



RESEARCH ARTICLE

ANATOMY

**THE STUDY OF BRONCHIAL TREE***Corresponding Author***Dr.C.MRUDULA**

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**ABSTRACT**

Respiratory system is the basic prerequisite for living organisms to retain their life . This system has undergone various modifications and in multicellular organisms like man it developed into a system of branching network of bronchial tree. The bronchial tree includes the trachea , right and left principal bronchi and their branching upto alveoli. The study of this bronchial tree is done to know the dimensions of trachea and branching pattern of the bronchial tree by cadaveric dissection. This is useful for thoracic surgeons and others for doing various surgical procedures and during interventions.

The study was done using the 50 lung specimens obtained from the anatomy department of Osmania Medical College and from unclaimed bodies of Forensic department of Osmania General Hospital. Various dimensions like tracheal length, width, subcarinal angle ,length of right and left principal bronchus and their width are taken.

In the present study all the dimensions are with in the normal limits. Out of the 50 lungs 4 specimens showed variations in the branching patterns.



## KEY WORDS

Trachea, bronchial tree, subcarinal angle, branching pattern.

## INTRODUCTION

The exchange of respiratory gases is the basic essentiality of life process in all the organisms. This system has greatly evolved from unicellular level to mammalian airway passage. The pathway in human beings include nasal cavity , pharynx , larynx, trachea, bronchi and their terminal ramification in lungs. Malpighi in 1661 announced that trachea terminated in dilated vesicle. A century later Diemerbroock identified the bronchial tree pattern.

The study of this bronchial tree and their dimensions is useful in various aspects as

- To thoracic surgeons for doing difficult maneuvers.
- To know spread of pathological conditions like bronchiectasis.
- To maintain posture for patients suffering from suppurative lung disorders.
- To know the entry of foreign particles.
- For anesthetist to know the caliber of trachea for intubation, bronchoscopy etc.
- For surgical resection of segments or lobes in diseases of lungs.
- The subcarinal angle indirectly helps in diagnosing some cardiovascular problems.

The study of bronchial tree is done by both invasive and noninvasive techniques like bronchograms, virtual bronchoscopy, computed tomography scan, magnetic resonance imaging scan. In the present study 25 pairs of lungs are

taken and dissected out till the level of terminal bronchi and various parameters are calculated.

## MATERIAL AND METHOD

The study was done by using the lung specimens from the embalmed cadavers from dissection hall of Anatomy department of Osmania Medical College and unclaimed postmortem specimens from Forensic department of Osmania General hospital, Hyderabad.

### METHOD :

Cadavers received into the Anatomy Department were embalmed with embalming fluid. After proper fixation, cadaver is kept on the dissection table in supine position. Sex of each cadaver was noted. An incision was done on either side of sternum ,the ribs and clavicles were cut with the bone cutter. The sternopericardial ligaments were cut. The sternum is dissected down, the pericardium is incised to view the pulmonary vessels entering the lung and are cut and separated. The trachea is cut at the lower end of the cricoid cartilage and separated from the esophagus posteriorly. The lungs are removed en mass from the thoracic cavity and are thoroughly washed with water ,they are soaked in 10% Hcl for 24 hours. Later,the parenchymatic tissue is

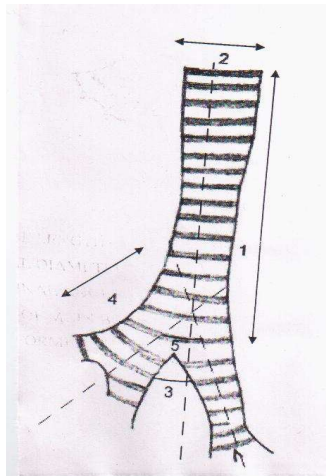


scraped with the help of scalpel and blunt forceps. The bronchial tree was cleaned up to the third generation. The bronchial tree after its separation from the parenchyma was dried in air for 1hr, kept on the paper and outline of the tree is drawn. Later the measurements are taken as follows:

1. Tracheal length : It is measured from the lower end of cricoid cartilage to the carina where the trachea is bifurcated.
2. Tracheal diameter: External diameter at the level of origin of trachea is taken by measuring the distance between the two outer borders.
3. Subcarinal angle: The angle is measured between the main bronchi at the level of carina with the help of protractor.

