Measurement of Tracheobronchial Tree Dimensions in Egyptian population and itsCorrelation withSex, Age, Weight and Height (Computed Tomographic Study)

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Abstract: Measuring measurements of an airway is verysignificant for interventional bronchoscopists, investigators and clinicians in order to precisely diagnose anatomical anomaliesand detect the pathological alteration along a time or in reaction to therapies.Treating and exploration of images, thoughtful of topicsconnected to the achievement, and for any extent liketopics effect on imaging the tracheobronchial tree, is importantforevaluateddimensions precision and to createactualapplication of advanced techniques. The present workadds to this understandingby providing accurate measurements of the normative parameters of the tracheobronchial trees in the Egyptianresidentsapplying multi-planar reconstruction (MPR)andmulti-slice spiral computed tomography (CT).Six hundreds of persons submit to the Benha University Hospital for performing thoracic CT scans including the dimensions of tracheal and bronchial tree.Tracheallengths(LT)and its transvers diameter (TrTD) and anteroposterior diameter (APTD), the lengths of main stem bronchi as right bronchial length (RBL), left bronchial length (LBL), and the sizes of the right bronchial angle (RBA), left bronchial angle (LBA) were gotten via MPR of CT imaging. Multi-variance analyses were done to identifypossible associations amongacquired measurements.The anteroposterior tracheal diameter (APTD) was 20.13 ± 1.61 mm (22.46 ± 1.81mm for male and 17.81 ± 1.12mm for female).The transvers tracheal diameter(TrTD)was 18.64 ± 1.40 mm (20.92± 1.36 for male and 16.36 ± 1.18 mm for female).The length of the trachea(TL) was 125.88 ± 2.33mm (130.31 ± 2.22 mm for male and 121.46 ± 2.41mm for female). The mean lengths of left main stem bronchus (LBL) andthe right main stem bronchus (RBL)were 48.75 ± 1.88 and32.39 ± 1.11 mm respectively. The right bronchus angle and the left bronchus anglewere 35.68 ± 2.11 and 47.77 ± 1.55 degrees, respectively. The differences regarding the gender were significant in all the dimensions measured, there were significant increasein all parameters with increasing height except for the right and left bronchial angels there were no significant difference with increasing height,and there were no significant change in alltracheobronchial parameters with increasing weight and age.

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1. Introduction

The customary standardvalue and range of anthropometric differences varied between numerous races, and also between various ethnic groups inside the identical race [1], e.g, Caucasian individuals or Negroid persons have a tendency toshowlarger physical sizesthan Mongolian persons. For that reason, the measurements of the tracheobronchial tree may similarly varyfrom race to race [2].

The facility to determine airway measurements is significant for interventional bronchoscopists and investigators, in addition toclinicians, for the purpose of precisely count structuralanomalies and recording the alterations which occur along time or occur in as a result of therapies.Furthermost quantitative airway dimensions are depended on X-ray computed tomography and recently, on multidetector computed tomography [3].

Many studies since the 1950s, have concentrated on the anatomical structures of the tracheobronchial tree[4-9]. Anatomically, the trachea is situated at the height of the 6th cervical vertebra and bifurcates at the level of the 4–5th thoracic vertebra into the rightandleft main bronchus (RMB&LMB). Advanced investigation reported that during examining chest computed tomography (CT) of Asian peoples, the angle of the the LMB is 43°, where the angle of RMB is 35°. On the other hand, many factors may be influencing the variations in the tracheobronchial angles such as race, age, and subjects, and the methods used for estimation of measurement of angle [10].

With regard to the studies which carried out in the Western countries on the measurements of the tracheobronchial tree, there are several studies which dealing with this issue[3-11], and the collected data from these researches constitute themodernsource of the tracheobronchial tree measurements in a lot of textbooks.

Generally, the data concerning the fine information about the anatomical structure of the trachea and its branches is essential in the pure anthropometry area, in addition to in several other fields. The precise information regarding the anatomical structure of tracheobronchial tree, in spite of its importance in the physiology of lung and chestoperations, it is also essential in the field of anesthesiology. Determining the tracheobronchial tree parameters, for instancediameters, angulations, and the lengths, assist in the improving the surgical stepslikeinsertion of tube,restoration of the airway tree, and optimizing the medical instruments, for instance double-lumen endobronchial tube. A further clinical suggestion of this investigation is to direct the airway supervision for bronchus or tracheal cancerremovalalong the jet ventilation of interventional fiberoptic operations. It is commonlyimportant at the moment to confirm there is sufficient ratio of jet catheter to the diameter of bronchus or trachea, therefore,sufficientventilation and oxygenation is sustained, while the hazard of barotrauma is less [12-13].

In addition, accurate information about a correlation, or lack thereof, between these dimensions may decrease the require for expensive, needless, or invasive diagnostic techniques by supporting the surgeon with formerdeterminations of applicabledimensions. For instance,gaining preciselydimension of the tracheobronchial tree in an individual can reorganizepossibletroubles in airway handling and optimize patient care [10].

Because of the mentioned profit, in the present study, we aimed to do a large scale investigation demonstrating the anatomical structures of the tracheobronchial tree in an Egyptian people by applying multiplaner reconstruction(MPR) and multi-slice spiral CT. Also, we analyzed probablerelationships of measurementsusuallyapplied in illustrating the tracheobronchial tree. The current worksupplies with a applicableassessmentdimension of the tracheobronchial tree in an Egyptian peoples and should offerhelpfuldirection for applicable clinical practice and medical devices, particularlythe manufacture of the double-lumen tube.

