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Comparative study of effect of intracuff alkalinized lignocaine with intracuff air for prevention of postoperative sore throat

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Abstract
Background: Alkalinized intracuff lignocaine has lower incidence of post extubation sore throat and also has decreased haemodynamic response to extubation when compared to intracuff air. Alkalinized lignocaine also maintains a stable cuff pressure during oxygen nitrous anaesthesia.
Methods: 100 healthy patients of both sexes, aged between 18-50 years, ASA physical status I & II, scheduled for elective surgeries were divided into 2 groups of 50 patients each as Group A (intracuff Alkalinized lignocaine, n=50) and Group B (intracuff air, n=50) by a computer generated randomized table. Immediately after extubation patient was assessed for sore throat, heart rate, blood pressure at 1hour and 24 hours.
Results: In group A the mean cuff pressure at the end of surgery was 19.96±0.727. In group B the mean cuff pressure at the end of surgery was 38.58±8.129. 14% had sore throat after 1 hour in group A as compared to 36% in group B. At 24 hour the incidence of sore throat in group A was 12 % as compared to 52% in group B.
Conclusion: Alkalinized intracuff lignocaine has lower incidence of post extubation sore throat and also has decreased hemodynamic response to extubation when compared to intracuff air. Alkalinized lignocaine also maintains a stable cuff pressure during oxygen nitrous anaesthesia.

Keywords: cardiovascular system, sore throat, drug synergism, alkalinized lignocaine, sodium bicarbonate

Introduction

The laryngoscope is held in left hand and introduced into the right hand side of the mouth. The tongue is swept to the left and the tip of the blade is advanced until a fold of cartilage is visualised at 12 O' clock. This is the epiglottis and this sits over the glottis. The tip of blade is advanced to the base of epiglottis, known as the vallecula, and the entire laryngoscope is lifted upwards and outwards. This flips the epiglottis upwards and exposes the glottis below. An opening is seen with two white cords forming a triangle on each side.

The tip of the endotracheal tip is advanced through the vocal cords to the sufficient length. The correct position of the tube is confirmed by auscultation & $EtCo_2$ monitor. The tube is secured at this level and the cuff is inflated. Cuffed endotracheal intubation offers additional safety to the patient by preventing aspiration syndromes. However, amongst the squealed inherent to the usage of cuffed endotracheal tube, the ischaemic injuries to the tracheal mucosa caused by prolonged cuff inflation and the resulting increase in cuff pressure are the prominent ones which result in post intubation morbidities like sore throat, difficulty in swallowing and hoarseness.

Tracheal cuff pressure should always be maintained below the mean capillary perfusion pressure of 30cm H_2O to prevent ischemic damage. Obstruction to the tracheal mucosa flow begins at 30cm H_2O and becomes absolute at 45-50cm H_2O. Endotracheal extubation occurs at the end of general anaesthesia and patients are usually in the lighter planes of anaesthesia. Hence a lot of problems are encountered during endotracheal extubation. These problems could range from mild sore throat to severe hemodynamic changes that can even result in catastrophe. Sore throat during endotracheal extubation is presumed to be due to the irritant or stretch stimuli caused by the tube and its cuff. Rapidly acting receptors are found throughout trachea and are primarily superficial. Sore throat and cardiovascular response can lead to variety of complications like Bronchospasm, surgical site bleeding, myocardial ischemia, arrhythmias, and increased intraocular and intracranial pressure.

Many studies have been performed and published exploring the measures to minimize/eliminate post intubation morbidities, viz, Use of high volume-low pressure cuffed endotracheal tubes, Use of smaller sized endotracheal tubes, Use of lidocaine by various routes, Topical application of lubricant jelly.

In some of recent studies done they have shown that lignocaine can be used intracuff and this serves as a reservoir and also allows diffusion of lignocaine molecules through the cuff to the tracheal mucosa at a constant rate.

