USING RENAL LENGTH FOR ACCURATE ESTIMATION OF GESTATIONAL AGE

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ABSTRACT

BACKGROUND
Accurate measurement of gestational age is important for obstetric management. Ultrasound estimation of gestational age is the standard practice. Several biometric parameters can be used to calculate gestational age, commonest being biparietal diameter (BPD), abdominal circumference (AC) and femoral length (FL). In the present study, an additional parameter, the fetal renal length (KL), is taken as a biometric variable and the correlation between gestational age and renal length are calculated. AIMS- To find out the correlation between gestational age and kidney length, biparietal diameter, femoral length and abdominal circumference in the third trimester. To find out regression equations for these variables with gestational age and thus to predict gestational age.

MATERIALS AND METHODS
The study was done as a cross sectional study. This study was conducted among 100 low risk antenatal women, who attended the antenatal clinics of the Department of Obstetrics and Gynaecology, Government Medical College, Thiruvananthapuram. Statistical Analysis- The data collected in the study concerning biometry and gestational age is represented in graph form called scatter diagram. Depending on the alignment of the data, the correlation between the two is visualized. Then curve fitting is done using regression analysis and regression equation for calculating the dependent variable from independent variable is found out using linear regression analysis. The coefficient of correlation (R) and coefficient of determination (R^2) is then found out. The better the correlation the closer these coefficients will be to one. Root mean square deviation shows how accurate is the estimate.

RESULTS
The average gestational age of the study population was 35.6 ± 2.81. When comparing the correlation, it was found that kidney length had the highest correlation followed by femoral length. Regression equations for calculating gestational age from the various biometrics were calculated. Correlation was greatest when combination of KL, BPD, AC, FL and AC was used. RMSD was least with KL. The prediction interval width was least for KL.

CONCLUSION
Kidney length can be used along with the usual biometric variables like BPD, AC and FL with better accuracy for predicting gestational age.

KEYWORDS
Gestational Age, Kidney Length, Correlation Gestational Age & Frequency Distribution.

BACKGROUND
Determination of gestational age (GA) is an important obstetric practice. All obstetric management decisions depend on the accuracy of gestational age so that appropriate management is possible at the right time. In many of the cases clinical parameters to estimate gestational age are inaccurate. Thus estimation of gestational age using ultrasound parameters is indeed a standard practice. The usual parameters used are biparietal diameter (BPD), femur length (FL), abdominal circumference (AC) and head circumference. The error of the calculated gestational age is around 3 weeks in the third trimester.[1] The error of 3 weeks becomes crucial when decision regarding early termination of pregnancy arises. In this study an additional parameter, the fetal renal length (KL), is used as biometric parameter to assess the gestational age of fetus to see whether this can be improved.

OBJECTIVES
1. To find out the correlation between gestational age and kidney length, biparietal diameter, femoral length and abdominal circumference in the third trimester.
2. To find out regression equations for these variables with gestational age and thus to predict gestational age.

MATERIALS AND METHODS

The study was done as a cross sectional study. This study was conducted among 100 low risk antenatal women who attended the antenatal clinics of the Department of Obstetrics and Gynaecology, Government Medical College, Thiruvananthapuram. Permission from the institution and informed consent from the patient were obtained.

Inclusion Criteria

Those antenatal ladies with excellent dates more than 30 weeks of gestation

Exclusion Criteria

Those antenatal ladies with any obstetric or medical complications.
Those having foetal renal problem.
Those with poor dates.

An antenatal lady is said to have excellent dates if she knew her last menstrual date, she had 3 regular cycles prior to her last periods, she had gestational age corresponding to her period of amenorrhea in a first trimester or early second trimester scan.

The BPD was measured as the distance from the outer surface of proximal calvarium to the inner surface of distant calvarium at the maximum width of the head in the BPD plane.

The AC was measured in the transverse axial plane of the foetal abdomen along its outer margin in the maximal transverse plane at the level of the liver, just superior to the umbilicus. A major landmark in this section is the umbilical portion of the left portal vein deep in the liver, with the foetal stomach forming secondary landmark.

The FL measurement was made from the outer surface of the proximal end of femoral bone to the distal end, not including the distal femoral epiphysis. The transducer is aligned along the long axis of the bone, with the beam perpendicular to the shaft.

The KL was taken in the sagittal view taking the longest length. Both kidneys were measured and the mean of them were taken.

Those foetuses which were included in the study were followed up till delivery to rule out IUGR and anomalies.

The data collected in the study concerning biometry and gestational age is represented in graph form called scatter diagram with the biometric values in the X-axis and the latter in the Y-axis. Depending on the alignment of the data, the correlation between the two is visualized. Then curve fitting is done using regression analysis which evaluates the relationship between two variables thus making it possible to predict one value from another. Regression equation for calculating the dependent variable from independent variable is found out using linear regression analysis. The coefficient of correlation (R) and coefficient of determination (R^2) is then found out which determines the quality of fit of equation. The F test is used to discriminate the curves. The better the correlation the closer these coefficients will be to one. Parameters that correlate very well have R^2 values in

the range 0.90 -0.99 ranges. Root mean square deviation shows how accurate is the estimate. This is a combination of both random error and systemic error.