4. Length of main bronchi: It is measured from the origin of bronchus to the point of its division with the help of scale.
5. Angles formed by main bronchi: The angles are measured from central axis passing through the trachea to the axis of main bronchi.
6. Width of left main bronchus : The maximum diameter at the point of origin is measured with the scale.
7. Any variations in the branching pattern are identified.  
Later all the measurements are tabulated and the specimen is preserved in plastic jar with 10% formalin for further study.

**The measurements are done as follows :**



Length of trachea  
Width of trachea  
Subcarinal angle  
Length of right principal bronchus

Angle formed between right and left principal bronchus

### **OBSERVATIONS**



The study of bronchial tree is done in 25 pairs of lungs and the following are observed.

- 1) **Tracheal length** – It is ranging between 6.1cms and 9.6 cms and on average was 7.87cms.
- 2) **Tracheal diameter** – On average was 1.99 cms and range varied between 1.2 cms and 2.5 cms.
- 3) **Number of tracheal rings** – These are C shaped hyaline rings ranged between 14 and 24 and on average 17.
- 4) **Subcarinal angle** – The angle between the two principal bronchus varied between 50 ° and 130 ° and mean is 77.58 °
- 5) **Right main bronchus** – Length is between 1 to 2.4 cms and on average is 2.28 cms  
Angle is 39.68 ° on average and range between 30 ° and 60 °

- 6) **Left main bronchus** - Length varied between 2.9 and 4.2 cms and on average is 3.86 cms . Angle is 43.4 ° on average and range between 30 ° and 60 ° . Width varied between 0.59 and 1.5 cms and on average is 0.82 cms.

7) **Variations in branching pattern – Right lung :**

- a) In 2 specimens the upper lobar bronchus took origin at the level of carina.
- b) In 1 specimen the middle lobar bronchus originated from anteromedial surface of main bronchus and ran downwards medially instead of being lateral in direction.

### Left lung

In 1 specimen the upper lobar bronchus divided into apical and anteroposterior segmental bronchus.

	Trachea			Subcarina l angle	Right main bronchus	Left mainbronchus		Left bronchus width / tracheal width	
	Length (cms)	Width (cms)	Number of rings		Length (cms)	Angle	Length (cms)	Angle	
Range	6.1- 9.6	1.2- 2.5	14-24	50 - 130	1-2.4	30 -60	2.9- 4.2	30 -60	0.6- 1.5
Average	7.87	1.99	17	77.8	2.28	39.68	3.86	43.4	0.82



## DISCUSSION

A review of the literature revealed measurements of bronchial tree done by dissection of specimens, chest X rays, CT scan of the bronchial tree along with the tracheal dimensions. Their aim is to establish international anatomical standards for various parameters. In the present study various parameters are measured and compared with the available literature.

**Tracheal length** : Strenberg S (1999) in his text book of diagnostic surgical pathology 3<sup>rd</sup> edition described the tracheal length to be 11 cms long. Rosen FS (2003) studied 50 specimens and found that the length varied between 4.2 – 9.9 cms and on average is 6.68 cms. A CT scan study was done by Leader JK (2004) in 24 males and 19 females and found length to be 7.86 cms + /\_ 1.68cms. In the present study the length is on average 7.87 cms and the range is between 6.1 and 9.6 cms.

**Tracheal Diameter** : Breatnach (1984) studied X rays of 808 patients and found the diameter to be 2.5 – 2.7 cms in males and 2.1 – 2.3 in females. Strenberg S (1999) in his text book of diagnostic surgical pathology 3<sup>rd</sup> edition described the tracheal diameter as 2- 2.5 cms. The present studies shows the diameter as 1.99 cms on average and varied between 1.2 and 2.5 cms.

