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A Study of Age Estimation of Foetuses and Neonates Between 10 and 24 Weeks Gestation

KEYWORDS: age estimation, fetuses, neonates, CRL, BPD, femoral length, foot length, weight

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ABSTRACT *It is well known fact that the physical stature of Indian on an average is shorter than the western one. Considering this an attempt has been made to establish average values of various parameters of Indian foetuses/ neonates in different gestational age groups. As no Indian records (direct measurements) are available on parameters of foetuses/neonates below 36 weeks of gestational age so crown rump length, weight, biparietal diameter and maximum foot length of six hundred foetuses /neonates were measured and analysed directly. It has been observed that, the average values of these four parameters in each gestational age group are on the lower side when compared with the western figures. Ultrasound studies (indirect measurement) by western and Indian workers have established the value of femoral length (diaphyseal length) in estimating the gestational age of the foetuses. Therefore the diaphyseal length of the femur along with a new parameter i.e. total length of femur was measured directly in 142 foetuses/neonates between 10 and 28 weeks of gestational age. It was observed that there is minimum overlap in the values of both parameters in adjacent age groups and statistical analysis showed that the means for these groups are significantly different ($p < .001$ between all adjacent groups). Hence these two seem to be good indicators to estimate the age of foetuses/ neonates. All these parameters will help in obstetrical, medicolegal, embryological and anthropological examinations.*

INTRODUCTION:

A study of various foetal parameters is important to verify the age of foetuses/ neonates for medicolegal purposes (e.g. in criminal abortions, feticide/ infanticide) and for the diagnosis of premature and dysmature babies. Streeter (1920), Hill (1939), prey (1961), Willis (1962), Moore (I974), Langman (1983) and Hern (1904) have tried to ascertain the age of foetuses by directly measuring their crown rump length, weight, biparietal diameter etc. Singh (1962), Ghai (1969), Dikshit (1969), Madhavan (1969), Shrivastava (1988) and Gohil (1991) have reported the values of crown rump length, weight and foot length of Indian newborns between 37 to 40 weeks of gestational age. However, the Indian data for the above parameters below 36 weeks of gestational age are not available.

Hern (1984), Jeanty (1987), and Levi (1988) have mentioned in their ultrasound studies that the BPD and the length of femur are reliable parameters to estimate the gestational age of foetuses. Buckshee (1983), Rajan (1991) and Mhaskar (1992) have revealed that the ultrasound values of various parameters of Indian foetuses in different gestational age groups are smaller as compared to western. It is evident that the ultrasound study does not give the exact dimensions of foetuses because of their various positions inutero and many technical difficulties in operating the machine. The present study was, therefore, undertaken to estabilish the average values for various parameters of Indian foetuses/neonates of known age groups by measuring them directly. These values are to be utilised for age estimation of unknown foetuses/neonates and comparison of intrauterine values by non invasive techniques.

MATERIALS AND METHODS:

The present study as carried out for postnatal estimation for gestational age on the basis of six parameters in 600 fresh and normal subjects in Government medical college and hospital and maternity homes of Jabalpur. The subjects were122 complete foetuses between 10 weeks and 24 weeks of gestational age, obtained by medical termination of pregnancy and 478 premature and mature neonates born 25 weeks and 40 weeks of gestational age. Premature neonates were obtained by spontaneous abortion/ premature delivery due to maternal cause. Out of 42 subjects between 25 and 28 weeks of gestational age, 20 died due to asphyxia but were included in the study with aim to get the femora from them. The age of the above subjects was confirmed by the first day of last menstrual period and antenatal examination of the mother. All these subjects were placed in different age groups at 4 weeks interval, starting at 13th week. However the first age group was between 10 and 12 weeks of gestational age.

The crown rump length, weight, and foot length of all the subjects were measured according to the methodology of previous workers. The biparietal diameter i.e. maximum distance between the two parietal eminences of all the subjects was measured with the help of vernier calipers.

One femur from each foetus or dead neonate was dissected out and its maximum length i.e. distance between the inferior most point on medial condyle and the superior most point on the head was measured. Then the cartilagenous ends were gently removed from all the femora and diaphyseal length was measured.

OBSERVATIONS:

The average values, standard deviation and range of crown rump length, weight, and foot length of foetuses of different gestational age groups in the present study are shown in table 2. The ranges of above values slightly overlap with the adjacent age groups till 24 weeks of age. After that the overlap increases. This is most marked with the weight and least marked with the foot length.

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It is evident from table 3 there is a minimum overlap in the values of total length of femur and no overlap in the case of diaphyseal length in adjacent age groups and on analysis means for these groups are significantly different ($p < 0.001$ between all adjacent groups). Hence these two seem to be good indicators to estimate the age of foetuses/ neonates.

DISCUSSION:

A number of workers have studied various parameters of foetuses/neonates but studies on Indian subjects have been restricted only to neonates between 36 and 40 weeks of gestational age. The present study includes values for CRL, weight, BPD and foot length for all foetal age groups (Table-2).