2. Subject and Methods

The selection of cases was subjected to certain criteria:

From May 1st, 2013 to January 1st, 2017, 800persons were involved in this study from the Benha University Hospital, which provides free medical service to Egyptian population. These persons underwent CT scans in the hospital, after that their ages, heights, and weights were recorded under supervision. 200 patients were excluded from this study for at least one of the following exclusion criteria: (1) Non-Egyptian (2) Younger than 16 or older than 90 (3) Prior diagnosis of compulsive position, musculoskeletal deformity(4) Presence of hearing impairment severe enough to preclude cooperation; and (5) A history of tracheobronchial surgery. The remaining 600persons continued the study. Prior to participation, all patients were fully informed the study and provided their informed, written consent.

Groups:

For the purpose of studying the changes occur in tracheobronchial dimensions we further dividing the whole number of subject (600 subject) into groups (sexgroups, height groups, weight groups and age groups)tocompare these dimensionsin thesegroups:

1- Males and females groups (300 subject each)

2- Height groups: we divide the 600 subject into 4 height groups

A- Group1: subject their height varying from155-165 cm (145 subjects).

B- Group2: subject their height varying from 166-175 cm (165 subjects).

C- Group3: subject their height varying from 176-185 cm (133 subjects).

D- Group4: subject their height varying from 186-195 cm (153 subjects).

3- weightgroups:we divide the 600subject into 6 weightgroups

A- Group1: subject their weight varying from65-75 kg (95 subjects).

B- Group2: subject their weightvarying from76-85 kg (106 subjects).

C- Group3: subject their weightvarying from86 – 95 kg (99 subjects).

D- Group4: subject their weight varying from96 – 105 kg (85 subjects).

E- Group5: subject their weight varying from 106 – 115 kg (115 subjects).

F- Group6: subject their weight varying from 116 – 125 kg (100 subjects).

4- Agegroups::we divide the 600subject into 6 weightgroups

A- Group1: subject their age varying from 16-25 years (65 subjects).

B- Group2: subject their age varying from26-35 years (136 subjects).

C- Group3: subject their age varying from 36-45 years (89 subjects).

D- Group4: subject their age varying from 46-55 years (105 subjects).

E- Group5: subject their age varying from 56-65 years (120 subjects).

F- Group6: subject their age varying from 66-75 years (75 subjects).

Methods:

● **The CT apparatus (Scanning unit):**

The CT apparatus used in this study was:

- Toshiba spiral CT-scan Auklet
- System TSX-003A
- S#A9582405
- Patient couch CBTB-013AA9582410
- Console CKCN -007AA9582409
- Tube CXB-200BMHU
- Gantry slice492074
- Tube slice only 10000
- Input 24 kilowatt

It was the CT unit of Radiology Department in Benha University Hospital. The CT scanning unit is formed of a table, scanning gantry (which includes an x-ray tube and a detector array), an x-ray generator, computer, monitor, printer and a viewing consoles.

All the scanned films were viewed and reexamined carefully by an experienced radiologist to insure that they are carefully chosen from a healthy low risk volunteers.

Preparing the Subjects for CT Scanning of the Chest:

All persons were trained to hold deep breath for at least 10s before the thorax CT scans during suspended end inspiration at total lung capacity. The arms were fully extended above the head. The acquisition time was selected based on the distance from the vocal cord to the diaphragm. The scanned CT images were uploaded to the local area network server of the Hospital and stored in DICOM format.The findings were retrospectively reviewed and the diameters were measured with using ONIS 2.5 software program.

The parameters in use (figure 1):

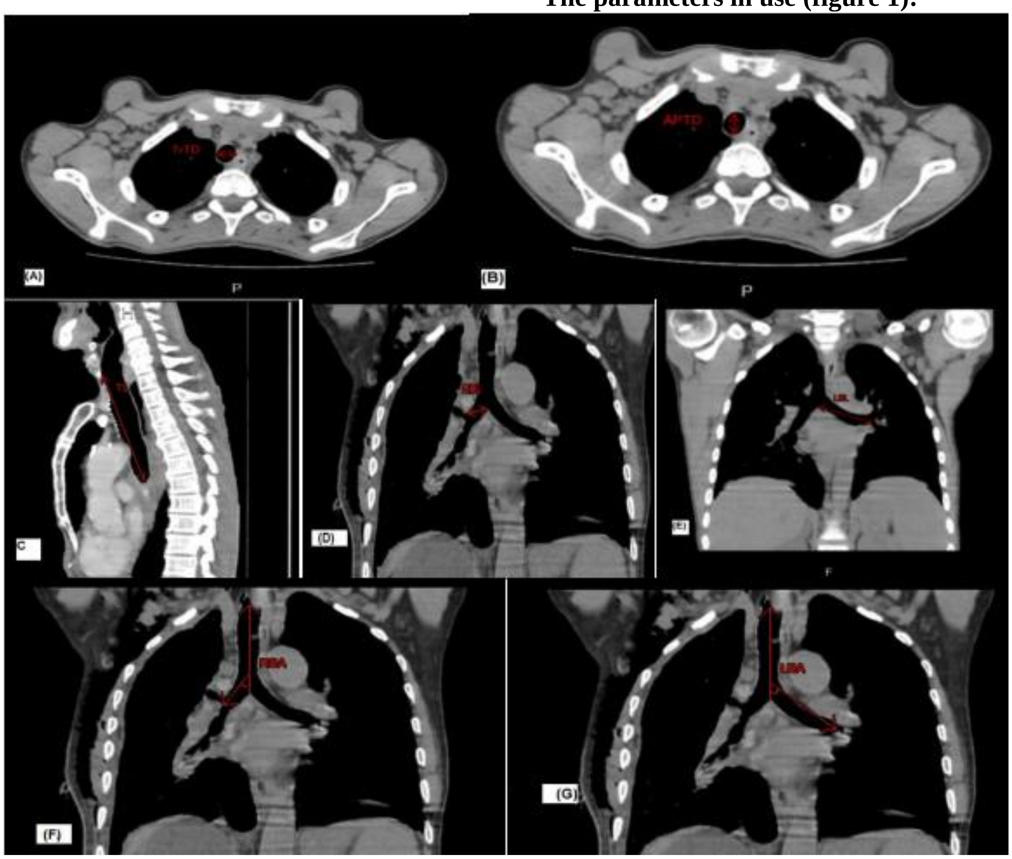


Figure 1: A CT chest images (axial and multiplanerreconstruction): (A) TrTD (transvers tracheal diameter sternoclavicular level), (B) APTD (antroposterior tracheal diameter steronoclavicular level), (C) TL (tracheal length) starting from cricoid cartlage to the carena), (D) RBL (Right main bronchus length), (E) LBL (left main bronchial length), (F) RBA (right bronchial angle), (G) LBA (left bronchial angle).