**Number of tracheal rings** : Michael G (1992) told that for every 2 cms there are 2 rings.

Rosen FS (2003) studied 50 specimens and observed that trachea on average contains 13.3 rings.

In the present study there are 14 rings minimum and 24 rings on maximum and on average there are 17 rings.

**Sub carinal angle** : Latarjet .M (1956) studied CT scans of 129 cases and found the angle 71° and the range between 40° – 108°. Coppole V (1998) examined CT scans of 500 patients and found the angle as 79.7° and varied between 37° – 105°. The present study shows the angle 77.8° and the range is between 50 – 130°.

### **Right main bronchus :**

**a) Length** – Richard S Snell in text book of clinical anatomy 7<sup>th</sup> edition describes the length as 2.5 cms. Present studies shows the length to be 2.28 cms on average.

**b) Angle** – Miller (1997) studied by gross dissection and found the angle as 20°. Boyd E (1958) studied 100 cases and found the angle between 27 – 30°. In the present study the angle is 43.4° on average.

### **Left main bronchus :**

**a) Length** - Richard S Snell in text book of clinical anatomy 7<sup>th</sup> edition describes the length as 4.5 cms. Present studies shows the length to be 3.86 cms on average .

**b) Angle** - Miller (1997) studied by gross dissection and found the angle as 40°. Boyd E (1958) studied 100 cases and found the angle between 43.5 – 46°. In the present study the angle is 39.68° on average.

**Ratio of Left Bronchus Width / Tracheal width**

: Brodsky (2001) studied CT scans in 31 patients and found the ratio as  $0.75 + /_ 0.09$  in males and  $0.77 + /_$  in females. In the present study it is 0.82 on average.

**Variations in the bronchial tree** : Tomoda M (

1992) observed in a male a tracheal bronchus originating 1 cm above the carina by fibre optic microscope. Kyo S (2000) observed in 63 yrs female tracheal bronchus originating 1 cms

above carina. CT scans of 17500 patients were studied by Ghaye and identified 8 cases of tracheal bronchus. Kagadis GC (2001) identified double tracheal bronchi in a 42 yrs old male by CT scan and bronchoscopy. In the present study 2 specimens show tracheal bronchus one at the level and the other above the level of carina.

**CONCLUSION**

Standard measurements of various parameters of bronchial tree are essential for various people like cardiothoracic surgeons, chest physicians, ENT specialists and anesthetists etc. The subcarinal angle indirectly helps the cardiologist to know the changes in left atrium. These parameters help us to get the correct size of bronchoscope to be passed. The various ways to study these are by gross dissection, X rays, CT scans, Virtual bronchoscopy. The present study was done by dissection of 25 pairs of lungs.

- 1) The tracheal length is observed as 7.87 cms which lies in the normal range of previous studies.
- 2) Tracheal diameter is on average 1.99 cms which correlates with the previous studies.
- 3) Number of tracheal rings are 17 and is in normal range.
- 4) The subcarinal angle is  $77.8^\circ$  and is the normal range.

**5) Right bronchus :**

- a) Length – It is on average 2.28 cms which correlates with the available literature.

- b) Angle – The angle is  $43.4^\circ$  which is slightly more than the average value present previously.

**6) Left bronchus :**

- a) Length – It is on average 3.86 cms which is lower than the available literature.
- b) Angle – The angle is  $39.68^\circ$  which is greater than the average value present previously
- c) Ratio of left bronchial width / tracheal width : In the present study the ratio 0.82 which correlates with the previous studies.
- 7) Variations in branching pattern : Among the 25 pairs of lungs studied 2 lungs showed tracheal bronchus on right side and in 1 lung the left upper division divided into apical and anteroposterior segments.



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