A comparison of CRL with several western and Indian figures shows that throughout the gestational period the average CRL continues to be shorter in Indian subjects. This is most marked in the 40th week of gestation. On the other hand the average value i.e. 322.1 mm in the 37 to 40 weeks of gestational age group observed in the present study is comparable to the values reported by other Indian workers. Thus it can be concluded that Indian foetuses of this age group have a shorter CRL when compared to their western counter part.

Little data is available on BPD. However, compared to that value of BPD reported by Hern the values observed in the present study are lower.

The importance of diaphyseal length of femur in the estimation of foetal age has become apparent after the advent of ultrasonography. On the basis of this the diaphyseal length of femur along with a new parameter i.e. Total length of femur was measured directly. These two parameters seem to be good indicators to estimate the age of foetuses/neonates as they have minimum overlap in adjacent age group and on analysis means for these age groups significantly different (p value is < 0. 001 between all adjacent age groups for both the parameters (table 3).

The present values of BPD and femur length (diaphyseal length) are in accordance with the ultrasound values of these parameters observed by Rajan et al (1991). However, the ultrasound values of BPD reported by Bukshee et al (1983) are little higher and the values of foot length reported by Mhaskar et al (1992) are little lower than those observed in the present study. This could be due to different methodology or regional variations.

In medicolegeal work, determination of gestational age of foetuses/ neonates depends upon various parameters including those mentioned above. The Indian values for these parameters are not, available for all the age group of foetuses/neonates. It is hoped that the present, study will be of some help to the Indian forensic experts who constantly face the problem of age estimation of foetuses/ neonates (complete, mutilated, fresh, putrefied or macerated) brought, to them for opinion. The above parameters will also help in the diagnosis of premature and dysmature babies and in the field of correlative and developmental Anatomy.

TABLE 1

Showing number of subjects in various gestational age groups

Subject	S	Gestational age in weeks								TOTAL
	E	10 to 12	13 to 16	17 to 20	21 to 24	25 to 28	29 to 32	33 to 36	37 to 40	
Aborted foetuses (n=122)	M	11*	24	31	18	-	-	-	-	84
	F	-	10	20	8	-	-	-	-	38
Dead neonates (n=20)	M	-	-	-	-	13	-	-	-	13
	F	-	-	-	-	7	-	-	-	7
Alive neonates (n=458)	M	-	-	-	-	11	15	16	219	261
	F	-	-	-	-	11	12	3	171	197
TOTAL		11	34	51	26	42	27	19	390	600

* sex could not be identified on gross examination.

TABLE 2

Showing values of different parameters in various gestational age groups

Gestational age in weeks	Crown - Rump length in mm	Weight in gms	Biparietal diameter in mm	Maximum foot length in mm
10-12 (n=11)	50.5±8.9 (41.0-60.0)	12.2±7.7 (7.0-40.0)	16.3±4.8 (12.0-21.0)	8.1±1.3 (6.0-11.0)
13-16 (n=34)	104.0±8.6 (66.0-116.0)	90.3±13.2 (40.0-125.0)	32.1±3.4 (23.0-39.0)	19.9±4.3 (12.0-21.0)
17-20 (n=51)	153.6±11.0 (118.0-176.0)	280.6±45.1 (160.0-450.0)	46.2±4.0 (34.0-58.0)	32.6±2.0 (22.0-38.0)
21-24 (n=26)	188.4±6.3 (162.0-198.0)	540.0±38.2 (430.0-590.0)	56.5±3.6 (47.0-67.0)	42.1±1.5 (38.0-46.0)
25-28 (n=42)	233.6±9.6 (189.0-247.0)	846.8±66.3 (635.0-980.0)	69.2±2.1 (65.0-74.0)	52.9±3.8 (48.0-60.0)
29-32 (n=27)	263.0±10.9 (221.0-288.0)	1461.0±147.1 (1000.0-1900.0)	78.5±2.2 (73.0-85.0)	61.5±2.0 (58.0-65.0)
33-36 (n=19)	294.1±8.9 (241.0-307.0)	2098.4±121.2 (1690.0-2410.0)	84.2±2.3 (76.0-89.0)	69.6±1.7 (64.0-72.0)
37-40 (n=390)	322.1±10.2 (289.0-357.0)	2601.1±409.2 (1800.0-4500.0)	90.2±3.1 (79.0-98.0)	76.4±2.9 (66.0-84.0)

TABLE 3

Showing values of different parameters in gestational age groups and variance of means between two adjacent gestational age groups

Gestational age in weeks	Length of femur in mm	p value	Diaphyseal length of femur in mm	p value
10-12 (n=11)	12.2±3.4 (10.0-19.0)		6.4±2.1 (5.0-11.0)	
		>.001*		>.001*
13-16 (n=34)	29.2±2.3 (22.0-35.0)		17.3±1.7 (12.0-20.0)	
		>.001*		>.001*
17-20 (n=51)	46.4±2.7 (35.0-55.0)		30.8±2.1 (22.0-37.0)	
		>.001*		>.001*
21-24 (n=26)	59.7±1.6 (55.0-62.0)		41.0±1.8 (38.0-45.0)	
		>.001*		>.001*
25-28 (n=20)	69.2±2.3 (61.0-74.0)		49.8±1.9 (47.0-53.0)	

* difference very highly significant

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