

Title: Front-Teeth-to-Carina distance in children

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Introduction: To obtain values for normal Front Teeth to Carina distances (FT-C), which can be useful knowledge during oral endotracheal tube (ETT) placement, we measured FT-C in children of different ages. Clinically, we have found "Morgan's formula"¹ a good guide to intubation depth. The formula: ETT length at front teeth = patient height/10 + 5 cm, is based on bronchoscopy and radiographic measurements in children more than 4 years of age. A second objective of our study was to examine whether Morgan's formula is a useful rule of thumb also in younger children.

Methods: 182 AP Chest X-ray print-outs from 170 children, 1 day-19 years of age, undergoing cardiac catheterization, were examined. The patients were orally intubated and the X-ray was obtained with the head in a neutral position. The ETT length at the upper front teeth/dental ridge (A) was carefully noted, and the distance between the ETT tip and the carina (B) was measured on the chest X-ray, using the width of the ETT tube as reference. FT-C was calculated as A+B. For the analysis, each measurement was regarded as one individual. With FT-C as dependent variable, best fit regression equations were calculated for FT-C *versus* height, weight, and age, respectively.

Results: Of the 182 measurements, 70 were in patients less than 1 year of age and 27 in neonates (<1 month of age). The best R² value was obtained for FT-C *vs.* height (Fig.). Gender did affect the FT-C to height relationship but the difference was small - for a given height, FT-C was only 2.1-4.2% greater in boys (n=94) than in girls (n=88) - and the best fit regression line for boys and girls combined is therefore shown in the figure. Although most patients had congenital heart disease, no patient had signs of elevated abdominal pressure. None had specific head or neck anomalies, but thirteen children had syndromes that could affect tracheal length. Stepwise multiple regression analysis did not demonstrate that these children differed significantly from other children and they were therefore included in the analysis. Intubation depth calculated by Morgan's formula was 90±4% of FT-C. No patient would have been bronchially intubated had Morgan's formula been used, but the ETT would have been less than 0.5 cm from the carina in 5 neonates and in 3 older infants and children.

Discussion: FT-C was closely correlated to the length/height of the child. Morgan's formula is a useful guide to intubation depth, but can result in a low ETT tip position, especially in small infants, and the position should be confirmed with auscultation and/or chest X-ray.

References: 1. Morgan GAR, Steward DJ. Can Anaesth Soc J. 1982, 29:1-8