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Sonographic Measurement of Fetal Kidney Length as Parameter for Fetal Weight Estimation for Sudanese Population

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Abstract: ***Background: As far as independent extrauterine existence and optimum survival of the fetus is concerned birth weight is undoubtedly one of the most significant determinants of neonatal survival. It has become increasingly important, especially for the prevention of prematurity, evaluation of pelvic disproportion before induction of labor and detection of Intra Uterine Growth Restriction. Objective: This study aimed to evaluate the validity and efficiency of prediction of fetal birth weight by measuring fetal kidney length. Material and methods: Descriptive quantitative cross sectional study was conducted in AL sheikh hospital Omdurman during period from August 2012-2015 to evaluate the validity of fetal kidney length for fetal weight estimation using Ultrasonography. A total number of 384 pregnant women aged between 15-45 years old attended for routine checkup were studied after 17 years old of gestational, and the data analyzed by Statistical package for social science (SPSS). The results: The study revealed that there was linear and strong correlation between the mean of (LMP) Gestational age with biometric indices, kidney length and fetal weight (p< 0. 05). The was strong a significant correlation between fetal weight and fetal kidney length (p< 0. 05). There was no statistically significant correlation between the mean of the FWT and maternal age, weight, high, body mass index, parity and fetal gender (p>0. 05). The module derived indicated that the fetal kidney length can estimate fetal weight in combining with biparietal diameter, femur length with estimate error of 319 grams. Conclusion: It concluded that the fetal kidney length is a valuable tool for fetal weight estimation.***

Keywords: Kidney length, Fetal, Weight, Estimation, Sonography

1. Introduction

The correct determination of the fetal weight prior to delivery is most important and greatly influence the clinical management, the outcome of pregnancy, delivery and survival of the newborn, especially in case such as fetal macrocomia, fetal growth restriction, breech presentation or in a trail of vaginal birth after previous cesarean section. Fetal weight estimation has a significant bearing on management decisions on labor, therapy markedly improving perinatal outcome. [1]

Obstetric Sonographic assessment for obtaining fetal biometric measurements to predict fetal weight has been integrated into the mainstream of obstetric practice in the last quarter of a century. Estimation of fetal weight based on ultrasound images plays a key role in prenatal care. Obtaining accurate expected fetal weight (EFW) is of paramount importance in the prediction of fetal compromise and in management of labor. Ultrasound is a major tool for fetal weight estimation, due to its noninvasiveness, portability and relatively low cost. In clinical applications, the fetal weight estimates based on several ultrasound measurements with the regression analysis. The accuracy of EFW is disturbed by two main factors, the one is the random errors in measurements, and the other is the impropriety of regression equations. [2, 3]

The most accepted way of diagnosing abnormal growth in a fetus is to calculate the EFW using standard ultrasound measurements, then to compare the estimated weight with an accepted standard. Some tables still in use were based on the birth weight distribution at different gestational ages of children born in the 1960s or 1970s. 68 Kramer questioned the reliability of these and many subsequent studies. The problems he identified were that patients often had an unconfirmed gestational age, infants were included with implausible birth weight, there was an insufficient sample size at lower gestational ages, the samples were not population based, and the studies used inadequate statistical modeling techniques. He and his colleagues published sex-specific growth standards that avoided these problems.[4]

To address the issue of normal fetal growth before term, several authors have started since 1960s and developed in utero fetal weight standard at Ultrasound with no single equation clearly superior due to the differences in methods, variation in racial, population socioeconomic characteristic, sample size, source of data, geographic location, and criteria of exclusion.[2]

Many formulas and tables are available for the prediction of fetal weight. These formulas are based on a variety of combinations of BPD, HC, AC, and FL. The predictive accuracy of these formulas ranges from ±14. 8% to ±20. 2% (±2 SD). The most popular of these have been compiled in a review by Nyberg and colleagues. All incorporate the abdominal circumference because this is the standard measurement most susceptible to the variations in fetal soft tissue mass. Although the abdominal circumference alone is

a fairly good marker for detecting abnormal fetal growth, the addition of other standard measurements to estimated weight formulas increases their accuracy. It has been shown that the addition of measurements beyond the standard set (BPD, HC, AC, and FL) does not significantly improve weight estimations. It appears that the error inherent in obtaining the basic measurements (especially the AC) is great enough to obscure any refinement in accuracy that might be gained from additional measurements. Formulas are often compared against a commonly used table (Shepard and colleagues, 1987) [5, 6, 7]

