Evaluation of role of femur length / mid thigh circumference ratio in differentiation between small for gestational age but healthy fetuses and intrauterine growth restricted fetuses

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Abstract: Background: Intrauterine growth restriction represents pathological inhibition of fetal growth and failure of the fetus to attain its growth potential. There is a strong association between stillbirth and fetal growth restriction. A newborn infant is classified as growth restricted or small for gestational age, if his birth weight falls below the 10th percentile for his particular gestational age. **Objective:** The aim of the work is to evaluate the femur length / mid thigh circumference ratio in intrauterine growth restricted fetuses in comparison to small for gestational age but healthy fetuses. **Subject and Methods:** An observational case-control study was conducted at the department of Obstetrics and Gynecology, Faculty of Medicine, Ain Shams University, during the period from (June 2015 to May 2016), included 89 women pregnant ladies in third trimester with singleton pregnancy aged between 20 and 40 years old. They were diagnosed as having small for gestational age fetus and followed up for two weeks to differentiate their pregnancy into healthy small for gestational age fetus or intrauterine growth restricted fetus. They did not have medical disorders, the fetus did not have any congenital anomalies and is viable. **Result:** All women were either primigravida (45.5% vs. 11.8%) or multigravida (54.5% vs. 88.2%) with highly significant difference between both groups with more incidence of primigravida in SGA group than in IUGR group (P <0.001). But, there was no statistically significant difference between both groups regarding maternal age (29+/-4 vs. 31+/-5) (P> 0.05). Also there was statistically significant difference between both groups regarding gestational age being more in SGA group (34+/-1 week vs. 33+/-2 weeks) (P < 0.05). There was no statistically significant difference between both groups regarding BMI, blood pressure, history of CS or history of abortion (P>0.05). In IUGR group AFI was decreased (3.5 +/-1.4 vs. 8.4+/-4) with sensitivity 97.1% and specificity 89.1% and umbilical artery Doppler ultrasound (RI) significantly increased (0.8+/-0.08 vs. 0.61+/- 0.05) and when compared with the SGA this showed statistically highly significant difference (P<0.001) with sensitivity 87.1% and specificity 92.7%. In SGA group the BPD, HC was bigger (78.6mm+/-5.9mm vs. 74.7mm+/-8.9mm), (291.2mm+/-16.4 vs. 276.8mm+/-30mm) respectively, which indicate statistically significant difference between both groups (P<0.05). The FL also was longer in SGA group (60.2mm+/-4.7mm vs. 56mm+/-6.7mm) which indicate statistically significant difference between both groups (P<0.01). There was no statistically significant difference between both groups regarding FL/MCT ratio (P >0.05). **Conclusion:** Femur length / mid thigh circumference ratio cannot differentiate between small for gestational age but healthy fetuses and intrauterine growth restricted fetuses, but amniotic fluid index in case of intact membranes and umbilical artery resistance index can be used to differentiate between both groups.
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1. Introduction

Small for gestational age (SGA) infants are often designated as suffering from intrauterine growth restriction (IUGR). It is estimated that from 3 to 10 percent of infants are growth restricted *(Leveno et al., 2013).*

Small for gestational age infants are generally considered to be those whose weight are below 10th percentile for their gestational age. Not all infants with birth weights less than 10th percentile, however, are pathologically growth restricted; some are small simply because of constitutional factors. Indeed, 25 to 60 percent of infants conventionally diagnosed to be SGA are in fact, appropriately grown when determinants of birth weight such as maternal ethnic group, parity, weight, and height are considered (*Leveno et al., 2013).*

Most recently, individual fetal growth potential has been proposed in place of a population – based cutoff. In this model, a fetus that is less than its individual optimal size at a given gestational age would be considered growth restricted (*Leveno et al., 2013).*

In a prospective study about prediction of fetal birth weight from measurement of fetal thigh circumference by two-dimensional ultrasound, a two-dimensional ultrasound scan was performed between 38 and 40 weeks gestation, which measured the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL) and thigh circumference (TC) at the level of mid thigh, and incorporated them to estimate fetal weight. The results of this study show that the fetal thigh circumference, if incorporated with other standard biometric parameters in estimating fetal weight by ultrasound, improves the predictability of birth weight estimation, and can predict intra-uterine growth restriction *(Sanyal et al. 2012).*

2. Subjects and Methods

This is a hospital based observational case-control study conducted in 12 months at Ain Shams University Maternity Hospital, during the period from June 2015 to May 2016.

