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Original Research Article

Morphological Features of Trachea in Developing Human Fetuses

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ABSTRACT

OBJECTIVE: To study the Tracheal length, diameters (outer antero-posterior, outer transverse, inner transverse) at different gestational age & to compare the findings of this study with the findings of the previous workers.

MATERIALS & METHODS: 42 aborted human foetuses (24 male, 18 female) of 12-40 wks gestational age with no obvious congenital abnormality were obtained after permission of ethical committee of our college. The sex, gestational age, weight and crown rump length were noted. Trachea was obtained after dissection; external parameters (length & diameters) were taken.

OBSERVATIONS & RESULTS: It was observed that the length of trachea at 12th week of gestation was 0.6 cms and it increased to 3.6 cms in the 40th week of gestation. The average outer antero-posterior diameter of trachea was 1.5 mms at 12 wks of gestation & it increased to 6 mms at 40 wks of gestation.

CONCLUSION: it was observed that baby weight, CRL, tracheal length, tracheal diameters showed linear correlation with gestational age. All this factors are going to increase upto puberty.

Key words: CRL-crown rump length, tracheal length, tracheal diameters

INTRODUCTION

Respiratory system is one of the important & essential systems for the life of individual. It plays primary role in gaseous exchange & ventilation. Trachea is a part of lower respiratory tract. [1]

Trachea i.e. windpipe is situated in the neck. It acts as a conducting passage of air. It lies in front of oesophagus. The trachea part of a lower respiratory system begins to form during the 4th wk of development from laryngo-tracheal groove. [2]

The measurements of the external parameters of trachea will be helpful for the selection of appropriate sized endo-tracheal tube (ETT) during emergency management of premature infants. So the present study is aimed

i. To correlate the length of human foetal trachea and different diameters of trachea with the body weight, crown rump length and the estimated gestational age of foetus.
ii. To compare the findings of this study with the findings of the previous workers.

MATERIALS & METHODS

Forty-two aborted human foetuses (24 male, 18 female) of 12-40 weeks gestational age with no obvious congenital abnormality were obtained after permission of ethical committee of our college within 4-5 hours of birth to avoid post-mortem changes. The sex, gestational age, weight and crown rump length were noted. The fetuses were weighed in double pan balance. The crown rump length was recorded by using thread and scale.

Dissection and measurement

A midline vertical incision was taken just below the chin, extended over the front of neck, over the chest up to the xiphoid process. The front of neck & the chest cavity was opened. The trachea was cut from the larynx at the lower border of cricoid cartilage and then removed from the chest cavity along with lungs.

The external parameters of trachea were taken 1) Length (from lower border of the cricoid cartilage to the upper border of carina. and 2) Diameters of trachea like, outer antero-posterior, outer transverse, and inner transverse at the upper end were noted by using vernier calliper.

Table:- 1) Distribution of fetuses in gestational groups:

Groups	Age in wks	No. of fetuses	No. of Male	No. of Female
Group I	12 – 18 wks	13	5	8
Group II	19 - 24 wks	12	8	4
Group III	25 – 30 wks	8	5	3
Group IV	31 – 36 wks	7	5	2
Group V	37 – 40 wks	2	1	1

OBSERVATIONS AND RESULTS

The parameters considered were the body weight of fetus, crown rump length of fetus and thus gestational age of fetus was confirmed. Trachea - its length, its diameters (outer antero-posterior, outer transverse and inner transverse) & were compared with the crown rump length and the gestational age.

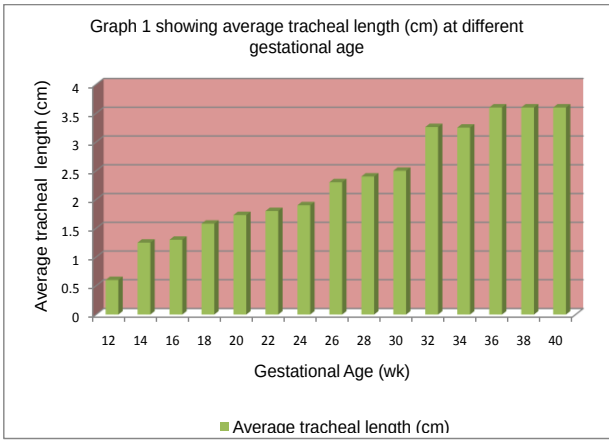
1. **Tracheal length** : (Table 1, Graph 1)

