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Original Research Article

Instillation of tube cuff lignocaine to reduce post-extubation morbidity– A randomized control study

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Abstract

Objectives: The use of endotracheal (ET) intubation is associated with post extubation emergence phenomenon comprising of sore throat, hoarseness and cough. This has been attributed to the physical effects of the tube cuff on tracheal mucosa, and thus any means to reduce this pressure effect can significantly improve on adverse symptoms. This study thus aims to compare the effects of instillation of air versus lignocaine into the ET tube cuff, on the post extubation morbidity.

Methods: Fifty patients were randomized into two groups of 25 members each – group A (air) and group L (lignocaine). In the former, air was filled in ET cuff, while in latter, lidocaine (4%) 5ml was instilled keeping the cuff pressure between 20-22 mmHg. Cough and hemodynamic parameters were noted at and after extubation. Extubation related morbidities were compared between the two groups.

Results: With both groups showing similar demographics, there was statistically significant difference in incidence of post-operative sore throat (60% and 22.7%, p=0.003) and hoarseness (44% and 16%, p=0.029) in group A and group L respectively. The cuff volumes of agents were found to be lesser ($p<0.05$) with lignocaine, indicating net diffusion across cuff membrane. Post operative nausea and vomiting were also appreciably reduced after lignocaine instillation (p=0.69, 0.43).

Conclusion: Instillation of Lignocaine in ET tube cuff is better in reducing post extubation sore throat, hoarseness and cough in comparison to air. It has a simple, easily reproducible and inexpensive means to alleviate emergence phenomenon.

Keywords: Endotracheal intubation; Sore throat; Hoarseness; Lidocaine; Emergence Phenomenon.

1. Introduction

Airway management with cuffed endotracheal (ET) intubation for General Anaesthesia (GA) is an integral part of an anaesthesiologist's responsibilities towards patient care. Among the sequelae inherent to the usage of cuffed ET tube are local irritation and inflammation of the airway caused by prolonged inflation of the cuff, which results in post extubation morbidities like sore throat, hoarseness of voice and cough. Sore throat is the most frequently encountered complication of GA, seen in about 30% to 70% of patients after ET intubation [1]. This is considered to be secondary to mucosal erosion caused by the cuff of ET tubes, prolonged dehydration, as well as intubation related trauma [2].

More specifically, when inflated, the pressure of the ET cuff gets transmitted to the tracheal mucosa. When cuff pressure rises beyond the tracheal artery capillary pressure, namely 30 cm H_2O, there ensues tracheal ischemia. The severity of this is in direct correlation to the pressure exerted by the cuff, contact area and duration of exposure. [3] Mucosal ischemia can further lead onto complications such as ciliary loss, inflammation, ulcers, bleeding, stenosis and tracheo-esophageal fistula.

There is a need to minimise the effect of inflated cuff on the tracheal mucosa. It was shown that a thin walled low pressure and high volume cuff preserved mucosal blood flow even at cuff pressures of 80-120 mmHg. [4] Any fluid, including saline, inflated into the cuff, could

maintain ideal volume and pressure. Lidocaine, an amide local anaesthetic agent, has been studied to diffuse from intra-cuff reservoir, and thus have a soothing effect on the mucosa. When lidocaine is injected into the ET cuff, it spreads through the semi-permeable membrane wall [5] and induces anaesthetic action in the trachea. This thereby reduces the incidence of coughing and minimizes hemodynamic alterations during intubation. [6] Moreover, increasing the alkalinity of lidocaine with sodium bicarbonate tends to increase its diffusion capacity through the ET cuff, thus permitting lower dosage of the drug. [7,8]

The aim of this study therefore, is to ascertain the efficacy of intra-cuff instillation of 4% lidocaine in the management of post-extubation morbidity, namely sore throat, cough, hoarseness, etc; and to compare its benefits over tradition air filled cuffed ET tubes. Simultaneously, the occurrences of post-operative nausea and vomiting (PNV) were also studied and compared.

2. Materials and methods

This prospective study was conducted in the Anaesthesiology department in a tertiary hospital in central India during the period September 2015 to March 2016. The clearance for the study was obtained from the Institutional Ethics Committee concerned, and each enrolled patient gave their written informed consent to participate. 50 patients were randomized via simple lottery method into 2 groups of 25 each – Group A (air filled ET cuff) and Group L (lidocaine filled cuff). Patients between ages of 18 to 50 years, within American Society of Anaesthesiologists (ASA) grade 1 and 2, undergoing surgical procedure requiring GA of one to three hours duration, were included in the study. Exclusions to the study included extremes of age groups, smokers, pregnant women, recent upper airway infections, hypersensitivity to lignocaine and associated co-morbid cardiac, respiratory, neurological or metabolic complications.

