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Full Length Research Paper

Correlation between First Trimester Crown-Rump Length and Birth Weight

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Abstract
Background: *First-trimester ultrasound measurements of crown–rump length (CRL) have also been demonstrated to be accurate predictors of birth weight and measuring CRL in the first trimester is a much simpler procedure, and a shorter-than-expected value is also significantly associated with low birth weight and its complications.* ***Aim of the work:*** *To study the association between first trimester CRL and birth weight.* ***Patients and Methods:*** *This prospective cohort study included 277 pregnant women with gestational age of first trimester divided into 3 groups according to ultrasound measurement of Crown-rump length and the association between CRL and birth weight was recorded and statistically analyzed.* ***Results:*** *There were statistical significant correlation between Actual birth weight and first trimester Crown rump length where (0.288, p-value= 0.0002).****Conclusion and recommendation:*** *The result of the present study showed that if the CRL is above expected, birth weight will be more than normal and if CRL is below expected, birth weight will be less than normal, so measurement of first trimester CRL is useful as a predictor of birth weight.*

Key Words: *Crown-rump length (CRL), birth weight, First-trimester.*

Introduction

The prediction and management of abnormal fetal growth are an important aim of antenatal care,the small-for-gestational age (SGA) fetus may suffer from fetal growth restriction and thus is at risk of increased morbidity and mortality and adult morbidity. On the other hand, the large for-gestational age (LGA) fetus is at risk of birth trauma and perinatal morbidity such as brachial plexus injuries and meconium aspiration[(1)].

Measuring CRL in the first trimester is a much simpler procedure, and a shorter-than-expected value is also significantly associated with low birth weight. Fetal growth impairment begins in the first trimester and had been shown to result in adverse pregnancy outcomes. The difference in size for gestational age of a preterm newborn with that of a newborn at term can therefore be predicted in the first trimester [(2)].

Significant discordance in CRL is associated with higher risk of adverse perinatal outcomes including fetal loss, weight discordance, fetal anomalies, preterm delivery and even perinatal death [(3)]. The aim of the present study was designed to study the association between first trimester CRL and birth weight.

Patients and methods

This prospective, cohort study was done in the department of obstetrics and gynecology, Al-Azhar University (New Damietta), during the period from November 2016 to January 2018 and included 277 pregnant women divided into 3 groups according to abdominal ultrasoundmeasurement of Crown-rump length.

Group 1(Normal CRL): included 92 pregnant women.
Group 2 (Smaller than expected CRL): included 98pregnant women.
Group 3(Larger than expected CRL): included 87pregnant women.

Normal CRL was defined as a value one day or less above or below the expected value (-1 to +1).
Smaller-than-expected CRL was defined when the observed CRL was smaller than expected by2–6 days.
Larger-than-expected CRL was defined when the observed CRL was larger than expected by 2–6 days.
At birth newborns were divided into 3 groups according to birth weight:
Normal birth weight: 2500-4000 g.
Low birth weight: Less than 2500 g.
Macrosomia: weight greater than 4000 g.

After explanation of the nature of the study to all participants an informed written consent was taken.

Inclusion criteria: singleton living fetus, gestational age between 11 and 13 weeks, term delivery.
Exclusion criteria: Pregnant women with unreliable menstrual history.Multiple pregnancies, Sub chorionic hematoma. Pregnant women with chronic diseases as cardiac, chronic hypertension and pregestational diabetes, Pregnant women who become affected by preeclampsia, gestational diabetes, preterm delivery, still birth, Pregnant women with discrepancy of more than 6 days with the gestational age based on the last menstrual period, history of genetic or congenital malformation, Pregnant women with BMI less than 18.5 or more than 25 kg/m^2.

For All pregnant women in the study, the following were done. Thorough history taking with special emphasis on menstrual history to be sure of LMP as a method for calculation of gestational age. General examination (Blood pressure, Pulse and Lower limb edema) Abdominal Ultrasound examination for CRL measurement. The foetal CRL obtained at 11- 13 weeks was done by obtaining a longitudinal section of the uterus, then sweep the probe horizontally to the sides to get a longitudinal view of the fetus obtaining a true, un flexed or extended mid sagittal view of the embryo showing fetal heart, with visualization of the end-points of the embryo clearly seen, and then placing the calipers correctly on these defined end-points (crown- rump) excluding the limbs and yolk sac.

The average maximal straight line (CRL) was measured in mm which was taken from 3 satisfactory images and Correlation between actual and expected CRL was done to categorize cases into 3 groups. Follow up the participant in the study until delivery and birth weight were recorded and correlated with CRL.