1-The internal diameter of the trachea was first measured from the axial images. The internal diameter of the trachea was measured at level of sternoclavicular level, we measured the anteroposterior diameter (APTD) and transverse diameter (TrTD) both measured at the same level. Thislocation was chosen because the supraclavicular fossa is easily recognizable Subsequently, multipalner reconstruction (MPR) was performed [10].

2- Tracheal length (TL) was measured as the distance between the lower border of the cricoid cartilage and the carina [10].

3- The length of the right main stem bronchus (RBL) and the length of the left main stem bronchus (LBL) were measured as the distances between the tracheal bifurcation point and the point where RBL or LBL divides into the secondary bronchi, respectively [10].

4-The angulation of the left bronchus (LBA) was measured as the angle between the elongation of the distal end of the trachea and the proximal end of the left bronchus [10].

5- The angulation of the right bronchus (RBA) was measured as the angle between the elongation of the distal end of the trachea and the proximal end of the right bronchus [10].

Statistical Analysis:

SPSS version 13.0 (SPSS Inc.; Chicago, IL) was used for the statistical analysis. Each data point was measured three times in the presence of an anesthesiologist and a radiologist, and represented as the mean of three measurements. All data were presented using descriptive statistics (mean and standard deviation). The unpaired Student's t test was used to compare the gender-related differences in the tracheobronchial tree. The correlations between the tracheobronchial tree parameters and demographic parameters were analyzed using multiple regression analysis. The influence of gender, weight and height were also examined by covariate analysis. The coefficient of variation (CV), which represents the extent of variability in relation to the mean of the population, is defined as the ratio of the standard deviation σ to the mean μ ($Cv = \sigma/\mu$). A P value<0.05 considered statistically significant.

3. Results

Subjects Demographics:

Total of 800 subjects (415 males, 365 females) enrolled, 200 subjectswere not included in the study due to at least one of the following parameters: (1) occurrence of a cancer or affection of the trachea and bronchus,(2) occurrence of hemothorax, massive hydrothoraxor pneumothorax, (3) chronic tuberculosis (4) occurrence of bronchiectasis, tracheomalacia or tracheo-bronchomegaly, (5) severatelectasis or consolidation and (6) unsuitability of obviouslyrecognized borderline of the airway lumen on CT image.

Descriptive characteristics of the subjectage, weight, and height, are tabulated in Table 1. Total number of subjects included in thisstudy were 600 subjects,divided into equal numbers of females and males (300 each of them). The individuals ages were ranged from 16 to 75 years, weight from 65 to 125 kg and height from 155 to 195 cm. The results revealed that there were asignificant variationsbetween the male and female subjects concerning weight and height.

Table 1. showing subjects Demographics:

Variables	Male	Female	P value
No. of subjects	300 (50%)	300(50%)	
Age, yr	52±3.7	45±2.5	
Height, cm	180±8.7	168±3.6	<0.001S
Weight, kg	95±9.9	85±7.8	< 0.001S

Values are given as No. (%) or mean ±Sd, S= significant value <0.05

Tracheobronchial Dimensions:

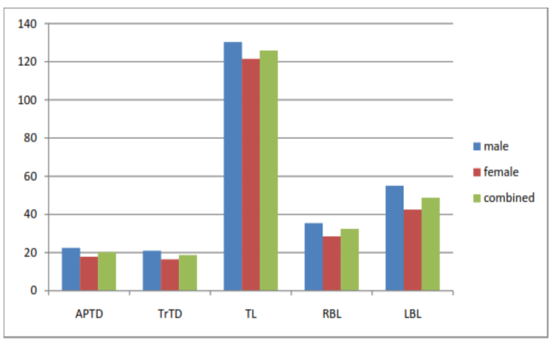
As shown in table 1, the average values of all anestimated tracheobronchial parameters, such as the diameter and the length, were significantly elevated in males than the females(in male group APTD were22.46 ± 1.81mm, ArTD were 20.92± 1.36 mm, TL were 130.31 ± 2.22mm, RBL were 35.34 ± 1.39mm and LBL were55.02 ± 1.44mm) but the result in female groups were (APTD were 17.81 ± 1.12mm, ArTD were 16.36 ± 1.18mm, TL were 121.46 ± 2.41mm, RBL were 28.44 ± 1.11mm and LBL were 42.48 ± 2.11 mm) (Table2 and Figure 2), except for the LBA, RBAthe result for male subject were (RBA were 34.18 ± 2.22mm and LBA were 45.22 ± 1.42mm) and the result for the female subject were (RBA were37.18 ± 1.19mm and LBL were 50.33 ± 1.91 mm). The LBA and RBA values werelower significantly malesthan females (Table 2, Figure3). The LBA was larger than the LBA in most of the subject in this study(Table 2). The APTD was biggersignificantly (P <0.001) than the TrTD in males and females.The normal standardvalue (mean±SD) of the tracheobronchial tree, was shown in Table 2.