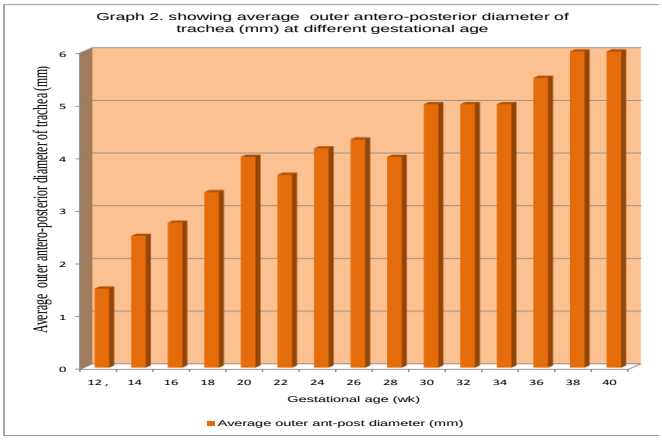
Table 1. Showing the Average tracheal length in cms at different Gestational age.

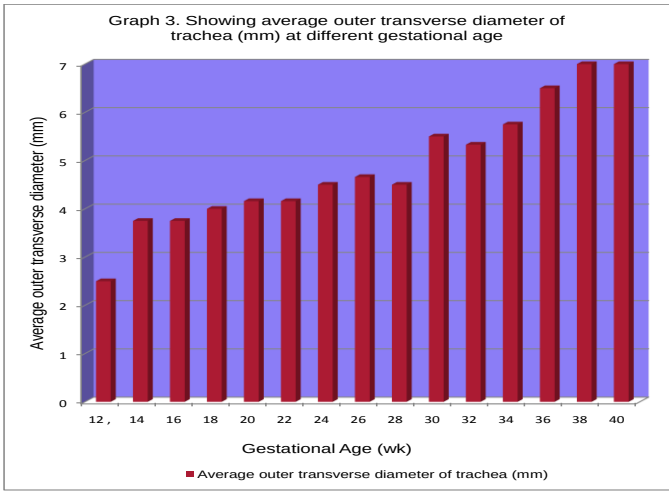
Gestational age (week)	Average tracheal length(cm)
12	0.6
14	1.25
16	1.3
18	1.58
20	1.73
22	1.8
24	1.9
26	2.3
28	2.4
30	2.5
32	3.26
34	3.25
36	3.6
38	3.6
40	3.6

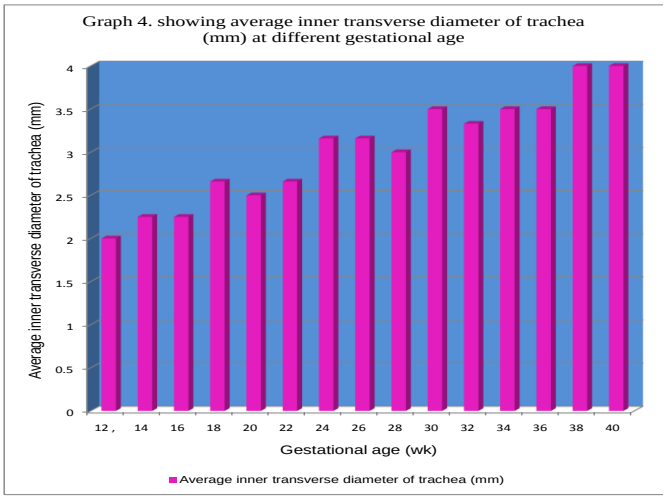
Table 2 :- Showing average tracheal diameters in mms at different gestational age (Table 2 , Graph 2,3,4)

