

# A Comparative Study to Assess the Effectiveness of using Air, a 50% N<sub>2</sub>O:O<sub>2</sub> and Lignocaine 2% to Inflate the Endotracheal Tube Cuff During General Anaesthesia

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## ABSTRACT

**Introduction:** Endotracheal tube (ETT) is one of the most frequently used mode for administering general anaesthesia at the time of surgeries and it provides an artificial channel through which the inhalational anesthetic agents like halothane, isoflurane, sevoflurane, nitrous oxide(N<sub>2</sub>O) can be delivered to the lungs. An ETT cuff when inflated with either Air, N<sub>2</sub>O, saline, lignocaine during general anaesthesia will have complications like emergence phenomenon and post-operative sore throat. Study objectives were to find out the most effective intra-cuff inflating agent among air, a 50% gaseous mixture of N<sub>2</sub>O: O<sub>2</sub> and 2% lignocaine and to assess post-operative sore throat pain in each group.

**Material and methods:** The present study was a comparative study carried out in adult patients who underwent surgeries under general anaesthesia during Oct 2014-May16. Study was done in KMC Attavar hospital and KMC hospital Jyothi circle, Mangalore and District government Wenlock hospital, Mangalore. For comparison of cuff pressures, with an  $\alpha$  error of 5%,  $\beta$  error of 20% and mean difference in pressure of 10cm H<sub>2</sub>O and variance of 15cmH<sub>2</sub>O, the sample size was 105 with 35 subjects in each arm-Group A (Air), Group N (N<sub>2</sub>O: O<sub>2</sub>) and Group L (lignocaine). Randomization of the subjects into study groups was done after obtaining a written informed consent and the study has been approved by Institutional Ethics committee.

**Results:** Out of 105 study subjects, 59(56.2%) were found to be male and 46(43.8%) were found to be female. Mean age of the participants was 39.4±10.8 years. ANOVA test showed a significant difference in mean cuff pressures in three groups with air showing an increased cuff pressures, Group N showed decreased and L with stable pressures (p<0.001).

**Conclusion:** The use of lignocaine 2% to inflate the endotracheal tube cuff provides stable intracuff pressure and reduces the incidence of sore throat pain when compared to air and a mixture of 50% N<sub>2</sub>O:O<sub>2</sub>.

**Keywords:** Endotracheal tube cuff, lignocaine, 50% N<sub>2</sub>O:O<sub>2</sub>

## INTRODUCTION

Endotracheal tube (ETT) is one of the most frequently used mode for administering general anaesthesia and it provides an artificial channel through which the inhalational anesthetic agents like halothane, isoflurane, sevoflurane, nitrous oxide (N<sub>2</sub>O) including oxygen can be delivered to the lungs for oxygenation. An ETT with inflated cuff provides an adequate tracheal seal and reduces the risk of aspiration.<sup>1</sup>

Air is most commonly used to inflate the cuff. Nitrous oxide (N<sub>2</sub>O) is the least potent and oldest inhaled anesthetic which has the property to diffuse in to air filled cavities and also through the semipermeable membrane of ETT cuffs, there by gradually increasing the cuff pressures. ETT with cuff

stimulates the Rapidly adapting stretch receptors (RARs) in the tracheal mucosa which are associated with cough and cause uncontrollable cough during extubation and in post-operative care.<sup>1-4</sup>

Intravenous Lidocaine has a central nervous system depressing effect on the medulla and reduces the occurrence of emergence phenomenon. Intravenous and topical lignocaine has been used in blunting the complications during emergence after general anaesthesia by reducing the tracheal stimuli.<sup>2,5</sup>

The present study was conducted to compare the intra cuff pressures when using Air, a 50% mixture of N<sub>2</sub>O: O<sub>2</sub> and 2% Lignocaine and to evaluate the effectiveness of using a 50% gaseous mixture of N<sub>2</sub>O: O<sub>2</sub> and effectiveness of lignocaine for the prevention of postoperative sore throat pain in adults undergoing endotracheal intubation as a part of general anaesthesia using visual analogue score (VAS).

## MATERIAL AND METHODS

A Comparative study was done in two tertiary care hospitals and one district hospital attached to a teaching institution during October 2014 and May 2016. The study subjects included ASA I and ASA II (American society of Anesthesiologists) patients in the age group of 18-60 years. Patients scheduled for elective surgery requiring general anaesthesia with endotracheal intubation and controlled ventilation lasting for minimum of 90 minutes were included and those posted for head and neck surgeries, allergic to local anesthetics, cervical spine injuries and trismus were excluded from the study.

