Appropriate Placement Of Endotracheal Tubes In Pediatric Cardiac Patients

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Citation

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Abstract

AIM To evaluate the appropriateness of intubation depth marks on the pediatric tracheal tube as a method of achieving midtracheal tube placement.To review other methods used for correct depth placement of endotracheal tube (ETT). METHODS This is a prospective study carried out at Innova children's heart hospital Hyderabad India between June 1st to September 30th 2010. One hundred patients with body weight of 10kg and below who had elective cardiac surgeries under general anesthesia were included in the study. Demographic data were obtained from patients' case file. Data concerning type of operation done, ETT (uncuffed polyvinyl chloride tube) size, position, adjustment, type of endotracheal intubation and level of carina were observed. The tube was placed with the recommended centimeter marking aligned with the vocal cords. Radiological examination was carried out in the surgical intensive care unit immediate post operation and after 24hrs with the head in neutral, flexed and extended positions. RESULT The patients were between the ages of 23 days and 4years. They were 58 males and 42 females. The mean body weight of patients was 6.2 ± 2.0kg and height 68.2 ± 10.6cm. The sizes of ETT used were 4.0 (n=37), 4.5 (n=44), and 5.0 (n=9). In 76% of cases the ETT was located at first thoracic vertebra (T1) and in 6% of patients ETT was adjusted to T1. No case of endobronchial intubation or accidental extubation was recorded. CONCLUSION Midtrachea ETT placement was achieved by using intubation depth marks on the pediatric tracheal tube.

INTRODUCTION

Endotracheal intubation is a technique which allows placement of endotracheal tube (ETT) in the trachea. The trachea is a cartilaginous and membranous tube, extending from the lower border of the larynx, on a level with the sixth cervical vertebra, to the upper border of the fifth thoracic vertebra where it divides into the two bronchi. The appropriate depth of placement of ETT in the trachea is as important as the technique itself.

The unexpected displacement of the ETT as a result of neck movements can cause endobronchial intubation and accidental extubation if the tube is not located in midtrachea, on a level with the first thoracic vertebra. Therefore, it is very important to accurately place the ETT to a predetermined depth in order to ensure safety during neck movement. Several clinical methods have been used to establish adequate depth of ETT tip in the trachea[1-4]. We evaluate the appropriateness of intubation depth marks on the pediatric tracheal tube as a method of achieving midtracheal tube placement.

METHODS

This is a prospective study carried out at Innova children's heart hospital Hyderabad India between June 1 st to September 30 th 2010. One hundred patients with body weight of 10kg and below who had elective cardiac surgeries under general anesthesia were included in the study. Demographic data were obtained from patients' case file. Data concerning type of operation done, ETT (uncuffed polyvinyl chloride tube) size, position, adjustment, type of endotracheal intubation and level of carina were observed. Intravenous induction with sodium thiopentone 5mg/kg was carried out and endotracheal intubation was achieved with 0.2mg/kg of pancuronium. For cases of nasotracheal intubation the nostrils were prepared with nasal drops and the ETT were lubricated with 2% lidocaine gel. The tube was placed with the recommended centimeter marking aligned with the vocal cords (i.e., the 4-cm mark for tubes with an internal diameter of 4 or 4.5 cm and the 5-cm mark for tubes with a diameter 5 cm). Correct placement of ETT was ascertained by chest auscultation and capnography.

All patients were electively ventilated after surgery. Radiological examination (chest and neck -X-ray

anteroposterior view) was carried out in the surgical intensive care unit immediate post operation and after 24hrs with the head in neutral, flexed (chin touching the sternum) and extended positions. The depth of ETT in the trachea was assessed by its corresponding level with the thoracic vertebra (T) on X-ray. Data were analyzed by simple percentage.

RESULT

The patients were between the ages of 23 days and 4years (mean of 12.4 ± 10.9 month). They were 58 males and 42 females. The mean body weight of patients was 6.2 ± 2.0kg, height 68.2 ± 10.6cm and basal surface area 0.34 ± 0.08m^2. The predominant case was ventricular septal defect closure 35% (Table 1).