All the enrolled patients underwent a prescribed anaesthetic protocol: They were first premedicated with intravenous glycopyrolate 0.2mg, midazolam 0.05mg/kg, and fentanyl 2mcg/kg. Induction was carried out with propofol 2mg/kg i.v. and muscle relaxation with vecuronium. The endotracheal tube used was made of polyvinylchloride material, a high volume low pressure tube of internal diameter varying from 7 to 8.5, varying according to size of patient airway. The syringes with different agents i.e. air (Group A) and lignocaine 4% (Group L) - 5 ml each were prepared and inflated in the endotracheal tube cuff after intubation as per randomization. Anaesthesia was maintained on O_2/N_2O and sevoflurane. Post surgical reversal was achieved with neostigmine and glycopyrolate. Before extubation, cuff was deflated and the volume of aspirated agent was documented.

The patient was evaluated at extubation and for a period of one hour thereafter in the recovery room. The incidence of post-operative nausea, vomiting, dysphonia, hoarseness and sore throat was noted 24 hours after the completion of surgery and graded as per patient's subjective evaluation. Any differences in groups were subject to statistical analysis, with significance represented by p – value. ($p < 0.05$ considered as statistically significant)

3. Results

The two allotted groups were almost similar in demographics, with comparable mean age of 37.2 yrs for group A and 38.4yrs for group L. Sex ratio showed a similar distribution among groups, with females comprising about 44% and 40% in Group A and L respectively. Mean body weight was measured as 67.6kg for the air group and 72.1 kg for the lignocaine group. The difference in mean duration of anesthesia in surgery was also statistically insignificant ($p > 0.05$) between the groups. [Table 1 & Figure 1] Majority of the patients in both groups, 81% in Group A and 88% in Group L were ASA grade 1.

The incidence of post-operative sore throat was greater in Group Air, with 60% of patients developing the complication, compared to 22.7% patients in Group Lignocaine. ($p = 0.003$) Similarly, 44% of patients in Group Air had hoarseness of voice and dysphonia, compared to 16% in Group Lignocaine. ($p = 0.029$) These differences were noted both at the immediate time of extubation, and after one hour in the recovery; on both occasions the differences were statistically significant. ($p < 0.05$) On evaluation at 24 hrs post extubation, the observations showed 30% of patients in Group A and 18% in Group L, having persistent symptoms. ($p = 0.008$)

Post-operative nausea and vomiting was present in about 30-35% of patients in Group Air, whereas in Group Lignocaine, the corresponding value was only 20 % ($p = 0.69, 0.43$). The incidence of agitation at the time of endotracheal extubation was considerably less in the lignocaine group ($p = 0.022$) than in the air group. [Table 2]

When the volumes of agent removed from the cuff were studied, there was a notable rise in the volume removed in relation to the volume injected when air was used, with a mean instillation of 5ml and mean removal of 7ml air from the cuff. In contrast, in the lignocaine group, the volume extruded from the cuff (average 4ml) was always lesser than the volume instilled (average 5ml). This was found to be statistically significant with $p < 0.05$. [Table 3] This indicates the possible diffusion of lignocaine out of and air into the cuff membrane.

Table 1: Patient demographics

Variable	Group(n=50)		p Value
	Air (n=25)	Lidocaine (n=25)	
Mean Age (in yrs)	37.2	38.4	0.43
Sex (M:F)	14:11	15:10	0.92
Mean Weight (in Kgs)	72.1	67.6	0.28
Mean Duration (in min)	136.4	140.2	0.07
ASA Grade (1:2)	18:7	20:5	0.33

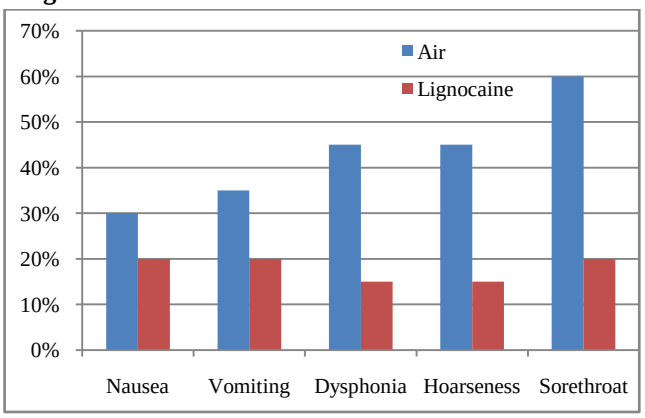
Table 2: Comparison of incidence of comorbidities between two groups

