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Endotracheal Tube Cuff Inflation By 4% Lignocaine, Saline and Air: A Comparative Study

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Abstract: Laryngoscopy and endotracheal intubation are inevitable before undertaking any major operations or for long term intubation. They are often beset with noxious pathological consequences, such as hoarseness of voice, sore throat, cough, pain etc. Inflation of endotracheal tube cuff with air or saline helps in securing leak less snug fit in the trachea, but of late, there are few reports of the use of Lidocaine as an inflation agent. It is of interest to study the general incidence of post-extubation complications as also whether the choice of Lidocaine makes any difference to the known morbidities of endotracheal intubation. This was a randomized controlled prospective study consisting of 90 patients (ASA I and II) who were allocated into group A (4 % Lidocaine), group B (Normal Saline) and group C (Air). Patients were premeditated with Midazolam 0.03 mg/kg I.V. and Inj Glycopyrrolate 0.005mg/kg. All patients were induced with Thiopentone (4 mg/kg), Suxamethonium (1.5 mg/kg) followed by intubation with appropriate size cuffed oral (portex tube) endotracheal tube. The study period extended upto 48 hours post-extubation. Apart from routine hemodynamic monitoring, post-extubation complications like- hoarseness of voice, sore throat, cough, pain, dysphonia were also compared. The mean values of heart rate, systolic blood pressure, diastolic blood pressure, oxygen saturation for all the groups were comparable and statistically insignificant. One patient developed hoarseness of voice (Gp A). 8 patients developed sore throat lasted 48 hrs in 4 patients (Gp B). 22 patients developed pain in the throat (9 patients in Group A, 6 patients in Group B and 7 patients in Group C). 23 patients experienced cough (11 patients in Group A; 8 patients in Group B and 4 patients in Group C).

Keywords: Cough, Haemodynamic changes, Endotracheal intubation, Heart rate, 4% Hoarseness of voice, Lidocaine, Pain, Sore throat, SpO_2.

INTRODUCTION

The endotracheal tube has remained the foundation stone of modern Anaesthetic practice and critical care. It is not without complication. Similarly laryngeal and tracheal stimulation associated with endotracheal intubation are also associated with the usual haemodynamic responses and pathological consequences. Postoperative sore throat is the most common complaint after endotracheal intubation and is seen in up to 90% of intubated patients [1].

Haemodynamic responses due to mechanical stimulation of the respiratory tract due to endotracheal intubation were known since 1940 [2]. These facts were later confirmed by various studies and were believed to be the result of reflex sympatho-adrenal stimulation [2].

The haemodynamic responses are further augmented, when laryngoscopy is followed by endotracheal intubation, as there will be recruitment of additional receptors in the larynx and trachea eliciting a further enhanced sympatho-adrenal discharge [2, 3].

Haemodynamic responses due to endotracheal intubation may be harmful to patients with Ischemic Heart Disease, Hypertension, Aortic Dissection, and Sick Sinus Syndrome [2, 6, 7]. Post-extubation complications may manifest as sore throat, hoarseness of voice, cough and pain [2, 6]. Various methods have been employed for modifying or attenuating these complications to endotracheal intubations such as:

- Lidocaine: Topical, intravenous [8].
- 4 % Lidocaine: Endotracheal tube cuff inflation [8, 9].
- Use of alternative airway control techniques [10].

Inflation of endotracheal tube cuffs helps in securing snug fit in the trachea. It prevents gas leak around the tube, ensuring adequate pulmonary ventilation. This is of paramount importance both in prolonged anaesthesia and critically ill patients.

However inappropriate cuff inflation is beset with post-extubation morbidity leading to pain, difficulty in breathing or phonation.

Both experimental and clinical evidence suggests that endotracheal cuff inflation by various media eg. 4% Lignocaine, Normal Saline and Air have got their own advantages and disadvantages [8, 9].

Of late, there are few reports of use of Lidocaine as the agent for inflation of the tracheal cuff. It is of interest to study whether the choice of Lidocaine makes any difference to the incidence of known morbidity of endotracheal intubations, by virtue of its local anaesthetic activity. Hence, this study.

MATERIALS AND METHODS

Method of collection of data

90 patients of either sex admitted at Vikhe Patil Institute Of Medical Sciences in various specialties for surgery during the study period, meeting the inclusion and exclusion criteria were taken up for the study.