There have been several strategies aimed at improving the performance of ultrasound for estimating fetal weight. One is to develop formulas based on subpopulations of fetuses, such as those who are preterm or are thought to be small or large for gestational age. Although this approach seems reasonable, most studies have not shown an improvement in the accuracy of weight esThe kidneys are normally situated on both sides of the spine just caudad to the liver. Typically, the kidneys have the same configuration as in postnatal life—round in axial and ovoid in long-axis views. [8]

Fetal kidney length correlates well with gestational age. Can be used reliably as an additional parameter to predict gestational age in the third trimester of pregnancy in conjunction with other established parameters or when other methods fail to contribute to the assessment of gestational age[9]

This study aimed to evaluate the validity and efficiency of fetal kidney length for fetal weight estimation.

2. Material and Methods

Descriptive quantitative cross sectional study was conducted in AL sheikh hospital Omdurman during period from August 2012-2015 to evaluate the validity of fetal kidney length for fetal weight estimation using Ultrasonography. A total number of 384 pregnant women aged between 15-45 years old were attended for routine checkup were studies after 17 years old of gestational. Patient with singleton pregnancy, who were certain of their last menstrual period and who had regular menstrual cycle. Women known hypertension, diabetes, oligohydrominous, poly hydrominous, multiple pregnancy, intrauterine growth restricted, chronic renal diseases and fetal anomalies were excluded from the study. Data was collected through data collected sheet which included demographic characteristics and ultrasound measurement. Ultrasound scanning was performed using curve array real time ultrasound machine equipped with 3.5 Mhz transducer. Fetal biometry of KL, BPD, FL and Fwt was measured and the result was analyzed.

Statistical Analysis

Statistical analyses were performed using SPSS software v.20 and MD Excel. Correlations between various maternal parameters (age, weight, height, BMI, parity) and fetal ultrasonographic measurements with fetal weight were calculated. Correlations between fetal weight and ultrasonographic fetal measurements were evaluated using Pearson's correlation co-efficient. Stepwise linear regression analysis was performed to predict fetal weight.

3. Results

384 pregnant women were collected in the study. Women with maternal and fetal pathology that affected fetal kidney length was excluded from the study. The mean age, weight, body mass index was26.8 ± 5.9, 66.2 ± 11.5, 160.2 ± 4.9 and 25.7 ± 4.5 respectively. Most of the pregnant women in the study sample were multigravida (69.5%) while primgravida were (30.5%). (Figure 1) Most of the fetuses in the study sample were female, there were 125 (32.6%) male, 248 (64.6%) female and 11 (2.9) unknown fetal gender (missing =11 cases) 2.9%. There was a strong linear correlation between the mean fetal weight and FL, FKL, and BPD (r=0.916, 0.916, and 0.832 respectively (Table 2, Figures 2–4). There was no correlation between FKL and maternal age, weight, height, BMI, parity, socioeconomic status, or fetal sex (Table 3). There were no significant differences between right and left FKL. A model using a combination of Femur length (FL), Biparetal diameter (BPD), and mean fetal kidney length (KL_m) revealed that a combination of all three biometric parameters gave the most accurate estimation of Fetal weight with estimate error (Er) of 319 grams The following linear regression equation was used to calculate GA based on these three parameters (Table 5, 6).

Table 2: Show personal Correlation coefficient of fetal weight with (LMP) Gestational age and ultrasonic fetal biometric parameters (n=384)

	LMP	FL	BPD	FWT
FL	.938**			
BPD	.923**	.952**		
FWT	.904**	.916**	.931**	
KL_m	864**	.854**	.836**	.832**

LMP: last menstrual period; FL: femur length; FWT: fetal weight; KL_m: kidney length (mean RT &LT) ** P Value <0.01

There was linear and strong correlation between the mean of (LMP) Gestational age with biometric indices, kidney length and fetal weight. The best correlation coefficient was observed between LMP and femur length.

Table 3: Person correlation coefficient of mean fetal weight with maternal and fetal characteristics:

Dependent variable	*N*	*Person correlation*	*Sig(2-tailed)*
Age	384	.047	.361
Weight	384	.061	.230
High	384	.036	.488
Body mass index	384	.105**	.075
Parity	384	.031	.540
Socioeconomic status	384	.148**	.004
Fetal gender	373	.093	.073

*correlation was significant at the 0.05(2-tailed)
**correlation was significant at the 0.01(2-tailed)

There was no statistically significant correlation between the mean of the FWT and maternal age, weight, high, body mass index, parity and fetal gender (p>0. 05). However, there were statistically significant differences between FWT and socioeconomic status (p < 0.05).

