [12]

The Juncture from extubation after general Anaesthesia and ensuing period are usually associated with tachycardia, Hypertension, coughing hoarseness dysphonia and sore throat. [11]

Navarro *et al*. 2007 [1] 2012 [8], Estebe *et al.* [13-16] reported that alkalinization of intracuff lignocaine increases the diffusion of its nonionized neutral base across cuff membrane from 1% to 65% within 6 h and showed that there was significant decrease in dose requirement of lignocaine in alkalinized form as compared to non-alkalinized lignocaine which inspired us to plan our study using alkalinized lignocaine to prevent endotracheal tube induced emergence phenomenon. Navarro *et al.* [1] Tanaka *et al.* [4] and Maruyama *et al.* [17] made study more authentic by avoiding external lubricant on ETT cuff which is traditionally used to assist the smooth entrance of cuff beyond vocal cords and we followed the same principle. They noted unfavourable emergence phenomenon when external lubricants were used. Maruyama *et al.* [17] that lignocaine spray contains additives like L- methanol and ethanol which could also be the factor to cause POST, Hoarseness. Navarro *et al.* [1] Tanaka *et al.* [4] found that intravenous lignocaine is many times associated with sedation or deepening plane of anaesthesia which is not acceptable at the time of extubation.

In Gp A intracuff volume during surgery increased from 3.5 ±0.63 ml to 5.8 ±0.54 ml with an increase of 2.3 ml which is statistically highly significant suggesting hyperinflation of ETT cuff with N2O with course of surgery as also depicted in study by Navarro *et al*. 1 where as such change is not appreciated in Gp L suggesting that lignocaine prevented the diffusion of N2O intracuff and it permeated through semipermeable membrane of cuff to provide soothing effect on tracheal mucosa.(Table 2a and 2b)

Despite keeping the intracuff pressure below the critical pressure of 30 cm of water at the start of surgery (just after intubation) the intracuff pressure rose from 20.48 ±0.7 to 39.86 ± 7.13 cm of H2O in Gp A where as it remained near to inflated pressure at the start of surgery in Gp L This showed a highly significant difference in the two Groups p value <0.0001 (Table 3a and 3b) these results corelated well with the studies of Navarro *et al.* [1, 8], porter *et al.* [10] Fagan *et al.* [11] bennet *et al.* [18].

Occurrence of coughing and POST at immediately (0hr), 1, 6, 12, and 24 h postoperatively was just significantly higher in Gp A in comparison to lignocaine Gp L [Table 4 and 5]. These results are coherent with the studies of Navarro *et al.* 2007 [1]. Navarro *et al.* 2012 [8]. Jaichandran *et al.* 2009 [19]. Shroff and Patil, 2009 [20]. Wetzel *et al.* [21] could not appreciate the attenuation in coughing and POST possible reason could be duration of surgery was less than 1.5 hrs Thus, using lignocaine instilled cuffs for longer duration> 1.5 hrs, surgeries would evolve better consequence proposing that diffusion across the cuff membrane is a function of time [16].

Instilled lignocaine in the cuff did not cause any depression of swallowing reflex and other protective reflexes. This has been confirmed by the study of Estebe *et al.* which stated that alkalinized intracuff lignocaine improves cuff tolerance without depressing the swallowing reflex so that the patient can protect his airway.

Conclusions

Intracuff instillation with Alkalinized lignocaine prevents the rise of intracuff pressure and intracuff volume and improves endotracheal tube induced emergence phenomenon (coughing and post operative sore throat) in comparison to traditional inflation with Air.