Before the start of the study, permission was obtained from Ethical Committee in the faculty of medicine, Ain Shams University. Also Informed written consents from patients included in the study was obtained.

Subjects:

A total number of **89** women aged between **20 - 40** years old all were pregnant in third trimester with small for gestational age fetuses. They were divided into two groups:

1. Small for gestational age fetuses group: will include 55 pregnant females all in third trimester followed by serial ultrasound over 2 weeks and show normal growth during this follow up. On first ultrasound the estimated fetal weight should be below the 10th percentile according to that of gestational age, on the second ultrasound the fetal weight will be increased by the same rate and the growth curve will be parallel to the normal growth curve, e.g., if during first ultrasound the fetal weight was at the 5th percentile of that gestational age, on the second ultrasound the fetal weight will be at the 5th percentile of the new gestational age.

2. IUGR fetuses Group: will include 34 pregnant females all in third trimester followed by serial ultrasound for 2 weeks and showing retarded growth, and show much retarded growth during follow up. On the first ultrasound the estimated fetal weight should be below the 2SD of the mean weight of the same gestational age, and the growth rate of the fetus will not be parallel to the normal growth curve.

Inclusion Criteria:

∗   All pregnant women aged between 20-40 years.

∗   Singleton pregnancy.

∗   Gestational age of 28-34 weeks.

∗   Reliable last menstrual period or early antenatal ultrasound for calculation of gestational age reliably (crown rump length between 9-11 weeks gestation).

Exclusion Criteria:

∗   Ultrasonographically detected.
congenital fetal malformation.

∗   Fetal hydrops.

∗   Multiple pregnancy.

∗   Post-term pregnancy.

∗   Intrauterine fetal death.

∗   medical disorders associated with pregnancy e.g. hypertension and diabetes.

- **Methods:**

- History taking:

reliable history taking especially age, medical disorders, obstetric history, menstrual history especially date of last menstrual period (LMP), drugs taken during current pregnancy, and family history.

- General examination:

Especially blood pressure, chest, heart and abdominal examination, symphysis fundal height, lower limb examination, body mass index.

- Serial obstetric ultrasound examination of pregnant females included in the study 2 weeks apart, measuring biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), mid-thigh circumference (MTC), estimated fetal weight (EFW), amniotic fluid index (AFI), umbilical artery Doppler, middle cerebral artery Doppler (MCA Doppler) and FL/MTC ratio using two dimensional ultrasound (2D US).

o   The women will undergo two ultrasound readings 2 weeks apart by single operator.

- Following up until delivery to know the neonatal outcome, regarding mode of delivery, birth weight and condition of neonate.

Study tools:

Medison X6 ultrasound machine equipped by a 3-7 MHz convex probe will be used for measurement of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), mid thigh circumference (MTC), estimated fetal weight (EFW), amniotic fluid index (AFI), umbilical artery Doppler, middle cerebral artery Doppler (MCA Doppler) and FL/MTC ratio.

Measurement of Femur Length (FL) to Mid-Thigh Circumference (MTC) ratio:

The whole length of femur from greater trochanter to the distal metaphysis will be visualized on the ultrasound monitor and will be measured. Then the ultrasound transducer will be rotated by 90º to obtain a cross sectional profile of the middle of the thigh at a position that the thigh profile will be round

as possible and the boundary of the thigh profile will be well defined. The mid-thigh circumference will be then obtained by direct perimeter method using the ultrasound curser then the ratio between them will be calculated.

Statistical Analysis:-

Data were revised for completeness and consistency. Accordingly, some ladies were excluded from the study and replaced by an equal number of other patients. Pre-coded data were entered and analyzed with the aid of Statistical Package of Social Science Software program (SPSS) version 22.

Mean, standard deviation, range, frequency and percentages were used as descriptive statistics. Chi square test and t-test were used according to type of variables analyzed.

The results were represented in tabular and diagrammatic forms then interpreted.

3. Results

Regarding patient characteristics as shown in table (1), there was no statistically significant difference regarding patient age(31+/-5 years vs. 29+/-4 years), BMI (25.7+/-4 vs. 27.1+/-2.9), or BP, but there was statistically significant difference regarding gestational age(33+/-2wks vs. 34+/-1wk).

