

TRACHEA AND MODE OF BRANCHING OF BRONCHIAL TREE: ANATOMICAL STUDY

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ABSTRACT

Background: Variations are common in human body and some of these variations are significant clinically. Knowledge of the variations in the length and diameter of trachea will be useful for anaesthetist and variations in the branching pattern of bronchial tree will be important for pulmonologist, surgeons, physicians and anatomists.

Aim: The present study was conducted to observe the variations in the length and diameter of trachea and also variations in the branching pattern of bronchial tree in both lungs.

Materials and Methods: This study was carried out by dissection in 50 pairs of lung irrespective of age, sex, socio-economic status or pathological bias obtained from the embalmed cadavers of Department of Anatomy, Thanjavur Medical College, Tamilnadu, India.

Results: The diameter of trachea was found to be greater than 2.5cms in 2% and in 4% it was less than 1.8cms. The length of the trachea was found to vary from 6.5cms to 16cms with the mean of 11.2cms. The length of right primary bronchus was found to vary from 1cm to 3 cm with an average of 2cm. The length of left primary bronchus was found to vary from 3.5cm to 5cm with an average of 4.4cm. The angle of right primary bronchus was found to be acute in all specimens with an average of 37°. The angle of left primary bronchus varied from 65° to 80° with an average of 74°. Sub superior bronchus was present in the right lower lobe in 92% and was found in all the specimens of left side.

Conclusion: This study showed variations in the parameters of trachea and also in the branching pattern of the bronchial tree which is significant for the clinicians. These variations can be well documented by other method of studies like cast preparation.

KEY WORDS: Lung, Bronchi, trachea, bronchial tree.

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INTRODUCTION

Knowledge of anatomy is essential for the study of airway management. The trachea provides a passage for inhaled gas to reach the gas-

exchange regions of the lungs from the atmosphere. It is a continuation of larynx at the level of cricoid cartilage and it bifurcates into two principal or main bronchi. Each main bronchus

gives rise to lobar bronchi that supply the lobes of the lung. As the left lung grows into a smaller cavity than the right, the way bronchi divide to supply segments of lung is not identical on two sides. The each lobar bronchus divides into segmental bronchi [1].

More and more, rational dissection has come to replace the unnecessarily destructive method of mass ligature at the hilum. The availability of effective chemotherapy, especially for tuberculosis, has made the benefits of segmental resection available to an ever increasing number of patients. Peripheral lesions can be removed by “wedge” resection; here an account of knowledge of bronchial and vascular relationships is essential, if these operations are to be done with maximum safety. The present work is done to provide an account of the anatomy of trachea and branching pattern of bronchi so that it will help surgeons dealing with many challenges.

MATERIALS AND METHODS

This study was carried out in 50 pairs of lung irrespective of age, sex, socio-economic status or pathological bias obtained from the embalmed cadavers of Department of Anatomy, Thanjavur Medical College, Tamilnadu, India. Trachea was observed for its length, diameter and number of tracheal rings. Length, angle and the divisions of primary bronchus were also noted. Special care was given to find any variations in the bronchial tree of right and left lungs.

RESULTS

In 2%, the diameter of trachea was found to be greater than 2.5cms and in 4% it was less than 1.8cms. In the remaining 94%, the diameter was found to be in the normal range of 1.8-2.5cms.

The length of the trachea was found to vary from 6.5cms to 16cms with the mean of 11.2cms. In 76% of specimens, the length of the trachea was found to be in the normal range of 10-15cms. It was found to be less than 10cms in 22% and in one specimen (2%), the length was found to be greater than 15cms.

The number of tracheal rings was found to be in the range of 14 to 22 with the mean of 18.

In 45 Specimens the number of tracheal rings

was found to be in the normal range of 15-20. In 3 Specimens the number of tracheal rings was found to be <15. In 2 Specimens the number of tracheal rings was found to be >20.

The length of right primary bronchus was found to vary from 1cm to 3 cm with an average of 2cm. In 5 specimens, it was more than 2.6cm and in 1 specimen it was less than 1cm. The length of left primary bronchus was found to vary from 3.5cm to 5cm with an average of 4.4cm. In 8 specimens the length was less than 4cm.

The angle of right primary bronchus was found to be acute in all specimens with an average of 37°. The angle of left primary bronchus varied from 65° to 80° with an average of 74°.

Fig. 1: Presence of sub superior bronchus in both lungs (arrows).



Fig. 2: Presence of right lower lobe sub superior bronchus (arrow)



The right primary bronchus gave upper lobar bronchus before entering the hilum and it was eparterial in 100%. Middle and lower lobar bronchus was given on entering the hilum in all the specimens. The division of left primary bronchus into upper and lower lobar bronchus were within

the hilum in all the specimens. The branching pattern of lobar bronchus was given in the table. Sub superior bronchus was present in the right lower lobe in 92% and was absent in 8%. It was found in all the specimens in left side [Fig.1.2]. The branching pattern of the bronchus of right and left side was compared with statements of other authors in discussion.