Table 4: Shows linear regression analysis for FWT estimation

Coefficients*						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2493.022-	88.241		-28.252-	.000
	Biparietal diameter in mm	55.488	1.114	.931	49.806	.000
2	(Constant)	-2286.511-	92.984		-24.590-	.000
	Biparietal diameter in mm	37.153	3.505	.623	10.600	.000
	Femur length in mm	20.300	3.694	.323	5.495	.000
3	(Constant)	-2402.561-	96.184		-24.979-	.000
	Biparietal diameter in mm	35.240	3.479	.591	10.130	.000
	Femur length in mm	15.115	3.871	.241	3.905	.000
	fetal kidney length in mm	18.090	4.698	.132	3.851	.000
a. Dependent Variable: Expected fetal weight in gram						

Table 5: Show the models derived from the various biometric indices summery combinations for fetal weight estimation

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.931[a]	.867	.866	336.99
2	.936[b]	.876	.876	324.80
3	.939[c]	.881	.880	319.07
a. Predictors: (Constant), Biparietal diameter in mm				
b. Predictors: (Constant), Biparietal diameter in mm, Femur length in mm				
c. Predictors: (Constant), Biparietal diameter in mm, Femur length in mm, fetal kidney length in mm				

Fetal weight can estimate by a combination of femur length, biparietal diameter and kidney length.

Table 6: Shows linear regression equations defining the relationships between LMP gestational age and various indices for FWT estimation:

Parameters	*Equation*	*R Square*	*Std. Error of the Estimate*
BPD	FWT=(55.488*BPD)-2493.022	.867	336.9887
BPD, FL	FWT=[37.153 *BPD+20.300FL]-2286.511	.876	324.8048
BPD, FL.KL	FWT=[35.240*BPD+15.115*FL+18.090*KL]-2402.561	.881	319.0655

The most accurate equation were a combination of all parameters with SE of 319.0655 grams.

