Comparison of the three-finger tracheal palpation technique with triple ID formula to determine endotracheal tube depth in children 2-8 years in 2016-2017

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Abstract

Background and objective: Correct placement of the endotracheal tube is an important part of anesthesia and special care, and it is especially important in pediatric patients. The common methods and tools used to determine the proper depth of the tube trachea have significant limitations. The aims of the present study were to evaluate accuracy and error rate of the three-finger tracheal palpation technique and compare it with triple ID formulae technique in children aged 2-8 years in 2016-2017.

Methods: In this study, 100 children aged 2 to 8 years who were nominated for elective surgery with general anesthesia requiring intubation, were selected after receiving written consent from their parents about their satisfaction with the study. Patients were excluded from the study by exclusion criteria including abnormal anatomy of airways, or chest surface anatomy, history of active respiratory or cold infection in the past 3 weeks, history of chronic respiratory disease, asthma, and allergy. Each group consisted of 50 children and in both groups of children with premedication with metidazolam 0.5 mg / kg and ketamine 5 mg / kg orally. After entering the operating room, the installation of standard monitoring equipment, pulse oximetry, ECG, noninvasive blood pressure, induction of anesthesia in the operating room with sevoflurane (8%) was instituted, and continued with 2 liters per minute of anesthesia. After adequate anesthetic depth, venous thrombosis was performed with angioquate 22, and after thiopental injection of sodium 5 mg / kg, tracheal intubation began. In the first group, an anesthetist tested the tube with a formula of three times the diameter of the tube and compared with the auxiliary auscultation of the tube. Also, the duration of intubation was measured and recorded. In the second group, an experienced anesthetist experienced three-finger touch procedure, the endotracheal tube was exposed from the chip and after tubing passed through the supra sternal, the tube was fixed. Then, the tube was controlled by bilateral anesthetic tube and the duration of intubation was measured and recorded. The tube was transmitted by an experienced anesthetist and was touched by an anesthetist technician in the supra-standard. Finally, the accuracy and error rates of the two methods were compared. The obtained data and probable complications were recorded and analyzed statistically.

Results: Comparison of two methods in terms of success rate (correct insertion of the tube confirmed by bilateral lumbar auscultation) showed that there was no significant difference in determining the depth of the tracheal tube between the two groups ($p = 0.15$). The depth of the tube in the three-finger touch procedure was significantly different from the three-fold method ($p = 0.00$). Also, the duration of intubation between the two groups was significantly

different (p = 0.00). The two methods were similar in the course of intubation, and no complications occurred during intubation.

Discussion and conclusion: Overall, this study showed that the use of the three-finger tracheal palpation technique was acceptable as a standard method and compared with the three-pipe formula, the percentage of success was greater (100% versus 96%). Also, this method has a lower error rate than the three-fold method, but the rate of intubation is three times greater than that of a three-finger touch. Of course, considering the low volume of the sample, studies with a higher sample size seem to be necessary to investigate the possible complications and confirm the results of this study.

Key words: Endotracheal Tube Intubation, Three-finger Tracheal Palpation, Laryngoscopy

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Introduction

Correct placement of the endotracheal tube is an important part of anesthesia and special care, but incorrect placement is a common mistake that can lead to major morbidity and mortality (1-4). The correct placement occurs when the distal end of the tube is placed in the middle of the chip. If the tube is very superficial, it will lead to its accidental outflow, and if it is too deep, it will increase the risk of barotraumas and pneumothorax (3, 4). The placement of the tubes, especially in children, is vital and more difficult, because the chip is shorter in children and more susceptible to hypoxemia (5).

Conventional instruments used to determine the proper depth of the chip tube have considerable limitations (6). Chest radiography is the gold standard for the proper location of the chip tube. Bronchoscopy of optic fiber is also useful, but both are time-consuming, expensive and invasive and are not always available (1, 2, 4, 7). Other techniques, such as lung echo, chest movement, capnography, the observation of the vapor in the endotracheal tube and the tube placement based on tube length are calculations that are used (3, 8-10).