All tracheobronchial parameters measured using ONIS 2.5 softwareprogram in male and female subject (Figures11-23)

In addition, on further dividing the subject into 6groups according to their height we found significant change in all parameter with increasing height except for (RBA) and (LBA) we found no significant changes in these angels with increasing height (Table3, figure 4,5,6). Howeverour resultalso reveals no significant relation between the all parameters and increasingage (Table 4, Figures 7,8) andalso no significant relation between the all parameters and increasing weight (Table5, Figures 9,10).

Table (2): Showing the mean and standard deviation of the tracheobronchial parameters in both sexes:

variables	male	female	combined	P value
Diameters (mm)				
APTD	22.46 ± 1.81	17.81 ± 1.12	20.13 ± 1.61	> 0.001
TrTD	20.92± 1.36	16.36 ± 1.18	18.64 ± 1.40	> 0.001
Length (mm)				
TL	130.31 ± 2.22	121.46 ± 2.41	125.88 ± 2.33	> 0.001
RBL	35.34 ± 1.39	28.44 ± 1.11	32.39 ± 1.11	> 0.001
LBL	55.02 ± 1.44	42.48 ± 2.11	48.75 ± 1.88	> 0.001
Angle (degree)				
RBA	34.18 ± 2.22	37.18 ± 1.19	35.68 ± 2.11	> 0.001
LBA	45.22 ± 1.42	50.33 ± 1.91	47.77 ± 1.55	> 0.001



Figure(2): A histogram showing the changes of the tracheobronchial parameters (measured in mm) in the used male, female and combinedgroups.

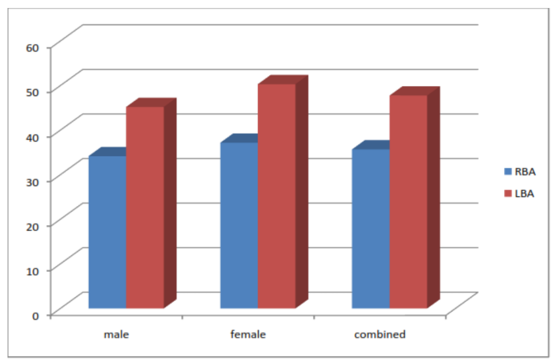


Figure (3): A histogram showing the changes of the right and left bronchial angles (measured in degree) in the used male, female and combinedgroups.

Table (3): Showing the mean and standard deviation ofthetracheobronchialparameters and the changes occur within these parameters in the used heightgroups:

	Heightgroup1(155-165 cm)	Heightgroup2(166- 175 cm)	Heightgroup3(176-185 cm)	Heightgroup4(186-195 cm)	P value
Diameters (mm)					
APTD	16.44 ± 1.11	18.12 ± 1.41	20.89 ± 2.11	22.46 ± 2.44	<0.05
TrTD	15.32 ± 1.14	17.33 ± 1.44	19.11 ± 1.36	21.91 ± 2.00	<0.05
Length (mm)					
TL	95.00 ± 2.00	99.18 ± 1.99	100.04 ±1.39	129.00 ± 1.22	<0.05
RBL	28.51 ± 1.22	30.22 ± 2.33	32.46 ±1.67	34.33 ± 1.96	<0.05
LBL	42.49 ± 3.22	48.11 ± 2.91	50.44 ± 2.22	55.00 ± 1.22	<0.05
Angles (degree)					
RBA	34.33 ± 3.22	33.22 ± 3.99	35.00 ± 2.55	34.11 ± 2.55	NS
LBA	45.11 ± 3.95	44.14 ± 4.22	45.22 ± 4.44	43.34 ± 2.88	NS

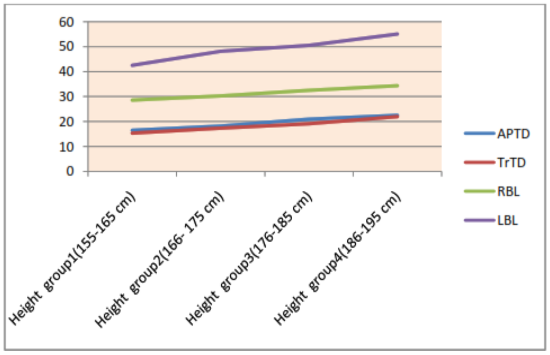


Figure (4): A histogram showing the changes of the tracheobronchial parameters (measured in mm) in the used heightgroups.

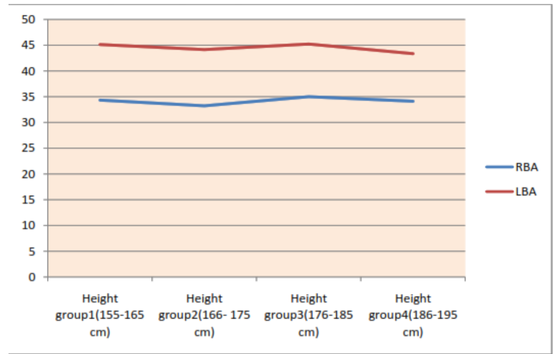


Figure (6): A histogram showing the changes of the right and left bronchialangles (measured in degree) in the used heightgroups.

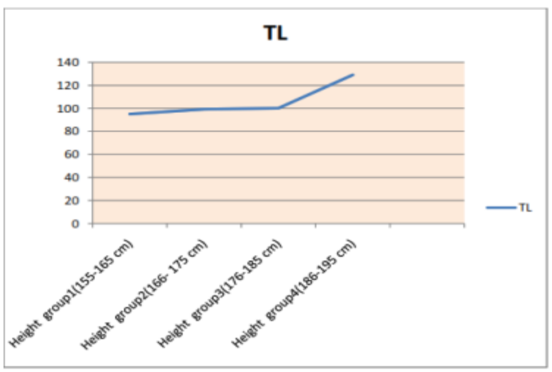


Figure (5): A histogram showing the changes of the tracheal length (measured in mm) in the used heightgroups.