Approval and Consent

This study was undertaken after obtaining approval from the Hospital Ethics Committee and written informed consent from the patients.

Inclusion criteria

- Surgical procedure expected to last 2 hours or more
- ASA I and II
- Only elective operations
- Age group 18-60 years

Exclusion Criteria

- Active upper respiratory tract infections.
- Patients for laryngeal or tracheal surgery
- Pre-existing pathology in the larynx or in the trachea
- Duration of surgery < 1 hour
- Pregnant women
- Difficult intubation

Sample Size

- Total 90 patients
- 30 individuals for each group
- Group A: ETT inflated with 4 % Lidocaine.
- Group B: ETT cuff inflated with Saline.
- Group C: ETT cuff inflated with Air.

Study Design

Randomized and prospective controlled study

Premedication

Standard monitors were attached which included ECG, NIBP, SPO2; ETCO2. Study subjects were premedicated with Inj Glycopyrrolate 0.005mg/kg body weight and Inj Midazolam 0.03mg/kg body weight. Baseline hemodynamic parameters were noted. Patients were preoxygenated with 100% oxygen for 3 min.

Procedure

All the patients were preoxygenated for 3 mins and induced by standard induction method using Thiopentone 3 mg/kg, Suxamethoniuim (1.5 mg/kg) followed by intubation with appropriate sized cuffed oral (Portex tube) endotrachial tube Tube size of 7.5mm was used in females and 8.5mm in males. In all cases endotracheal tube was lubricated by non anaesthetic water soluble jelly (known as K Y Jelly). The ETT cuff is inflated to the point of minimum leak by Air/ Saline/4% Lignocaine – depending upon their respective groups. Cuff pressure was measured with Cuff Pressure Monitor.

Anaesthesia was maintained with N_2O/O_2 (2:1) and Isoflurane (1%) with controlled ventilation using non- depolarizing muscle relaxant (Vecuronium 0.1 mg/kg) through closed circuit with circle absorber. Further dose of relaxant, sedatives were administered as per need. At the end of surgery patients were extubated after adequate reversal and shifted to recovery room for further observations.

Following observations were made in the intraoperative period and in the postoperative period in the course of this study.

- Ease of laryngoscopy/intubation.
- Volume of air, saline and Lidocaine used at intubation.
- Any changes in the said volume at the time of extubation.
- Cuff pressure changes if any.
- Intraoperative tube tolerance (bucking, spasm).
- Duration of surgery.
- Intraoperative haemodynamic changes and changes in SpO_2.
- Post-extubation: I) Cough II) Laryngeal spasm III) Stridor IV) Change in voice V) Pain in the throat
- 24 hour and 48 hours post-extubation assessment for sore throat, hoarseness of voice and pain.
- Direct laryngoscopy after 48 hours.

RESULTS

Table-1 Shows age and sex distribution in our series. Mean age ranged from 36 to 42 yrs. There were 34 males and 56 females in all.

Table-1: Comparison of Sex Distribution

Basic Characteristics		Group A	Group B	Group C	value
Number of patients		30	30	30	
Age in years (Mean±SD)		38.90 ± 11.45	42.67± 12.51	36.13 ± 14.13	0.143
Sex	Male	5 (16.7%)	16(53.3%)	13(43.3%)	0.010
	Female	25 (83.3%)	14 (46.7%)	17 (56.7%)	

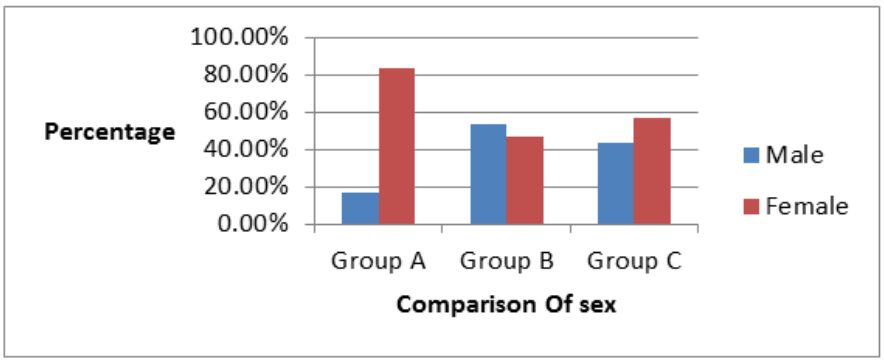

Fig-1: Sex Distribution

Table-2 Shows duration of surgery. The longest was 6 hrs; shortest was 1.55 hrs. Duration of surgery is statistically similar between three groups with p = 0.875.

