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Evaluation of Post-Operative Sore Throat Using Standard Versus Smaller Sized Cuffed Endotracheal Tubes in Patients Undergoing Laparoscopic Surgeries

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ABSTRACT

Background: We evaluated the incidence and assessed the severity of post-operative sore throat with standard versus smaller sized cuffed endotracheal tubes in patients undergoing laparoscopic surgeries.
Method: Total 200 patients undergoing laparoscopic surgery were allocated in two groups; Group A: standard sized endotracheal tubes used i.e. 8.5mm for male and 7.5mm for female patients. Group B: smaller sized endotracheal tubes used i.e. 7.5mm for male and 6.5mm for female patients. The endotracheal intubation was performed with high-volume, low-pressure cuffed oral endotracheal tube. A manometer was connected to the pilot balloon and the cuff pressure was monitored. During intraoperative period, hemodynamic and respiratory variables were recorded at frequent intervals. In the postoperative
period, coughing, sore throat and hoarseness of voice were recorded immediately after removal of endotracheal tube and thereafter at 1hr, 6hr,12hr and 24hrs.
Result: Demographic variables were comparable ($p > 0.05$). The incidence and severity of postoperative sore throat was greater in Group A at all points of time ($p<0.05$). The incidence and severity of hoarseness was greater in Group A at all points of time ($p< 0.05$). There was no significant difference in incidence and severity of coughing($p>0.05$).
Conclusion: This study highlighted the critical role of the size of endotracheal tube in the development of postoperative laryngotracheal morbidity in the form of sore throat, hoarseness and coughing in patients undergoing laparoscopic surgeries. A detailed comparison between the use of standard-sized and smaller- sized cuffed endotracheal tubes demonstrated that patients intubated with smaller-sized cuffed endotracheal tubes experienced a lower incidence and reduced severity of postoperative sore throat and hoarseness of voice.

Keywords*: Postoperative sore throat, endotracheal tube size, laparoscopic surgery, hoarseness, cuff pressure, airway morbidity, intubation complications.*

INTRODUCTION

Endotracheal tubes are commonly inserted in patients undergoing any surgical procedure under general anesthesia. Endotracheal tube cuffs create mechanical barrier between trachea wall and tube, thereby preventing air leakage and also reducing the risk of aspiration [1]. Coughing and sore throat are common considerations after general anesthesia. The incidence of painful sore throat following removal of endotracheal tube has been reported as 21-74%[2]. The problem is compounded if associated with hoarseness of voice and irritating cough. Factors that determine the incidence of post operative sore throat mainly includes size of the endotracheal tube, cuff design and intra-cuff pressure. The optimal values for endotracheal tube cuff pressures is between 20 and 30 cm water [3]. The high intra-cuff pressure results in irritation of trachea, which results in laryngotracheal morbidity. Air is used for inflating endotracheal cuffed tube while nitrous oxide

is used for maintaining anesthesia along with volatile anesthetic agents, diffuse into the air interface of cuff resulting in increased volume and pressure inside the air filled cuff. High endotracheal cuff pressures are frequently observed during nitrous oxide anesthesia. Since Nitrous oxide is 35 times more soluble in blood than nitrogen, it increases volume and pressure of the cuff by diffusing easily from the blood into air gaps [4]. Many other factors that can cause postoperative sore throat, such as unsuccessful attempts at endotracheal intubation, delayed intubation, additional delays are mix of these [5]. There is little data available regarding the recommended tube sizes for intubation in terms of prevention of post operative laryngotracheal morbidity. Hence the present study was conducted to evaluate incidence and severity of post operative sore throat, hoarseness and coughing using standard versus smaller sized cuffed endotracheal tubes in patients with laparoscopic surgeries.