Statistical analysis
The collected data were coded, fed to computer, organized and statistically analyzed using computer programs: Microsoft excels version 10 and **S**tatistical **P**ackage for **S**ocial **S**cience (SPSS) for windows version 25.

Results
Among277 pregnantwomen included in the study , 19 pregnant women dropped, 30 pregnant women had abortion and preterm labor, so at the end of the study 228 pregnant women met the study criteria and gave birth to term baby and divided into 3 groups. There is no statistically significant differences between groups as regard Age, gravidity, history of abortion and educational level ($p > 0.05$), while there is statistically significant difference between groups as regard parity **(Table 1)**. Tthere is no statistically significant differences between groups regarding gestational age by last menstrual period ($p > 0.05$), and highly significant difference between groups regarding gestational age by ultrasound, Crown rump length in mm(**Table 2)**there is no statistically significant differences between groups as regard gestational age, while highly statistically significant difference between groups as regard actual weight **(Table 3)** there is highly statistically significant differences between groups as regard birth weight ,$p \leq 0.001$(**Table 4).** There were statistically significant differences between neonatal birth weight groupsregarding Crown rump length / mm ($p \leq 0.05$) **(Table 5).** There is a statistically significant correlation between Actual birth weight and first trimester Crown rump length **(Table 6).**

Table (1). Demographic data of the studied pregnant women

Character		Group1 (Normal CRL)		Group 2 (Smaller than expected CRL)		Group 3 (Larger than expected CRL)		Significant test	P value
Age	Min-Max	17-38		20-42		18-43		0.944	**0.391** ^{ns}
	Mean± SD	26.60±5.57		26.45±5.53		27.62±5.99			
Gravidity	Min-Max	1-6		1-7		1-7		3.772	**0.152** ^{ns}
	Mean± SD	2.92± 1.25		3.08±1.56		3.30±1.38			
Parity	Min-Max	0-3		0-4		0-4		6.336	**0.042** ^{S}
	Mean ±SD	1.45±0.91		1.66±1.16		1.88±1.13			
		N	%	N	%	N	%	Chi square	**P value**
History of Abortion	No	51	67.1	49	64.5	55	72.4	1.128	**0.569** ^{ns}
	Yes	25	32.9	27	35.5	21	27.6		
Educational level	Faculty	9	11.8	13	17.1	11	14.5	12.887	**0.116 ns**
	Secondary	42	55.3	31	40.8	24	31.6		
	Preparatory	6	7.9	15	19.7	17	22.4		
	Primary	7	9.2	8	10.5	10	13.2		
	Not educated	12	15.8	9	11.8	14	18.4		

ns = non-significant at p -value > 0.05, S= significant at p value ≤ 0.0

Table (2): Comparison between groups regarding gestational age by last menstrual period, ultrasound and Crown rump length in mm

Character	Group1 (Normal CRL)	Group 2 (Smaller than expected CRL)	Group 3 (Larger than expected CRL)	F ratio	P value
Gestational age by last menstrual period in days In weeks	83.99±3.75 11 weeks+ 6.99 d ±3.75	83.29±3.96 11 weeks+6.29 d ±3.96	82.95±4.29 11 weeks+5.95 d ±4.29	8.523	0.243 ns
Gestational age by ultrasound in days In weeks	82.70±8.33 11 weeks+5.70 d ±8.33	79.50±3.91 11 weeks+2.50 d ±3.91	86.74±4.34 12 weeks+2.74 d ±4.34	16.583	0.0001 HS
Crown rump length in mm	50.89±7.11	45.60±6.68	57.28±8.45	32.163	0.0001 HS

ns = non-significant at p value > 0.05, HS = Highly significant at p value ≤ 0.001

Table (3): Comparison between groups regarding fetal outcomes

Character		Group1 (Normal CRL)	Group 2 (Smaller than expected CRL)	Group 3 (Larger than expected CRL)	F ratio	P value
Gestational age at delivery in weeks	Mean	38.46±0.97	38.63±1.02	38.63±0.96	0.764	0.467 ns
	Range	37-40	37-40	37-40		
Actual weight in grams	Mean	3218.42±530.33	2948.68±487.03	3643.42±570.69	33.134	0.0003 HS
	Range	2200-4400	2100-4100	2300-4800		

ns= non-significant at p value >0.05 , HS = Highly significant at p value ≤ 0.001