Table-3 Shows variations in heart rate among the 3 groups at various times. There was no significant intra-group variations.

Table-2: Duration of Surgery in Minutes

Duration of surgery in hours	Group A	Group B	Group C
Min-Max	2-3.40	2.0-5.30	1.55-6.00
Mean± SD	2.47± 0.46	2.38± 0.66	2.46±0.92

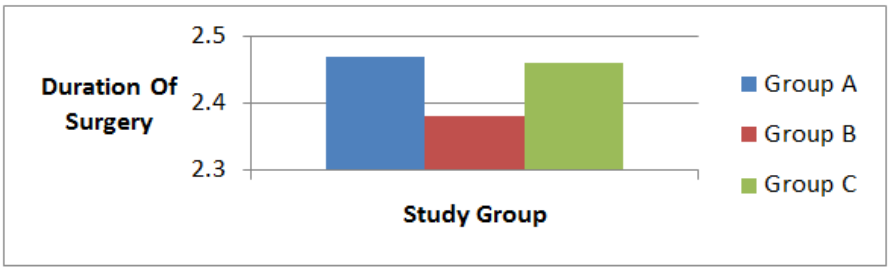

Fig-2: Duration of Surgey

Table-3: Comparison of Heart Rate /Min

Study Period	Heart Rate			value
Baseline	78.60±11.08	83.37±11.02	79.03±9.14	.155
Intra-op	87.47±11.81	88.67±13.13	82.80±8.40	.110
2 hrs post-op	89.77±14.09	83.37±11.57	81.67±6.75	.016
24 hrs post-op	83.53±12.35	87.27±10.33	82.13±5.94	.122
48 hrs post-op	83.03±9.75	86.53±9.05	83.40±6.69	.121

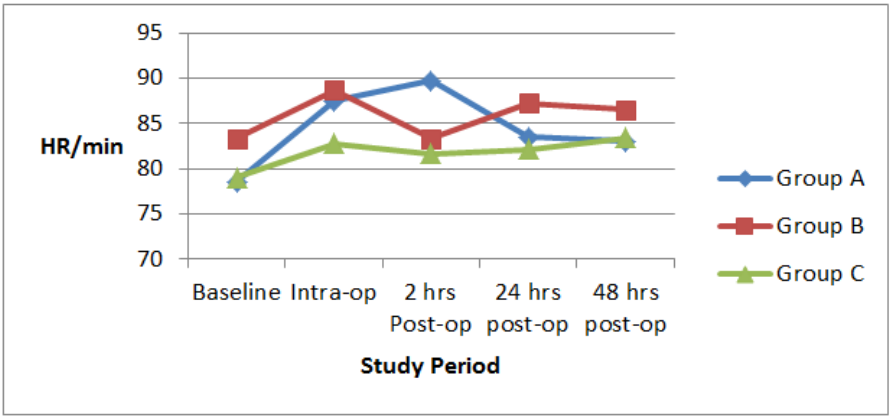

Fig-3: Comparison Of Heart Rate /Min

Table-4 Shows variation in systolic BP among the 3 groups of various times. There was no significant intra-group or inter group variations.

Table-5 Shows variation in diastolic BP among the 3 groups at various times. There was no significant intra-group or inter-group variations**.**

Table-4: Comparison of Systolic Blood Pressure in mmHg

Study Period	SBP mmHg			value
	Group A	Group B	Group C	
Baseline	122.40±14.43	130.47±14.08	123.60±13.83	.063
Intra-Operative	119.47±12.01	129.33±14.18	125.33±11.35	.012
2 hrs post-op	126.63±15.80	127.30±12.36	124.40±9.06	.653
24 hrs post-op	123.57±11.52	126.93±11.44	124.67±7.76	.444
48 hrs post-op	124.67±8.46	126.90±10.46	122.67±7.85	.422

