Section: Anaesthesiology

Original Research Article

A COMPARATIVE STUDY OF THE EFFECT OF ENDOTRACHEAL TUBE INTRACUFF AIR, PLAIN LIGNOCAINE, AND ALKALINIZED LIGNOCAINE ON THE INCIDENCE OF POST-INTUBATION SORE THROAT

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Abstract

Background: Postoperative sore throat, affecting up to 90% of intubated patients, arises from factors such as ET tube size, cuff pressure, and intubation duration, with high intracuff pressure exacerbated by nitrous oxide use. This study aimed to determine and compare the effects of intracuff air, intracuff plain lignocaine, and intracuff alkalinized lignocaine in decreasing post-intubation sore throat and cough in all groups. **Materials and Methods:** This single-centre cross-sectional study included 150 patients at the Government Medical College of Tirunelveli over 2 years. Patients undergoing elective surgery under general anaesthesia were divided into three groups: group A (ETT cuff filled with air), group B (ETT cuff filled with plain lignocaine), and group C (ETT cuff filled with alkalinized lignocaine). The degree of sore throat was assessed using a visual analogue scale, and the incidence of cough, restlessness, dysphonia, hoarseness, and hemodynamic parameters was recorded. **Result:** No significant differences were observed in age, sex, or procedure duration. The post-deflation air volume and pain scores differed significantly ($p<0.001$). Pulse rate differed significantly during extubation and postoperatively at 1, 2, and 24 h ($p<0.05$). SBP varied significantly during extubation and at 1 h ($p<0.05$), whereas DBP differences were noted only during extubation ($p<0.001$). Group C had the lowest incidences of cough, restlessness, dysphonia, hoarseness, and sore throat. Significant differences were observed at all symptom time points, with Group C showing reduced postoperative discomfort. **Conclusion:** When the ETT cuff inflation medium was alkalinized lignocaine rather than plain lignocaine or air, the incidence of tracheal intubation side effects such as hemodynamic abnormalities, restlessness, dysphonia, and hoarseness was reduced.

INTRODUCTION

The most frequent complaint following tracheal intubation is a postoperative sore throat, which affects 90% of intubated patients.[1] Emergence from general anaesthesia is frequently complicated by endotracheal tube-induced coughing. This may lead to potentially hazardous patient movements, hypertension, tachycardia or other arrhythmias, myocardial ischemia, surgical bleeding, bronchospasm, and an increase in intracranial and intraocular pressures. Intubations are frequently accompanied by laryngeal oedema and ischemia.[2,3] The causes of postoperative sore throat include ET tube size, lateral wall pressure, movement, and hypotension. Both lateral wall pressure and intubation time have an impact on tracheal injury caused by the cuffs. When the cuff applies a pressure of more than 30 cm of water, tracheal mucosal pressure decreases. The ideal pressure was that the ETT cuff applied to the tracheal wall was high enough to avoid air leaks and aspiration of regurgitated stomach contents, and low enough to permit adequate capillary mucous membrane blood flow. To prevent ischemic damage, endotracheal tube cuff pressure should be maintained below the mean mucosal capillary perfusion pressure. The most significant cause of the high incidence of excessive intracuff pressure during the intraoperative period is the use of nitrous oxide during general anaesthesia,

which is known to diffuse into endotracheal tube cuffs.

An ETT-induced cough can make it more difficult to avoid general anaesthesia. Presumable mechanisms include irritant or stretching sensations in the trachea caused by the tube and cuff. The tracheal mucosa's rapidly adapting stretch receptors (RAR) are thought to be the irritating receptors responsible for the cough reflex.[4,5] Local anaesthetics that are applied topically inhibit these receptors. Lignocaine diffused across the ETT cuff. Polyvinyl chloride (PVC) is a hydrophobic chemical compound that is frequently used to manufacture ETT cuffs. The diffusion of lignocaine was slow. The diffusion of lignocaine through the ETT cuff follows a mechanism like that of the epidural space.[6]

Lignocaine can be found as an ionized cation or non-ionized free base. Penetration and diffusion over the cuff are improved when the non-ionized fraction of lignocaine is increased. The percentage of the non-ionized form reliably increases as the pH of the solution increases.[7,8] The alkalinization of lignocaine enhances the diffusion capacity through the ETT cuff, according to earlier studies. Intracuff alkalinized lignocaine and plain lignocaine were used to compare the incidence of post-intubation sore throat.

