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Research Article

Ultrasonic Measurement of Fetal Foot Length for Estimation of Gestational Age

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Abstract: Appropriate knowledge of gestational age is very essential for management of pregnancy, particularly for determination of viability in preterm labour, interpretation of biochemical serum screening test or for counseling patients regarding the option of pregnancy termination. Various ultrasonic fetal parameter like gestational sac mean diameter, crown- rump length (CRL), biparietal diameter (BPD), Head circumference (HC), abdominal circumference(AC) and femur length(FL) are used for determination of gestational age. This study is being undertaken to find out other ultrasonic fetal parameter like fetal foot length (FTL) for determination of gestational age more accurately. In this study ultrasonic measurement of fetal foot length was done in 500 antenatal cases from 20 to 40 weeks of gestation, calculated from the first day of last menstrual period. In this study we found that, there is linear increase in the fetal foot length with increase in the gestational age and the correlation is significant with r value of 0.97. From our study we can conclude that fetal foot length is a reliable ultrasonic parameter for assessment of gestational age.
Keywords: fetal foot length, gestational age, ultrasonic fetal parameter.

INTRODUCTION

The knowledge of accurate gestational age is very essential for the management of pregnancy from the first trimester to delivery. It is particularly necessary for determination of viability in premature labour and in post dated pregnancies. Accurate knowledge of gestational age is also important in the interpretation of biochemical serum screening test or for counseling patients regarding the option of pregnancy termination. Prior to the era of ultrasonography, obstetricians were relied on a combination of history (menstrual cycle, LMP, quickening etc) and physical examination (uterine size) for clinical determination of gestational age.

Uses of ultrasound gave clinicians an accurate measurement of the fetus and thereby help in accurate estimation of gestational age. For last 30 years lots of fetal parameter like gestational sac mean diameter, crown- rump length (CRL), biparietal diameter (BPD), Head circumference (HC), abdominal circumference (AC) and femur length (FL) are used for determination of gestational age. But in presence of brachycephaly or dolichocephaly, BPD measurement would be altered. Similarly in presence of fetal macrosomia or IUGR, the AC would be overestimated or underestimated. Underestimation of FL would occur in presence of femur achondroplasia.

In 1920, streer had proposed that fetal foot length has a characteristic growth pattern and it could be used for estimation of gestational age [1].Campbell *et al.;* [2] had evaluated the fetal femur/foot length ratio and conclude it to be a useful parameter to differentiate fetuses having dysplastic limb reduction from those whose limbs are short because of constitutional factors or intrauterine growth retardation.

Mercer *et al.;* [3] had shown that fetal foot length is a reliable parameter for the estimation of gestational age and particularly useful when other parameters cannot accurately predict gestational age as in cases of hydrocephalus, anencephaly or short-limb dwarfism.This study is being undertaken to determine the accuracy of fetal foot length measurement for estimation of gestational age and correlating it with the previously approved parameters like BPD, HC, AC and FL.

MATERIAL AND METHODS

The present study "Ultrasonic measurement of fetal foot length for estimation of gestational age" was conducted in the Department of Obstetrics and Gynaecology of Gauhati Medical College and Hospital, Guwahati during a period of 6 months from March 15th 2015 to September 15th 2015. The study was conducted

in 500 antenatal cases, selected from those attending the antenatal clinics, labour room and from antenatal wards of Gauhati Medical College and Hospital. The pregnant women were so selected that they were sure about their last menstrual period, had regular menstrual cycle, had not experienced any vaginal bleeding during pregnancy, no one had taken oral contraceptives for at least 3 months before pregnancy, having singleton apparently normal fetuses between 20 to 40 weeks of gestation and no medical complications.

After thorough history, physical examination and routine investigations, all the cases were subjected to a real time ultrasonographic examination. Measurements of biparietal diameter (BPD), Head circumference (HC), abdominal circumference (AC) and femur length (FL) were taken by standard methods. Thereafter the composite gestational age (CGA) and effective fetal weight (EFW) were calculated using the above mentioned parameters. Then the fetal foot length measurements were taken. The fetal foot length was measured from sole to the distal end of the first or the second toe, whichever was larger. Thereafter the fetal foot length measurements were compared with the menstrual age and the ultrasound calculated gestational age and the relationship were found out.