Of these, one of the methods used to correct placement of chip tube is three-finger tracheal palpation technique chip tube in the suprasternal area, which has fewer restrictions, including the fact that it does not require the equipment, is cost-effective and available. Various studies have compared this method with other methods (10, 11). For example, in a 2014 study by Jonathan J Gamble et al., which was conducted on 50 children, it was concluded that using the chip touch technique to guide the endotracheal tube has excellent clinical results and the proper depth of the endotracheal tube relative to formula PALS is better (12). Accordingly, the aim of the present study was to examine the accuracy and error rate of a three-finger tracheal palpation technique of chip in the suprasternal area and compare it with the depth determination method using triple ID formula.

Method

Research method, population and sample

This study is a survey type. The population of this study was 100 patients aged 2 to 8 years old who referred to the operating room of the children's Hospital for elective surgery in year 2016. According to the statistical formula ($\alpha = 0.5$), $\beta = 20$, P0= 0%, P1 =14% and n1 / n2=1). The sample size was calculated for each group of 50 patients. These patients had inclusion criteria (grade 1 patients, ages 2 to 8 years, patients undergoing elective surgery requiring general anesthesia and intubation, parental consent for participation in the plan), and any patient who had exclusion criteria (abnormal anatomy of airways, history of active respiratory infections or colds within 3 weeks), history of chronic respiratory diseases, asthma and allergies, lack of parental consent to participate in the program, patients grade 2 and above) were excluded.

Data collection method

Data collection form including patient's age, patient's weight, sex, patient group (group 1: a group in which the triple ID method was used to determine endotracheal tube depth, and group 2: the group in which three-finger tracheal palpation technique is used to determine the depth of the endotracheal tube), length of intubation, tube size, tube depth (in the first group, the number on the side of the lip based on triple ID formula, and in the second group, the number on the lips based on the three-finger tracheal palpation technique of the chip), and complications (expiratory sounds, exhaustion, nausea and vomiting, loss of oxygen saturation, bronchospasm or laryngospasm, coughing and respiratory failure). Depending on the type of data, data were recorded by direct observation, hearing, and use of patient files.

Procedure

Each group consisted of 50 children. Oral medication with midazolam 0.5 mg / kg of vitamin 5 mg / kg was used in both groups of children. After entering the operating room and after the installation of standard monitoring equipment, pulse oximetry, ECG, noninvasive blood pressure, anesthetic induction in the operating room with

Sevoflurane (8%) was done and anesthesia continued in the gas flow of 2 liters per minute. After adequate anesthetic depth, venepuncture was performed with Angiocate No 22 and after the injection of thiopental sodium 5 mg/kg, the tube placement was begun. In groups, an anesthetist fixed the tube using triple ID formula and it was compared with the auxiliary auscultation of the tube. Also, the duration of intubation was measured and recorded. In the second group, an experienced anesthetist using three-finger tracheal palpation technique touched endotracheal tube from the chip, and after the sense of the tube passing through the supra-district, the tube was fixed. The tube was then controlled by auscultation of the chip tube and the duration of the intubation was measured and recorded. The tube was transmitted by an experienced anesthetist and was touched by an anesthetist technician in the supra-standard. Finally, the accuracy and error rates of the two methods were compared. The collected data and probable complications were recorded and analyzed statistically.
The collected data were analyzed by SPSS software 22 and the significance level of 0.05. In order to analyze the variables in independent groups for quantitative data without normal distribution, Mann- U - Whitney test and for qualitative data, Chi-square test was used.

Findings

In the first group, out of 50 patients, 33 (72%) were male and 14 (28%) were female, and in the second group, out of 50 patients, 38 were male (76%) and 12 female (24%). The mean age in the first group (triple ID formula) was 3.88 and in the second group (three-finger tracheal palpation technique) was 4.9. Also, the mean weight in the first group was 16.07 with a standard deviation of 6.38 and in the second group 17.77 with a standard deviation of 5.53. The findings of Chi-square and Mann-Whitney tests indicated no significant difference between the two groups in terms of age (p = 0.64, Mann-Whitney U = 1183), gender (p = 0.41, = Pearson Chi-Square) and weight (p = 0.38 Mann-Whitney U = 1125.50).

