

Accuracy in placing oral cuffed endotracheal tube to correct depth in Indian adults based on conventional guidelines

Debjyoti Mandal *, Tirtha Ratan Ghosh and Subrata Pahari

Department of Anaesthesiology, Bankura Sammilani Medical College, Bankura, West Bengal, India.

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Abstract

Background & Aims: Precise positioning of oral Endotracheal tube (ETT) anytime is difficult however if attained will ease complications of its misplacement. The accuracy in positioning oral cuffed ETTs to the correct depth in Indian adults following conventional guidelines was sought for.

Methods: This study was conducted upon 240 adults ageing 20 to 60 years of both sex, who required endotracheal intubation at operation rooms or already intubated due to any reason admitted in CCU of BSMC&H, Bankura, West Bengal, excluding patients with hemodynamic instability and upper airway deformities. Oral ETT intubation was performed and ETT fixed at incisors following conventional guidelines. ETT tip to Carina distance was measured with fiberoptic bronchoscope thereafter. The power of study was kept at 0.95. Obtained data were evaluated with descriptive and inferential statistical tests by Microsoft Excel 2016.

Results & Conclusions: Only 60% (n=144) of ETTs were found to be accurately positioned. In the rest 40% (n=96) of misplaced ETTs, the majority (91%, n=87) were placed too deep. Predetermined fixing the ETTs at 21 cm and 23cm mark in females and males respectively leads to deep placement in 36% of them. Hence, we can declare that securing ETT at midline according to the conventional guidelines doesn't match our Indian people.

Keywords: Endotracheal tube; Patient height; Tip to carina distance; Depth; Accuracy

1. Introduction

Endotracheal intubation is a medical technique of placing a specialized tube into the trachea to maintain airway patency. It's one of the most important and commonly performed procedures in the field of anaesthesiology, emergency medicine and critical care medicine. Currently, an endotracheal tube (ETT) with cuff is still the proverbial "gold standard" when it comes to securing and protecting a patient's airway.¹ It is very important that every practicing anaesthesiologist should be able to accurately place an oral ETT. One of the major concerns while securing endotracheal tube (ETT) is its correct and appropriate depth of placement because of the major complications associated with its malplacement.² The incorrect placement of an endotracheal tube can lead to serious complications including endobronchial intubation, vocal cord paralysis, accidental extubation, collapsed lung, hypoxaemia and pulmonary barotrauma.^{3,4} Black mark(s) if provided proximal to the cuff and kept at level with cords aids in assessing correct depth of ETT placement to avoid the above complications. Several methods are available to confirm the intratracheal ETT placement at the bed side, however, although these tests can exclude oesophageal intubation, they cannot accurately declare how far an ETT is positioned within the trachea.^{1,5-8} Thus, this scientific study was conducted with the aim of describing the accuracy in placing oral cuffed ETTs to the correct depth based on conventional guidelines in Indian adult population.

*Corresponding author: Debjyoti Mandal

2. Materials & methods

This is a descriptive cross-sectional study, which was conducted in a tertiary care hospital and medical college. Institutional Ethics Committee after careful consideration approved to undertake the proposed community based study. Patients were assessed for eligibility into the study, based on inclusion and exclusion criteria. This study was conducted in 240 adults aged 20 to 60 years who required endotracheal intubation at operation rooms or had already been intubated due to any reason admitted in CCU, excluding patients with hemodynamic instability, and anatomical changes to the face, cervical region and upper airway. Written informed consent was obtained from all willing participants after proper explanation of procedure and expected outcomes of the study. Non-invasive monitors such as ECG, non-invasive blood pressure measurement, pulse oximetry and end-tidal CO₂ analysis were attached and thereafter patient was positioned in the classic ‘morning sniffing position’. Following orotracheal intubation, the ETT of appropriate size was secured at the midline over central incisors following conventional guidelines; patient was positioned on the operation table with the head in the neutral position. Following confirmation of ETT’s intratracheal placement vide presence of mist within the ETT, inspection of proper chest rise, auscultation of the chest and abdomen, breathing circuit with capnography was connected thereafter. A swivel connector with a port for fiberoptic bronchoscope (FOB) was attached to the machine end of the ETT and anaesthesia was being maintained. Following few minutes of administration of anaesthesia subsequent to stabilization of the haemodynamic variables, FOB was introduced within the ETT through swivel connector and approximated towards carina. FOB was withdrawn 5cm from the same and tip of ETT was assessed subsequently. Either ETT tip was even with FOB tip or ahead by ≤ 2 cm, if so ETT was kept as such and marking on ETT over the upper incisors was noted. Whereas ETT tip if not visible or ahead by >2 cm from FOB tip, ETT tip was kept 4 cm away from carina to validate Goodman’s criteria and marking recorded. Similarly, for patients within CCU who had been already intubated for any purpose; haemodynamic stability was assessed clinically, procedure was conducted with adequate monitoring after thorough oral suctioning of the patient and the ETT was fixed at midline over the central incisors based on conventional guidelines had it not been done. A swivel connector with a port for fiberoptic bronchoscope (FOB) was attached to the machine end of the ETT. The rest steps were same as described earlier. During the whole process, an assistant ensured no undesired movement of ETT occurred during that period and movement of FOB in either direction was based on its marking at the level of swivel adaptor. The sample size of 240 was determined by keeping power of the study as 0.95 who were distributed equally among males and females within 20 to 60 years, without any need for control population. The data was tabulated in Microsoft Excel Worksheet and analysed using both descriptive and inferential statistical tests by Microsoft Office 2016. Kolmogorov Smirnov test was performed over the continuous variables beforehand to look out for normality in their distribution pattern. Continuous variables that were normally distributed included patient age, patient height and the distance of the ETT tip above the carina. The only continuous variable not normally distributed was the ETT marking measured at the upper central incisors. Continuous variables that were normally distributed were described using means and standard deviations, and those not normally distributed with medians and inter-quartile ranges. Standard tests of significance were applied to find out the p-value. $p < 0.05$ was considered as significant.