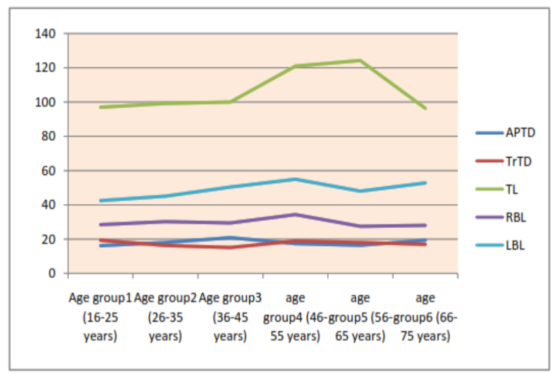


Figure (7): A histogram showing the changes of the tracheobronchial parameters (measured in mm) in the used age groups.

Table(4)showing the changes of the tracheobronchial parameters in the used agegroups:

	Age group1 (16-25 years)	Age group2(26-35 years)	Age group3 (36-45 years)	agegroup4 (46-55 years)	agegroup5 (56-65 years)	agegroup6 (66-75 years)	P value
Diameters (mm)							
APTD	16.22 ± 3.11	18.12 ± 1.41	20.89 ± 2.11	17.46 ± 2.44	16.44±4.03	19.33±1.33	NS
TrTD	19.32 ± 1.14	16.33 ± 1.44	15.11 ± 1.36	18.91 ± 2.00	17.99± 3.33	16.99± 4.22	NS
Length (mm)							
TL	97.00 ± 2.00	99.18 ± 1.99	100.04 ±1.39	121.00 ± 1.22	124.30 ± 1.27	96.33 ± 1.29	NS
RBL	28.51 ± 1.22	30.22 ± 2.33	29.46 ±1.67	34.33 ± 1.96	27.50 ± 1.22	28.00 ± 1.22	NS
LBL	42.49 ± 3.22	45.11 ± 2.91	50.44 ± 2.22	55.00 ± 1.22	48.00 ± 1.29	52.80 ± 1.55	NS
Angles (degree)							
RBA	36.33 ± 3.22	33.22 ± 3.99	34.00 ± 2.55	36.11 ± 2.55	34.29± 3.88	36.28± 4.19	NS
LBA	50.11 ± 3.95	45.14 ± 4.22	44.22 ± 4.44	49.34 ± 2.88	46.22 ± 2.99	47.22 ± 3.59	NS

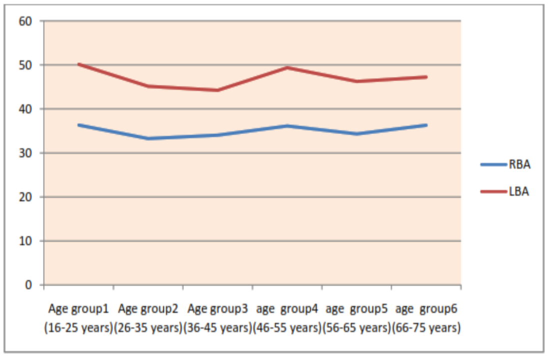


Figure (8): A histogram showing the changes of the right and left bronchial angles (measured in degree) in the used agegroups.

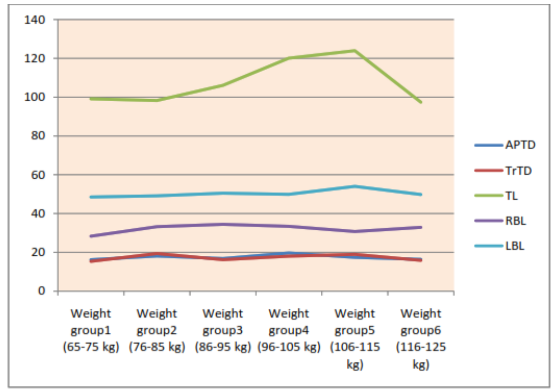


Figure (9): A histogram showing the changes of the tracheobronchial parameters (measured in mm) in the used weight groups.

Table (5) showing the changes of the tracheobronchial parameters (measured in mm) in the used weightgroups.

	Weight group1 (65-75 kg)	Weight group2 (76-85 kg)	Weight group3 (86-95 kg)	Weightgroup4 (96-105 kg)	Weightgroup5 (106-115 kg)	Weight group6 (116-125 kg)	P value
Diameters (mm)							
APTD	16.27± 3.61	18.15± 1.21	16.89 ± 2.71	19.66 ± 2.84	17.44±4.83	16.43±1.93	NS
TrTD	15.34± 1.64	19.39± 1.34	16.16± 1.37	17.97± 2.09	18.99± 3.83	15.90± 4.62	NS
Length (mm)							
TL	99.08± 2.80	98.18 ± 1.29	106.04 ±1.99	120.00 ± 1.29	123.90 ± 1.29	97.33± 1.49	NS
RBL	28.31 ± 2.22	33.22 ± 1.33	34.46 ±2.67	33.43 ± 1.26	30.70 ± 1.82	32.90 ± 1.42	NS
LBL	48.49 ± 4.22	49.11 ± 391	50.44 ± 322	49.90± 5.22	54.00 ± 1.29	49.80 ± 5.55	NS
Angles (degree)							
RBA	36.33 ± 3.22	35.22 ± 3.99	36.02± 2.55	34.11 ± 2.55	36.29± 3.88	33.28 ± 4.19	NS
LBA	45.11 ± 3.55	44.14 ± 4.72	44.22 ± 4.84	49.34 ± 2.48	46.26± 2.79	46.22 ± 3.49	NS

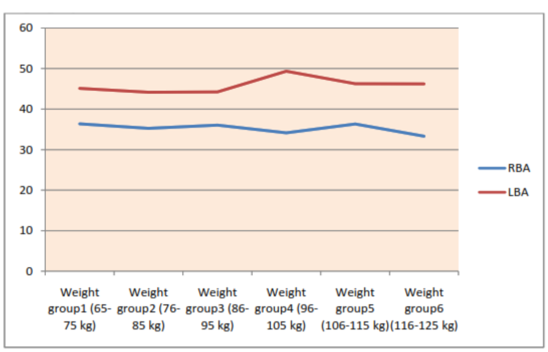


Figure (10): A histogram showing the changes of theright and left bronchial angles (measured in degree) in the used weightgroups.