Gestational Age (Weeks)	Average outer antero-posterior diameter (mms)	Average outer transverse diameter (mms)	Average inner transverse diameter (mms)
12	1.5	2.5	2
14	2.5	3.75	2.25
16	2.75	3.75	2.25
18	3.33	4	2.66
20	4	4.16	2.5
22	3.66	4.16	2.66
24	4.16	4.5	3.16
26	4.33	4.66	3.16
28	4	4.5	3
30	5	5.5	3.5
32	5	5.33	3.33
34	5	5.75	3.5
36	5.5	6.5	3.5
38	6	7	4
40	6	7	4









DISCUSSION

In present study Body weight of fetus in gram was compared with the findings other workers Greunwald[3], Hamilton.[4]

Findings of Langman [5] were more or less similar to the present study. The findings of Schultz [6] showed weight less than the findings in the present study where as the findings of Moore [2] showed increase in weight from 18wks onwards.

Crown rump length of fetus in cms of present study was compared with findings of above workers. It was seen that the values of crown rump length given by Hamilton, [4] Langman [5] and Moore [2] were more or less similar to the findings of the present study.

Length of trachea

Menu and Lallemand (1981) [7] also proved the linear dependence of the tracheal length on age. Wailoo MP, Emery JL, (1982) [8] reported trachea becomes cylindrical with increasing age. The trachea appears to grow at a greater rate, in relation to crown-rump length, during the age of 1 month to 4 years than in utero or around puberty.

The findings in the present study also showed linear dependence as compared to above studies.

The length of trachea compared with findings of Harjeet et. al. [9] For purposes of statistical analysis the fetuses were divided into three age-groups based on CRL: 61–130 mm (CRL 1), 131–200 mm (CRL 2), and 201–270 mm (CRL 3). The data of

trachea was subjected to following statistical tests

a) Mean b) standard deviation c) p-value by using SPSS.

Table no 3 - Showing the comparison of tracheal length of fetus in mms at different Crown rump length with findings of previous workers.
(Mean ± SD) and P-value

Groups	CRL1: 61-130mm Harjeet n=16 Present study n=8	CRL2: 131-200mm Harjeet n=13 Present study n=13	CRL3: 201-270mm Harjeet n=11 Present study n=12	
Harjeet, et al. [9] Study	12.72 ± 2.50	17.48±2.89	24.17±2.30	P-value <0.001
Present study	12.25 ± 2.81	16.84 ± 2.70	22.33 ± 2.57	<0.001

The findings of present study were less compared to Harjeet et. al. [9] study that can be due to racial variation. The comparison between the groups was done by ANOVA Test, P-value < 0.001 (highly significant).

Diameters of Trachea

In present study up to 16 weeks the transverse diameter of trachea was more than antero-posterior then from 18weeks onward both diameters gradually became equal. Ewa, Edyta (2002) [10] –reported in smaller foetuses the trachea presents antero-posterior flattening, but in older ones the tracheal lumen becomes cylindrical. Pracy (1938), Chiba et al. (2000) [11] Pierre Fayoux, Bruno Marciniak [12] observed the anatomical tracheal lumen measurements (in newborns and babies), show the linear growth and correlation with gestational age. The findings of Harjeet also showed gradual increase in diameters of trachea as age progressed.

Table no 4 - Showing the comparison of tracheal diameters of fetus in mms at different Crown rump length with findings of previous worker.
(Mean ± SD) and P-value

Outer antero-posterior diameter				
Groups	CRL1: 61-130mm Harjeet n=16 Present study n=8	CRL 2: 131-200mm Harjeet n=13 Present study n=13	CRL 3: 201-270mm Harjeet n=11 Present study n=12	P-value
Harjeet	2.48 ± 0.62	3.57±0.65	5.20±0.47	<0.001
Present study	2.25 ± 0.46	3.57 ±0.40	4.16 ± 0.38	< 0.001
Outer transverse diameter				
Harjeet	3.26 ± 0.68	4.42 ± 0.64	5.35 ± 0.42	<0.001
Present study	3.06 ± 0.32	4.03 ± 0.24	4.66 ± 0.38	< 0.001
Inner transverse diameter				
Harjeet	1.87± 0.5	2.67 ± 0.70	3.68 ± 0.39	<0.001
Present study	2.18 ± 0.25	2.53 + 0.24	3.04+ 0.33	< 0.001

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