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ORIGINAL ARTICLE

Tolerable Versus Classic Endotracheal Tube Effect on Hemodynamic Response During Extubation: Comparative Study

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ABSTRACT

Background: The process of laryngoscopy, endotracheal intubation and extubation is usually associated with exaggerated hemodynamic response including, hypertension, tachycardia, and increased intracranial and intraocular pressure. The aim of this study is to evaluate and compare the effectiveness of the modified Tolerable Endotracheal Tube (TET) with the classical one in relation to hemodynamic response during extubation in patients under general anesthesia.

Methods: Sixty patients with physical status were being classified according to American Society of Anesthesiologists (ASA) I, II aged 21‑60 years, scheduled for elective laparoscopic cholecystectomy. The patients were randomly divided into 2 groups (30 each), group C: Classic Endotracheal Tube (classic group), and group T: Tolerable endotracheal tube (TET); that receiving intratracheal 7ml 0.5% Bupivacaine. Hemodynamic parameters; Heart rate and mean blood pressure were evaluated during the extubation.

Results: Classic group showed significantly higher HR than tolerable group at 10 & 20 minutes after induction P =0.031, P=0.025 respectively, at extubation P=0.001 and 3minutes post extubation p = 0.003. Regarding to MBP, group C showed significantly higher reading than group T at 20 minutes P=0.032 after induction and at extubation time P=0.002.

Conclusions: Spraying intratracheal 7 ml of bupivacaine 0.5% via TET can decrease the incidence of complications in the form of hemodynamic instability on emergence from general anesthesia (GA).

Key words: Bupivacaine; Extubation; Hemodynamic response; Tolerable endotracheal tube

INTRODUCTION

The process of laryngoscopy, endotracheal intubation and extubation is usually associated with exaggerated hemodynamic response including hypertension, tachycardia, and increased intracranial and intraocular pressure. In patients undergoing surgery under general anesthesia, hemodynamic changes should be attenuated especially in high risk patients [1,2].

Extubation can increase the concentration of catecholamine in the blood by stimulating the sympathetic nervous system and intratracheal tube-induced laryngeal irritation, including, bucking, laryngeal oedema, sore throat, tachycardia and hypertension. The incidence of coughing has been reported to occur in 38% and 96% of cases during emergence from general anesthesia [2,3].

Various methods have been applied to attenuate hemodynamic response during extubation, including tracheal extubation while the patient is in a deep plane of anesthesia or intravenous administration of various drugs, such as lidocaine and short-acting opioids, before tracheal extubation or laryngotracheal Instillation of Topical Anesthesia *via* what is known by (LITA) tube that may provide an effective topical drug delivery system [4,5].

Objectives: to evaluate and compare effectiveness of the modified TET with the classical one in relation to hemodynamic response during extubation in patients under general anesthesia.

METHODS

This study was conducted at Anesthesia and Surgical Inten
[5].

The sample size was 60 patients classified randomly into 2 groups (30 in each group) using computerized randomization table.

The work has been carried out in accordance with the code of ethics of the world medical association (Decleration of Helsinki) for studies involving humans. A written informed consent was obtained from all participants.

Inclusion criteria: All patients age (21- 60) years old, both sexes, BMI < 35 Kg /m^2, ASA I - II patients and requiring GA scheduled for elective laparoscopic cholecystectomy surgery of 1 to 2 hours in duration.

Exclusion criteria: Difficult intubation cases, active upper respiratory tract infection, history of cardiac or chest problems, laryngeal or tracheal surgery or pathology and cigarette smoking.

Type of study: Comparative Prospective randomized controlled clinical study.

Group C (classic group):

Patients were fasted and were given atropine 1mg IM one hour before anesthesia, establishing IV line and routine monitoring of electrocardiogram (ECG), heart rate (HR), blood pressure (BP) systolic, diastolic, mean BP, blood oxygen saturation (SPO_2) and end tidal carbon dioxide ($Etco_2$).

