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Extubation Response after Tolerable Versus Classic Endotracheal Tube

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Significant systemic stress responses to airway stimulation can occur during extubation, including agitation and cough, which may cause hypertension, tachycardia, increased intracranial and intraocular pressure. The aim of this work was to evaluate and compare effectiveness of the modified tolerable endotracheal tube (TET) with the classical one in relation to the extubation response in patients under general anesthesia. Sixty patients with physical status American Society of Anesthesiologists ASA I, II aged 21–60 years, scheduled to undergo elective laparoscopic cholystectomy. The patients were randomly divided into 2 groups (30 each), group C: Classic Endotracheal Tube (classic group) and group T: Tolerable Endotracheal Tube (TET) receiving intratracheal 7 ml 0.5% Bupivacaine. The incidence and severity of cough, sore throat, bucking laryngospasm and hemodynamic parameters were evaluated during the extubation. Classic group showed significantly higher HR than tolerable group at 10 & 20 min *P*=0.031, *P* = 0.025 respectively, at extubation*P*=0.001 and 3min post extubation *p*=0.003. Regarding MBP, group C showed significantly higher reading than group T at 20 min *P*=0.032 after induction and at extubation time *P*=0.002. Bucking was significantly associated with group C 90%. Cough scoring during extubation was presentin ***56.6***% in group C, and 10% in group T. Sore throat at 1 hour post extubation was present 43.3% in group C and 30% in group T. While post 24 hours group C was presentin 20%, and 10% in group T. Regarding Aldrete score Group T 9.03±0.88 was significantly higher *P*=0.00 than Group C 7.16±0.46. Intratracheal 7 ml of bupivacaine 0.5mg via TET can decrease the incidence of complications in the form of extubation response; hemodynamic stability, coughing, sore throat, laryngospasm and bucking on emergence from general anesthesia GA.

Keywords: Tolerable endotracheal tube, Bupivacaine, Extubation response.

INTRODUCTION

Extubation can increase the concentration of catecholamine in the blood by stimulating the sympathetic nervous system and the incidence of intratracheal tube-induced laryngeal irritation, including, bucking, laryngeal oedema, sore throat, tachycardia, hypertension and coughing during emergence from general anesthesia has been reported to occur in 38% and 96% of cases (Meng et al.,2014; Wang et al.,2018).

Coughing during emergence result from irritation of the respiratory mucosa by the ETT and application of local anesthesia to the mucosa in contact with the ETT as a method of increasing ETT tolerance. Various methods have been applied to attenuate this response, including tracheal extubation while the patient is in a deep plane of anesthesia and IV administration of various drugs, such as lidocaine and short-acting opioids, before tracheal extubation (Gonzalez et al.,1994). A modified ETT, the Laryngotracheal Instillation of Topical Anesthesia (LITA) tube may

provide an effective topical drug delivery system. This new type of ETT differs from a traditional ETT only in that it contains an additional small-bore channel incorporated into the wall of the lesser curvature of the ETT , The spray is intended to deflect off the wall of the larynx and trachea and to thereby bathe the entire circumference of the laryngeal and upper tracheal mucosa(Diachun et al.,2001 ; Nofal,2013).

Therefore,the aim of the current study was to evaluate and compare effectiveness of the modified tolerable endotracheal tube (TET) with the classical one in relation to the extubation response in patients under general anesthesia.

MATERIALS AND METHODS

A Comparative Prospectivestudy was conducted at Anesthesia and Surgical Intensive Care Unit department, Faculty of Medicine, Zagazig University Hospitals during the period between Oct 2018 to Sep 2019.Using open epi info, the sample size is 60 (30 in each group), Assuming that % of patients having cough suppression among patients using local anesthesia (bupivacaine 0.5%) is 75% and those using classic ETT is 13 %at 80% power of test , 95% confidence level.

Inclusion criteria

All patients age (21- 60) years old, both sexes, BMI < 35 Kg /m^2, ASA I - II patients and requiring GA for elective surgery of (1 -2 hrs) duration.

Exclusion criteria:

Difficult intubation cases, active upper respiratory tract infection, history of cardiac or chest problems, laryngo-tracheal pathology and smoking .

Patients were divided into:

1-Group C (classic group):

who 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 intubated by using classic endotracheal tube with 7.5ID in males, 7ID in females, pilot balloon inflated and bilaterally were confirmed and patient was mechanically ventilated.At end of surgery and when the patient was ready for extubation after fulfilling the following criteria; Full reversal of neuromuscular block and clinical data of full reverse. If possible to get patient awake otherwise extubate with occurrence of coughing and bucking.