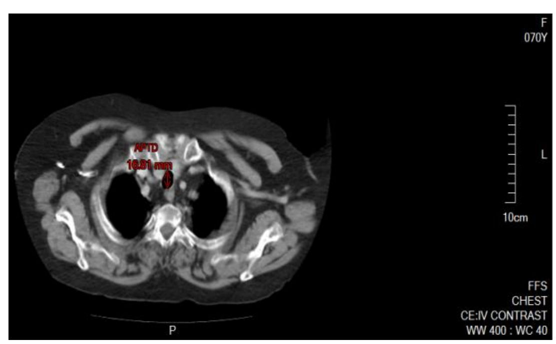


Figure (11): An axial CT chest image at the sternoclavicular level of a 70 years -old female showing: anteroposterior tracheal diameter (APTD)=16.81 mm

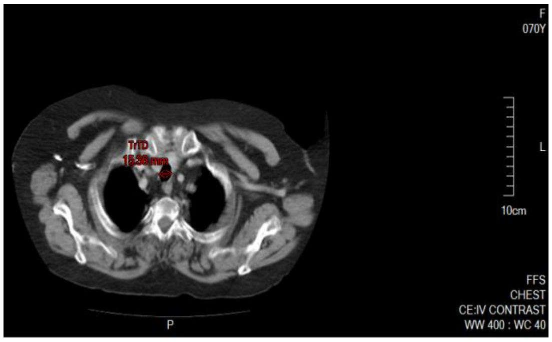


Figure (12): An axial CT chest imageatthe sternoclavicular level of a 70 years -old female showing: transverse tracheal diameter (TrTD) =15.36 mm

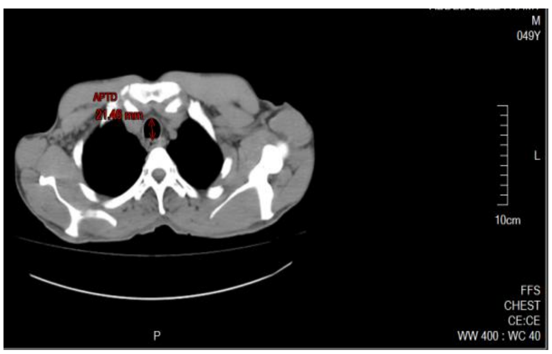


Figure (13): An axial CT chest image at thesternoclavicular level of a 49 years -old male showing:anteroposterior tracheal diameter (APTD) = 21.46 mm

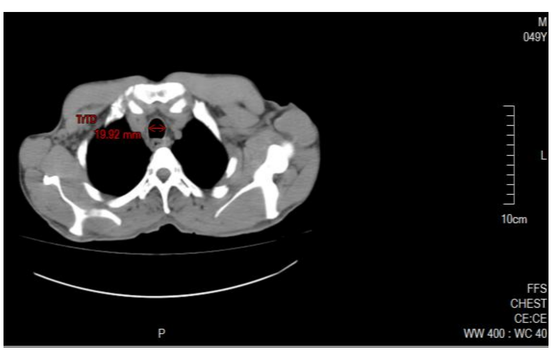


Figure (14): An axial CT chest imageat the sternoclavicular level of a 49 years -old male showing: transverse tracheal diameter (TrTD) =19.92 mm

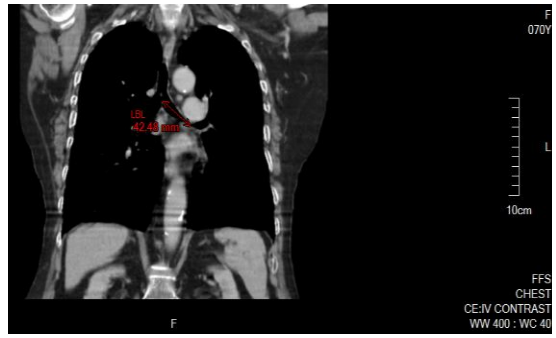


Figure (15): A CT chest imageofmulti-planer reconstruction (MPR) of a 70 years -old female showing: left main bronchial length (LBL)= 42.48 mm.

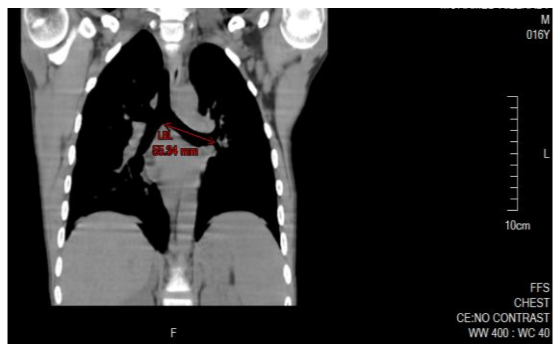


Figure (16): A CT chest imageofmulti-planar reconstruction (MPR) of a 16 years -old male showing: left main bronchial length (LBL)= 55.34 mm

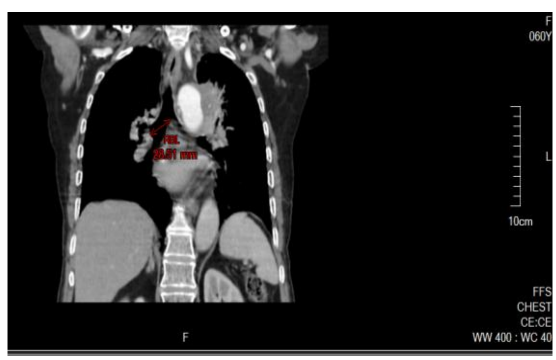


Figure (17): A CT chest imageofmulti-planar reconstruction (MPR) of a 60 years -old female showing: right main bronchial length (RBL)= 28.51 mm.