3. Results

Table 1 Distribution of ETT tip to Carina distance in study population based on age, gender & height

Variables	Measurement	Males	Females	p-value
Age (years)	Mean \pm SD	39.33 \pm 11.43	41.25 \pm 10.87	0.082487
	Range	20-60	20-60	
Height (cm)	Mean \pm SD	165.88 \pm 4.69	156.41 \pm 5.21	1.11698E ⁻³⁵
	Range	154-180	145-173	
ETT tip to Carina (cm)	Mean \pm SD	3.89 \pm 1.18	3.14 \pm 1.12	3.45262E ⁻⁰⁷
	Range	1.2-6.9	0.5-5.8	

Table 2 Correctness of depth of tube placement in adults following conventional guidelines

ETT placement	Male	Female	Total	p-value
Correct	80	64	144	< 0.05
Incorrect	40	56	96	
Total	120	120	240	

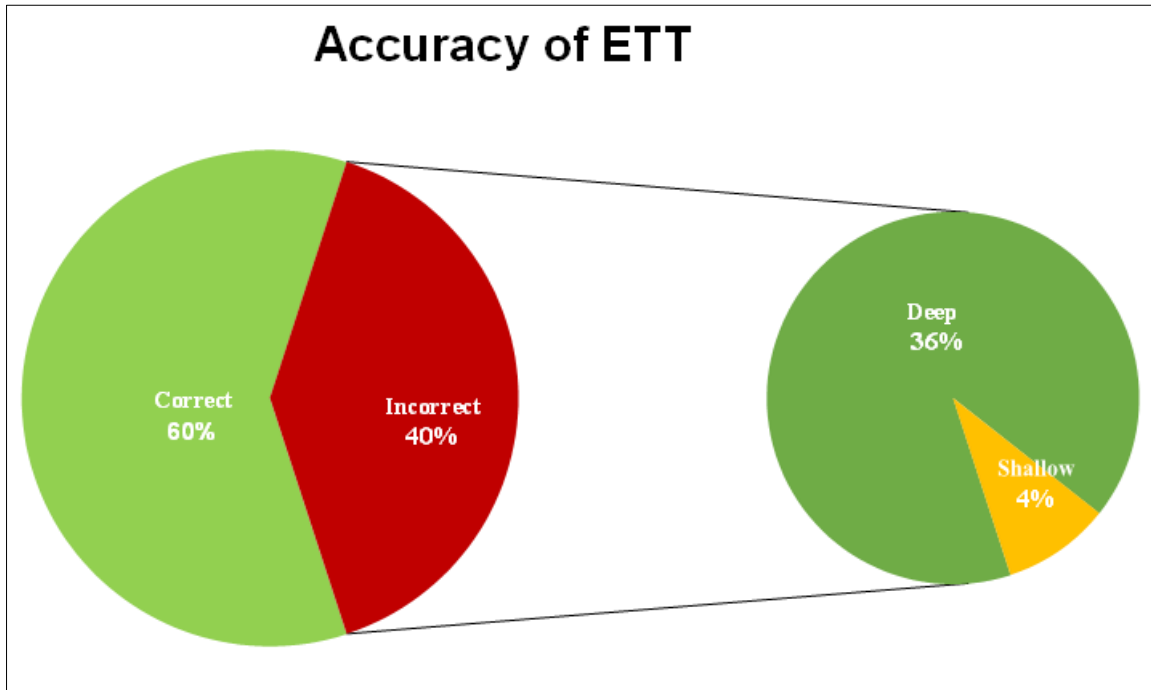


Figure 1 Pie Chart describing accuracy of ETT placement

Following table has been designed to establish influence of patient height on accurate depth of oral ETT placement.