Aim

This study aimed to determine and compare the effects of intracuff air, intracuff plain lignocaine, and intracuff alkalinized lignocaine in decreasing post-intubation sore throat and cough and to compare the incidence of side effects of tracheal intubation, such as hemodynamic changes, restlessness, dysphonia, and hoarseness, in all groups.

MATERIALS AND METHODS

This single-centre cross-sectional study included 150 patients in the Department of Anaesthesiology at the Government Medical College of Tirunelveli over two years. This study was approved by the Institutional Ethics Committee before initiation, and informed consent was obtained from all patients.

Inclusion Criteria

Patients in the age group of 18-60 years, irrespective of sex, belonging to ASA grades I, II, and III, who underwent elective surgeries from 90 min to 210 min under general anaesthesia with endotracheal intubation were included.

Exclusion Criteria

Patients aged < 18 and > 60 years, irrespective of sex, belonging to ASA grade IV, V, VI, documented hypersensitivity to lignocaine, predicted difficult intubation, could not be intubated in the first attempt, had a history of recent sore throat, recurrent history of tracheitis or laryngitis, history of Asthma and COPD, smoking, elective ventilation after surgery, and head and neck surgeries were excluded.

Methods

The patients were divided into three groups. Group A was the control group, in which the ETT cuff was filled with air, group B was filled with plain lignocaine, and group C was filled with alkalinized lignocaine (2% lignocaine and 8.4% sodium bicarbonate (10:1)).

Patients were premedicated with an intramuscular injection of glycopyrrolate (4μg/kg) and midazolam (0.05 mg/kg) 45 min before surgery. Patients were connected to standard monitoring devices, and ranitidine (50 mg) and ondansetron (4 mg) were administered intravenously. Propofol (2 mg/kg), Fentanyl (2μg/kg), and atracurium (0.5 mg/kg) were used for induction, and inhalational agents were isoflurane and nitrous oxide. Endotracheal intubation was performed using an appropriately sized ETT with a high-volume, low-pressure PVC cuff.

The ETT cuff was inflated to the minimal occlusive volume to prevent air leakage; in group A, the cuff was inflated with air; in group B, the cuff was inflated with 2% lignocaine; and in group C, the cuff was filled with a mixture of 2% lignocaine and 8.4% sodium bicarbonate (10:1). Anaesthesia was maintained using inhalational agents and intermittent doses of fentanyl (2 μg/kg) and atracurium (0.1 mg/kg). The neuromuscular blockade was reversed with neostigmine (50 μg/kg) and glycopyrrolate (20 μg/kg). Patients were extubated after all the following criteria were met: full reversal of neuromuscular blockade, spontaneous ventilation, ability to follow verbal commands, eye opening, and hand grip.

The degree of sore throat was assessed in the postoperative recovery room using a visual analogue scale (VAS 0-100 mm). Patients were asked to point to different facial expressions depicted on the VAS scale, which quantified different degrees of pain. Cough and restlessness were assessed during extubation and 24 h after extubation (1, 2, 12, and 24 h). Other evidence of throat discomfort, such as hoarseness, restlessness, and dysphonia, was evaluated, and hemodynamic parameters were recorded. The volume of air or liquid used to inflate the cuff was noted and the volume retrieved during extubation was recorded.

Statistical analysis: Data are presented as mean, standard deviation, frequency, and percentage. Continuous variables were compared using an independent sample t-test and analysis of variance (ANOVA). Categorical variables were compared using Pearson's chi-square test. Significance was defined as P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Corp., Armonk, NY, USA).

RESULTS

There were no significant differences in age, sex, or duration of the procedures between the groups (p=0.993, p=0.651, p=0.232). The mean volume of air required for inflation and retrieved after deflation was significantly different between the groups (p=0.055 and p<0.001, respectively) [Table 1].

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There were significant differences in the mean pulse rates during extubation at 1, 2, 12, and 24 h between the groups (p<0.001, p=0.003, p=0.060, p=0.044, and p=0.005, respectively). There were no significant differences in preoperative values between the groups (p=0.234) [Figure 2].