A total of 100 patients were examined. Two cases of unilateral chest echo (auscultation) were observed, both of which occurred in the first group, using triple ID formula to determine the depth of the endotracheal tube. In the second group, the pulmonary auscultation was bilateral in all cases (Table 1).

Chi-square test (P = 0.15, P = 0.24 = Pearson Chi-Square) indicates that there is no significant difference between the two groups in terms of bilateral pulmonary auscultation (Table 2). That is, it can be said that the two groups are the same in terms of bilateral pulmonary auscultation to control the location of the tube.

The mean of tube depth in the first group was 14.79 with a standard deviation of 1.24 and in the second group it was 94.9 with a standard deviation of 1.94 (Table 3).

Mann-Whitney U- test (p = 0.005, Mann-Whitney U-431.50, P=0.00) showed a significant difference between the two groups in terms of tube depth, so that in the first group the depth of the tube was higher than the second group (Table 4).

The mean of duration of intubation in the first group was 17.37 with a standard deviation of 23.3 and in the second group it was 21.82 with a standard deviation of 3.77 (Table 5).

Mann-Whitney test (Mann-Whitney U=487, p = 0.00) indicates a significant difference between the two groups in terms of the duration of intubation, so that the duration in the first group is less than that of the second group (Table 6 - page 52).

In this study, complications such as bronchospasm or laryngospasm, coughing, nausea and vomiting, dementia or exhalation and respiratory depression were investigated in both groups. As shown in Table 7, the incidence of these complications did not occur in the two groups and the two groups were the same for the incidence of these complications.

Discussion

In this study, which was done in a survey of methods, 100 patients were randomly divided into two groups and were evaluated. The first group included the use of triple ID formula for determining the depth of the tracheal tube, and the second group included the use of a three-finger tracheal palpation technique of chip tube in the suprastanchal touch site to determine the depth of the tube. The main objective of this study was to compare the appropriate placement in these two methods. For this, in both groups, after the tubing (tube placement), the pulmonary auscultation was used to confirm the correct placement.

The findings showed that there was no significant difference between the two groups in terms of age, gender and weight, and the two groups were similar in terms of these factors. Therefore, it would be possible to judge the results of other factors without considering these variables. The unwanted side effects that we were expecting such as nausea and vomiting, coughing, respiratory failure, inspiratory and expiratory wheezing, and bronchospasm or laryngospasm did not differ significantly between the two groups and the incidence of these complications in either of the two groups was not observed. Among other important issues examined in this study, was the correct placement of the endotracheal tube confirmed by the bilateral pulmonary auscultation, and as it was observed, its success rate was 100% in the three-finger tracheal palpation technique and in the triple ID formula was 96%, but in triple ID formula the tubing (tube placement) was more rapid than the three-finger touching group. In the case of examining the depth of the endotracheal tube (the distance from the lips), which was one of the main factors in this study, it was also found that the depth of the three-finger tracheal palpation group was clearly less than that of the triple ID formula group.

In the studies, touch technique has been shown to be superior to some methods. For example, in the study of Mckay WP et al., the chip touch technique was compared

Table 1: The pulmonary auscultation indices between the two groups

			Group		Total
			1	2	
Tube Location	bilateral	Count	48	50	98
		% within Tube Location	49.0%	51.0%	100.0%
		% within 1	96.0%	100.0%	98.0%
	unilateral	Count	2	0	2
		% within Tube Location	100.0%	.0%	100.0%
		% within 1	4.0%	.0%	2.0%
Total		Count	50	50	100
		% within Tube Location	50.0%	50.0%	100.0%
		% within 1	100.0%	100.0%	100.0%

Table 2: Chi-square test between two groups in terms of bilateral pulmonary auscultation