Table (1): Characteristics of patients with IUGR or SGA baby

Variable	IUGR (n=34)		SGA (n=55)		*p*-value¶
	Mean	SD	Mean	SD	
Age (years)	31	5	29	4	0.062 NS
BMI (kg/m^2)	25.7	4.0	26.1	2.9	.586 NS
GA by LMP (weeks)	33	2	34	1	**.019 S**
GA by US (weeks)	29	3	31	2	**.022 S**
SBP (mmHg)	117	11	113	11	.104 NS
DBP (mmHg)	74	7	74	8	.811 NS

¶Unpaired t test., NS= non significant, S= significant

Regarding obstetrics history all patients were either primigravida or multigravida with more primigravida in SGA group (45.5% vs. 11.8%)(*P*<0.001) with highly significant statistical difference, but there was no statistically significant difference regarding history of abortion or history of CS as shown in table (2).

Table (2): Obstetric history in patients with IUGR or SGA baby

Variable		IUGR (n=34)		SGA (n=55)		*p*-value¶
		n	%	n	%	
Parity	PG	4	11.8%	25	45.5%	**<.001 HS**
	P1	9	26.5%	12	21.8%	
	P2	12	35.3%	12	21.8%	
	P3	4	11.8%	6	10.9%	
	P4 or higher	5	14.7%	0	0.0%	
History of CS	negative	15	44.1%	30	56.6%	.258 NS
	positive	19	55.9%	23	43.4%	
History of abortions	negative	21	61.8%	37	67.3%	.651 NS
	postive	13	38.2%	18	32.7%	

¶Chi-squared test for trend., HS= highly significant, S= significant, NS= non- significant
§Fisher's exact test.

Regarding fetal biometric measures as shown in table (3) and figure (1), there was statistically significant difference regarding BPD(74.7+/-8.9mm vs. 78.6+/-5.9mm), HC (276+/-30 mm vs. 291.2+/-16.4 mm), FL (56+/-6.7mm vs. 60.2+/-4.7mm).

Regarding AFI and UA RI there was highly significant statistical difference between both groups with sensitivity 97.1%, and 87.1% respectively and specificity 89.1%, and 92.7% respectively.

Table(3): Fetal biometric measures in patients with IUGR or SGA babies

Variable	IUGR (n=34)		SGA (n=55)		p-value¶
	Mean	SD	Mean	SD	
BPD (mm)	74.7	8.9	78.6	5.9	**.026 S**
HC (mm)	276.8	30.0	291.2	16.4	**.013 S**
AC (mm)	249.0	36.9	253.3	22.4	.544 NS
FL (mm)	56.0	6.7	60.2	4.7	**.002 S**
MTC (mm)	110.4	13.7	116.6	15.5	.061 NS
FL/MTC ratio	.510	.061	.522	.048	.347 NS
EFW (g)	1533	591	1646	407	.331 NS
AFI	3.5	1.4	8.4	4.0	**<.001 HS**
UA RI	0.80	0.08	0.61	0.05	**<.001 HS**
MCA RI	0.76	0.09	0.77	0.11	.579 NS
MCA PSV (cm/s)	40.8	7.3	44.4	9.4	**.047 S**

¶Unpaired t test., HS= highly significant, S= significant, NS= non- significant
¶Unpaired t test., HS= highly significant, S= significant, NS= non- significant
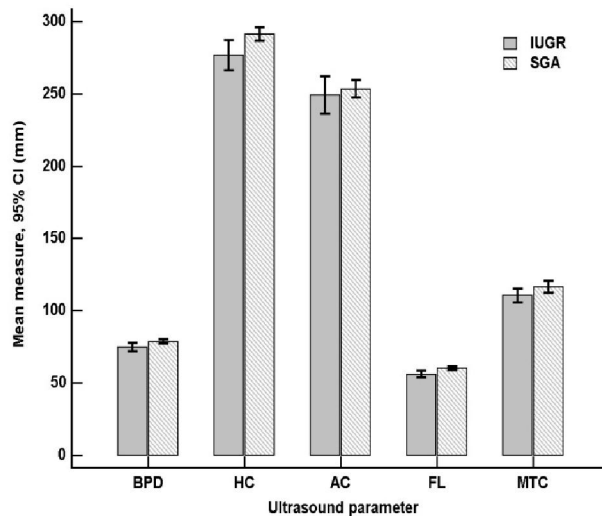
Figure(13). Fetal biometric measures in patients with IUGR or SGA babies**.**

4. Discussion

The current study has proposed the sonogragic measurements of fetal mid-thigh soft tissue circumference (MTC) in relation to femur length (FL) as a possible parameter for assessment of fetal growth. The aim of this study was to evaluate the accuracy and usefulness of measuring femur length to mid-thigh circumference ratio in differentiation between small for gestational age but healthy fetuses(SGA) and intrauterine growth restricted fetuses (IUGR) by ultrasound.