Patients are pre-oxygenated for 3 minutes, then general anesthesia is induced with intravenously fentanyl (2 ug/kg), propofol (2-2.5 mg/kg) as induction agent followed by cisatracrium (0.15-0.2 mg/kg) after ensuring ability to ventilate the patient to facilitate tracheal intubation.

Patients underwent the general anesthesia and intubated by using classic endotracheal tube with 7.5 ID for males, 7 ID for females, pilot balloon inflated and bilaterality were confirmed and patient was mechanically ventilated with tidal volume (8–10 ml/kg), respiratory rate adjusted to keep patients normocapnic, $Etco_2$ level (32-36 mmHg), anesthesia maintained using isoflurane MAC (1- 1.5), fentanyl supplement (1ug/kg), not within 30 minutes before extubation and cisatracrium (0.03 mg/kg) were given to maintain ulnar N train of four at less than 3 of 4 with the patient adequately anesthetized.

HR and mean BP were recorded pre intubation, immediately after intubation, and every 10 minutes tell extubation.

At end of surgery, the oropharynx was gently suctioned, isoflurane was stopped. While waiting the return of spontaneous respiration attempt, muscle relaxant is reversed with dose of (neostigmine 0.05mg/kg and atropine 0.02 mg/kg combination). After fulfilling the following criteria and clinical data of full reverse: Full reversal of neuromuscular block, (TOF 4/4 with sustained tetanus at 50 Hz for more than 5 seconds and no fade) and spontaneous ventilation.

There after the patient was ready for extubation. HR and Mean BP were measured at the end of the surgery, any residual neuromuscular blockage was antagonized with neostigmine (0.04 mg/kg) if needed with atropine (0.02 mg/kg).

Trachea was extubated when extubation criteria were met that are able to follow commands (e.g. Open your eyes) or attempting self extubation. At extubation, immediately after extubation, (HR) and (MBP) were measured at 3 minutes, and 5 minutes. As result of that, if possible, to get the patient awake otherwise extubate with occurrence of coughing and bucking.

Group T (Tolerable group):

Patients underwent the general anesthesia as mentioned before and intubated by using a modified prototype manually made Endotracheal Tube (ETT); It's just classic endotracheal tube plus nelaton catheter of 6-gauge size, closed at its tip and punctured by small needle under complete sterilization technique. The punctured catheter tightened by a thread e.g., surgical silk along the lesser curvature of the tube with its closed end at the tracheal tip of the endotracheal tube. These small holes at the distal part of tube allow the injected medication to be sprayed above, along and below the ETT cuff onto the pharyngeal, laryngeal and upper tracheal mucosa circumferentially (Figure1). Head was raised up to 15-20 degrees and the pilot balloon deflated then 7 ml of bupivacaine 0.5% was sprayed followed by manual ventilation using about the double tidal volume for 5-7 times or more to get air bubbles distributed within the upper airway to anesthetize the adjacent mucosal structures, the upper part of the trachea, larynx, laryngopharynx and oropharynx, then the cuff was inflated and patient was mechanically ventilated as usual. We repeat the same technique 15 minutes prior to anticipated extubation.

Statistical Analysis: Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Qualitative that were represented as number and percentage and quantitative continues group were represented by mean ± SD. The following tests were conducted to test differences for significance; difference and association of qualitative variable by Chi-square test (X^2). Differences between quantitative dependent groups by t test. P value was set at <0.05 for significant results & <0.001 for high significant result.

RESULTS

In this present study, there was no significant difference between the two groups with respect to their demographic variables such as age, ASA grade, body weight. However, it was clearly found that the majority of participants was females among groups with no significant difference (Table 1).

Classic group is showing significantly higher HR than tolerable group at 10 & 20 minutes *P*=0.031, *P*=0.025 respectively, at extubation *P*=0.001 and 3minutes post extubation *p*=0.003 (Table 2).