MATERIALS AND METHODS

It is a randomized, prospective, double blinded comparative study. The study was registered with the Clinical Trials Registry of India (CTRI/2023/03/050900) and approved by the Institutional Ethics Committee. Patients 18-65 yrs age, ASA grade I/II, posted for laparoscopic surgeries in general anesthesia were added in the study. Anticipated difficult intubation, obesity, upper respiratory infection of more than one month, obstructive pulmonary disease was not included in the study. Written informed consent was obtained from the eligible participants before enrolling them in the study. Total 200 participants were enrolled and were divided randomly into two equal groups using computer generated tables. Group A: standard sized endotracheal tubes used i.e. 8.5mm for male and 7.5mm for female patients. Group B: smaller sized endotracheal tubes used i.e. 7.5mm for male and 6.5mm for female patients. Intra operatively we monitored participants with five lead electrocardiogram, NIBP, SPO2 and end tidal carbon dioxide concentrations. Patient induced with inj. propofol 1-2mg/kg iv and inj. fentanyl 1-2mcg/kg iv while participants breathing 100% oxygen. We facilitated tracheal intubation with adequate neuromuscular blockade using inj. Succinylcholine 2mg/kg iv and high-volume low-pressure cuff poly vinyl chloride tubes, well lubricated with 2% xylocaine jelly, was inserted. We performed endotracheal intubation with the allocated tube as per the study group and inflated the cuff with 3-5 ml air sufficient to prevent leak while maintaining cuff pressures between 20-30 cm H2O. Endotracheal intubation was attempted by experienced anesthetist. Patients requiring more than two attempts or >30seconds were not included in the study. Heat Moisture Exchanger filter was used in all the patients so as to humidify the inhaled gases and prevent microbial contamination. Tidal volume of 6-8 ml.kg-1, positive end-expiratory pressure of 5 cmH2O with 50% oxygen and air was delivered. We checked endotracheal tube cuff pressure every 30 min and maintained it around 20-30 cm H2O. We adjusted the respiratory rate to maintain end tidal CO2 partial pressure of 35- 45mm Hg. The intra-abdominal pressure was maintained at around10-14mm Hg. We recorded hemodynamic and ventilator variables at frequent time periods intra operatively. After completion of surgery, we noted coughing, post- operative sore throat and hoarseness at 0, 1, 6, 12 and 24 hours after removal of endotracheal tube. The postoperative sore throat, hoarseness and coughing were graded according to the severity [6]. The grading of post-operative sore throat was: None-No sore throat at any time since the operation; Minimal-Patient answered when asked about sore throat; Moderate-Patient complained on his/her own; Severe-Patient is in obvious distress. Post-operative cough was graded as: Mild - single episode; Moderate -single episode of unsustain cough for 5sec; Severe - sustained bought of coughing for >5sec.Post-operative hoarseness of voice was graded as: None-no hoarseness of voice ; Mild -noted by the patient; Moderate-obvious to the observer; Severe- aphonia, patient not able to speak. Sample size of 100 subjects in each group was calculated at 95% confidence interval and 80% power of the study to verify the expected difference of 15.4% (72.7% vs 88.1%) of proportion of cases with no sore throat at 24 hours between both the study groups. The data were tabulated in Microsoft excel and analyzed with SPSS V.24(Statistical Package of Social Sciences) software. Independent t test and chi square test were used for the statistical analysis. The p value ≤0.05 was considered statistically significant.

RESULTS

Table 1: Comparison of Coughing

Coughing		Group		P value
		Group A	Group B	
Immediate post-op	No	0	0	1.000
	Yes	100 [Mild – 0% Moderate – 100% Severe – 0%]	100 [Mild – 0% Moderate – 100% Severe – 0%]	
1 hr	No	1	3	0.312
	Yes	99 [Mild – 99% Moderate – 0% Severe – 0%]	97 [Mild – 97% Moderate – 0% Severe – 0%]	
6 hrs	No	75	76	0.869
	Yes	25 [Mild – 25% Moderate – 0% Severe – 0%]	24 [Mild – 24% Moderate – 0% Severe – 0%]	

12 hrs	No	98	99	0.561
	Yes	2 [Mild – 2% Moderate – 0% Severe – 0%]	1 [Mild – 1% Moderate – 0% Severe – 0%]	
24 hrs	No	100	100	1.000
	Yes	0 [Mild – 0% Moderate – 0% Severe – 0%]	0 [Mild – 0% Moderate – 0% Severe – 0%]	