DISCUSSION

Diameter of trachea is important to anaesthetist for selecting the endotracheal tube for intubation. The external diameter of trachea is about 2cm in adult male and rather less in female [2] which is 1.5 cm in adult females [3]. In the present study, it ranged from 1.3cm to 2.6cm with the average of 2.10cm.

The length of trachea is 9-15cm in adult [2]. In the present study the length of the trachea was found to vary from 6.5cm to 16cm with the average of 11.2cm.

Abnormalities in cartilage development lead to development of excessive laxity in the affected airway and are termed as tracheomalacia or bronchomalacia [3]. No such abnormalities were noted in the present study.

The number of tracheal rings is 15-20 [4]. In the present study, the number of tracheal rings was observed to vary from 14 to 22 with the average of 18.

A tracheal bronchus may occasionally arise from the lateral wall of the trachea, more frequently from the right side. It may be supernumerary or may represent a displaced upper lobe airway [3]. No such tracheal bronchus was observed in the present study.

The length of right primary bronchus was 2.5cm and that of left bronchus was 4 to 5cm [5]. The left principal bronchus was narrower than the right bronchus [2]. In the present study the length of right main bronchus was found to vary from 1.0cm to 3.0cm, with the average length of 2.0cm and the length of left main bronchus was found to vary from 3.5 to 5cm with the average of 4.4cm.

The right main bronchus is wider, shorter and more vertical than the left and so aspirated foreign objects often pass more easily into right main bronchus and lung [6]. The angle of right and left main bronchus is given in table [Table.1].

Table 1: Angle of Right and left main bronchus.

Author	Angle of right main bronchus	Angle of left main bronchus
W.Henry Hollinshead [5]	30.3°	43.8
Weidong Mi et al [11]	34.9°	42.5°
Present study	37°	74°

Abnormalities in branching include a common origin of the right upper and middle lobe bronchi; an accessory cardiac bronchus; and a right lower lobe bronchus that may arise from the left main stem bronchus. These anatomical variants are largely asymptomatic, but occasionally may cause haemoptysis, recurrent infection and development of bronchiectasis of the airway [3].

In all specimens of the present study the right main bronchus gave off superior lobar bronchus before entering the hilum. On entering the hilum it divided into a middle and inferior lobar bronchus and the left main bronchus divided within the hilum into upper and lower lobe bronchus which is similar to that described by Richard S.Snell [7].

Table 2: Branching Pattern of right bronchus.

Author	Right Upper Lobe Bronchus.		Right Middle Lobe Bronchus		Superior Segmental Bronchus of Right Lower Lobe.		Basal Trunk of Right Lower Lobe.	
	bifurcation	trifurcation	Bifurcation	trifurcation	bifurcation	trifurcation	bifurcation	trifurcation
Edward A.Boyden [8]	54%	46%	98%	2%	89%	5%	-	-
William E.Bloomer[9]	-	-	96%	4%	74%	16%	100%	-
Present study	66%	34%	94%	6%	90%	10%	84%	16%

Table 3: Branching Pattern of left bronchus.

Author	Left Upper Lobe Bronchus		Superior Segment-Branching Pattern		Basal Trunk of Left Lower Lobe Bronchus	
	bifurcation	trifurcation	bifurcation	trifurcation	bifurcation	trifurcation
Edward A.Boyden [8]	73%	27%	83.70%	15.40%	77.30%	22.70%
William E.Bloomer [9]	86%	14%	85%	15%	96%	4%
Present study	88%	12%	90%	10%	78%	22%

Branching pattern of right and left bronchus is given in Table 2 and 3 respectively.

Edward A. Boyden [8] described that the subsuperior occurs much less frequently on the left side 27%. William E. Bloomer [9] stated that the subsuperior or accessory subsuperior bronchi chiefly the latter occur in all left lungs. In the present study the subsuperior bronchus was present in all left lungs.

In the right side, William E. Bloomer described that a subsuperior or an accessory subsuperior or both were present in 98%. Brock R.C. [10] stated subsuperior bronchus was present in 61% and accessory subsuperior bronchus was present in 48%. In the present study the subsuperior bronchus was present in 92% specimens of right side.

CONCLUSION

This study is presented to shed more light on anatomy of trachea and the branching pattern of bronchi. Knowledge of variations in the parameters of trachea and bronchi will be useful for anaesthetist in endotracheal intubation and pulmonologist in bronchoscopic procedures. It will be also useful in lung segmental resection surgeries. More studies are still required to have a clear documentation of these variations.

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Conflicts of Interests: None

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