Regarding heart rate comparison within each group between HR pre-extubation, at extubation, 3, and 5 minutes post extubation is showing significant decrease in T group at 3 and 5minutes post extubation (Table 3).

Regarding MBP, group C showed significantly higher reading than group T at 20 minutes *P*=0.032 after induction and at extubation time *P*=0.002 (Table 4).

Regarding mean blood pressure (MBP) comparison within each group is showing significant increase in group C at extubation (Table 5).

Regarding SPO_2 there was no significant difference between groups at different times (Table 6).

Table 1: Demographic data distribution between studied groups

			Group C (N=30)	Group T (N=30)	t/X^2	P
Age			**36.2±11.5**	**41.53±11.1**	**-1.822**	**0.074**
BMI			**25.8±3.6**	**26.12±6.2**	**-0.784**	**0.435**
Sex	**Female**	**N**	**25**	**24**	**0.11**	**0.73**
		%	**83.3%**	**80.0%**		
	Male	**N**	**5**	**6**		
		%	**16.7%**	**20.0%**		
Total		**N**	**30**	**30**		
		%	**100.0%**	**100.0%**		

Group C: Classic endotracheal tube — Female 25 = 83.3%, Male 5 = 16.7%
Group T: Tolerable endotracheal tube — Female 24 = 80.0%, Male 6 = 20.0%
BMI: Body mass index

Table 2: Heart rate distribution between groups at different times

	Group C (N=30)	Group T (N=30)	T	P
HR pre-Intubation	**82.0±9.6**	**82.23±12.2**	**-0.082**	**0.935**
HR Immediate post- Intubation	**95.2±11.5**	**91.03±12.9**	**1.316**	**0.193**
HR 10 min	**91.03±14.15**	**83.43±12.34**	**2.216**	**0.031***
HR 20 min	**87.13±11.69**	**80.16±11.81**	**2.295**	**0.025***
HR 30 min	**84.9±10.99**	**80.9±11.32**	**1.388**	**0.170**
HR 60 min	**83.36±11.18**	**81.33±10.4**	**0.729**	**0.469**
HR 90 min	**85.09±13.06**	**83.0±9.43**	**0.612**	**0.544**
HR pre-Ext	**100.67±25.3**	**94.55±1.0**	**1.185**	**0.358**

	Group C (N=30)	Group T (N=30)	T	P
HR at Ext	106.03±17.9	91.53±13.3	3.558	0.001**
HR 3 min post-Ext	99.83±17.7	87.93±10.7	3.143	0.003*
HR 5 min post-Ext	94.73±16.6	84.26±8.2	3.086	0.003*

HR: Heart Rate *: significant Group C (N=30)
Ext: Extubation Min: minutes Group T (N=30)
**: High significant

Table 3: Heart rate comparison within each group at different times

	HR Pre Extubation	HR at Extubation, 3, 5 min post-extubation and relative P values					
		At Extubation	P_1	HR_3_min	P_2	HR_5_min	P_3
Group C (N=30)	100.67±25.3	106.03±17.9	0.26	99.83±17.7	0.091	94.73±16.6	0.31
Group T (N=30)	94.55±1.0	91.53±13.3	0.32	87.93±10.7	0.02*	84.26±8.2	0.002*

P_1, P_2, P_3: Heart rate comparison within each group between pre-extubation and at extubation, 3min, 5 min post-extubation respectively.
Group C (N=30), Group T (N=30).

Table 4: Mean arterial blood pressure distribution between groups at different times

	Group C (N=30)	Group T (N=30)	T	P
MBP pre-Intubation	97.0±9.85	99.86±14.51	1.044	0.136
MBP Immediate post-Intubation	103.66±11.45	103.56±14.9	0.029	0.977
MBP 10 min	97.53±10.62	96.56±12.62	0.321	0.750
MBP 20 min	96.5±12.5	89.9±10.66	2.199	0.032*
MBP 30 min	94.3±13.98	89.86±11.73	1.330	0.189
MBP 60 min	91.73±11.53	89.76±9.03	0.735	0.465
MBP 90 min	92.27±10.9	90.77±11.3	0.448	0.657
MBP pre-Extubation	98.33±4.65	97.33±5.03	0.458	0.624
MBP at Extubation	112.96±10.68	99.46±6.31	2.956	0.002*
MBP 3min post-Ext	104.96±9.06	98.23±4.6	1.574	0.087
MBP 5min post-Ext	101.6±8.9	97.46±5.21	0.471	0.511