The desired sample size of 105 with 35 subjects in each arm was obtained by using the formula:

$$n = \frac{2(Z\alpha + z\beta)^2 \sigma^2}{d^2}$$

where  $Z\alpha = 1.96$  at 95% confidence interval,  $\beta = 0.84$  at 80% power with  $\sigma$  or variance of 15 cm H<sub>2</sub>O<sup>1</sup> and mean difference of 10 cm H<sub>2</sub>O. The allocation of the subjects in to the control group

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(group A or Air) and comparative groups (group N or N<sub>2</sub>O: O<sub>2</sub> and group L or Lignocaine) was done by randomization in an allocation ratio of 1:1:1, so that every subject had an equal probability of being selected in to the groups until the desire sample size was achieved. Randomization of subjects into study groups was done by using table of random numbers only after obtaining a written and informed consent from the participants and anonymity was maintained. The post-operative sore throat was assessed by Visual analogue scale. While using this visual analogue scale, patient was asked to rate his/her pain on a linear scale 10 cm long. Zero (0) cm was considered as no pain and 10cm marking was considered as maximum pain intensity.<sup>6</sup>

**STATISTICAL ANALYSIS**

Data was analyzed using SPSS software (version 16 SPSS, Inc., Chicago, IL, USA). Descriptive statistics was used for analyzing quantitative data. One-way ANOVA test used to compare the mean pressures between the groups. Kruskal Wallis test (with Chi-square) was done to see the differences in median pain scores between the groups and p value of <0.05 was considered as significant. The study was approved by Institutional Ethics Committee, Manipal University.

**RESULTS**

Study subjects were allocated into three comparative groups (Group A, Group N and Group L) with 35 in each arm. Out of

105 subjects, 59 (56.2%) were found to be male and 46(43.8%) were found to be female. In all the groups, the proportion of male was found to be comparatively higher than female (Figure 1) Mean age of the participants was 39.4±10.8 yr's ranging from minimum age being 21 yr's and maximum up to 60 yr's. Mean age of male subjects was 39.2±11.6 yr's and females was 39.6±9.9 yr's.

To compare the mean intra cuff pressures in the three groups at different point of time, one way Anova was applied and it showed that there was a gradual increase in pressures among the patients belonging to group A(Air). whereas, a decreasing intra tracheal pressure trend was observed in patients belonging to group N (N<sub>2</sub>O: O<sub>2</sub>) and intra tracheal cuff pressures were almost stable with not much variations in subjects belonging to group L(Lignocaine) at the end of every 10 minutes. There was a significant difference in mean pressures in the 3 groups with p value (< 0.001) (Table 1).

The intensity of sore throat pain in the three groups was assessed using Visual analog score (VAS) by Kruskal Wallis test with Chi square. The study showed Median VAS scores for group L(lignocaine) being 4, 3 and 2 and Median VAS scores for group N (N<sub>2</sub>O:O<sub>2</sub>) was 5, 3 and 2 and group A(air) was 6, 4 and 3 at the end of 1<sup>st</sup> hr, 24 hr's and 48 hr's respectively. There was a significant difference in sore throat pain scores in the three groups (p<0.001) and the sore throat pain scores were comparatively low in lignocaine or Group L at the end of first

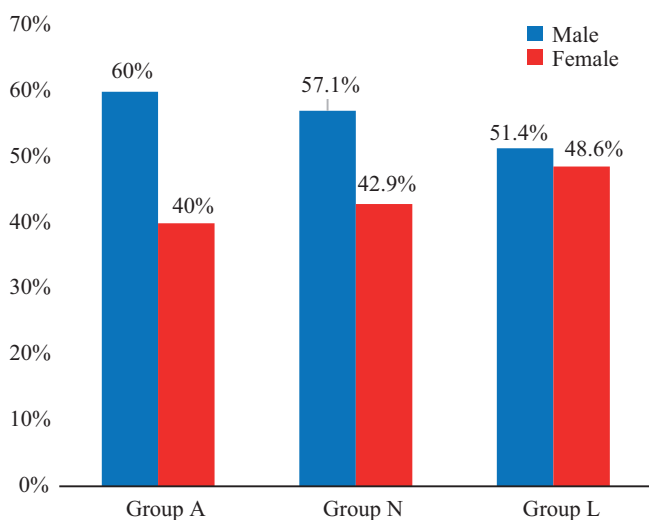
Duration (Minutes)	Mean pressure (cm of h <sub>2</sub> o)			F value	P value
	Group a (N=35)	Group n (N=35)	Group l (N=35)		
	Mean ±SD	Mean ±SD	Mean ±SD		
0	30±0	30±0	30±0		<0.001
10	31.47±0.52	29.53±0.72	30.09±0.21	123.9	
20	36.19±3.82	28.47±0.71	30.37±0.30	111.3	
30	39.83±3.05	27.50±0.66	30.60±0.33	437.5	
40	42.8±2.83	26.98±0.71	30.66±0.26	845.1	
50	45.90±2.36	26.70±0.66	30.87±0.37	1.732	
60	49.90±2.36	26.22±0.73	30.96±0.29	2.146	
70	51.47±1.96	25.68±0.74	31.01±0.40	4.254	
80	53.20±1.54	25.07±0.63	31.09±0.51	7.572	
90	54.79±1.37	24.10±0.90	31.10±0.54	9.055	