Wood *et al.*, 2014 found that more patients with a borderline AFI had   underlying growth restriction, which may provide a useful tool for risk stratification in the management of a borderline AFI which supports our finding in this study.

Rotmensch *et al.*, 1999 made a study for evaluating efficacy of subcutaneous tissue width /femur length ratio in diagnosis of macrosomic babies and it was found that the SCT/FL ratio is a poor sonographic predictor of fetal macrosomia in the non-diabetic pregnancy and does not improve fetal weight estimations by conventional sonographic parameters.

Hays *et al.*, 1987 made a study on fetal biometric ratios and found that neither AC/FL nor TC/FL were significantly related to birth weight or skin-fold thickness. These data suggest that the diagnostic reliability of antenatal studies of fetal biometric ratios may be enhanced by using the ponderal index as a neonatal endpoint rather than birth weight or skin-fold thickness, this support our study finding.

Hebbar and Varalaxmi, 2005 made a study to evaluate role of feta thigh circumference in estimation of birth weight in 110 singleton pregnancies from whom 39 weighted below 2500 grams and they reported that FL/TC ratio can be used as indicator of IUGR with cut off value >0.63 with 95% CI 0.28-0.63. In the current study FL/MTC ratio the cutoff point value 0.57 with 95% CI 0.402-0.618 and it has sensitivity 29.41%, specificity 98.2%, positive predictive value 90%, negative predictive value 68.4% and accuracy 70.8%.

Hebar and Varalakshmi, 2007 studied comparison between sonograghically measured three fetal ratios in third trimester (HC/AC, FL/AC and FL/TC) in 102 singleton pregnancies, they divided the study group based on their weight into group weighs less than 2500 gm and group weighs more than 2500 gm and found that all ratios significantly predicted growth restriction. They also confirmed that FL/TC had the highest ability in this aspect (the best cutoff value of FL/TC was 0.52 with sensitivity 82%, specificity 81%, PPV 73% and NPV 87%). This differs from our

study owing to that both study groups weighs less than 2500 gm.

Conclusion

Femur length / mid thigh circumference ratio cannot differentiate between small for gestational age but healthy fetuses and intrauterine growth restricted fetuses, but amniotic fluid index in case of intact membranes and umbilical artery resistance index can be used to differentiate between both groups.

References

1. Kenneth J. Leveno, James M. Alexander, Steven L. Bloom, Brian M. Casey, Jodi S. Dashe, Scott W. Roberts, Jeanne S. Sheffield: Williams manual of pregnancy complications. 23rd edition, international edition, 2013, chapter no. 38, p 250.
2. Poushali Sanyal, Tarun Kumar Ghosh, Shyamal Dasgupta, Rezaul Karim, Amitava Mukherjee, Anita Das: Predictability of Fetal Birth Weight from Measurement of Fetal Thigh Circumference by Two-dimensional Ultrasound: A Prospective Study, Journal of South Asian Federation of Obstetrics and Gynaecology, January-April 2012;4(1)35-38.
3. Wood SL, Newton JM, Wang L, Lesser K.: Borderline amniotic fluid index and its relation to fetal intolerance of labor: a 2-center retrospective cohort study. J Ultrasound Med 2014; 33(4):705-11.
4. Rotmensch S, Celentano C, Liberati M, Malinger G, Sadan O, Bellati U, Glezerman M: Screening efficacy of the subcutaneous tissue width/femur length ratio for fetal macrosomia in non-diabetic pregnancy. Ultrasound Obstet Gynecol 1999; 13(5):340-4.
5. Hays D, Patterson RM: A comparison of fetal biometric ratios to neonatal morphometrics. J Ultrasound Med 1987; 6(2):71-3.
6. Hebbar S and Varalaxmi N: Role of fetal thigh circumference in estimation of birth weight by ultrasound. Malaysian Journal of obstetrics & Gynaecology2005; Vol. 8, No. 9: 13-23.
7. Hebbar S, Varalakshmi N.: Comparison of three ultrasound ratios in term low birth weight babies – is there a role for thigh circumference? Calicut Medical Journal 2007; 5(3) e1.

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