MBP: Mean blood pressure *: significant Group C (N=30)
**: High significant min: minute Group T (N=30)
Ext: Extubation

Table 5: Mean blood pressure comparison within each group at different times

	MBP Pre Extubation	MBP at Extubation, 3, 5 min post extubation and relative P values					
		At Extubation	P_1	MBP_3_min	P_2	MBP_5_min	P_3
Group C (N=30)	**98.33±4.65**	**112.96±10.8**	**0.02***	**104.96±9.06**	**0.11**	**101.6±8.9**	**0.23**
Group T (N=30)	**97.33±5.03**	**99.46±6.31**	**0.18**	**98.23±4.6**	**0.38**	**97.46±5.21**	**0.91**

P_1, P_2, P_3: mean blood pressure comparison within each group between pre-extubation and at extubation, 3min, 5 min post-extubation respectively.
Gro up C (N=30), Group T (N=30).

Table 6: Blood oxygen saturation distribution between groups at different times

	Group C (N=30)	Group T (N=30)	t	P
SPO_2 pre-Intubation	**99.0±0.88**	**99.06±0.88**	**0.034**	**0.9677**
SPO_2 Immediate post Intubation	**98.8±1.01**	**98.96±1.01**	**0.029**	**0.977**
SPO_2_10 min	**99.0±0.75**	**99.0±0.55**	**0.019**	**0.995**
SPO_2_20 min	**99.0±0.8**	**99.0±0.65**	**0.027**	**0.975**
SPO_2_30 min	**98.8±1.21**	**98.96±0.66**	**0.028**	**0.978**
SPO_2_60 min	**99.0±0.75**	**99.0±0.55**	**0.035**	**0.958**
SPO_2_90 min	**98.5±0.31**	**98.46±0.44**	**0.015**	**0.998**
SPO_2 pre-Ext	**99.0±0.4**	**99.2±1.22**	**0.02**	**0.979**
SPO_2 at Ext	**99.0±0.5**	**99.06±1.0**	**0.022**	**0.981**
SPO_2 3min post Ext	**99.0±0.5**	**99.2±0.58**	**0.021**	**0.979**
SPO_2 5min post Ext	**99.2±0.2**	**99.35±0.6**	**0.011**	**0.999**

Group C: Classic endotracheal tube
SPO_2 : blood oxygen saturation
Group C (N=30)

Group T: Tolerable endotracheal tube
min: minutes
Group T (N=30)