Material and Method

The present study entitled "Comparative Study of Effect of

Intracuff Alkalinized Lignocaine with Intracuff Air for Prevention of Postoperative Sore Throat" was carried out in the department of anaesthesiology MGM Medical College and M.Y. Hospital, Indore. The study was done in 100 healthy patients of both sex, aged between 18-50 years of ASA grades I & II, scheduled for elective surgical procedures, after approval from institutional ethical committee.

Criteria for inclusion of patients

1. ASA grade I & II, Age between 18-50 years, Wt. 40-80 Kg
2. Patient undergoing General surgery, orthopaedic, gynaecological, neurosurgery operations.

Criteria for exclusion of patients

1. Difficult airway: Mallampatti III/IV
2. History suggestive of Gastro oesophageal reflux
3. Patients with h/o laryngeal or tracheal surgery and h/o asthma, cardiovascular disease
4. Patients with h/o smoking, recent respiratory infections.
5. Patients who need nasogastric tube intraoperatively.
6. Surgery lasting less than 40 min.

All patients received uniform premedication of inj. Glycopyrrolate 0.2 mg IM ½ hr before start of anaesthesia.
After the patient was admitted to operation room an electrocardiogram (ECG), non-invasive manometer, pulse oximeter, $EtCO_2$ were attached to the patient.

Patients were randomly divided into 2 groups of 50 each. The groups were as follows

Group A: Patients whose endotracheal tube cuff was applied with alkalinized lignocaine 2ml (40 mg) made alkalinized with 1.4% sodium bicarbonate 3ml.

Group B: Patients whose endotracheal tube cuff was filled with air.

Technique: Standard monitors were attached to all patients which included ECG, NIBP, SPO_2, $EtCO_2$. Study subjects were premedicated with Injection Glycopyrrolate 0.005mg/kg body weight, Inj. Midazolam 0.05mg/kg body weight, Inj. Fentanyl 2microgram/kg body weight. Baseline hemodynamic parametersnoted. Patients preoxygenated with 100% oxygen for 3 min. Patients induced with Injection propofol 2mg/kg body weight, Injection atracurium 0.5mg/kg body weight to facilitate tracheal intubation. Tube size of 7.5mm was used in females and 8.5mm in males. For group A alkalinized lignocaine was applied and in group B patients, endotracheal tube was inflated with a syringe, with air as inflating agent and the cuff pressure set at 20cm of water with a *Rush endotest cuff inflator*. For group B amount of air required to attain set cuff pressure i.e. 20cm H_2O was measured and the same amount of alkalinized lignocaine injected to inflate the cuff. Anaesthesia maintained with Nitrous: Oxygen (35:65), Inj atracurium $1/4^{th}$ the intubating dose depending on $EtCO_2$ changes. Lungs mechanically ventilated with tidal volume of 8-10ml/kg body weight. Pulse oximeter, non-invasive blood pressure, ECG, $EtCO_2$ monitored. Immediately after extubation patient assessed for sore throat, heart rate, blood pressure at 1 hr& 24 hr. Sore throat recorded as either occurred or not occurred by another anaesthesiologist who was not present at the time of intubation (Blinding).
Appropriate statistical analysis was done with the help of SPSS version 21. Demographic data and hemodynamic data was analysed by using Unpaired Student t test and chi square test. The incidence of sore throat compared using the Test of proportions.

Results

Table 1: Distribution of Age and Weight

Groups	Age (IN YRS) (Mean ± SD)	Weight (IN KGS) (Mean ± SD)
Group A	37.26±9.84	57.10±8.24
Group B	34.32±9.36	56.02±9.22
'p value'	0.129	0.539

The mean age in group A was 37.26±9.84 and in group B was 34.32±9.36. The mean weight in group A was 57.10±8.24 and in group B was 56.02±9.22 and was comparable, with insignificant 'p' value.

Table 2: Distribution of Sex

Groups	Male	Female
Group A	30	20
Group B	30	20

The distribution of sex was similar in both the groups with 30 males and 20 females. Both the groups were comparable and were statistically insignificant.

Table 3: Duration of Anaesthesia

Groups	Duration (In Minutes)
Group A	162.70±78.35
Group B	141.10±62.70
'p' value	0.131

The mean duration of anaesthesia in the group A was 162.70±78.35 and in group B was 141.10±62.70 were comparable and an insignificant 'p' value (0.131).