The sizes of ETT used were 4.0 (n=37), 4.5 (n=44), and 5.0 (n=9). In 76% of cases the ETT was located at first thoracic vertebra (T1) and in 6% of patients ETT was adjusted to T1 (Table 2). The adjustments were made because the tubes were located at the carina when the X-rays were taken with the head in the flexed position. Only one of the T3 placements was not adjusted because carina level was T5. None of the adjustment was downward replacement. No case of endobronchial intubation or accidental extubation was recorded and no further adjustment was needed after 24 hours. In 80% of cases the carina level was at T4.

Nasotracheal intubation was performed in 77 patients while orotracheal intubation was performed in 23 patients. All patients were followed-up for any airway complications at the paediatric intensive care unit and ward (particularly those that had nasotracheal intubation). There were no postextubation airway complications encountered.

Figure 1

Table 1. Types of surgical correction (%)

Ventricular septal defect	35
Atrial septal defect	4
Tetralogy of fallot	17
Tansposition of great arteries	2
Double outlet right ventricle	1
Bidirectional Glenn shunt	11
Blalock Taussig shunt	7
Pulmonary artery banding	19
Unifocalization	1
Anomalous pulmonary venous connection	3

Figure 2

Table 2. Demographic data of patients

Thoracic vertebra	ETT position	ETT adjustment	Level of carina
T1	76%	-	-
T2	18%	1%	-
T3	6%	5%	19%
T4	-	-	80%
T5	-	-	1%

DISCUSSION

The main finding was that the intubation depth marks provided a safe margin regarding inadvertent endobronchial intubation and accidental extubation. None of patient had ETT placed above T1 which could easily lead to displacement into the pharynx by extension of the head or a T4 (carina) placement that could lead to inadvertent endobronchial displacement during flexion of the neck. Through out the period of intubation, accidental extubation or endobronchial intubation was not recorded. This finding was in agreement with the study carried out by other investigators[4-6].

Yoo SY et al [4] reported that positioning the depth marker at the vocal cord level and palpation of the ETT tip on the suprasternal notch in children aged between 2 and 8 yr prevented endobronchial intubation and accidental extubation caused by neck flexion but positioning the ETT 2 cm above the carina by auscultation after a deliberate endobrochial intubation did not.

This series showed that 76% of cases had a T1 ETT placement which is midtrachea. Considering the variations in the carina levels in our patients T1 placement is considered safe. A similar result was reported by Freeman et al[1] (79%) in patients aged 0–14 yr. Only 6 of our patient required upward ETT adjustment because of its location at the carina during head flexion. In children aged between 16 and 19 month, the ETT tip moved a mean distance of 0.9 cm with a maximum movement of 1.2 cm during neck flexion[7]. Therefore, an ETT positioned 2 cm above the carina in children under 2 years (4) or at T1 as in this series can be considered to be safe from endobronchial intubation during neck flexion. The midtrachea is considered to be the ideal depth for an ETT[8]. The advantage of this technique (intubation depth marks) is that it is easily remembered and setting the tube length at the level of the vocal cord reduces the variability due to the length of the upper airway[4].

Considering the differences in the level of the carina in our patients it becomes difficult to predict which methods of ETT placement will achieve a perfect result in all patients. Chest X-ray remains the "gold standard" for confirming appropriate tube placement[9]. Other methods such as fiberoptic bronchoscope and fluoroscopy could be used but are not readily available[10].

Intubation depth marks in pediatric tracheal tubes were introduced for safe positioning of tracheal tubes, particularly in the emergency situation when tracheal intubation often has to be performed by inexperienced personnel[11].

CONCLUSION

Midtrachea ETT placement was achieved by using intubation depth marks on the pediatric tracheal tube and it prevented endobronchial intubation and accidental extubation during head flexion and extension respectively.

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