RESULTS

The study group selected had an average gestational age of 35.6 weeks with a standard deviation of ± 2.81.

Distribution of gestational age of the study population is shown in Figure 1.

The correlation of the foetal biometric parameters with gestational age and among themselves are given in the correlation matrix in Table 1

Regression equations for calculating gestation al age from foetal biometry is given in Table 2.

The standard error of the regression coefficients is given in parenthesis.

The coefficient of determination R^2, Root mean square deviation RMSD, F and p values are given in Table 3.

Comparison of prediction interval width for the different predictor variables are given in Table 4.

Thus we find that prediction width is least (1.5 weeks) when compared with other parameters.

The length of both the kidneys were compared.

Biometry	GA	BPD	FL	AC	KL
BPD	0.92	1	0.90	0.84	0.89
FL	0.95	0.90	1	0.86	0.92
AC	0.90	0.84	0.86	1	0.88
KL	0.97	0.89	0.92	0.88	1
Table 1. Correlation Matrix					

Fetal Measurements	Regression Equations		
KL	GA= 1.2022 *KL - 13.4891		
	(0.03)		(1.21)
FL	GA= 0.5484 *FL - 2.3630		
	(0.02)		(1.18)
BPD	GA=0.4663 *BPD - 4.9086		
	(0.02)		(1.72)
AC	GA=0.1001* AC - 4.22		
	(0.004)		(1.47)
FL, AC, BPD	GA = -4.2684+ 0.3011*FL + 0.296*AC + 0.1124*BPD		
	(0.03)	(0.01)	(0.03)
KL, FL, AC, BPD	GA = -9.7592 + 0.5846*KL + 0.1692*FL + 0.0157*AC + 0.0559*BPD		
	(0.07)	(0.03)	(0.004)	(0.02)
Table 2. Regression Equations for Calculating GA from Fetal Biometry			

Biometry	R^2 (%)	F	P value	RMSD
KL	94.41	1653	<0.01	0.66
AC	82.4	458.83	<0.01	1.17
BPD	84.97	554.16	<0.01	1.08
FL	91.34	1033.5	<0.01	0.82
FL,AC,BPD	94.99	824.75	<0.01	0.62
KL, FL,AC,BPD	97.17	602.44	<0.01	0.46
Table 3. R^2, RMSD, F and p Values				

Biometry	Prediction Interval Width		Mean	Standard Deviation
	Min	Max		
KL	1.52	1.62	1.56	0.07
FL	2.27	1.99	2.13	0.20
AC	2.44	2.05	2.24	0.28
BPD	3.39	2.46	2.93	0.65
Table 4. Prediction Interval Width				
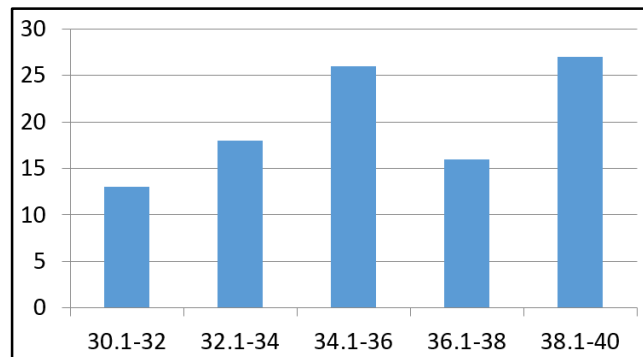
Graph 1. Gestational Age (x-axis) & Frequency Distribution (y-axis)

DISCUSSION

The frequency distribution of gestational age shows that it is distributed fairly evenly which is necessary to avoid bias.

The high correlation between kidney length and gestational age in the present study is similar to the study by Pandey et al[2] Konje et al. similarly found that KL and FL were the most accurate single parameters for predicting gestational age using linear regression models.[3] Similar good correlation was found in the study by Ansari et al. and Gloor et al[4,5]

The R^2 value when multiple parameters as FL AC and BPD were used in combination was 94.99 which is comparable to the studies by Chervenak et al. where R^2 value was 94.8.[6] Similarly in the study by Pandey et al. it was 92.8.[2] Coefficient of determination of multiple parameters in the study show that the value of R^2 is highest when KL is used as an additional parameter along with the usually taken FL, AC, and BPD. The R^2 value of this combination was 97.17. Thus it is seen that combination of multiple parameters improve the accuracy of prediction and adding foetal kidney length to the usual parameters improve the accuracy. There is improved prediction interval width with renal length which is 1.5 weeks in the present study. This is similar to that of 2 weeks in Pandey et al. study.[2] No significant difference in length was found between the right and left kidney. In the study by Cohen et al. no significant difference was obtained.[7]

CONCLUSION

The accuracy of estimation of gestational age in the third trimester can be improved using foetal renal length along with the usual variables with lesser prediction interval width. Further study should be done in a larger population and the application of this parameter in clinical conditions like intrauterine growth restriction has to be evaluated.

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