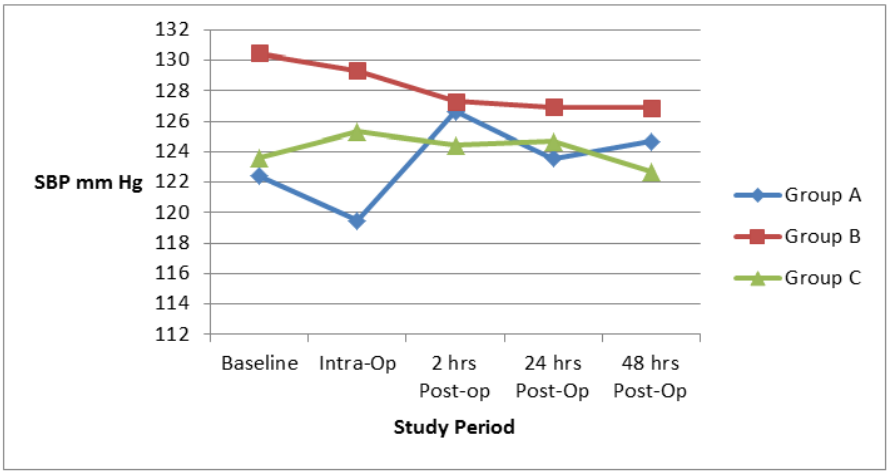

Fig-4: Comparison of Systolic Blood Pressure in mm Hg

Table-5: Comparison Of Diastolic Blood Pressure

Study Period	DBP mm Hg			P value
	Group A	Group B	Group C	
Baseline	78.03±7.22	80.80±10.18	78.47±7.44	0.393
Intra-operative	78.20±7.77	79.00±9.02	78.40±6.74	0.920
2 hrs Post-Op	78.20±7.67	80.87±8.37	77.00+5.89	0.122
24 hrs Post-Op	80.33±5.68	78.00±6.01	75.67±5.73	0.010
48 hrs Post-Op	82.00±6.48	78.07±5.88	75.33±5.07	<0.001

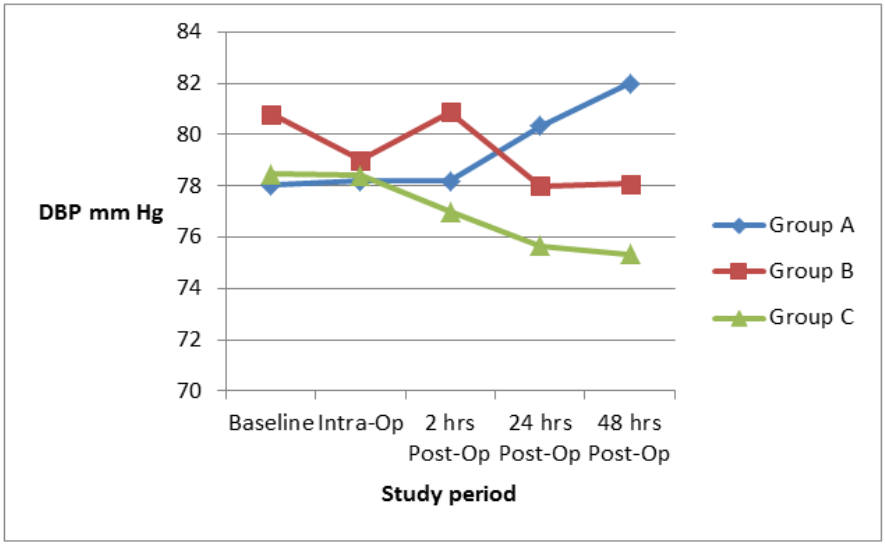

Fig-5: Comparison of Diastolic Blood Pressure

Table-6 Shows variations in SpO_2 among the 3 groups at various times. There was no significant intra-group or intra-group variations.

Table-7 Shows number of patients who complained of hoarseness of voice. Only 1 patient in Group A (4 % Lignocaine) has hoarseness of voice lasting two hours post-extubation.