**Table-1:** The Mean intra cuff pressures in the Groups (Air, N<sub>2</sub>O: O<sub>2</sub>, Lignocaine)

Ranks	VAS with Duration			Chi-square value	P value	Median Scores	Inter-quartile range
	Group	No. of subjects	Mean Rank				
VAS at 1 hr.	A	35	83.80	78.1	<0.001	6	5-6
	N	35	53.20				
	L	35	22.00				
	Total	105					
VAS at 24hr's	A	35	82.11	63.0	<0.001	4	4-5
	N	35	49.03				
	L	35	27.86				
	Total	105					
VAS at 48hr's	A	35	79.97	49.1	<0.001	3	3-3
	N	35	37.83				
	L	35	41.20				
	Total	105					

\*Group A(Air), Group N (N<sub>2</sub>O: O<sub>2</sub>), Group L(Lignocaine)

**Table-2:** Visual Analogues Score-to assess the pain intensity in the groups



**Figure-1:** Distribution of subjects by gender

hour (Table 2).

## DISCUSSION

The present study was conducted among 105 study subjects allocated in to three groups. Group A(Air), Group N (N<sub>2</sub>O<sub>2</sub>: O<sub>2</sub>), Group L(Lignocaine) to find out the best inflating agent among air, a 50% mixture of N<sub>2</sub>O:O<sub>2</sub> and 2% lignocaine. The study showed that during the course of general anaesthesia, use of 2% Lignocaine provided stable intracuff pressures with adequate tracheal seal and reduced the intensity of post-operative sore throat pain.

Intra tracheal cuff pressures that were recorded every 10 minutes during the study was associated with a gradual increase in intracuff pressure among the patients belonging to group A(air) with mean cuff pressure of 54.79±1.37 cm of H<sub>2</sub>O at the end of 90 minutes. The findings of the present study can be compared to earlier studies by Jesni et al showing similar results with total mean cuff pressure of 62.6±12.3 and increased mean pressures of 38.58±8.12 and 28.1± 5.07 at end of 60 minutes in study by Acharya and Prerana et al where air was used to inflate the cuff, which in turn compromises the tracheal mucosa capillary perfusion and at pressure above 50 cm H<sub>2</sub>O, there is cessation of blood flow to the tracheal mucosa over the tracheal rings and posterior tracheal wall of trachea.<sup>1,7,8</sup>

A decreasing intra tracheal cuff pressure trend was observed in patients belonging to group N where a 50% N<sub>2</sub>O:O<sub>2</sub> gaseous mixture was used as the inflating agent, it was found to have a total mean pressure of 24.10±0.90 cm H<sub>2</sub>O at the end of 90 minutes. Similarly, the study by Jesni et al and Mitchell showed a total mean pressure of 27.63 ± 3.221 and 27.0cmH<sub>2</sub>O respectively and this use of 50% N<sub>2</sub>O:O<sub>2</sub> provides adequate tracheal seal and maintains a stable and safe intra cuff pressure and reduces the risk of aspiration and hypoventilation.<sup>1,9</sup>

Intra cuff pressures were almost stable in subjects belonging to group L(Lignocaine) during the course of 90 minutes of anesthesia with a mean value of 31.10±0.54 cm H<sub>2</sub>O, and a stable mean pressure of 18.54±30 and 19.96±0.72 was also reported by Prerana and Acharya et al and in the current study, with the use of plain 2% lignocaine, the incidence of sore throat was significantly reduced when compared to group N (50% N<sub>2</sub>O:O<sub>2</sub>) and group A(air) showing a significant difference (p<0.001).

Group A when compared to Group N showed increased cuff pressures thereby compromising the perfusion of tracheal mucosa with increased incidence of emergence phenomenon. Similar observations were also made in study by Navarro et al where targeted delivery of alkalized lidocaine to the mucosa in contact with the tracheal tube (ETT) cuff can be used as a method for decreasing tracheal stimuli as it spreads through the semi-permeable membrane wall of endotracheal tube cuff and induces anesthetic action in the trachea. The results were also in agreement with earlier studies.<sup>5,7,8,10,11</sup>

**Limitation:** The limitation of the study was the inability to assess the concentration of N<sub>2</sub>O inside the ETT cuff at the end of general anesthesia, as it would have given an idea as to diffusion of N<sub>2</sub>O in to the cuff from tracheal mucosa and vice versa and its effect on emergence phenomenon.

## CONCLUSION

A comparative study done to find out the best inflating agent among air, a 50% mixture of N<sub>2</sub>O:O<sub>2</sub> and 2% lignocaine that were used to inflate the ETT cuff during the course of general anaesthesia found that the use of lignocaine 2% to inflate the endotracheal tube cuff provides stable intracuff pressures and reduces the incidence of sore throat when compared to air and a mixture of 50% N<sub>2</sub>O:O<sub>2</sub>.

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