Table 1 compares the incidence and severity of coughing between Group A and Group B at different postoperative time intervals (immediate post-op, 1 hour, 6 hours, 12 hours, and 24 hours). Immediately after surgery, all patients in both groups experienced moderate coughing (100%), with no significant difference (p = 1.000). At 1 hour post-op, coughing decreased slightly, with 99% of Group A and 97% of Group B reporting mild coughing (p = 0.312). By 6 hours, a significant reduction was observed, with only 25% of Group A and 24% of Group B reporting mild coughing (p = 0.869). At 12 hours, coughing further declined to 2% in Group A and 1% in Group B (p = 0.561). By 24 hours, no patients in either group reported coughing (p = 1.000). The severity of coughing was predominantly mild after the immediate postoperative period, with no cases of severe coughing beyond that point. Statistical analysis indicated no significant differences between the two groups at any time interval.

Table 2: Comparison of Sore throat

Sore throat		**Group**		**P value**
		Group A	**Group B**	
Immediate post-op	No	55	77	0.001*
	Yes	45 [Mild – 23% Moderate – 18% Severe – 4%]	23 [Mild – 10% Moderate – 12% Severe – 1%]	
1 hr	No	61	80	0.003*
	Yes	39 [Mild – 21% Moderate – 15% Severe – 3%]	20 [Mild – 9% Moderate – 10% Severe – 1%]	
6 hrs	No	67	83	0.009*
	Yes	33 [Mild – 20% Moderate –10% Severe – 3%]	17 [Mild – 8% Moderate – 8% Severe – 1%]	
12 hrs	No	71	88	0.002*
	Yes	29 [Mild – 19% Moderate – 8% Severe – 2%]	12 [Mild – 6% Moderate – 5% Severe – 1%]	
24 hrs	No	74	91	0.001*
	Yes	26 [Mild – 18% Moderate – 7% Severe – 1%]	9 [Mild – 6% Moderate – 3% Severe – 0%]	

Table 2 compares the incidence and severity of postoperative sore throat between Group A and Group B at different time intervals (immediate post-op, 1 hour, 6 hours, 12 hours, and 24 hours). Immediately after surgery, 45% of Group A reported sore throat (23% mild, 18% moderate, 4% severe), compared to only 23% of Group B (10% mild, 12% moderate, 1% severe), with a statistically significant difference (p = 0.001). At 1 hour post-op, sore throat persisted in 39% of Group A (21% mild, 15% moderate, 3% severe) versus 20% of Group B (9% mild, 10% moderate, 1% severe), remaining significant (p = 0.003). By 6 hours, the incidence decreased further, with 33% of Group A (20% mild, 10% moderate, 3% severe) and 17% of Group B (8% mild, 8% moderate, 1% severe) still affected (p = 0.009). At 12 hours, 29% of Group A (19% mild, 8% moderate, 2% severe) and 12% of Group B (6% mild, 5% moderate, 1% severe) reported sore throat (p = 0.002). Finally, at 24 hours, 26% of Group A (18% mild, 7% moderate, 1% severe) still experienced sore throat, compared to only 9% of Group B (6% mild, 3% moderate, 0% severe), with a highly significant difference (p = 0.001).

Table 3: Comparison of Hoarseness

Hoarseness		Group		P value
		Group A	Group B	
Immediate post-op	No	49	71	0.001*
	Yes	51 [Mild – 28% Moderate – 21% Severe – 2%]	29 [Mild – 15% Moderate – 13% Severe – 1%]	
1 hr	No	53	72	0.006*
	Yes	47 [Mild – 26% Moderate – 20% Severe – 1%]	28 [Mild – 14% Moderate – 13% Severe – 1%]	
6 hrs	No	59	75	0.016*
	Yes	41 [Mild – 28% Moderate –13% Severe – 0%]	25 [Mild – 14% Moderate – 11% Severe – 0%]	
12 hrs	No	63	80	0.008*
	Yes	37 [Mild – 26% Moderate – 11% Severe – 0%]	20 [Mild – 12% Moderate – 8% Severe – 0%]	
24 hrs	No	66	83	0.005*
	Yes	34 [Mild – 24% Moderate – 10% Severe – 0%]	17 [Mild – 11% Moderate – 6% Severe – 0%]	