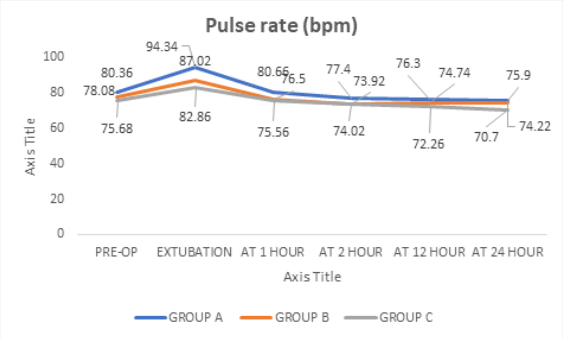

Figure 1: Comparison of pulse rate (bpm) in groups of patients

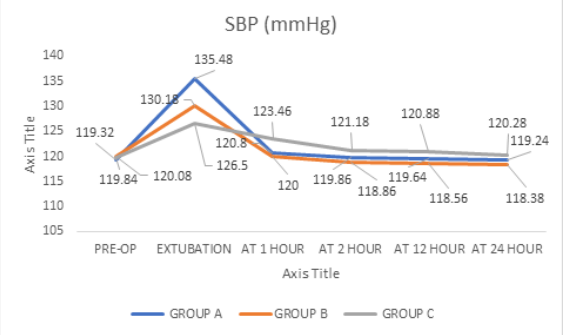

Figure 2: Comparison of SBP (mmHg) in groups of patients

There were no significant differences in the mean SBP rate preoperatively and at 2, 12, and 24 h between the groups (p=0.865, p=0.026, p=0.221, p=0.238, and p=0.366, respectively). There were significant differences in the mean values during extubation and at 1 h between the groups (p<0.001 and p=0.026, respectively) [Figure 2].

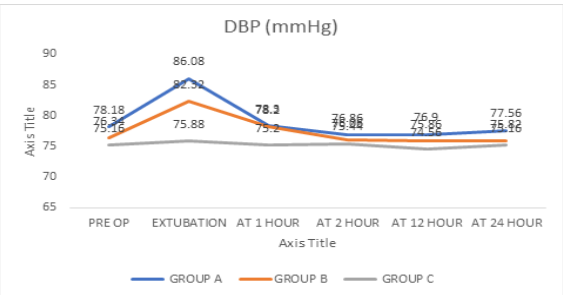

Figure 3: Comparison of DBP (mmHg) in groups of patients

There were no significant differences in the mean DBP rate preoperatively and at 1, 2, 12, and 24 h between the groups (p=0.151, p=0.072, p=0.198, p=0.241, and p=0.620, respectively). There were significant differences in the mean values during extubation between groups (p<0.001) [Figure 3].

There were significant differences in the mean pain scores at 1, 2, 12, and 24 h between the groups (p<0.001) [Figure 4].

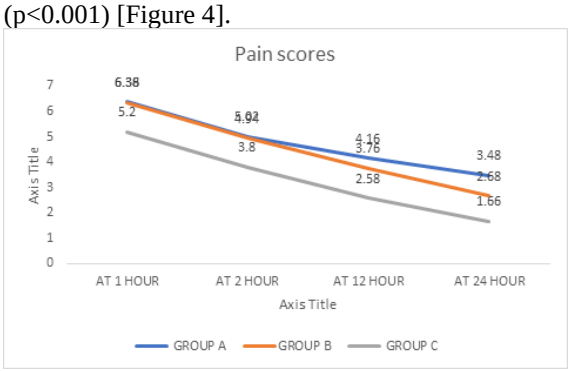

Figure 4: Comparison of pain scores in groups of patients

In group A, 44 (88%) coughed at the time of extubation and 31 (62%) after one hour. 24 (84%) patients in group B experienced cough, compared to 32 (64%) patients in group C at extubation. All three groups experienced steadily declining cough. At 24 h after extubation, nine patients in group A and one patient in group B experienced coughs. After 12 hours, there was no coughing in Group C. There were significant differences in the incidence of cough between the groups during extubation (p=0.005) and at 1 h, 2 h, 12 h, and 24 h (p<0.001, p<0.001, p<0.001, p<0.001).

At extubation, 40 (80%) patients in group A, 36 (72%) in group B, and 24 (48%) in group C were restless. Group C showed no signs of restlessness two hours after extubation. The restlessness decreased in both the C and B groups after 24 h. Restlessness was significantly different between the groups during extubation (p<0.001) and at 1, 2, and 12 h (p<0.001, p<0.001, and p=0.02, respectively), and there were no significant differences at 24 h (p=0.0078).