Table 3 Influence of patient height on accurate depth of oral ETT placement

ETT placement	Height/Length(cm)	Tip to Carina distance(cm)	p-value
Correct	163.38 ± 5.53	4.11 ± 0.70	< 0.05
	149 - 176	3.0 - 5.0	
Deep	156.23 ± 5.41	2.26 ± 0.59	< 0.05
	145 - 168	0.5 - 2.9	
Shallow	173.55 ± 5.00	5.99 ± 0.54	< 0.05
	164 - 180	5.2 - 6.9	

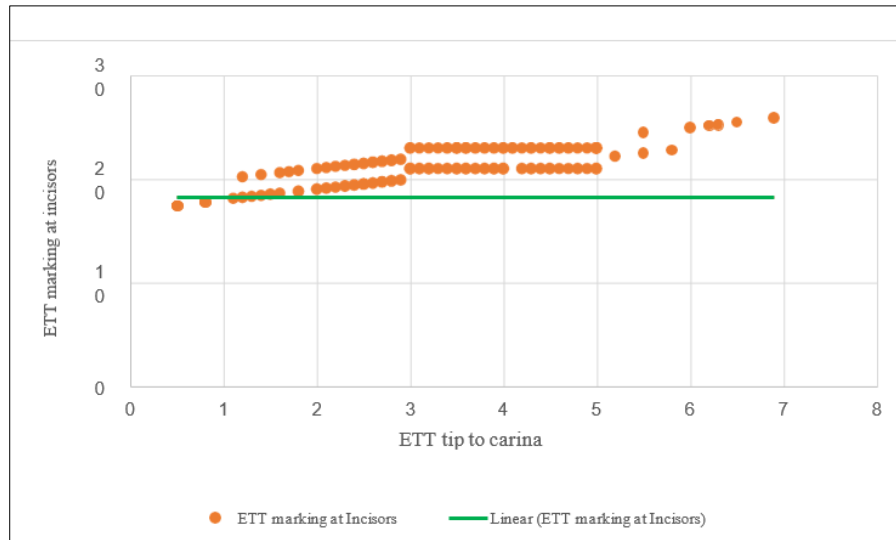


Figure 2 Pearson Correlation between ETT marking at incisors and TC distance

4. Discussion

Several factors mentioned in the literature said to influence tracheal length and ETT placement depth which include patient age, gender, height^{9,10} to name a few, yet the studies lead to uncertainty.

Mean height of Indian males is greater than their female counterparts; consequently tracheal lengths are relatively shorter in the females. Of the 240 patients who agreed to participate in the study, only 60% (n=144) of ETTs were found to be accurately placed. Although there was no significant difference in the number of accurately placed ETTs between the male and female groups, the number of deep ETT misplacements was significantly higher in the female group [61%, n=53] whereas shallow ETT placement occurred mostly in males. [67%, n=6] There was a general trend observed with patient height and ETT placement in our study. Patients with deep ETT placement tended to be shorter, while patients with shallow ETT placement tended to be taller contrasts significant difference with those with accurate ETT placement. Male patients were significantly taller and the mean ETT distance measured above the carina was also significantly greater. Varshney M et al.¹¹ in 2011 carried out a study on 200 adults whose mean ETT distance (SD) measured above the carina around was 3.69(1.65) cm and 2.28(1.55) cm for males and females, respectively.

It will be better to conduct a subsequent study using the proposed equation in a larger study population.

The limitation of this study lies in the fact that males and females included represent those scheduled for surgery during the time assigned for data collection. Once target sample population was reached no more inclusions were made that may have caused leaving a wide spectrum of body length/height inadvertently.

5. Conclusion

In agreement with other reports from the literature, the results of this study did not show differences related to sex in relation with the length of the airway: if a man and a woman of equal heights are considered. So, as of now we can conclude that securing ETT at midline following the conventional guidelines doesn't cater our population residing in the eastern zone of India.

Compliance with ethical standards

Disclosure of conflict of interest:

No conflict of interest to be disclosed.

Statement of ethical approval

Institutional Ethics Committee after careful consideration approved to undertake the proposed community based study.

Statement of informed consent

Informed consent was obtained from all willing participants after proper explanation of procedure and expected outcomes of the study.

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