References

1. Navarro LH, Braz JR, Nakamura G, Lima RM, Silva Fde P, Módolo NS. Effectiveness and safety of endotracheal tube cuffs filled with air versus filled with alkalinized lidocaine: A randomized clinical trial. Sao Paulo Med J 2007;125:322-8.
2. Lam F, Lin YC, Tsai HC, Chen TL, Tam KW, Chen CY. Effect of intracuff lidocaine on postoperative sore throat and the emergence phenomenon: A systematic review and meta-analysis of randomized controlled trials. PLoS One. 2015;10:e0136184.
3. Higgins PP, Chung F, Mezei G. Postoperative sore throat after ambulatory surgery. Br J Anaesth. 2002;88:582-4.
4. Tanaka Y, Nakayama T, Nishimori M, Sato Y, Furuya H. Lidocaine for preventing postoperative sore throat. Cochrane Database of Systematic Reviews 2009;3. Art. No.: CD004081. DOI:10.1002/14651858. CD004081.pub2.
5. Sole ML, Su X, Talbert S, Penoyer DA, Kalita S, Jimenez E, *et al.* Evaluation of an intervention to maintain endotracheal tube cuff pressure within therapeutic range. Am J Crit Care. 2011;20:109-17.
6. Fill DM, Dosch MP, Bruni MR. Rediffusion of nitrous oxide prevents increases in endotracheal tube cuff pressure. AANA J. 1994;62:77-81.
7. Manissery JJ, Shenoy V, Ambareesha M. Endotracheal tube cuff pressures during general anaesthesia while using air versus a 50% mixture of nitrous oxide and oxygen as inflating agents. Indian J Anaesth. 2007;51:24-7.
8. Navarro LH, Lima RM, Aguiar AS, Braz JR, Carness JM, Módolo NS. The effect of intracuff alkalinized 2% lidocaine on emergence coughing, sore throat, and hoarseness in smokers. Rev Assoc Med Bras. 2012;58:248-53.
9. Hoffman RJ, Dahlen JR, Lipovic D, Stürmann KM. Linear correlation of endotracheal tube cuff pressure and volume. West J Emerg Med. 2009;10:137-9.
10. Porter NE, Sidou V, Husson J. Postoperative sore throat: Incidence and severity after the use of lidocaine, saline, or air to inflate the endotracheal tube cuff. AANA J. 1999;67:49-52.
11. Fagan C, Frizelle HP, Laffey J, Hannon V, Carey M. The effects of intracuff lidocaine on endotracheal-tube-induced emergence phenomena after general anesthesia. Anesth Analg. 2000;91:201-5
12. 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.
13. 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.

14. Estebe JP, Delahaye S, Le Corre P, Dollo G, Le Naoures A, Chevanne F, *et al.* Alkalinization of intra-cuff lidocaine and use of gel lubrication protect against tracheal tube-induced emergence phenomena. Br J Anaesth. 2004;92:361-6.
15. Estebe JP, Gentili M, Le Corre P, Dollo G, Chevanne F, Ecoffey C. Alkalinization of intracuff lidocaine: Efficacy and safety. Anesth Analg. 2005;101:1536-41.
16. Estebe JP, Treggiari M, Richebe P, Joffe A, Chevanne F, Le Corre P. *In vitro* evaluation of diffusion of lidocaine and alkalinized lidocaine through the polyurethane membrane of the endotracheal tube. Ann Fr Anesth Reanim. 2014;33:e73-7.
17. Maruyama K, Sakai H, Miyazawa H, Toda N, Iinuma Y, Mochizuki N, *et al.* Sore throat and hoarseness after total intravenous anaesthesia. Br J Anaesth. 2004;92:541-3
18. Bennett MH, Isert PR, Cumming RG. Postoperative sore throat and hoarseness following tracheal intubation using air or saline to inflate the cuff – A randomized controlled trial. Anaesth Intensive Care. 2000;28:408-13
19. Jaichandran V, Bhanulakshmi I, Jagadeesh V. Intracuff buffered lidocaine versus saline or air – A comparative study for smooth extubation in patients with hyperactive airways undergoing eye surgery. SAJAA. 2009;15:11-4.
20. Shroff PP, Patil V. Efficacy of cuff inflation media to prevent postintubation-related emergence phenomenon: Air, saline and alkalinized lignocaine. Eur J Anaesthesiol. 2009;26:458-62.
21. Wetzel LE, Ancona AL, Cooper AS, Kortman AJ, Loniewski GB, Lebeck LL. The effectiveness of 4% intracuff lidocaine in reducing coughing during emergence from general anesthesia in smokers undergoing procedures lasting less than 1.5 hours. AANA J. 2008;76:105-8.