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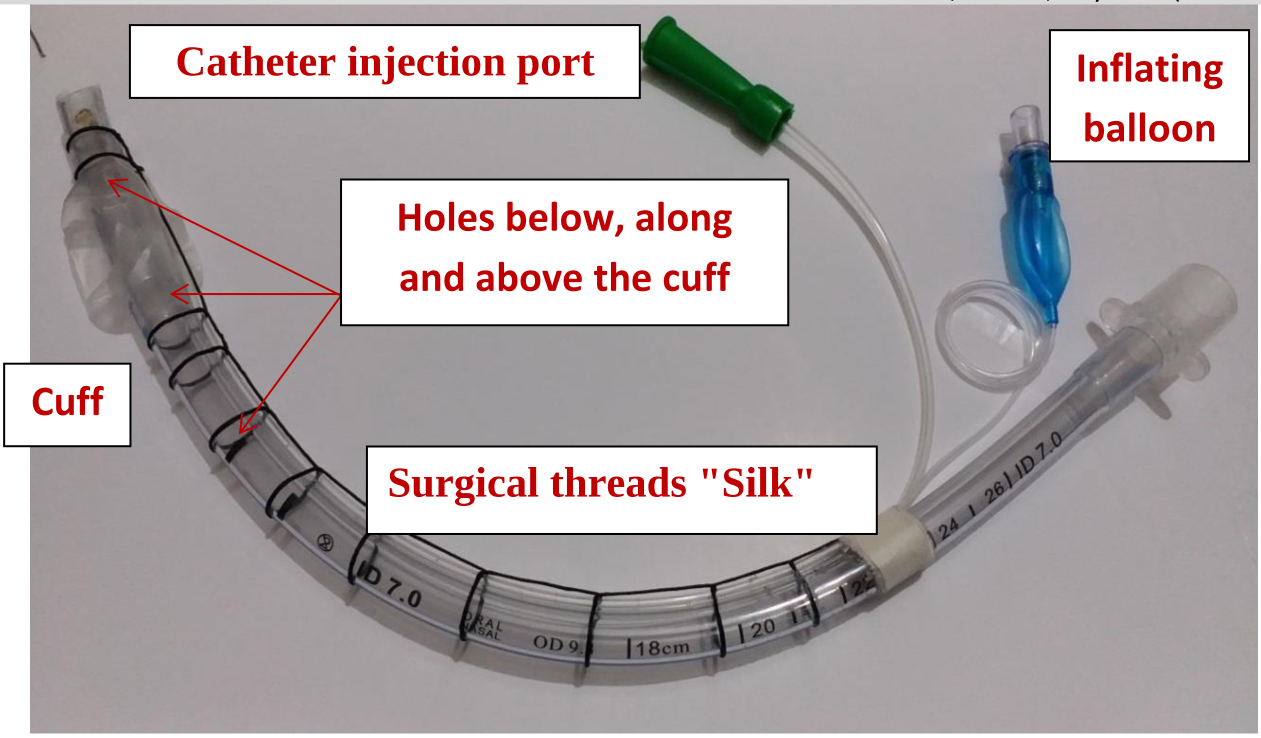

Figure 1: Tolerable endotracheal tube used in the study

DISCUSSION

During tracheal extubation there will be an increase in blood pressure and the heart rate, causing serious complications in patients with underlying abnormalities such as coronary artery disease, reactive airways or intracranial neuropathology [6]. To solve this problem local anesthesia topical application to upper airway mucosa may overcome the patient hemodynamic response to extubation.

In this present study, the findings show no significant differences between the two groups with respect to their demographic variables such as age, ASA grade, body weight, it was clearly found that the majority of participants was females among groups as the focus was dealing with laparoscopic cholecystectomy which is more common in females with no significant difference.

Also, the findings illustrate that tolerable group showed attenuation of hemodynamic response (HR, MBP) during extubation, which is in line with Hong, et al. [7] who showed that lidocaine group was given 1% lidocaine 0.5 mg/kg by endotracheal administration can be safely and effectively reduce the airway and hemodynamic responses during time of extubation. That could be explained by ability to spray of local anesthetic *via* the tolerable endotracheal tube and getting air bubbles with manual ventilation to anesthetize the surrounding mucosa of the upper airway above, along, and below the endotracheal tube cuff. So, the upper trachea, laryngeal, pharyngeal and mouth mucosa have been topicalized (anesthetized) immediately after intubation and 15 minutes before extubation compared with classic endotracheal tube which was significantly higher (HR, MBP) at extubation, 3 and 5 minutes post extubation.

Besides, inagreement with a randomized study of Meng, et al. [2], evaluating the effect of topical ropivacaine anesthesia which was given before endotracheal intubation on hemodynamic responses to extubation, results showed that HR and MBP were significantly lower in the ropivacaine group receiving topical anesthesia with 37.5 mg ropivacaine intratracheally than in the lidocaine group receiving topical anesthesia with 100 mg and saline group. In this study Bupivacaine (which is from the same group of ropivacaine) was used, showing attenuation of hemodynamic response (HR, MBP) during extubation, that may be explained by long-acting Bupivacaine than lidocaine to affect the extubation time.

