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Original Research Article

Fetal Umbilical Cord Circumference Measurement and Birth Weight

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ABSTRACT

Objective: To evaluate the relationship between umbilical cord circumference and birth weight.
Material and Methods: 50 singleton gravidae between 32 - 42 weeks admitted in labor and delivered within 12 - 24 hours were included. Pregnancies with structural anomalies were excluded. Ultrasound measurement of umbilical cord circumference was obtained from cross sectional three vessel view of a free loop. The relationship between umbilical cord circumference, birth weight and gestational age were analyzed using correlation and regression.
Setting: Department of Obstetrics and Gynecology, Al Sadr teaching hospital.
Results: There was no significant correlation between gestational age and umbilical cord circumference in the gestational range studied. Umbilical cord circumference correlated with birth weight, ($r = 0.8$, $P < 0.001$). A simple regression equation can be used to give an estimation of fetal weight.
Birth weight (gm) = $C^2 + 35$ C (mm)
Where C is the umbilical cord circumference.
Conclusion: Umbilical cord circumference, measured by ultrasound prior to delivery may be helpful in predicting birth weight.

Key words: Umbilical cord circumference, Birth weight.

INTRODUCTION

Fetal weight

The growth potential varies from race to race and from individual to individual. This is one reason for significant differences in birth weight among fetus of the same gestational age. [1]

Many factors affect fetal weight, but the principal known factors are weight, height, parity, race or ethnic group and the baby's sex.

The growth and maturation of the fetus in utero is divided into three periods: the prembryonic period begins with conception and ends on gestational day 14; the embryonic period encompasses gestational weeks 3 through 8; and there mainder of the pregnancy is known as the fetal period. Systems maturation essential to extra uterine survival begins during week 24 with the formation of pulmonary surfactant. Two critical events occur between weeks 26 and 29: the pulmonary vasculature becomes capable of gas exchange and the central nervous system becomes capable of controlling respiration. [2]

The fetus requires several substrates for normal growth like oxygen, glucose and aminoacids. Any persistent decrease in the availability of any of these substrates will limit the ability of the fetus to reach his or her growth potential. [1]

Most maternal diseases that affect fetal development probably do so by multiple mechanisms. Maternal disease can effect fetal development in the following

ways: 1.specific effects of metabolic end products or antibodies, 2.placental insufficiency, 3.maternal medications or toxic exposures, 4. infection, and 5.genetic disease. Well-studied maternal diseases that are prototypes for the above- mechanisms of fetal disease include: diabetes mellitus, hypothyroidism, Grave's disease, systemic lupus erythematosus. [(3)]

Abnormalities of the umbilical cord, like single umbilical artery and velamentous cord insertion are associated with fetal growth restriction. [(4)]

Birth weight is an important predictor of neonatal problems, since infants who deviate from physiologic norms of weight for gestational age have increased perinatal or neonatal mortality. [(5)]

An accurate prediction of birth weight can prepare the labor suite staff for a fetus with growth retardation who may develop distress or a macrocosmic infant who may experience shoulder dystocia or permit the avoidance of vaginal delivery of pregnancies in which labor would most likely be arrested because of true fetal pelvic disproportion. [(4)]

In breech presentation estimation of weight is of considerable importance in helping to determine the mode of delivery. Also decisions to induce labor before term in complicated pregnancies are to a certain extent influenced by assessment of fetal size. [(6)]

No method of checking fetal size before delivery can provide more than an estimation of fetal weight. The clinical estimate is often inaccurate because of variance of amniotic fluid, maternal obesity or uterine abnormalities. [(7)]

Ultrasound examination being a painless, non invasive inexpressive and apparently harmless technique, provide a more accurate way to determine fetal size, but even the best ultrasonic measurement are not 100% reliable, unlike weighing the baby on a scale after birth. [(8)]

Estimation of fetal weight with Ultrasound were based on measurements of individual parameters such as the biparietal diameter (BPD), head circumferences, abdominal circumference and femur length. [(6)] The equation which were used at first to give the estimate of fetal weight were complex like the equation:

Log 10 weight = 1.335 — 0.0034 AC x FL + 0.0316 x BPD + 0.0457 x AC+ 0.11623 xFL

Bruce and McCallum[cm] by using only one variable which is the sum of BPD, AC and FL in a simple equation were able to predict fetal weight.