After one hour, dysphonia was observed in 11 (22%) patients in group A, and at 24 h, it dropped to 4 (8%). At one hour after extubation in group B, 13 (26%) patients exhibited dysphonia, while at 24 h, only one patient had dysphonia. At 1 h, seven (14%) individuals in group C exhibited dysphonia, and there was no incidence beyond that. For Dysphonia, there were significant differences between the groups at 2 h (p<0.001), but there were no significant differences at 1, 12, or 24 h (p=0.370, p=0.004, and p=0.030, respectively).

At one hour, 26 (52%) patients in group A, 14 (28%) in group B, and 14 (28%) in group C had post-extubation hoarseness. After 12 hours, there was no hoarseness in Group C. There were significant differences in hoarseness between the groups at 1, 2, 12, and 24 h (p=0.02, p<0.001, p=0.001, p=0.034).

At 12 h, 34 (68%) patients in group A, 29 (58%) patients in group B, and 10 (20%) patients in group C reported sore throats. At 24 h, 18 (36%) patients in group A developed sore throat compared to 22% in group B. There were significant differences in sore

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throat between the groups at 12 h and 24 h (p=0.001 and p=0.001, respectively) [Table 2].

Table 1: Comparison of intraoperative parameters and post-deflation outcomes among groups.

	Group A	Group B	Group C	P value
Age in years (Mean ± SD)	41.38 ± 9.57	41.46 ± 9.49	41.60 ± 9.52	0.993
Male: Female	28:22:00	29:21:00	26:24:00	0.651
Duration of procedure (minutes)	130.6 ±22.71	138.50 ± 24.63	132.2 ± 25.52	0.232
For Inflation	3.90±0.49	3.69±0.45	3.76±0.32	0.055
After deflation	4.39±0.52	3.51±0.51	3.39±0.30	<0.001

Table 2: Comparison of postoperative symptoms in groups of patients

		Group A	Group B	Group C	P value
Incidence of cough (hour)	During extubation	44 (88%)	42 (84%)	32 (64%)	0.005
	At 1	31 (62%)	16 (32%)	11 (22%)	< 0.001
	At 2	19 (38%)	8 (16%)	3 (6%)	< 0.001
	At 12	12 (24%)	4 (5%)	0	< 0.001
	At 24	9 (18%)	1 (2%)	0	< 0.001
Restlessness (hour)	During extubation	40 (80%)	36 (72%)	24 (48%)	< 0.001
	At 1	23 (46%)	11 (22%)	6 (12%)	< 0.001
	At 2	13 (26%)	6 (12%)	0	< 0.001
	At 12	7 (14%)	5 (10%)	0	0.02
	At 24	4 (8%)	4 (8%)	0	0.078
Dysphonia (hour)	At 1	11 (22%)	13 (26%)	7 (14%)	0.37
	At 2	14 (28%)	1 (2%)	0	< 0.001
	At 12	6 (12%)	1 (2%)	0	0.004
	At 24	4 (8%)	1 (2%)	0	0.03
Hoarseness (hour)	At 1	26 (52%)	14 (28%)	14 (28%)	0.02
	At 2	16 (32%)	5 (10%)	1 (2%)	< 0.001
	At 12	10 (20%)	2 (4%)	0	0.001
	At 24	4 (8%)	0	0	0.034
Sore throat (hour)	At 12	34 (68%)	29 (58%)	10 (20%)	0.001
	At 24	18 (36%)	11 (22%)	0	0.001

DISCUSSION

In our study, we compared the incidence of post-intubation sore throat between intra-cuff alkalinized lignocaine and plain lignocaine. The main finding of this study was that alkalinized lignocaine significantly reduced the incidence of post-intubation sore throat. As the air volume increased during extubation owing to diffusion, the air volume required to inflate the cuff was higher than the liquid volume. No significant difference was observed in the liquid volume used for cuff inflation between groups B and C, although the amount of liquid drawn from the cuff was lower in group C.