Table 4: Comparison of Cuff Pressure

Groups	Cuff Pressure (Start)	Cuff Pressure (End)
Group A	20.00±0.00	19.96±0.727
Group B	20.00±0.00	38.58±8.129
'p' value		<0.000

In group A the mean cuff pressure at the end of surgery was 19.96±0.727. In group B the mean cuff pressure at the end of surgery was 38.58±8.129. The groups were incomparable and had a significant 'p' value (<0.000)

Table 5: Incidence of Cough within 1 Hour

Groups	Yes	No	Total
Group A	7	43	50
Group B	18	32	50
Total	25	75	100

*χ^2=6.453 df =1 p=0.011

Seven patients (14%) had sore throat after 1 hour in alkalinized lignocaine group (group A) as compared to 18 patients (36%) in intracuff air group. (group B).

Table 6: Incidence of Cough within 24 Hours

Groups	Yes	No	Total
Group A	10	40	50
Group B	22	28	50
Total	32	68	100

*χ^2=18.382 df =1 p=0.000

At 24 hour the incidence of sore throat with alkalinized lignocaine was 12% as compared to 52% in intracuff air group. There was a significant statistical difference between the alkalinized lignocaine group and intracuff air group.

Table 7: Comparison of Heart Rate

Groups	0 min (Mean±SD)	30 min (Mean±SD)	60 min (Mean±SD)	90 min (Mean±SD)	120 min (Mean±SD)
Group A	82.70±9.61	96.06±11.11	95.02±8.83	90.60±10.75	84.68±9.859
Group B	102.18±11.20	82.06±9.34	102.18±11.2	101.86±11.25	95.02±10.65
'p' value	0.080	0.000	0.001	0.000	0.000

The heart rate at 0 min was 82.70±9.61 and 102.18±11.20 in groups A and B respectively, were comparable and statistically insignificant. Heart rates at 30 min, 60 min, 90 min and 120 min were 96.06±11.11, 95.02±8.83, 90.60±10.75 and 84.68±9.859 for group A respectively and 82.06±9.34, 102.18±11.2, 101.86±11.25 and 95.02±10.65 respectively for group B which were statistically significant (p value<0.05).

Table 8: Comparison of Mean Arterial Pressure (Mm of Hg)

Groups	0 min (Mean±SD)	30 min (Mean±SD)	60 min (Mean±SD)	90 min (Mean±SD)	120 min (Mean±SD)
Group A	97.60±7.43	105.76±9.98	102.72±8.63	99.38±8.27	97.00±7.045
Group B	97.16±8.58	114.88±9.68	109.12±9.11	104.98±7.52	102±6.25
'p' value	0.785	0.000	0.000	0.0001	0.000

The mean arterial pressure at 0 min was comparable. The pressures were 105.76±9.98, 102.72±8.63, 99.38±8.27, 97.00±7.045 at 30 min, 60 min, 90 min and 120 min in group A. Similarly the pressures in group B were 114.88±9.68, 109.12±9.11, 104.98±7.52 and 102±6.25 respectively. These values were incomparable and highly significant statistically.

Discussion

Result of this study revealed that Alkalinized intracuff lignocaine has lower incidence of post extubation sore throat and also has decreased hemodynamic response to extubation when compared to intracuff air. Alkalinized lignocaine also maintains a stable cuff pressure during oxygen nitrous anaesthesia.

Extubation of trachea in a patient undergoing general anaesthesia is associated with its own complications, which can be detrimental to the patient and unpleasant to the attendant anaesthesiologist. Sore throat during emergence in a lighter plane of anaesthesia can result in hypertension, tachycardia, and myocardial ischemia, increased intraocular and intracranial pressures. These features are particularly undesirable in patients undergoing neurosurgical and ophthalmic procedures or those who are at an increased risk of adverse cardiovascular events.