Table (4): Comparison between groups regarding birth weight

Character			Group1 (Normal CRL)	Group 2 (Smaller than expected CRL)	Group 3 (Larger than expected CRL)	Chi square	P value
Birth weight	Normal (2500-4000 gm)	N	67	56	58	27.391	0.0001 HS
		%	88.2%	73.7%	76.3%		
	LBW (Less than 2500gm)	N	6	17	3		
		%	7.9%	22.4%	3.9%		
	Macrosomia (above 4000gm)	N	3	3	15		
		%	3.9%	3.9%	19.7%		

HS = Highly significant at p value ≤ 0.001

Table (5): Comparison between neonatal birth weight groups regarding Crown rump length in mm

	Actual birth weight			F ratio	P value
	Normal (2500-4000)	LBW (Less than 2500)	Macrosomia (Above 4000)		
Crown rump length in mm	53.60±8.32	49.04±8.81	55.57±7.23	4.338	0.014 S

s = significant at p value ≤ 0.05

Table (6): Correlation between Actual birth weight and first trimester Crown rump length

Items	Actual birth weight at delivery.	
	Pearson correlation coefficient (r)	P. value
1st trimester Crown rump length	0.288	0.0002

Correlation is significant at the 0.01 level

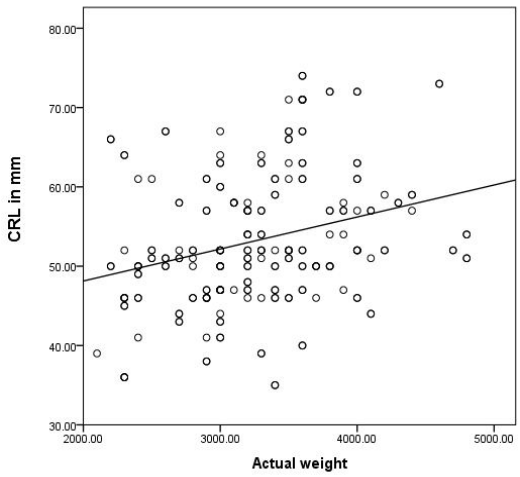

Fig (1): Linear correlation between Actual birth weight and first trimester Crown rump length and there is statistical positive correlation between Actual birth weight and first trimester Crown rump length

Discussion

Fetal growth impairment begins in the first trimester and could result in adverse pregnancy outcomes [4]. The present study was designed to investigate the association between first trimester CRL and birth weight. In the present study the mean age of the studied groups were 26.60±5.57 years, 26.45±5.53 years and 27.62±5.99 years for Group1 (Normal CRL), Group2 (Below expected CRL) and Group3 (Above expected CRL) respectively with no significant differences between the groups which is consistent with studies done by[5], where the mean age of the studied groups were 30.4 years with no statistically significant differences,[4]where the mean age of studied groups were 32.8 years with no significant differences ,[6]where the mean age were27.5 ± 6 yearswith no significant difference between groups. The present study is inconsistent with study done by[11], where the mean age showed statistically significant differences.

In this present study there are no significant differences between groups regarding history of abortion which is consistent with study done by [7] who found no significant differences between groups regarding history of therapeutic and spontaneous abortion. In the present study there was significant difference between groups regarding parity which are inconsistent with studies done by [8] and [9] where they concluded that there were no significant differences between groups regarding parity. In the present study the mean gestational age by LMP were 11 weeks+ 6.99 days ±3.75, 11 weeks+6.29 days ±3.96 and 11 weeks+5.95 days ±4.29 for Group1, Group 2 and Group3 respectively, there were no significant differences regarding gestational age by LMP. This is consistent with the study done by [9] where the mean GA for the groups was 12.2 weeks ± 0.60 with no significant difference, and inconsistent with the study done by [11] which showed significant difference between groups regarding gestational age (GA).

In the present study the mean gestational age by US were 11weeks+5.70 days±8.33, 11weeks+2.50 days±3.91 and 12 weeks+2.74 days±4.34 for Group1, Group2 and Group3 respectively, there were significant differences between groups regarding GA by US, the mean CRL were 52.89 mm, 45.60 mm and 58.28 mm for Group1, Group2 and Group3, respectively and there were statistically significant differences between groups regarding CRL. This is consistent with study done by [2] who found significant differences between groups regarding gestational ages (GA) by US and CRL. In the present study the mean gestational age at delivery for the three groups were 38.5 weeks and there was no significant difference regarding GA at delivery which is consistent with study done by[4]which showed no significant differences between groups regarding GA at delivery with the mean GA of 38weeks+4days and this inconsistent with the outcome of the study done by [2] where there were significant differences between groups regarding GA at delivery. Also, the present study is inconsistent with [9] study where there were significant differences between groups regarding GA at delivery.