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.041[a]	1	.153		
Continuity Correction [b]	.510	1	.475		
Likelihood Ratio	2.813	1	.093		
Fisher's Exact Test				.495	.247
Linear-by-Linear Association	2.020	1	.155		
N of Valid Cases [b]	100				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.00.
b. Computed only for a 2x2 table

Table 3: Indices related to mean of tube depth between two groups

	group	N	Mean	Std. Deviation	Std. Error Mean
Tube Depth	1	50	14.7900	1.24986	.17676
	2	50	12.9400	1.49024	.21075

Table 4: Mann-Whitney test between two groups in terms of mean of tube depth

	Tube Depth
Mann-Whitney U	431.500
Wilcoxon W	1706.500
Z	-5.780
Asymp. Sig. (2-tailed)	.000

Table 5: Indices related to the mean of duration of intubation between the two groups

Complications	Group 1	Group 2	Total
Bronchospasm/Laryngospasm	0	0	0
Cough	0	0	0
Nausea/Vomiting	0	0	0
Inspiratory/Expiratory Wheezing	0	0	0
Decrease Of O2 Saturation	0	0	0
Apnea	0	0	0

Table 6: Mann-Whitney test between two groups in terms of mean of tube depth

	Intubation Time
Mann-Whitney U	487.000
Wilcoxon W	1762.000
Z	-5.641
Asymp. Sig. (2-tailed)	.000

Table 7: Incidence of complications between the two groups

Complications	Group 1	Group 2	Total
Bronchospasm/Laryngospasm	0	0	0
Cough	0	0	0
Nausea/Vomiting	0	0	0
Inspiratory/Expiratory Wheezing	0	0	0
Decrease Of O2 Saturation	0	0	0
Apnea	0	0	0

with the method of using the patient's teeth to determine the depth of the endotracheal tube, which touch method with a 77% success rate (compared to 57%), led to proper placement (11). Also, in the study of Jenes Moll et al., by comparing the two methods of touching the cuff and the method of using the tube markers, it was concluded that in the touch method, the tip of the tube to the carina is shorter and this distance is more predictable than the method of using markers (10). A study by Okoyama M et al. showed that the cuff touch technique was a reliable, simple, and fast technique to ensure proper position of the endotracheal tube in children (13).

As you can see in this study, the touch method has a lower error rate than the triple ID formula. In addition, in the touch method, the depth of the tube was less than triple ID formula. In the studies, the auscultation method was also used to ensure proper tube placement, but the chest radiography as a gold standard was introduced to ensure proper tube placement (tubing) (1, 2, 4). For example, in a study, Koshy S et al., found that using chest radiography with 98.5% success is introduced as the preferred method for confirming the appropriate placement of the tracheal tube at the top of the other methods. In contrast, Anderson KH introduces the autistic method as a routine method for controlling the placement of an endotracheal tube in a review article after introducing reliable methods for confirmation of appropriate placement (15).

Finally, it should be noted that among the advantages found in this study was the measurement of factors including the length of tubing, the depth of the tube and the correct placement of the tube and complications such as nausea and vomiting, coughing, respiratory failure, bronchospasm and laryngospasm. In the mentioned studies, these factors were not studied simultaneously. Therefore, it is suggested that this should be considered in future studies and perhaps by more accurate studies, with higher sample sizes, we can get more accurate results. Other suggestions of this study for future research include doing studies with higher sample size to achieve more accurate results, in the age group of less than 2 years and over 8 years, and comparing the results with the present study, comparing the three-finger tracheal palpation technique with other methods and studies in patients with non-active surgery and in patients with ASA class higher than 1.

Conclusion

Overall, this study showed that the use of the three-finger tracheal palpation technique is acceptable as a standard method, and has a higher success rate (100% versus 96%) compared to the triple ID formula. Also, this method has a lower error rate than the triple ID formula, but the rate of intubation in triple ID formula is more than the three-finger tracheal palpation technique. Of course, to confirm these results, it seems necessary to repeat them in studies with a higher sample size.

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