Table 3 compares the incidence and severity of postoperative hoarseness between Group A and Group B at various time intervals (immediate post-op, 1 hour, 6 hours, 12 hours, and 24 hours). Immediately after surgery, 51% of Group A experienced hoarseness (28% mild, 21% moderate, 2% severe), compared to only 29% of Group B (15% mild, 13% moderate, 1% severe), with a statistically significant difference ($p = 0.001$). At 1 hour post-op, hoarseness persisted in 47% of Group A (26% mild, 20% moderate, 1% severe) versus 28% of Group B (14% mild, 13% moderate, 1% severe), remaining significant ($p = 0.006$). By 6 hours, the incidence decreased to 41% in Group A (28% mild, 13% moderate, 0% severe) and 25% in Group B (14% mild, 11% moderate, 0% severe), still showing a significant difference ($p = 0.016$). At 12 hours, 37% of Group A (26% mild, 11% moderate, 0% severe) and 20% of Group B (12% mild, 8% moderate, 0% severe) reported hoarseness ($p = 0.008$). Finally, at 24 hours, 34% of Group A (24% mild, 10% moderate, 0% severe) still had hoarseness, compared to only 17% of Group B (11% mild, 6% moderate, 0% severe), with a highly significant difference ($p = 0.005$).

Table 4: Demographic variables

S no.	Parameter	Group A	Group B	P value
1.	Age (years)	42.19±13.15	37.51 ±11.49	0.107
2.	Weight (kg)	67.01 ± 10.09	66.73± 8.50	0.832
3.	Gender(M/F)	69.7	30.5	0.878
4.	Duration (minutes)	95.73 ±38.58	91.20 ±31.07 0.304	0.304

Table 4 presents the demographic and baseline clinical characteristics of Group A and Group B, showing no significant differences between the groups in terms of age (42.19±13.15 vs 37.51±11.49 years, $p=0.107$), weight (67.01±10.09 vs 66.73±8.50 kg, $p=0.832$), gender distribution (69.7% male vs 30.5% female, $p=0.878$), or surgical duration (95.73±38.58 vs 91.20±31.07 minutes, $p=0.304$), indicating that the groups were well-matched for these variables prior to intervention. This demographic similarity strengthens the validity of comparing postoperative outcomes between the groups, as observed differences in coughing, sore throat, and hoarseness in previous tables are less likely to be confounded by these baseline characteristics.