In the present study the mean actual birth weight were (3218 gram), (2948 gram) and (3643 gram) for Group1, Group2 and Group3 respectively, there were highly statistically significant differences between groups regarding actual birth weight which are consistent with ([9] study that found significant differences between groups regarding birth weight. Also [11] found significance difference between groups regarding actual birth weight. In the present study the percentage of macrosomia was (9.2%) from all full-term delivery most of them were in Group3 (6.5%), low weight at birth (11.4%) most of this percentage is in Group 2 (7.4%) and normal weight was (79.3%) most of them in Group1 (29%) and there is a positive correlation between CRL and birth weight where p=0.228. This is consistent with study which was retrospective cohort study done on 521 pregnant womenby [9] and found positive correlation between CRL and birth weight, also observed that macrosomia babies were characterized by larger-than expected CRL measurements, the study done on pregnant women with singleton pregnancy at 11 to 14 weeks, they found about 9.6 % high birth weight, 7.3% low weight at birth and 83.1% normal weight. [10] Observed that significant greater difference between the measured and expected CRLs at 11 to 14 weeks' gestation led to severely macrosomia neonates (birth weight ≥97th percentile) compared with controls and concluded that severe macrosomia may manifest as early as 11 to 14 weeks' gestation which is consistent with the present study. The study was a case control study and included 120 neonates divided into 30 macrosomia baby and 90 normal weight neonates as a control group. [12] Study is consistent with the present study and found that crown-rump length of the fetus in the age between 10 to 13 weeks of pregnancy was associated with the birth weight. The effect

of size of the fetus in the first trimester on the duration of pregnancy responsible for mostly half of the association, and the second half of pregnancy was responsible for the other half of the growth. That study was inconsistent with our study in that it included 976 pregnant women who conceived by assisted reproductive technology not by spontaneous pregnancy to be sure about gestational age. [6] Had a prospective cross-sectional study, where CRL was measured in 544 healthy pregnant women undergoing ultrasound assessment at the age of 9 to 14 weeks of gestation. Weight at birth, mode of delivery and gestational age at delivery were studied for these cases. They found that Low (2500 g) and high (>4000 g) birth weights were correlated with the difference between actual and expected CRL expressed in days of gestation, but no correlation was found between the difference between actual and expected CRL and preterm delivery, low birth weight (P=0.005) and abortion (P=0.03) were also correlated with the difference between actual and expected CRL, this result is consistent with the present study but differs in the GA of CRL measurement. [1] who studied the embryonic growth rate at 7 weeks and 3 days in a prospective observational study, the study resulted in that there was a positive correlation between slow rate of growth in the first trimester and SGA. Smokers tend to have a smaller CRL at presentation compared to non-smokers. The sample size was 415 pregnant women. They calculate expected CRL according to LMP and exclude discrepancies of more than 7 days. They scanned pregnancies by transvaginal US. It depended on serial CRL measurements at least 2 times and this differs from the present study in its design. [13] Had a retrospective study on 8978 pregnant women which was consistent with the present study as it detected asignificant relationship between CRL z-scores and the incidence of SGA and low birth weight?

In another cross-sectional retrospective study by [14] also noted a significant correlation between the CRL z-scores and the birth weight z-scores in an assisted reproductive pregnancy population, the mean gestational age of their sample was 12 weeks and 5 days gestation.The study resulted in that CRL that was two to six days smaller than the expected was associated with an increased risk (as compared with a normal or larger-than-expected crown–rump length) of a birth weight below 2500 g. Also, CRL greater than expected by 2-6 days had greater incidence for macrosomia than other groups.

Another prospective cohort study which is consistent with the present study done by serial measurements of CRL from 9 to 13 weeks determined the relation between early embryonic growth and birth weight. It found a relation between growth in first trimester and birth weight [15].

Inconsistent with the present study,[16] study, there was no significant correlation between CRL discrepancy and birth weight discordance in both IVF and fertility treatment-conceived pregnancies. The study was on dichorionic twin pregnancy. Studying the discordance in CRL between twins and recording their birth weight. They divided the study sample into two groups. One fertilized spontaneously and the other had IVF. The reason for inconsistency of the findings andthe present study could be attributed to determining the precise gestational age per the time of intrauterine insemination (IUI) or IVF.

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