Intratracheal topicalization was technically impossible because the ETT itself has imposed a mechanical barrier to the effective delivery of topical anesthetic to the laryngo-tracheal mucosa [4]. This could be overcome by the use of tolerable endotracheal tube (TET) which allow the injected medication to be sprayed above, a long and below the ETT cuff onto the pharyngeal, laryngeal and upper tracheal mucosa circumferentially [8]. These results support a previous findings published by Oh, et al. [9]**,** whom reported that intubated with 10% lidocaine spray to pharyngolaryngea

CONCLUSIONS

Based on the findings of this study, it can be concluded that the use of TET allows the anesthesiologist to infiltrate local anesthetics to the airway safely by bupivacaine (7 ml with 0.5% concentration), and decrease the incidence of complications in the form of extubation response and hemodynamic instability in patients, making the situation to be more effectively blunt the hemodynamic response to tracheal extubation in patients undergoing elective surgeries under general anesthesia. Furthermore, to finalize this conclusion, it can be said that the modified tolerable ETT was being manually developed, making this work more invaluable.

Conflicts of interest: None.
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REFERENCES

1- Allu H, Kulkarni M, Dinesh E. Study to determine the effect of oral pregabalin premedication on haemodynamic response to laryngoscopy, intubation and carbon dioxide insufflation during laparoscopic cholecystectomy. Sri Lankan J Anaesth. 2019; 27(1):8–14**.**

2- Meng Y-F, Cui G-X, Gao W, Li Z-W. Local airway anesthesia attenuates hemodynamic responses to intubation and extubation in hypertensive surgical patients. Medical science monitor: Int Med J Exp Clin Res. 2014; 20:1518–24**.**

3- Wang F, Zhong H, Xie X, Sha W, Li C, Li Z, et al. Effect of intratracheal dexmedetomidine administration on recovery from general anaesthesia after gynaecological laparoscopic surgery: a randomised double-blinded study. BMJ. 2018; 8(4):e020614.

4- Gonzalez RM, Bjerke RJ, Drobycki T, Stapelfeldt WH, Green JM, Janowitz MJ, et al. Prevention of endotracheal tube-induced coughing during emergence from general anesthesia. Anesthesia & Analgesia. 1994; 79(4):792–5.

5- Diachun CAB, Tunink BP, Brock-Utne JG. Suppression of cough during emergence from general anesthesia: laryngotracheal lidocaine through a modified endotracheal tube. J Clin Anesth. 2001;13(6):447–51**.**

6- Tung A, Fergusson NA, Ng N, Hu V, Dormuth C, Griesdale DG. Pharmacological methods for reducing coughing on emergence from elective surgery after general anesthesia with endotracheal intubation: protocol for a systematic review of common medications and network meta-analysis. Systematic reviews. 2019; 8(1):32**.**

7- Hong S-M, Ji S-M, Lee J-G, Kwon M-A, Park J-H, Kim S, et al. The effect of endotracheal 1% lidocaine administration to reduce emergence phenomenon after general anesthesia. Anesthesia and Pain Medicine. 2019;14(2):152–7**.**

8- Nofal O. Tolerable endotracheal tube, Academy of Scientific Research and Technology (ASRT), 2013; Patency no. 26322, Egypt**.**

9- Oh YJ, Kim HK, Park DH. The effect of 10% lidocaine spray on hemodynamics and postoperative sore throat accompanied by endotracheal intubation. Korean J Anesthesiol. 1996; 30(6):663.

Hokoma, M., Nofal, O., Elsawy, A., Medhat, M. Tolerable Versus Classic Endotracheal Tube Effect on Hemodynamic Response During Extubation: Comparative Study. *Zagazig University Medical Journal*, 2022; (897-903): -. doi: 10.21608/zumj.2020.23346.1718