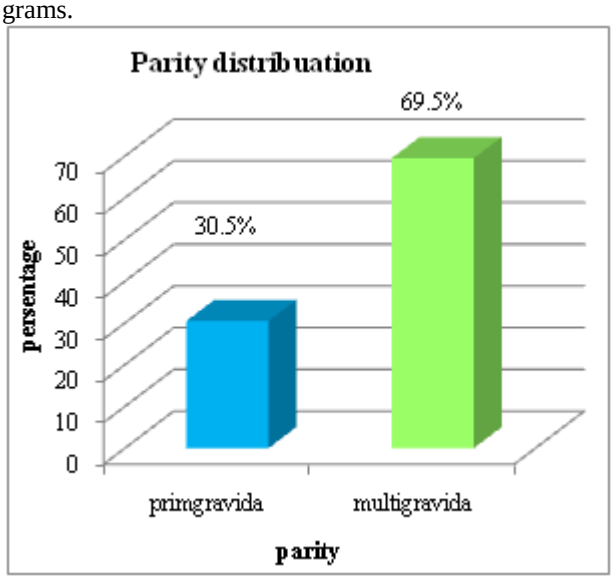

Figure 1: Shows parity distribution

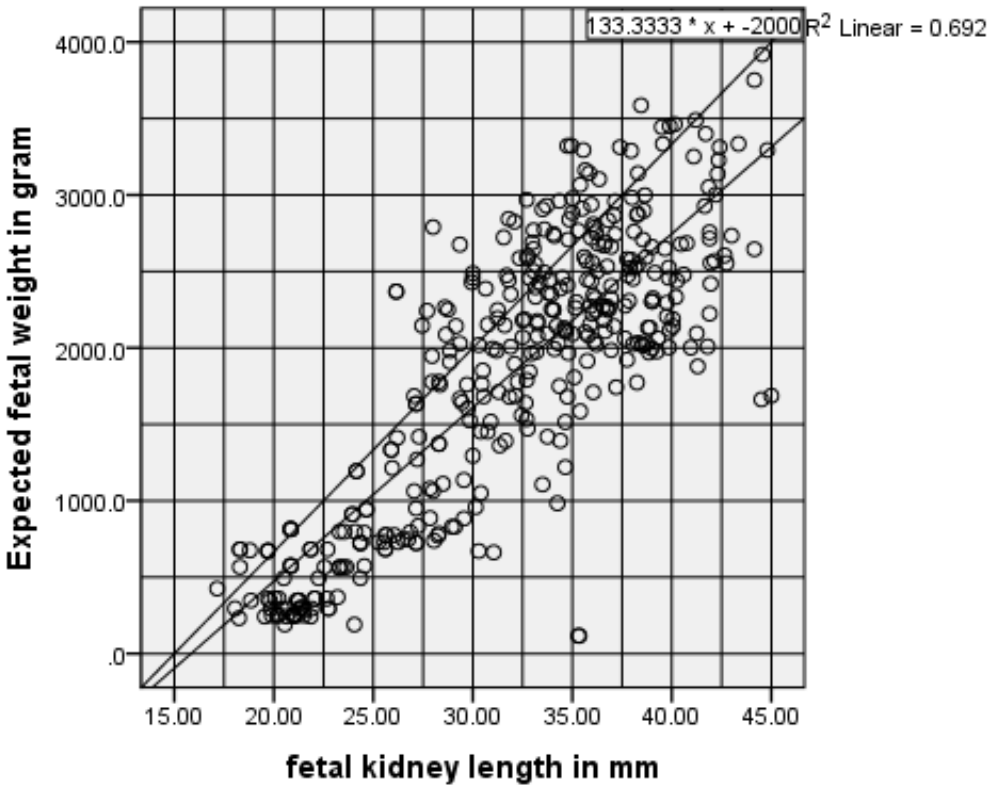

Figure 2: Show Regression of FWT with KL

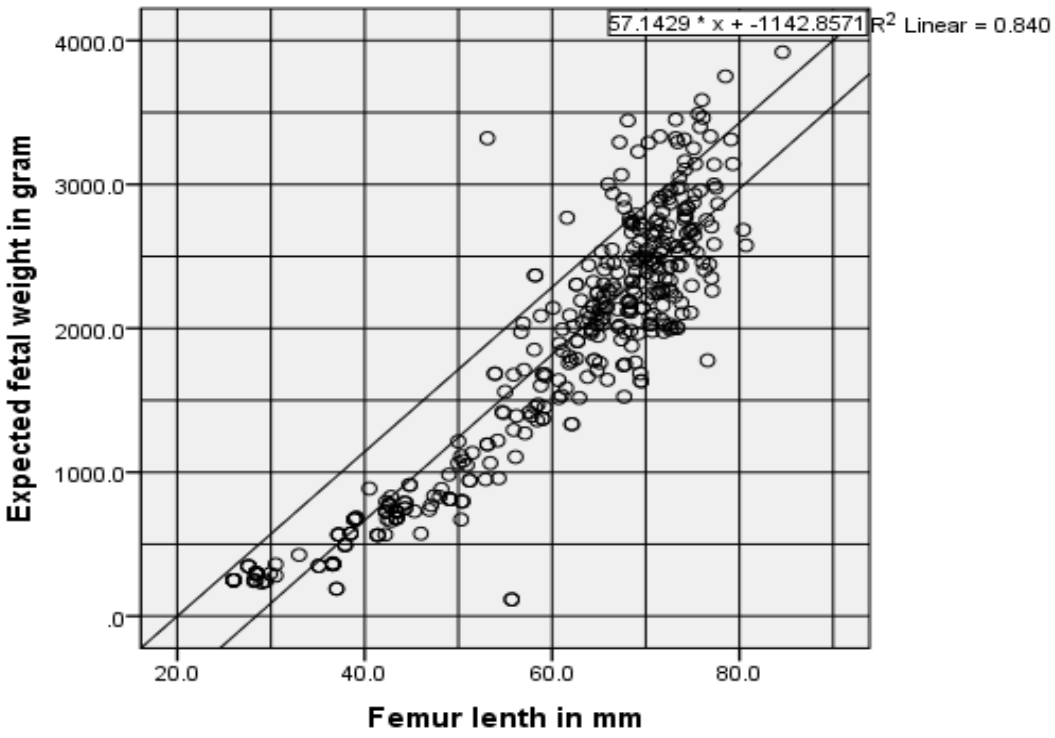

Figure 3: Shows Regression of FWT with FL

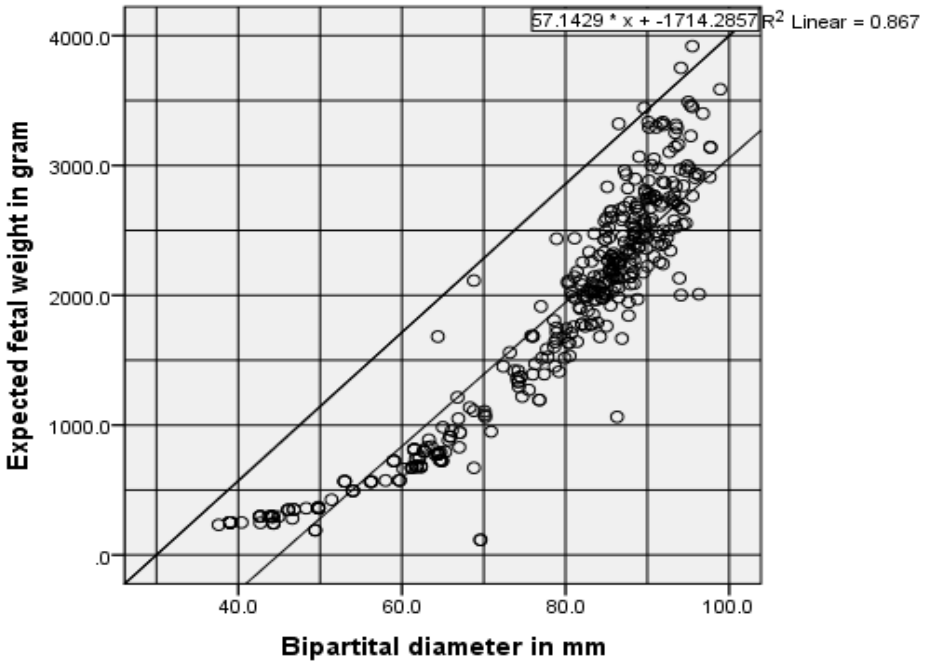

Figure 4: Shows regression of FWT with BPD

4. Discussions

Accurate sonographic EFW can be an intangible objectively for any sonographer because the endpoint or the ultrasound estimated fetal weight will lead to a management decision that will have a direct impact on the mother and fetus. Polyhydramnios, oligohydramnios, fetal macrosomia, and intrauterine growth restriction can lead to potential complications affecting management decisions for patients presenting in labor and delivery. Fetal weight estimations that are frequently determined by sonography play a major role in obstetric decision making and management. Both low birth weight and excessive fetal weight at delivery are associated with an increased risk of newborn complications during labor and delivery[10].

Ultrasounds methods do not estimate fetal weight directly rather they do so indirectly by measuring the various segments of the body. Two dimensional ultrasonography is routinely used for the purpose, and the estimated fetal weight is calculated using appropriate tables or integrated computer programs. The most frequently used parameters include the biparietal diameter, abdominal circumference and femur length. There is a cumulative error inherent in each of the fetal dimensions measured. Then, there is acoustic shadowing at extreme ends of diaphysis. A single formula is not capable of covering the entire range of fetal weight [11] This study was descriptive quantitative cross sectional study conducted on 384 Sudanese pregnant women to evaluate the validity of fetal kidney length for fetal weight estimation.