DISCUSSION

Endotracheal tubes are used to control airway but causes possible complications such as sore throat, hoarseness, coughing, pain, stridor etc. which can be prevented. Both over and under inflation of cuffs should be avoided. Endotracheal tube cuff pressure should not exceed the hydrostatic pressure on cuff and negative pressure created during inspiration. Therefore, it is recommended that endotracheal tube cuff pressure to be kept between20 and 30 cmH2O. Hence, we maintained the cuff pressures around 20-30cm H 2O [7]. Medical gases like nitrous oxide used in general anesthesia, can diffuse into endotracheal tube cuffs and cause rise in cuff pressures, leading to respiratory complications like post operative sore throat, cough and hoarseness of voice. We avoided the use of nitrous oxide, rather we used air: oxygen 50:50 concentration. Many studies which include pharmacological agents like Opioid and non-opioid analgesics, local anesthetic agents, adjuvant analgesics, non-steroidal anti-inflammatory drugs and steroids are frequently used pharmacological agents [8,9]. Larger sized endotracheal tube exert higher pressure at mucosal interface of tube and lead to greater area of mucosal trauma. Stout et al [10] showed that incidence of postoperative sore throat and hoarseness were reduced by use of smaller tubes (6.5 mm for women) compared with larger ones (8.0 mm for women). We also observed similar results but in our study we compared 6.5 mm versus 7.5 mm sized endotracheal tube for women. Our study population also included male subjects in whom we compared 7.5 mm versus 8.5 mm sized endotracheal tube. A study by Ali S et al stated that out of total 110 patients, 47 patients reported sore throat at 24 hours after surgery; whereas 63 patients did not report sore throat [11]. The incidence was greater in endotracheal tube size 7.0 group (51%) than endotracheal tube size 6.5 (27.1%). In our study, out of 200 patients, 33 patients in group A were diagnosed with a postoperative sore throat, whereas 14 patients in group B were diagnosed with a sore throat at 24 hours which was greater with Group A (45%) compared to Group B (23%), $p<0.001$. A study by H. Y. Cho et al with 172 participants stated that rates of no, mild, moderate or severe sore throat 1 h after surgery were 60, 10, 17 and 1 with larger tracheal tubes and 79, 5, 0 and 0 with smaller tubes, $p < 0.001$. The equivalent rates 24 h after surgery were 64, 16, 8 and 0 vs. 74, 6, 3 and 1, $p = 0.037$. Female gender and Large tube diameter independently associated with postoperative sore throat as females are intubated with tighter fitting tube [12]. Researchers have also studied that cylindrical tube has greater incidence of postoperative sore throat versus conical tubes. The conical-cuff tubes having a sealing zone where outer diameter of cuff is corresponding to inner diameter of the trachea when inflated [13,14]. The lower part of the cuff is not folded in trachea because of its shape and remains limited to upper part of the cuff. So use of endotracheal tube with conical cuffs have been found to potentially reduce postoperative sore throat and hoarseness as a result of smaller cuff-tracheal contact area. However, we used cylindrical cuffed endotracheal tube which are routinely used everywhere. Y. J. Xu et al stated that, there were significant difference in the severity of postoperative sore throat between four groups at all time points ($P < 0.001$). The patients divided into four groups: Group A, size 7.0 with saline; Group B, size 6.0 with saline; Group C, size 7.0 with lidocaine; Group D, size 6.0 with lidocaine. The severity of postoperative sore throat were higher in Group A at all time points ($P < 0.05$). At 6 h and 24 h after removal of endotracheal tube, Group D had decreased severity of postoperative sore throat compared with Groups A, B and C ($P < 0.05$). The incidence of hoarseness were different between four groups at 6h after removal of endotracheal tube ($P = 0.03$). At 6 h after removal of endotracheal tube, the incidence of hoarseness were higher in Group A compared with Groups B (28% vs. 13%, $P = 0.043$), C (28% vs. 13%, $P = 0.043$) and D (28% vs. 10%, $P = 0.01$) [15]. Postoperative sore throat have now become a complication in patients undergone thyroid surgery. The factors responsible for postoperative sore throat are movement of tube and cuff in trachea, at time of positioning and manipulation of goiter during surgery. Hisham et al. found that use a smaller size tube would be a remedial action to prevent sore throat following thyroid surgery after general anesthesia. Kadri et al. reported that the main contributing factor for occurrence of postoperative sore throat following thyroid surgery is the use of larger size tube [16]. The frequency of sore throat increases with prolonged duration of endotracheal intubation and surgery, even though cuff is checked at regular intervals. It is because stretch receptors in tracheal mucosa is responsible for cough reflex and will be activated if time period prolongs (150-225 min) [17]. The stress caused by post-operative sore throat can affect patient's satisfaction, comfort, and activities. The aim is to reduce postoperative sore throat, analgesic use and provide more comfortable postoperative period. Hence in our study the duration of surgery was not more than 150 minutes in either group ($p>0.05$)

There are some limitations to our study. Firstly, the duration of surgery was less than 2 hrs. Secondly, we could have used some liquid medium instead of air for inflating the cuff of endotracheal tube.

CONCLUSIONS

This study highlighted critical role of endotracheal tube size in development of postoperative sore throat in patients undergoing laparoscopic surgeries. A detailed comparison between the use of standard-sized and smaller-sized cuffed endotracheal tubes demonstrated that patients intubated with smaller-sized cuffed endotracheal tubes experienced a lower frequency and reduced intensity of sore throat and hoarseness of voice postoperatively. Ultimately, this research contributes valuable insights to the field of anesthesiology and surgical practice, suggesting that a relatively simple adjustment in endotracheal tube size can have a significant impact on patient well-being and satisfaction in the postoperative period. Adopting smaller- sized endotracheal tubes can lead to a marked improvement in postoperative outcomes. Such a change would not only improve patient comfort but also potentially decrease the need for postoperative analgesics and

interventions aimed at managing sore throat. There was no conflict of interest. There was no financial support for the conduct of study.

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