Numerous methods of attenuating cough reflex during tracheal extubation have been advocated such as use of narcotics, extubation in a deeper plane of anaesthesia, and use of IV alkalinized lignocaine.

In one of early studies Sconzo and colleagues [34] demonstrated that air diffuses across the cuff of endotracheal tubes. This finding applied by Waka Hirota [40] showed that when endotracheal tube cuffs were inflated with alkalinized lignocaine, concentrations of alkalinized lignocaine in a water bath would reach 8 and 17µgm-l after 30 and 60 minutes of cuff inflation respectively. Alkalinized lignocaine concentration of 100 µ M is required to produce a 50% reduction in Na^+ channel activity. This data suggests that a minimum period of 2 hours would be required for attaining these concentrations.

Another study by Efthimiou [34] with 41 patients undergoing fibreoptic bronchoscopy, using average doses of 9.3 mg/kg of lidocaine, recorded only two patients in which plasma levels exceeded the toxic levels (5µg/ml) and no complications were observed. All tube cuffs were intact post extubation.

The basis of our study was that lignocaine inserted into the endotracheal cuff might cause anaesthesia of the trachea by diffusing across the polyvinyl chloride membrane of which the cuff is made of. Anaesthesia should be confined to the mucosa in contact with the cuff, thus overcoming the difficulties experienced by Gonzalez and others [21]**.** In addition, the protective cough reflex above the tube cuff and of the vocal cords should remain intact.

Previously done studies by Carl Fagan and colleagues have compared the incidence of sore throat and hemodynamic changes between intracuff alkalinized lignocaine, intracuff saline and intracuff air. And concluded that incidence of sore throat is significantly lower in intracuff alkalinized lignocaine group. In one study by Soltani and colleagues [22] compared the incidence of sore throat and sore throat after general anaesthesia in six different groups which included spraying of distal end of ETT cuff with 10% alkalinized lignocaine, spraying of 10% laryngopharyngeal structures, application of 2% alkalinized lignocaine jelly to cuff of the tube, intravenous alkalinized lignocaine at the end of surgery, intracuff alkalinized lignocaine and application of normal saline to the cuff end of the tube. They concluded that IV lignocaine, intracuff alkalinized lignocaine considerably decreases the incidence of sore throat post extubation.

Since alkalinized lignocaine is most commonly used as a lubricant and as an agent to decrease the emergence phenomenon. We compared intracuff alkalinized lignocaine

which can be easily administered without any special equipment needed. We monitored the cuff pressure changes with air used as an inflating agent when air was applied against intracuff alkalinized lignocaine, which was not done in some of the previous studies. We also recorded the hemodynamic parameters in both the groups and studied the effect of the technique on the hemodynamic parameters.

In our study the incidence of sore throat was recorded in four different intervals. It was recorded as having occurred or not. The severity or grade of sore throat was not recorded since categorization is very subjective. Seven patients (14%) had sore throat at 1 hour in alkalinized lignocaine group as compared to 18 patients (36%) in intracuff air group. At 24 hour the incidence of sore throat in alkalinized lignocaine was 14% much higher than that noted at 1 hour in alkalinized lignocaine group as compared to 52% in intracuff air group. Thus, showing a considerable decrease in the incidence of sore throat. There was a significant statistical difference between the alkalinized lignocaine group and intracuff air group. The 'p' value being 0.003, <0.001 is highly significant. These results were comparable to the previous studies done. In the study done by Estebe JP and others [19] on 60 patients intracuff alkalinized lignocaine was compared with intracuff saline and intracuff air. The results stated that there was a trend of reduced hypertension and tachycardia in the intracuff air group and alkalinized lignocaine group.

Lais Helena [28] (2012) found that the dose [lidocaine 6.9±2.6ml (138±52mg)] 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 bronchioles leading to toxicity. However, lidocaine induced cuff rupture has never been reported either in vivo or in vitro. 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 (1ml of 8.4% bicarbonate in 20ml 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.

Limitations of this study

Measurement of plasma alkalinized lignocaine levels was not done in our study. There was no practical way of assessing the amount of alkalinized lignocaine that diffused across the cuff.

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