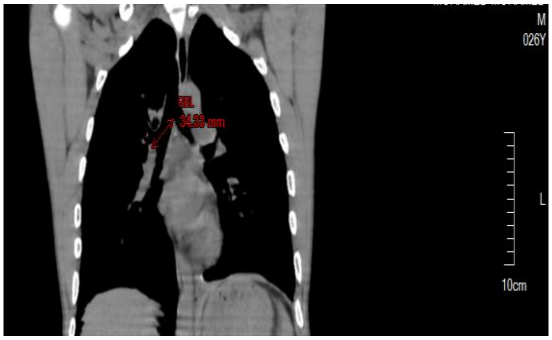


Figure (18): A CT chest imageofmulti-planer reconstruction (MPR) of a 26 years –old male showing: right main bronchial length (RBL)= 34.33 mm

Figure (20): A CT chest imageofmulti-planer reconstruction (MPR) of a 60 years -old female showing: left main bronchial angle (LBA)= 45.00 degree.

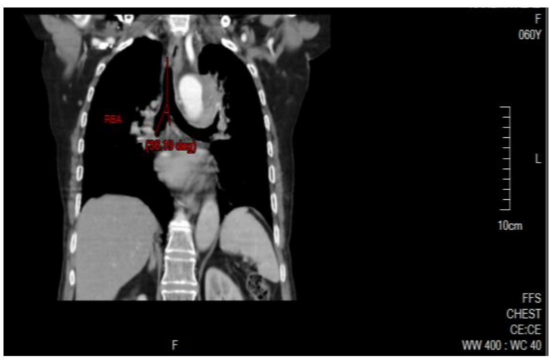


Figure (19): A CT chest imageofmulti-planer reconstruction (MPR) of a 60 years -old female showing: right main bronchial angle (RBA)= 36.19 degree.

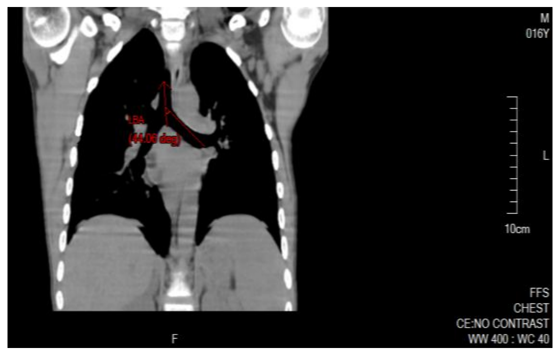


Figure (21): A CT chest imageofmulti-planer reconstruction (MPR) of a 16 years -old male showing: left main bronchial angle (LBA)= 44.06 degree.

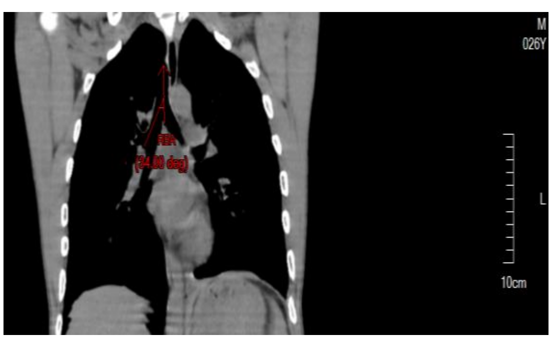


Figure (19): A CT chest imageofmulti-planer reconstruction (MPR) of a 26 years -old male showing: right main bronchial angle (RBA)= 34.00 degree.

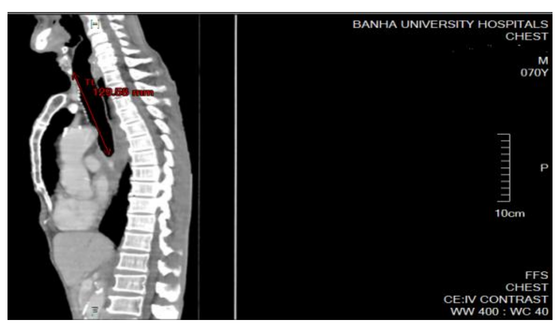


Figure (22): A CT chest imageofmulti-planer reconstruction (MPR) of a 70 years –old male showing: tracheal length(TL)= 129.58 mm.

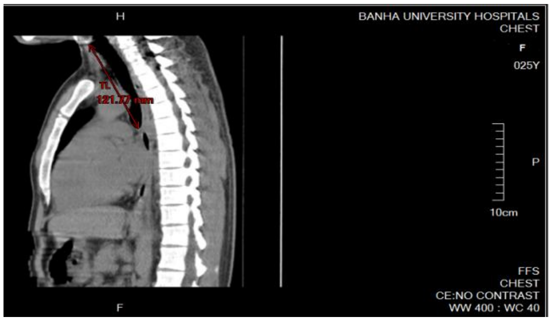


Figure (23): A CT chest imageofmulti-planer reconstruction (MPR) of a 25 years –old female showing: tracheal length(TL)= 121.77 mm.