2-Group T (Tolerable group):

Patients underwent the general anesthesia and intubated by using TET; is prototype manually made modified classic endotracheal tube plus nelaton catheter of 6 gauge size, closed at its tip and punctured by small needle. 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 distal holes allow spray of injected drug above, along and below the ETT cuff onto the pharyngeal, laryngeal and upper tracheal mucosa circumferentially. We use TET 7.5ID in males,7ID in females, pilot balloon inflated and bilaterally were confirmed, head was raised up to15-20 degrees and the pilot balloon deflated then 7ml 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 structures, then the cuff was inflated and patient was mechanically ventilated. Techniques was repeated 15 min prior to anticipated extubation. Trachea was extubated when full reversal of neuromuscular block and clinical data of full reverse and extubation criteria was met that is able to follow commands (e.g. Open your eyes) or attempting self extubation. HR and BP was measured at 3 min, and 5 min, bucking, coughing, laryngospasm was assessed and sore throat was assessed 1hr, and 24hrs post extubation.

RESULTS

In this present study, there was no significant difference between two groups with respect to their demographic variables such as age, ASA grade, body weight, and regarding sex female were majority among groups with no significant differenceTable 1. Classic group showed significantly higher HR than tolerable group at 10 & 20 min P=0.031, P=0.025 respectively, at extubation and 3min post extubation p=0.003Table 2.

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, Group T: Tolerable endotracheal tube,BMI: Body mass index

Table 2: Heart rate distribution between groups at different time

	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 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
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, Ext : Extubation, Min : minutes, ***** : significant **,**** : High significant

Table3: Mean arterial blood pressure distribution 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 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

Table 4: Laryngospasm and bucking distribution between groups

			Group		Total	X^2	P
			C	T			
laryngospasm	Absent	N	29	30	59	1.01	0.31
		%	96.7%	100.0%	98.3%		
	Present	N	1	0	1		
		%	3.3%	0.0%	1.7%		
Bucking	Absent	N	3	25	28	32.41	0.00**
		%	10.0%	83.3%	46.7%		
	Present	N	27	5	32		
		%	90.0%	16.7%	53.3%		
Total		N	30	30	60		
		%	100.0%	100.0%	100.0%		

****** : High significant

Table 5: Cough and sore throat distribution between groups

			Group		Total	X^2	P
			C	T			
Cough	Absent	N	13	27	40		
		%	43.3%	90.0%	66.7%		
	Mild	N	4	2	6		
		%	13.3%	6.7%	10.0%	15.85	0.00**
	Moderate	N	13	1	14		
		%	43.3%	3.3%	23.3%		
Sore throat 1hr	Absent	N	17	25	42		
		%	56.7%	83.3%	70.0%		
	Minimal	N	8	3	11		
		%	26.7%	10.0%	18.3%	5.46	0.14
	Moderate	N	4	2	6		
		%	13.3%	6.7%	10.0%		
	Sever	N	1	0	1		
		%	3.3%	0.0%	1.7%		
Sore throat 24hrs	Absent	N	24	27	51		
		%	80.0%	90.0%	85.0%		
	Minimal	N	4	3	7	2.31	0.31
		%	13.3%	10.0%	11.7%		
	Moderate	N	2	0	2		
		%	6.7%	0.0%	3.3%		
Total		N	30	30	60		
		%	100.0%	100.0%	100.0%		

Regarding mean arterial blood pressure (MBP), group C showed significantly higher reading than group T at 20 min after induction and at extubation time Table 3. Regarding laryngospasm, there was no significant difference between both groups; shows 1 of 30 patients in group C and 0/30 in group T. Bucking was significantly associated with group C 90% and 16.7% in group T Table 4.

Cough scoring during extubation was presentin ***56.6***% in group C, and 10% in group T. Sore throat at 1 hour post extubation was present 43.3% in group C and 30% in group T. While post 24 hours group C was presentin ***20***%, and 10% in group T. (Table 5).

DISCUSSION

During tracheal intubation and extubation there will be an increase in blood pressure and the heart rate and can cause serious complications in patients with underlying abnormalities such as coronary artery disease, reactive airways or intracranial neuropathology (Tung et al.2019).

To dissolve this problem local anesthesia topical application to upper airway mucosa may overcome the patient response to intubation and

extubation. Topical anesthesia applied before intubation will have little or no effect on prevention of hemodynamic instability during extubation. Application of topical anesthetic near to the time of extubation has been used. Many authors describe instillation of lidocaine solution via the lumen of the ETT (Wang et al.2018).

In this present study, there was no significant difference between two groups with respect to their demographic variables such as age, ASA grade, body weight, and regarding sex female were majority among groups because we are dealing with laparoscopic cholecystectomy which more common in females with no significant difference. Tolerable group that showed attenuation of hemodynamic response (HR, MBP) during extubation can 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 min before extubation compared with classic endotracheal tube which was significantly higher (HR, MBP) at extubation and 3, 5 minutes post extubation.