RESULTS AND OBSERVATIONS

The present study was conducted in 500 pregnant women, selected from those attending the antenatal clinics, labour room and from antenatal wards of Gauhati Medical College and Hospital. Sonographic measurement of fetal foot length (FTL) was done from 20- 40 weeks of gestation. BPD, HC, AC and FL were also measured for comparison.

Table 1: The mean values of FTL, BPD, HC, AC and FL at weekly intervals from 20 to 40 weeks

GA (Weeks)	Mean FTL in mm	Mean BPD in mm	Mean HC in mm	Mean AC in mm	Mean FL in mm
20	33.1	47.5	172.2	144.4	33.5
21	35	48	175.2	147.2	34.2
22	38.5	51.3	188.7	164.9	37.1
23	43.5	56	210	194	43
24	47.3	60.3	219.6	196.6	47.2
25	49.8	63.7	231.5	198	47
26	50.1	65.1	239.3	211	48
27	53.8	70.2	253.3	229	52.5
28	53.9	70.2	255.6	232.5	52.8
29	57.5	72	264	233	56
30	60.7	75.3	272.2	254.3	57.5
31	61	76	277.4	255.4	58.6
32	62.2	78.1	284	272.8	60.8
33	65.4	80.7	295.1	280.7	66.4
34	66.7	82.4	298.9	289.1	66
35	67.8	83.5	303	297.2	66.8
36	68.8	84.3	307.5	307.5	69.4
37	69.9	86.4	308.5	308.5	69.6
38	70.3	86.9	314.1	314.1	70.3
39	70.8	88.6	318	318	70.8
40	71.6	88.8	319	319	71.1

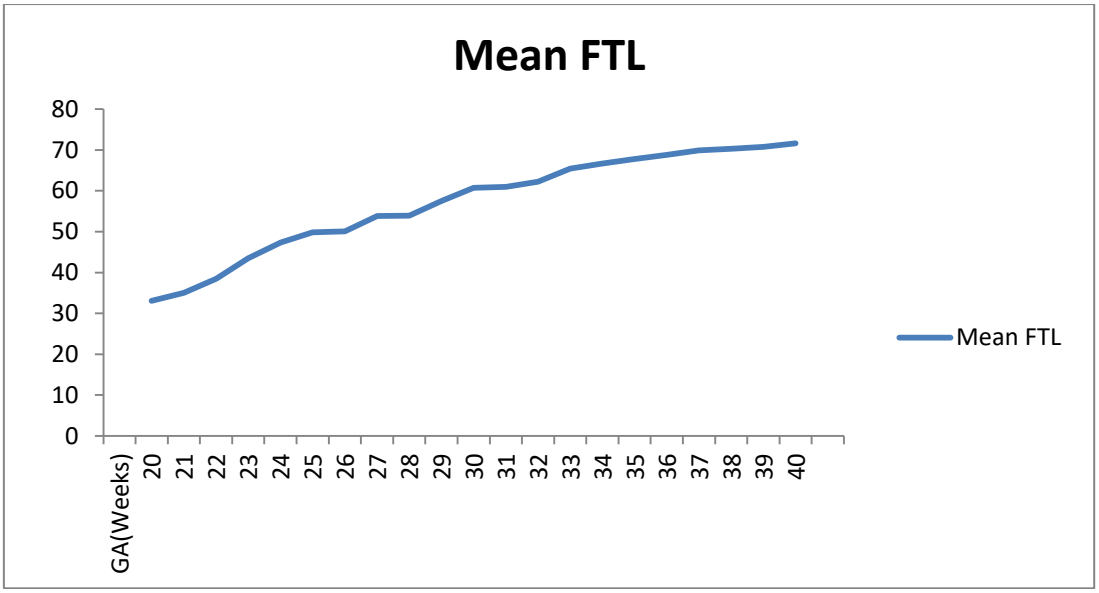

Fig 1: the graph showing the mean values of fetal foot length against gestational age which shows linear increase in FTL with the progress of pregnancy.