4. Discussion

The results of current work revealed that the demotionsof the measured trachea in anumber of Egyptian population were Theantero-posteriortracheal diameter (APTD)was 20.13 ± 1.61 mm (22.46 ± 1.81mm for male and 17.81 ± 1.12mm for female). The transvers tracheal diameter (TrTD)was 18.64 ± 1.40 mm (20.92± 1.36 for male and 16.36 ± 1.18 mm for female). The length of the trachea (TL) was 125.88 ± 2.33mm (130.31 ± 2.22 mm for male and 121.46 ± 2.41 mm for female). The average lengths of the right main stem bronchus (RBL) and left main stem bronchus (LBL) were 32.39 ± 1.11 mm and48.75 ± 1.88 respectively. The (RBL of male subject were 35.34 ± 1.39 mm and of female subject were 37.18 ± 1.19mm) and (LBL of male subject were 55.02 ± 1.44 mm and of female subject were 42.48 ± 2.11 mm). The right bronchus angle and the left bronchus angle were averaged 35.68 ± 2.11 and 47.77 ± 1.55 degrees, respectively. The (RBA of male subject were 34.18 ± 2.22mm and of female subject were 37.18 ± 1.19mm). The (LBA of male subject were 45.11 ± 3.95 mm and of female subject were 50.33 ± 1.91mm).Significant differences were present among genders in all estimated parameters,there were significant increasein all parameters with increasing height exceptfor the right and left bronchial angels there were no significant difference with increasing height,and there were no significant change in alltracheobronchial parameters with increasing weight and age.

From the results above we found: (1) the male persons have biggermeasures and length of the tracheobronchial tree, whereas, the the female persons have bigger main stem bronchial angles(2) there is a strong positive relationshipamongthe height of body and the average tracheal length.(3) TL, RBL, LBL, APTD,TrTD, RBA and LBA have medical applications and are more discussed underneath. All tracheal parameters in the current study were larger than those measuredfor Chinese populations [10]and the measurementsreported by other tools as described on Chinese textbooks [14,15], and also differ fromother sources [16, 17,18] obtained from other countries. These results prove the variation of tracheobronchealdimensions between different ethnic groups.

To investigate whether gender influences the tracheal dimensions, we divide the subjects involved in this study into two large sex group and we analyzed the tracheobronchial parameters in these groups, a univariante analysis associatinggender like covariates was done. We reported that sex had a significant impact in tracheobronchial dimension. The impact may be moderatelyreturned to the sexvariation in height becauseour resultsproposed that height had a significant influence on these parameters. Some previous studies [19, 20, 21] demonstrated a significant relationshipsamong the tracheal length (TL) and the height merely in youth in growth stage, there are big individual differences of thelength (TL)stillbetweenindividuals of the equivalent height. Additionalresearches are required to clarify other probable factors dealing with the gender variations of the (TL).

The current work reported also, a diminish of the tracheal length (TL) in persons their ages 66 years or more. This may be attributed to the decrease of fibrous tissue in elderly peoples. Additionally, the trachea is much more vertical on lateral projection in youth than in elderly peoples [22].

Regarding thelength of the Main Bronchi inthe current study,found that the length of the right main stem bronchi islargerthan the values recorded on Chinese peoples in many textbooks [14, 15].Also our findings on the length of the main stembronchialso vary from the recorded data from different countries [19, 20, 21] once morestress the meaning of estimating anatomical dimensions inside individual ethnic clusters. The large coefficient of variance presentwithin the lengths of the right bronchi,in addition to resultconcerning the frequency of impression of the right upper lobe from the trachea wasmore than formerlydocumented[23], they proposed a high individual differences in the length ofthe right main stem bronchus. The current work in addition, has proposition on clinical applications. It has been observed that Broncho-Cath double lumen tubes (Mallinckrodt, Athlone, Ireland) create a danger to personsas soon as the tube length go above the lengths of the right bronchi by 1cm, where it can induce trauma to the airway and may lead to rupture of the cell membranes of the trachea [24]. According to the safety scoperecorded by Benumof et al. [25], we showedthat onlythe short persons (their height below 155 cm), who the lengths of their right bronchi are

1cm shorter than the tubes were in risk.In case of the patients were subjected for intubation at the right-sided double-lumen endobronchial tube, the right upper orifice may simply be blocked by the endobronchial balloon.

So, the presentresultspowerfullyhold up three clinical applyproposals: (1) the left sided double-lumen tube should be appliedat any timeprobable; (2) anesthesiologists should assessment and examine the CT image of the thorax prior to intubation with the purpose ofrecognize the airway tree morphology and select a best-fit endobronchial tube; (3) Fiberoptic bronchoscope is suggested to validateappropriateposition of endobronchial tube.

Regarding the dimension of the trachea and main stem bronchi the present results revealedthat the APTD waslarger than (TrTD) is consistent with previous publications [16,26].

As regarding the angles of the main bronchi with the trachea our result were in agreement with those reported previously [10,21,27]. We found that the averageof right and left bronchial anglescalculated in the female peoples was higher compared with that in males, in opposing to a preceding cadaveric surveillance[20]. This inconsistency may be clarified by the finding that lungs develop more transversally than downwards before the chest wall becomes rigid in females, in addition to the diaphragmatic muscle is stronger in males than in females. Moreover, a cadaver differs from a living body, owing to the comparativelocation of active and inactive diaphragm asrecorded by Fearon et al. [28].In our study the angle of the right main stem bronchus wassmaller thanthat of the left bronchus these data were in agreement withGrey’s Anatomy [29], who found that the angle of the right main stem is supposed to be constantlylesser.

We can concluded from our study that we recorded the normal dimension values of the tracheobronchial tree for Egyptian citizens from this work using CT. We supplementary analyzed the correlations between the basic parameters defining the tracheobronchial tree. Our data offer a basic information that can be valuable for improving clinical practice in the fieldofbronchotrachealintubation. The current findings discovered also the distinctive aspects of the anatomical structure of trachea in Egyptian citizens.The present finding also pointed to a definite parameters for instance RBL, APTD, LBL, TL,andTrTDhave a thinallocation, whilefurther parameters, likeRBA and LBA,display large individual changeabilitybetween Egyptian citizen. in spite of thestrong association within the length oftrachea (TL) and subject height,no precise and dependable equations were available for predicting the complete tracheobronchial measurements by usingage, height, and gender alone or in combination. Computed tomography and bronchoscopy should still the mainlyreliable tools for precisely determining the airway proportions.

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