Study Factors	Group A	Group L	p Value
Nausea	8 (30%)	5 (20%)	0.659
Vomiting	9 (35%)	5 (20%)	0.43
Dysphonia	11 (45%)	4 (15%)	0.029
Hoarseness	11 (45%)	4 (15%)	0.029
Sore throat	15 (60%)	5 (20%)	0.003

Table 3: Volume of agent removed from endotracheal tube cuff

Cuff Status	Mean Volume of Agent within Cuff		Result
	Group Air	Group Lidocaine	
Instilled	5 ml	5ml	Air = Lidocaine
Removed	7ml	4ml	Air > Lidocaine
Result	Removed > Instilled	Instilled > Removed	

Figure 1: Incidence of Post-extubation Comorbidities



4. Discussion

Lignocaine as a topical agent in the management of local complications of ET intubation was studied by Hashimoto *et al* in 1981 in Japan.[9] However, the first ever reports of managing post operative sore throat and cough using the intra-cuff instillation of lignocaine were the works of Gonzales *et al* (1993) and Tunink *et al* (1994). Both these groups studied the effect of this novel therapy on immediate post extubation cough and bucking. [10,11] This led the subsequent researchers to identify the causal relationship, as well as mechanism of action of the topically administered lignocaine.

The aetiology is believed to be secondary to mucosal erosion from the cuff of the ET tube [12]; trauma from bucking and coughing; frictional rub between the mucosal and tube; and mucosal dehydration [2]. Direct laryngoscopy or tube adjustments may stimulate the sensory C fibres and produce secondary neuroplasticity, which results in post-operative sore throat and cough. Lignocaine in the ET tube cuff has physical and pharmacological actions during and after surgery, by preventing mucosal trauma and erosion. Lignocaine has also been found to suppress the stimulation of nociceptive sensory C fibres [13] and reduce the release of sensory neuropeptides such as tachykinins that produce broncho-constriction [14].

The aetio-pathological factors mentioned above can be attributed directly or indirectly to ET tube cuff pressures. In fact, the design and sizes of ET tubes used may be important factors for consideration. [15] Cuff pressure measurement, although indicated by the pressure on the pilot balloon of the tube, is not routinely performed; and when done, tends to give false negative readings for elevated pressures. [16,17] A study by Navarro *et al* in 2007 found significantly lower cuff pressures when lignocaine was used compared to air, with the air filled cuff showing rise in pressure over time. [2] This translated into reduced agitation during extubation, and post-operative nausea, sore throat and vomiting in the lignocaine group.

Several studies have shown the comparative effects of the two groups, with Bennet *et al* (2000) showing significant symptomatic relief with lignocaine [18]; and Husson *et al* (1999) showing similar improvements that were not statistically significant [19]. Lignocaine as an agent to combat post extubation morbidity was studied by Soltani *et al* (1999) via different routes of administration; with intracuff drug delivery found to be the most effective in this regard. [20] The meta-analysis conducted by Tanaka *et al* favored lignocaine therapy for controlling the risk and severity of post-operative sore throat. [1] Hence our study is found to corroborate with most of the findings in various studies.

Certain limitations have crept into our study. Firstly, the severity of sore throat, cough and hoarseness were scored on the patient's subjective assessment. Husson *et al* had used the McGill pain score [19] whereas other studies formulated their own scoring systems for this purpose. Moreover, the hemodynamic effects of lignocaine during extubation were not included in the study design; inclusion of which could have broadened the perspectives of increased use of this therapy.

5. Conclusion

The high incidence of post extubation comorbities, including sore throat, hoarseness and PNV, is a major deterrent in the normal post-operative recovery of patients from GA. The simple and reproducible technique of instilling 4 % lignocaine into the ET tube cuff has shown to cause local soothing effects to tracheal mucosa, and eventual relief in comorbid symptomatology. Although further detailed studies will be necessary to estimate maximum dose permissible and probable toxic potential, current usage of lignocaine instillation as per guidelines that we have followed in this case is safe, inexpensive and efficacious for the general community.

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