Table-6: Comparison of SpO2

Study Period	SpO_2			value
	Group A	Group B	Group C	
Baseline	99.10±0.80	99.60±0.93	99.57±0.90	.003
Intra-Op	99.77±0.57	99.63±0.76	99.80±0.48	.838
2 hrs Post-Op	99.30±0.75	99.83±0.46	99.47±0.78	.006
24 hrs Post-op	99.40±0.72	99.40±0.97	99.20±1.88	.842
48 hrs Post-op	99.90±0.31	99.50±0.94	99.70±0.60	.123

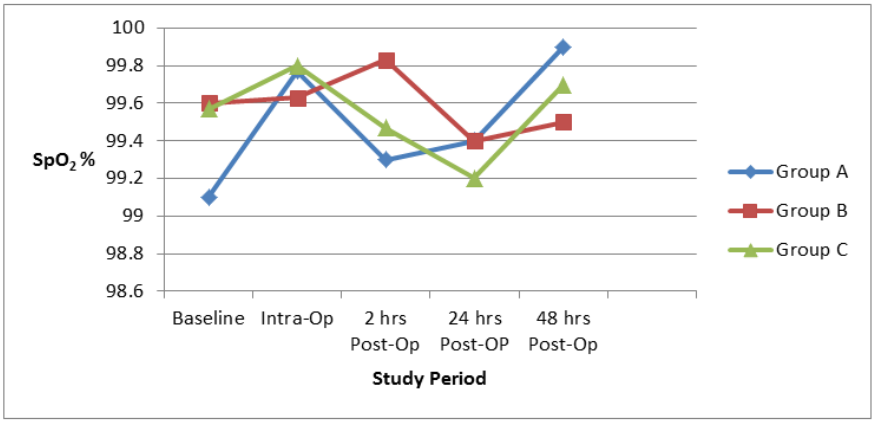

Fig-6: Comparison of SpO2

Table-7: Comparison of Hoarseness Of Voice

Study Period	No. of patients with hoarseness of voice		
	Group A (n=30)	Group B (n=30)	Group C (n=30)
Post Extubation	1 (3.3%)	0	0
2 hrs Post-Op	1 (3.3%)	0	0
24 hrs Post-Op	0	0	0
48 hrs Post-Op	0	0	0

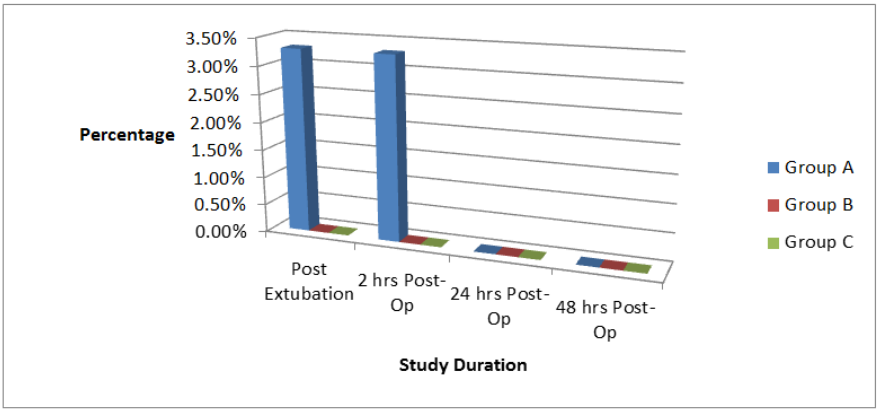

Fig-7: Comparison of Hoarseness of Voice

Table-8 Shows number of patients who complained of sore throat. Only 1 patient in Group C (Air) has sore throat lasting 48 hours.

Table-9 Shows number of patients who complained of pain subsequent to extubation. There were 3 patients in Group C (Air) having pain in the throat at the end of 48 hours. This was similar to the Lignocaine group (2 patients). However, its occurrence in saline group was about 3 times more at 48 hours.

Table-8: Comparison of Sore Throat

Study period	No. Of patients with sore throat		
	Group A (n=30)	Group B (n=30)	Group C (n=30)
Post Extubation	1(3.3%)	0	0
2 hours Post-op	3(10%)	2(6.7%)	0
24 hours Post-op	1(3.3%)	4(13.3%)	1(3.3%)
48 hours Post-op	1(3.3%)	4(13.3%)	1(3.3%)