At extubation, 88% of Group A, 84% of Group B, and 64% of Group C experienced coughing, while Group C showed a significant reduction over time. The incidence of cough declined steadily in all groups, with significant differences noted at extubation and 1, 2, 12, and 24 h (p<0.001). Restlessness was observed in 80% of the patients in Group A 72% in Group B, and 48% in Group C at extubation; group C showed no restlessness after 2 h. Significant differences in restlessness were observed at extubation and 1, 2, and 12 h (p<0.001, p<0.001, and p=0.02, respectively), with no significant difference at 24 h (p=0.078). Dysphonia was more prevalent in groups A and B at 1 h, with significant differences at 2 h (p<0.001); however, no significant differences were observed at 1, 12, or 24 h. Hoarseness was higher in groups A (52%) and B (28%) at 1 h, with significant differences at 1, 2, 12, and 24 h (p=0.02, p<0.001, p=0.001, p=0.034). The sore throat was most common in group A at 12 h (68%), with significant differences between the groups at 12 and 24 h (p=0.001).

In Rao et al.'s study, 90% of intubated patients experience postoperative sore throat, the most frequent complaint following tracheal intubation.1 In the Altintas et al. study, tracheal tube insertion can cause hematomas, mucosal laceration or granulomas, or injury to the cartilage of the arytenoids in the upper respiratory tract.[9]

In a study by Seegobin et al., factors such as tube size, tube design, lateral wall pressure, intracuff pressure, tube lubricant use, hypotension, local infection, steroid use, and intubation duration were associated with sore throat. At lateral wall pressures above 30 cm of water (22 mmHg), evidence of mucosal blood flow obstruction was observed. At lateral wall pressures above 37 mmHg, the flow to the mucosa across the tracheal rings and posterior tracheal wall was completely blocked. Large-volume cuffs have been theorised to have a sparing impact on capillary blood flow over cartilaginous rings by draping the intercartilaginous mucosa and exerting pressure on the arterioles in the intercartilaginous submucosa, hence increasing the effective perfusion pressure.[10]

Tu et al. concluded that lateral wall pressure, which affects tracheal capillary blood flow, is a significant component of tracheal morbidity, and that tracheal mucosal erosion may be reduced by ongoing monitoring and avoiding high lateral wall pressures. After air inflation, the cuff pressure and volume

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increased over time. When employing nitrous oxide for anaesthesia, the cuff pressure rises as the cuff's temperature rises and nitrous oxide diffuses into it more quickly than it does so.[11] Sconzo et al. over-inflation of the ETT has been linked to laryngeal nerve palsy and pharyngeal mucosa injury.[12] Ahmad et al. also caused increased receptor stimulation in the tracheal mucosa and thus increased emergence and extubation phenomena and complications were decreased by filling the ETT cuff with liquid.[13]

According to Matias, in vitro experiments, lignocaine's diffusion is significantly (63-fold) improved by alkalinization.[14] Estebe et al. studies in vivo and at modest doses (40 mg) have demonstrated a reduction in postoperative side effects.[15] Dollo et al. studies have demonstrated that the dose of lignocaine used between 20 and 40 mg relates to the amount of lignocaine diffusing through the ETT cuff when NaHCO3 is present.[16]

Soltani et al. reported that coughing may stop or start as a patient emerges from an intravenous bolus of lignocaine, and the serum level drops. If adequate cough suppression and a fully awake patient are sought at the same time, the ideal timing of treatment during emergence may be challenging because of the limited antitussive window of intravenous lignocaine. Although lignocaine has been used to lubricate ETTs, it exacerbated ETT-induced emergence phenomena from anaesthesia whether applied as a spray or jelly.[17] Walmsley et al. found that the incidence of tracheal tube cuff rupture was noted in 30 polyvinyl chloride tracheal tubes lubricated with three different solutions. All cuffs moistened with water were intact after 2 h of cuff inflation, whereas two I0 cuffs lubricated with a 4% lignocaine solution burst. Both had leaked at the site of the cuff attachment to the tube.[18]

CONCLUSION

Our study showed that using alkalinized lignocaine instead of plain lignocaine or air to inflate the ETT cuff resulted in a lower incidence of sore throat during the postoperative period. When the ETT cuff inflation medium was alkalinized lignocaine rather than plain lignocaine or air, the incidence of tracheal intubation side effects, such as hemodynamic abnormalities, restlessness, dysphonia, and hoarseness, was reduced.

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