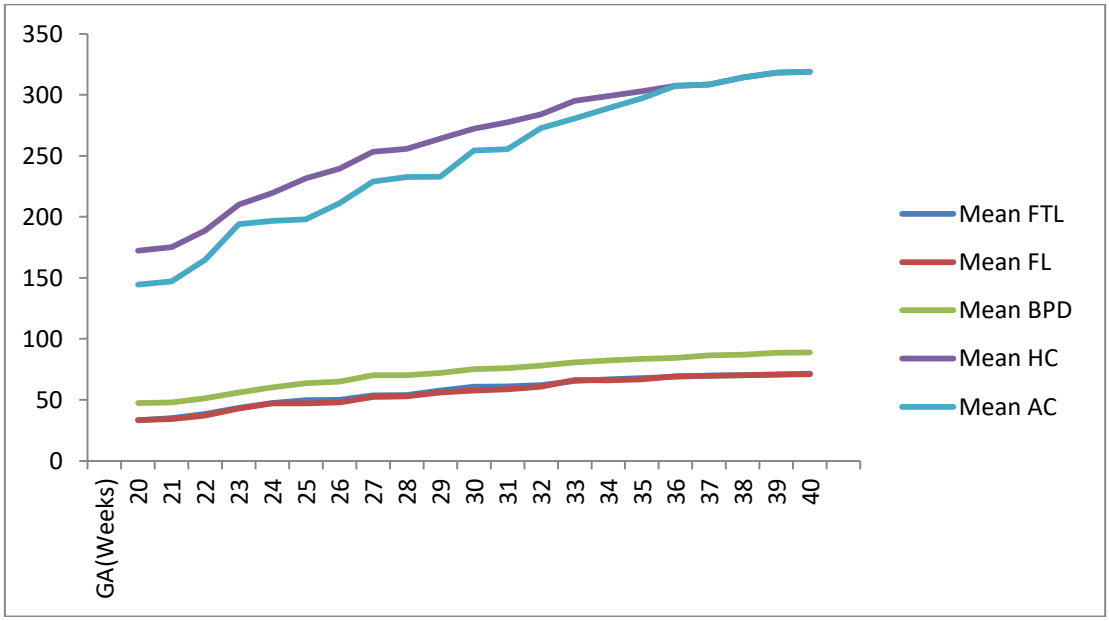

Fig 2: the graph showing the mean values of FTL, FL, BPD, HC and AC against gestational age showing linear increase in different parameters with the progress of pregnancy.

In our study, the mean fetal foot length was increased with increase in the gestational age. The r (coefficient of correlation) value was 0.97, suggesting that the mean FTL and gestational age were highly correlated. Similarly the mean FL, BPD, HC and AC were also increased with increase in gestational age. We found a good correlation between FTL and FL (r^2 value 0.99), FTL and BPD (r^2 value 0.99), FTL and HC (r^2 value 0.99), FTL and AC (r^2 value 0.99).

DISCUSSION

In our study, we found a good correlation of fetal foot length with gestational age with correlation coefficient 0.97. Goldstein I, Reece EA, Hobbins JC *et al;* [4] found a significant correlation between FTL and gestational age with r value of 0.9. Platt LD *et al.;* [5] showed significant relationship between FTL and gestational age. Molley S. Chatterjee *et al.;* [6] in 1994 had found significant correlation between FTL and gestational age with r2 value of 0.89. Ji E K., [7] in 2001 concluded that fetal foot length during the second trimester is a reliable parameter for the assessment of gestational age.

M.C. Lutterodt *et al.;* [8] in 2009 showed that there was linear correlation between fetal foot length to

embryonic and fetal age and was unaffected by gender, environmental tobacco smoke, maternal smoking and alcohol consumption. Pandey VD *et al.;* [9] in 2015 concluded that there was a linear correlation(r=0.96) between FTL and fetal gestational age and the correlation was not altered in presence of fetal abnormalities like femur achondroplasia, hydrocephalus, anencephaly, short limb dwarfism etc.

On comparing the results of the present study with that of the previous studies, we can see that, our study is concordant with the previous studies. In our study, we also compared the fetal foot length with the more recognizable previously used parameters like FL, BPD, HC and AC. We found significant correlation between FTL and the other parameters individualy.

CONCLUSION

The fetal foot length grows with the advancement of pregnancy along with the other fetal structures. The assessment of fetal foot length helps in estimation of gestational age. There exist wide margin of error when the composite gestational age is determined on the basis of usual fetal parameters like BPD, AC, HC and FL. Also they give false results in presence of fetal anomalies like there is alteration of BPD and HC in presence of brachycephaly, FL in femoral achondroplasia, AC in presence of IUGR. In such situations fetal foot length measurement is immensely helpful in determination of gestational age precisely.

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