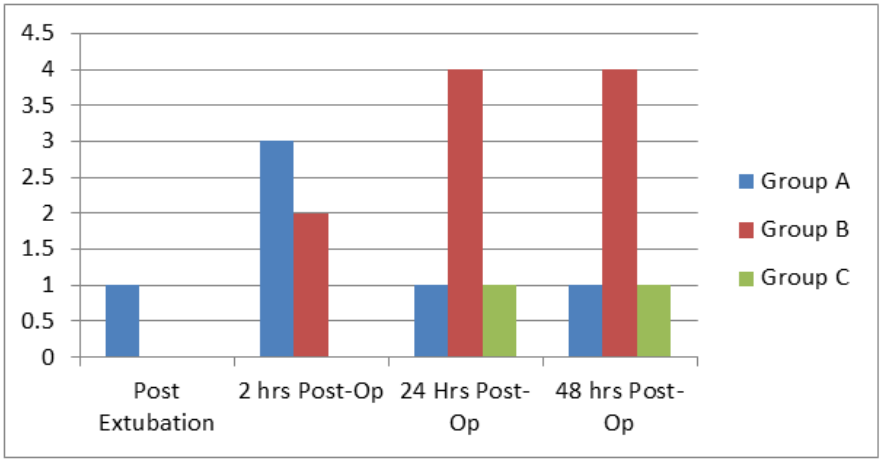

Fig-8: Comparison of Sore Throat

Table-9: Comparison of Pain

Study period	No. of patients with pain		
	Group A (n=30)	Group B (n=30)	Group C (n=30)
Post Extubation	7(23.3%)	4(13.3%)	7(23.3%)
2 hours Post-Op	9(30.0%)	0	7(23.3%)
24 hours Post-Op	2(6.7%)	5(16.7%)	6(20.0%)
48 hours Post-Op	2(6.7%)	6(20.0%)	3(10.0%)

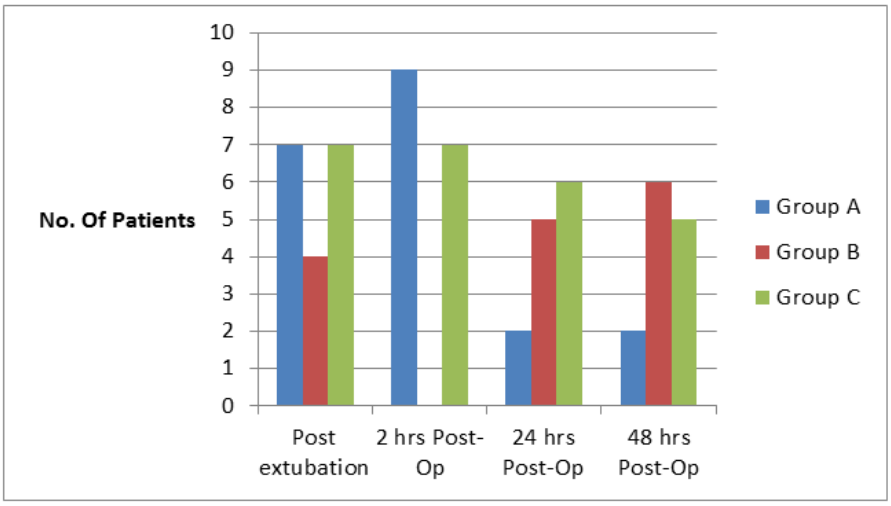

Fig-9: Comparison of Pain

Table-10 Shows incidence of postoperative cough. At the end of 24 and 48 hours, there was no difference in the incidence of cough in Group A (4% Lignocaine) and Group C (Air) and occurred in roughly 24% of the group. In Group B (saline) this had doubled (50%).

Table-11 shows incidence of dysphonia, only 1 patient belonging to Lignocaine 4% group showed dysphonia, which lasted less than 2 hours.

Table-10: Comparison of Cough

Study Period	No. of patients with cough		
	Group A (n=30)	Group B (n=30)	Group C (n=30)
Post extubation	11(36.7%)	8(26.7%)	1(3.3%)
2 hrs Post-op	8 (26.7%)	0	1(3.3%)
24 hrs Post-op	3 (10.0%)	8 (26.7%)	4 (13.3%)
48 hrs Post-op	4 (13.3%)	7 (23.3%)	3 (10.0%)