variety of formulas and parameters have been correlated with fetal weight. Among them, the Shepard formula, which includes BPD and AC,]12] and the Hadlock formula using FL and AC[6] are widely accepted and commonly used for estimation of fetal weight. These parameters are considered to be more accurate and simpler than others. [14, 16] The results from combining all three parameters (BPD, FL, and AC) for predicting fetal weight appear to be controversial in the literature. Hadlock and coworkers [17] and Rose and McCallum [18] found that combining all three of these parameters produced more accurate results than the use of only two parameters, but Woo and Wan[19] conversely found no improvement in predictive accuracy over that of formulas using two parameters. However the present study include FL, BPD and KL for fetal weight estimation

In the present study fetal kidney length can reliably using for fetal weight estimation in combine with FL and BPD with estimate error of 319.06 grams the accuracy of this formula is 88.1 % (R Square). The correlation of this formula with fetal weight estimation is 0.939 (r).However in had lack formula using ultrasound to estimated fetal weight by measuring HC, AC and FL found that the estimated error was 299.11 grams and twari and sood shows an average error of 364.96 grams.[20]

5. Conclusion

This descriptive quantitative cross sectional study demonstrate that fetal weight estimation could be estimated accurately by measuring fetal kidney length in combine with BPD and FL

The limitation of this study that the researcher were not compare between the actual birth weight and ultrasound fetal weight using FKL, FL and BPB

Fetal kidney length is valid for fetal weight estimation in combine with femur length and Biparietal diameter with estimate error of 319.06grams

References

[1] Boyd ME, Usher RH, and McLean FH. Fetal macrosomia: prediction, risks, proposed

management.Obstetrical Gynacology1983;61(6):715-22.

