

Morphometric study of trachea in adult cadavers

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Abstract

Introduction: Knowledge of tracheal morphometry is essential for carrying out interventional procedures of the airway like endotracheal intubation, tracheostomy and tracheal stenting. It has been described that the length of human trachea ranges from 10 to 11 cm and the internal tracheal diameter in transverse axis is about 12 mm in adults. The main objective of this study is to evaluate the tracheal length and its internal and external diameters from adult Nepalese cadavers.

Methods: A total number of 182 cadavers, 132 male and 50 female, with Nepalese nationality were studied. The study subjects were 18 years or above. Tracheal length, internal and external tracheal diameters in anteroposterior and transverse axes were measured after photographic record of the sample.

Result: The mean tracheal length was 82.87 ± 8.3 mm in male and 77.59 ± 9.3 mm in female. The TEDAP were 18.95 ± 2.0 mm and 15.83 ± 2.2 mm in male and female respectively. The TEDTR were 23.73 ± 3.5 mm and 20.70 ± 3.0 mm in males and females respectively. The TIDAP in males was 9.34 ± 2.2 mm and in females was 6.88 ± 1.7 mm. The TIDTR was 13.24 ± 2.9 mm in males and 10.51 ± 2.9 mm in females.

Conclusion: The tracheal dimensions of our study showed marked dissimilarity with those of the studies conducted in western population.

Keywords: endotracheal intubation, tracheal diameter, tracheal length.

Introduction

Endotracheal intubation is done frequently for airway management. Selection of proper size of endotracheal tube is important to prevent complications like hoarseness¹ or sore throat² caused by improper tube size selection. Furthermore, it has been found that iatrogenic tracheo-bronchial ruptures most frequently occur during tracheal intubation due to pushing the endotracheal tube too distal (may damage the carina or the primitive bronchi) or using a too thick endotracheal tube (more commonly in female patients)³. These situations can be prevented if there is proper knowledge of airway morphometry.

Studies have been carried out to measure the actual tracheal parameters in other population⁴⁻⁸ but similar study in our population is not known till date.

Current study aimed at constructing the morphometric data of trachea in adult cadavers presenting in the department of Forensic Medicine.

Methods

This was a descriptive study carried out from Jan to Nov 2015 in the Department of Forensic Medicine and Toxicology, Maharajgunj Medical Campus. A total of 182 cadavers (132 male and 50 female) were chosen who bore Nepalese citizenship certificate and were 18 years or above with unaltered air passages. The cases of hanging, strangulation, putrefied cadavers were excluded from the study.

The age group 18 and above was selected because the study aimed at measuring the dimensions of trachea in adult population.

The data was collected using scalpel, dissecting forceps, digital Vernier calipers and flexible measuring tape. The specimen was obtained from standard autopsy procedure using M. Letulle’s technique. After evisceration and removal of aorta and esophagus from the posterior aspect of the organ block of thoracic and cervical region, the trachea along with the larynx and tongue was freed from the rest of the block. After thorough washing and dividing the isthmus of thyroid gland, the cricoid cartilage was identified. The specimen was photographed. The length of the trachea was measured from the lower border of cricoid cartilage upto carina in millimeters with the help of digital Vernier calipers and noted. Next, the lumen of trachea was cut 1 cm proximal to the bifurcation and measurements of external and internal diameters were taken in antero-posterior and transverse axes. The specimen was replaced within the body. The data was analysed using SPSS version 20.

Result

In our study, age ranged from minimum 18 years to maximum 86 years in males and a minimum of 18 to maximum of 82 years in females. More than 50% of cases were in the age group 21 to 50 years in both males and females.

The mean tracheal length in this study was 82.87± 8.3 mm in males and 77.5±9.3 mm in females. The TEDAP were 18.95±2.0 mm and 15.83±2.2 mm in males and females respectively. The TEDTR were 23.73±3.5 mm and 20.70±3.0 mm in males and females respectively. The TIDAP in males was 9.34±2.2 and in females was 6.88±1.7 mm. The TIDTR was 13.24±2.9 in males and 10.51±2.9 in females. (tables1 and 2)

Table1: Measurement of body length and various tracheal dimensions in male (n=132)

Parameter	Range	Mean	Standard deviation	P value
Body length (cm)	150-185	163.84	5.71	
Tracheal length (mm)	65.37-110.4	82.87	8.36	.007
TEDAP (mm)	12.52-24.79	18.95	2.04	.036
TEDTR (mm)	13.75-39.65	23.73	3.56	.424
TIDAP (mm)	3.72-24.73	9.34	2.24	.020
TIDTR (mm)	8.01-22.92	13.24	2.96	.318

p-value<0.05 is significant

Table2: Measurement of body length and various tracheal dimensions in female (n=50)