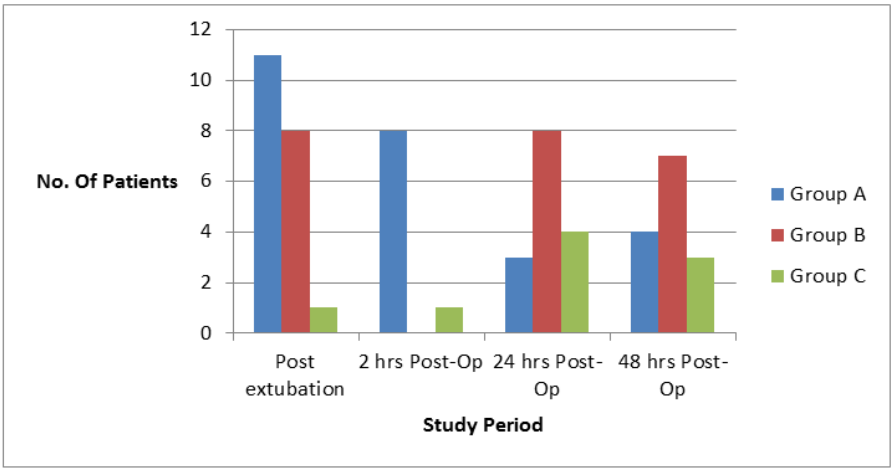

Fig-10: Comparison of Cough

Table-11: Comparison of Dysphonia

Study period	No. of patients with dysphonia		
	Group A (n = 30)	Group B (n = 30)	Group C (n = 30)
Post Extubation	1(3.3%)	0	0
2 hrs Post-op	0	0	0
24 hrs Post-op	0	0	0
48 hrs Post-op	0	0	0

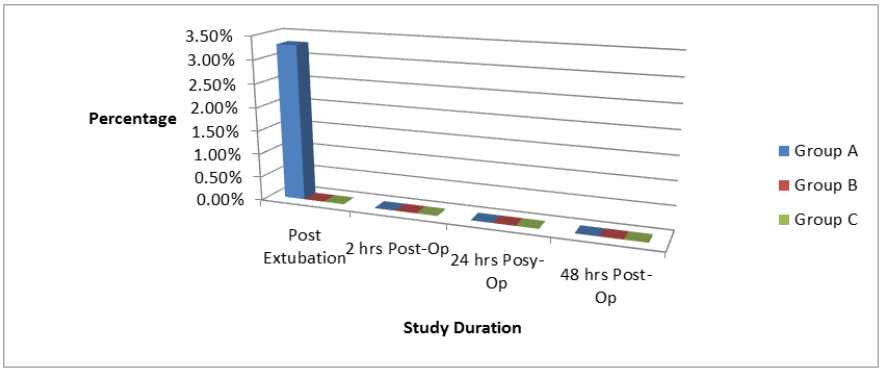

Fig-11: Comparison of Dysphonia

Table-12: Comparison of all Complications

Study Period	All Complications			P Value
	Group A (n=30)	Group B (n=30)	Group C (n=30)	
Post Extubation	14(46.7%)	12(40.0%)	7(23.3%)	0.155
2 hrs Post-Op	16(53.3%)	2(6.7%)	7(23.3%)	<0.001
24 hrs Post-Op	5(16.7%)	8(26.7%)	7(23.3%)	0.638
48 hrs Post-Op	6(20.0%)	8(26.7%)	5(16.7%)	0.627

Results are presented in Numbers (%)

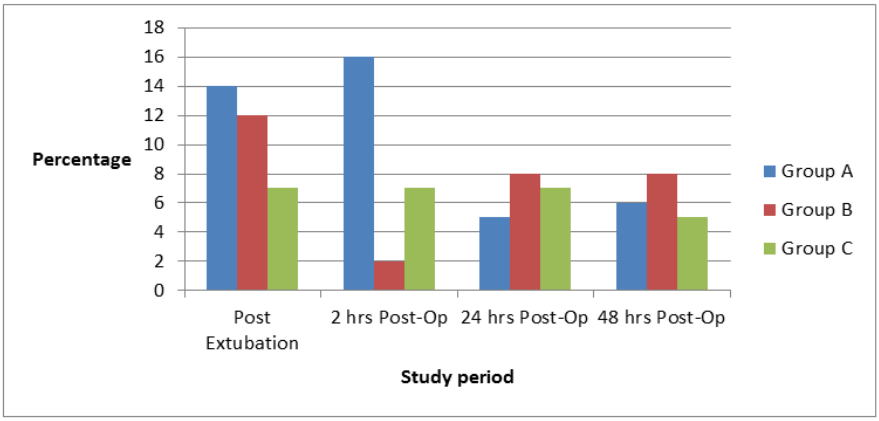

Fig No.12: Comparison of all Complications

DISCUSSION

Post-operative sore throat after tracheal intubation is an unpleasant and distressing experienxe to the patients.