This obtained results are in agreement with Meng, et al. (2014) who evaluate the effect of topical ropivacaine anesthesia on hemodynamic responses to extubation, they found HR and MBP were significantly lower in the ropivacaine group receiving topical anesthesia with 37.5 mg ropivacaineintratracheally than in the lidocaine group receiving topical anesthesia with 100 mg and saline group that may be explained by long acting ropivacaine than lidocaine to affect the extubation time. Simillary, Hong, et al. (2019) who showed that lidocaine group was given 1% lidocaine 0.5 mg/kg by endotracheal administration can be safely and effectively used to reduce the airway response and hemodynamic response during time of extubation.

The significant increase in both T& C group at extubation and 3 min post extubation may be explained by the presence of surgical pain that may keep BP high in spite of tube tolerability in T group. During emergence from general anesthesia of intubated patients by classic endotracheal tube with no topicalization of LA, 76.5% of patients showed coughing before responding to command that may be due to stimulated by the endotracheal tube, by noxious effects of the anesthetic gas itself, or by unclearedsecretions (Kim and Bishop,1998).

The present study, showed that spraying bupivacaine 7 ml 0.5% viathe TET tube immediately after intubation and 15 minutes before extubation prevented coughing at extubation by 90% with fully awake patient obeying commands and even extubating his or her self on commands which explained by spraying of LA to the trachea, larynx, pharynx, and mouth mucosa in addition to dryness of the airway due to injection of atropine 1mg IM 1hr before induction of anesthesia. This results are in agreement with Diachun, et al. (2001) who suggested that the administration of topical lidocaine to the laryngotracheal airway before extubation*via* the LITA™ tube prevented coughing on emergence. Specifically, 2 mg/kg of 4% lidocaine given topically 30 min before anticipated extubation prevented coughing in 75% of awake patients who can follow verbal commands to open their eyes or grip their hands. Furthermore, it prevented coughing in 64% of alert patients able to lift their heads to command.

Moreover,the present study wasin agreement with Shabnum et al. (2017) who stated that cough suppression (65%) was seen in (patients receiving intra-tracheal lidocaine1.5 mg/kg of 2% preservative-free lignocaine and IV 0.9% saline) at the time of wound dressing. Topicalization was has been technically impossible because the ETT itself has imposed a mechanical barrier to the effective delivery of topical anesthetic to the laryngo-tracheal mucosa(Gonzalez et al.,1994).This could be overcome by the use of Tolerable endotracheal tube (TET) which allow the injected medication to be sprayed both above, a long and below the ETT cuff onto the pharyngeal, laryngeal and upper tracheal mucosa circumferentially (Nofal,2013).

In the present study, Sore throat at 1 hr post extubation was present 43.3% in group C and 30% in group T. While post 24 hrs group C was presentin ***20***%, and 10% in group T. This results was in agree with Oh et al. (1996) who reported that intubated with 10% lidocaine(1mg /kg) spray to pharyngolaryngeal and intratracheal during the induction of anesthesia reduces the incidence of postoperative sore throat. Simillary, Hong, et al.(2019) the incidence and score of sore throat were also lower in lidocaine group administered 1% lidocaine 0.5mg/kg intratracheally than receiving intratracheal placebo group.

However, our results are in disagreement with Crerar et al.(2008) who found a higher incidence of sore throat 71% was reported in the LITA

group was receive an instillation of 2 mg/kg of 4% lidocaine injected through the LITA port approximately 30 min before extubation. The application of lidocaine via LITA tube with the cuff inflated conceivably prevents adequate distribution of the local anesthetic to the areas of the tracheal membrane that are in direct contact with the ETT cuff Thus an inadequate nociceptor blockade may result. Future researchers may consider deflating the ETT cuff before administration of lidocaine via the LITA tube to facilitate the spread of the local anesthetic to the affected tracheal structures.

In the present study, incidence of bucking was significantly high associated with classic group 90% while Tolerable group show lower incidence rate 16.7%, due to local anesthetics installation via TET onto the pharyngeal, laryngeal and upper tracheal mucosa circumferentially with getting air bubbles. This results are concur with Khezri et al. (2011) who reported that patients in both groups had bucking, the incidence of bucking were 66.7% in patients received 1.5 mg/kg of lidocaine intravenously and 46.7% in patients received the same dose of lidocaineintratrcheally. Ability to bypass Post anesthesia care unit (PACU) allows higher theater turnover and better utilization of the operation room and the medical staff schedules, especially when high workloads are expected (Guerriero and Guido, 2011).The modified tolerable ETT being manually made may limit itis use by anesthesiologist waiting for commercial product.

CONCLUSION

Intratracheal 7 ml of bupivacaine 0.5mg via TET can decrease the incidence of complications in the form of extubation response; hemodynamic stability, coughing, sore throat, laryngospasm and bucking on emergence from general anesthesia GA.

CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

All authors were contributed in this study equally.

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