Parameter	Range	Mean	Standard deviation	P value
Body length (cm)	138-168	153.80	6.17	
Tracheal length (mm)	63.21-99.48	77.59	9.37	.825
TEDAP (mm)	10.21-20.69	15.83	2.22	.449
TEDTR (mm)	13.79-27.17	20.70	3.08	.498
TIDAP (mm)	3.79-10.76	6.88	1.75	.385
TIDTR (mm)	4.22-16.80	10.51	2.90	.863

p-value<0.05 significant



Fig 1: Photograph of measurement of the tracheal length (TL)



Fig 3: Photograph of measurement of the external tracheal diameter in transverse axis (TEDTR).

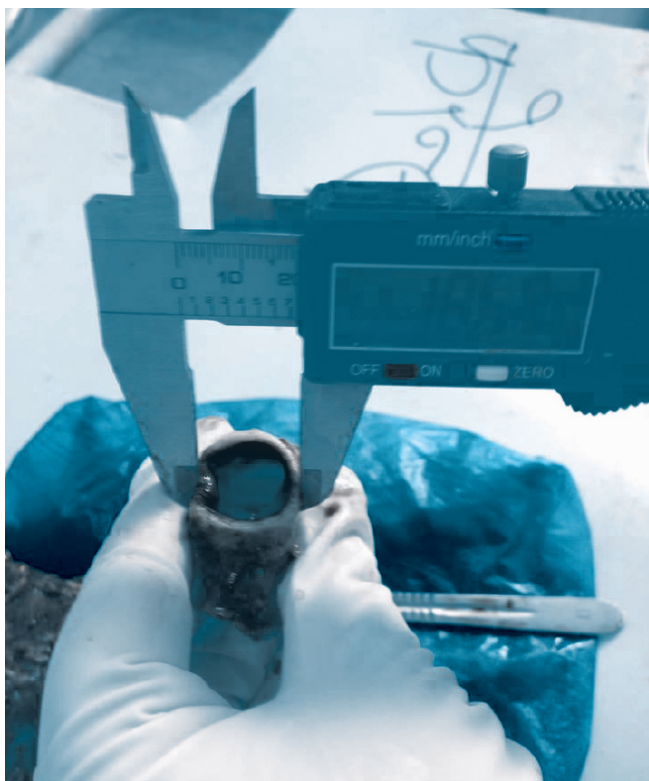


Fig 2: Photograph of measurement of the external diameter of trachea in AP axis (TEDAP)



Fig 4: Photograph of measurement of the internal tracheal diameter in AP axis (TIDAP)



Fig 5: Photograph of measurement of the internal tracheal diameter in transverse axis (TIDTR)

Discussion

In the present study, the mean tracheal length in males and females were $82.87 \text{ mm} \pm 8.36$ and $77.59 \text{ mm} \pm 9.37$ respectively, which was slightly less than the mean of Bangladeshi⁴, Mexican⁵ and Bengali⁶ population while much lower than most of the measurements found in the literature^{7, 9-13}.

The internal tracheal diameter in the transverse axis (TIDTR) in our study was similar to that of R Chunder et al.⁶ It was lower than that of other studies^{5,7,8}.

The internal tracheal diameter in the anteroposterior axis (TIDAP) in the present study was slightly lower than the data available in the literature.

According to Standring et al¹⁴, there is postmortem increase in the size of tracheal lumen (internal diameter) due to relaxation of smooth muscle on its posterior aspect. Thus a slight variation in the dimensions between live individuals and cadavers is expected.

The external tracheal diameter was not measured by the majority of studies. The external tracheal diameter

in transverse axis (TEDTR) of our study was slightly higher than that of R.Chunder et al.⁶

The tracheal length of our study was less than that of studies which measured tracheal length by CT scans^{9, 13, 15, 16}. The TIDTR was also much lower as compared to the radiological studies^{10, 12, 13, 17-22}

Conclusion

Since the length of trachea in our study has been found lesser than that of a majority of study population, it can be concluded that the commercially available endotracheal tubes would be longer for use in Nepalese patients. Thus care must be taken not to push the endotracheal tube too distal while fixing the tube during intubation.

Similarly, the TIDTR was found to be narrower than most of the studies pointing to the necessity of selecting tubes with lower internal diameter so as to prevent complications.

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Conflict of interest: None declared

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