Xavier Combes *et al*., [11] have studied inra cuff pressure and tracheal morbidity with nitrous oxide by filling cuff with saline or air. The incidence of sore throat was greater in Air group than in Saline group.

According to Porter *et al*., [12] there was no statistical difference in post-operative sore throad among these three groups: Lidocaine. Saline and Air.

Thomas, Poulton and Francis James [13] have concluded that Lidocaine clearly depresses the cough response in doses not associated with significant central nervous system toxicity.

Ko Takakura *et al*., [14] have found that plastic infusion balloon containing Lidocame adsorb non-ioniszed Lidocaine. This adsorption is promoted at high pH, as non ionized frationis higher.

Sconzo and colleagues [8] demonstrated that air diffuses across the cuff of endotracheal tubes.

In our series, 12 patients of Lignocaine group developed sore throat/ pain. In the same group, 11 patients had post-operative cough. This was higher than the other 2 groups. The only patient who developed hoarseness also belonged to Lignocaine group.

Table-13: Overall Comparison of Study Parameters

Study Parameters	Overall comparisons			Clinical Significance	Statistical Significance
	Group A (n=30)	Group B (n=30)	Group C (n=30)		
Mean duration of surgery in hours	2.47+0.46	2.38+0.66	2.46+0.92	Comparable	Comparable
HR at 48 hrs post-op	83.03+9.75	86.53+9.05	77.40+6.69	Within Normal	Significant (0.001)
SBP at 48 hrs post-op	130.67+8.46	126.90+10.46	122.67+7.85	Within Normal	Significant (0.004)
DBP at 48 hrs Post-op	82.00+6.48	78.07+5.88	75.33+5.07	Within Normal	Significant (0.001)
SpO_2 at 48 hrs Post-op	99.90+0.31	99.50+0.94	99.70+0.60	Comparable	Comparable (P=0.123)
Hoarseness of voice at 48 hrs post-op	0	0	0	Comparable	Comparable
Sore throat 48 hrs post-op	1 (3.3%)	4(13.3%)	1(3.3%)	Comparable	Comparable (P=0.393)
Pain at 48 hrs post-op	2(6.7%)	6(20.0%)	3(10.0%)	Comparable	Comparable (P=0.290)
Cough at 48 hrs Post-op	4(13.3%)	7(23.3%)	3(10.0%)	Comparable	Comparable (P=0.313)
Dysphonia at 48 hrs post-op	0	0	0	Comparable	Comparable
All complications at 48 hrs Post-op	6(20.0%)	8 (26.7%)	5(16.7%)	Comparable	Comparable (P=0.627)

The main factors associated with throat complaints were female sex, history of smoking or lung diseases, passage or omission of NG tube, ease or difficulty in intubation. In our series all the patients were intubated with ETT no 7.5 for females amd 8.5 for males and were lubricated with water soluble lignocaine free jelly without using any stylet. None of the cases had nasogastric tube.

The incidence of sore throat and sore throat on emergence from general anesthesia in the presence of ETT has been estimated to range from 38% to 96%. Selvaraj and Dhanpal [15] found the incidence of postoperative cough and hoarseness to be higher in the lidocaine jelly group than in the control group.

Loeser *et al*., [16] confirmed the relation of area of contact of cuff to post-extubation sore throat. Stenqvist and Kristen Nilsson [17] have shown that post-extubation sore throat is caused by many factors and tracheal tube cuff is one. The effects of cuff design has not been studied in our series. We used high volume low pressure portex cuffed tubes lubricated with water-soluble jelly. The relation of duration of intubation to the associated morbidity depends on whether it is short or long-term intubation.

CONCLUSIONS

It is concluded that:

- The overall morbidity following short term intubation with cuffed high-volume low- pressure endotracheal tubes (Portex) is 60%. The incidence of post-operative sore throat/ pain was 33.3%.
- Post-extubation complications like sore throat, pain & cough are commonest in saline filled cuffs.
- Lignocaine, when used for cuff inflation instead of air or saline, does not confer any benefit of reduction of these complications.

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