[2] Mohamed Adam, Jumaa Yousif Tamboul, Mohamed Yousef, Abdelmoneim Sulieman, The accuracy of Ultrasound in Estimation of fetal weight, Journal of American Science : 2014: ISBN 978-3-659-25951-7

[3] Jin-Hua Yu, Yuan-Yuan Wang, Ping Chen, and Yue-Hua: SongUltrasound Estimation of Fetal Weight with Fuzzy Support Vector Regression.2007 PAGE 426 ISBN: 978-3-540-72394-3 DOI: 10.1007/978-3-540-72395-0_54

[4] Kramer MS, Platt RW, Wen SW, et al: A new and improved population-based Canadian reference for birth weight for gestational age. Fetal/Infant Health Study Group of the Canadian Perinatal Surveillance System. Pediatrics 2001; 108: pp. E35

[5] John L. Pfenninger, Grant C. Fowler. Pfenninger and Fowler's Procedures for Primary Care 3rd edition: 2011: ISBN by Mosby, Inc, an affiliate of Elsevier Inc. All rights reserved.

[6] Nyberg DA, Abuhamad A, and Ville Y: Ultrasound assessment of abnormal fetal growth. Semin Perinatol 2004; 23: pp. 3

[7] Hadlock F: Evaluation of fetal weight estimation procedures. In Deter R, Harist R, and Birnholz J (Eds): Quantitative Obstetrical Ultrasonography. New York: Wiley, 1986. Pp. 113

[8] Robson SC, Gallivan S, Walkinshaw SA, et al: Ultrasonic estimation of fetal weight: use of targeted formulas in small for gestational age fetuses. Obstet Gynecol 1993; 82: pp. 359

[9] Hafizur Rahman, Asqm Sadeque, Salahuddin Alzad, Asm Zakir Hossain, Nazrul Islam, Saiful Islam, Sharif Chodhury, Noman Chowdury. Ultrasound Evaluation of Fetal Kidney Length in Third Trimester: Correlation with Gestational age. Bangladesh Journal of Radiology and Imaging (2008); VOL.16(1) :6-11.

[10] SHARON A. DURBIN, CONNIE W. VERONICA G. PARKER, PHD: The Effect of Amniotic Fluid Index on the Accuracy of Sonographic Estimated Fetal Weight (2005) JDMS 21:329–335

[11] Schild RL, Fimmers R, Hansmann M. Fetal weight estimation by threedimensional ultrasound. Ultrasound Obstet Gynaecol (England) 2000; 16:445-52.

[12] Shepard MJ, Richards VA, Berkowitz RL, et al: An evaluation of two equations for predicting fetal weight by ultrasound. Am J Obstet Gynecol 142:47, 1982

[13] Hadlock FP, Harrist RB, Carpenter RJ, et al: Sonographic estimation of fetal weight: The value of femur length in addition to head and abdominal measurements. Radiology 150:535, 1984

[14] Sampson MB, Thomason JL, Kelly SL, et al: Prediction of intrauterine fetal weight using real-time ultrasound. Am J Obstet Gynecol 142:554, 1982

[15] Timor-Tritsch JE, Itskovitz J, Brandes JM: Estimation of fetal weight by real-time sonography. Obstet Gynecol 57:653, 1981.

[16] Ott WJ: Clinical application of fetal weight determination by real-time ultrasound measurements. Obstet Gynecol 57:758, 1981

[17] Hadlock FP, Harrist RB, Sharman RS: Estimation of fetal weight with the use of head, body and femur measurements: Aprospective study. Am J Obstet Gynecol 153:333, 1985

[18] Rose BI, McCallum WD: A simplified method for estimating fetal weight using ultrasound measurements. Obstet Gynecol 69:671, 1987

[19] Woo JSK, Wan MCW: An evaluation of fetal weight prediction using a simple equation containing the fetal femur length. J Ultrasound Med 5:453, 1986

[20] Bhandary A mritha A, Pinto Patric J, Shetty Ashwing P Comparative study of various methods of fetal weight estimation At term pregnancy.J Obstet Gynecol I nd 54, 336:339, 2004.