The equation as follows: BW = 0.143 X + 4.198

Where X is the sum of BPD, AC and FL.

In our study we tried to see if there is any relation between umbilical cord circumference and birth weight, and if we can depend on the umbilical cord circumference for the estimation of fetal weight.

MATERIALS AND METHODS

A prospective study of 50 singleton gravidae was done at Al Sadr teaching hospital from May 1st to December 1st 2014. All pregnant women in labor who fulfilled the inclusion criteria presented to the department of Obstetrics and Gynecology on Sunday, Monday and Tuesday were included. The antenatal records, for each patient, were reviewed to exclude any obstetrical or medical complication. All 50 gravidae were normotensive, Rh +ve and had normal uncomplicated pregnancies. Evident structural abnormalities were excluded by midtrimester ultrasound. Pregnant women with abnormal glucose tolerance and those with personal or family history of deliveries of abnormal babies were excluded from the study.

All 50 pregnant women were diagnosed to be in early labor as judged from assessment of uterine contractions and pelvic examination.14 pregnant women were primigravidae and the rest were multgravidae. Their ages were ranged from 18-39 years. The gestational age ranged from 32-42 weeks as obtained

from the known last menstrual period and an early ultrasound. Transabdominal ultrasound examination was performed to each woman using real- time ultrasound scanner (Siemens, Sonoline versa pro) with 3.5 MHZ transducer. After taking measurement for BPD and FL, umbilical cord circumference was obtained from a cross sectional three vessel view of a free loop. Freeze frame image was used to facilitate measurements by using the built-in electronic calipers (circle or ellipse), three measurements were taken and an average was recorded in millimeters. Umbilical cord abnormalities like velamentous insertion, single umbilical artery, stricture, torsion, true knot and nuchal cord were excluded. Pregnant women discovered to have oligohydramnios during the ultrasonic examination were also excluded because of difficulty in obtaining accurate measurements.

All the pregnant women delivered within 12-24 hours in the same hospital after their admission. 13 pregnant women underwent cesarean section for fetal distress, failure of progress or abnormal presentation. The remaining 37 women delivered vaginally. After delivery the umbilical cord circumference was not measured because in our study the three vessels (The two umbilical arteries, the umbilical vein) were taken to obtain the cord circumference without including the Wharton's jelly.

The sex of each baby was recorded in addition to the birth weight which was measured using a digital baby scale, none of the neonates had a visible congenital anomaly. Relationship between umbilical cord circumference with birth weight and gestational age was analyzed using correlation and regression analysis. Student t-test was used to assess statistical significance, which was defied as a P value < 0.05.

RESULT

For the 50 pregnant women included in the study, measurement of umbilical cord circumference by ultrasound showed a mean of 42.60 ± 3.18 mm, a median of 43 mm with the lower value of umbilical cord circumference of 35 mm and the upper value of umbilical cord circumference of 35 mm and the upper value of 50 mm (Table 1).

Table 1: Umbilical Cord Circumference (U.C.C.) Measurements of the Total Sample Included in the Study

Sample Size	50 50
Mean U.C.C.	42.60 mm
Range	35-50 mm
SD	±3.18 mm
Median	43 mm

Tables 2 show a comparison between female and male umbilical cord circumference. The mean umbilical cord circumference for females was slightly lower (42.31 ± 2.53 mm) than that for males (43.11 ± 4.12 mm).

According to these results, there was no significant sex difference
In umbilical cord circumference in the study group. (P. >0.05).

Table 2: U.C.C. Measurements of both sexes Included in the Study

	Female	Male
Sample Size	32 mm	18 mm
Mean U.C.C.	42.31 mm	43.11 mm
Range	35-46 mm	36-50 mm
SD	± 2.53 mm	± 4.12 mm
T	0.851	
P	0.399	

Regarding birth weight measurements for the total sample, the results showed a mean of (3333 ± 349.74 gm) and a range of 2400-4600 gm. (Table - 3).

Table 3: Birth Weight Measurements of the Total Sample Included in the Study.

Mean Birth Weight	3333 gm
Range	2400-4600 gm
Median	3300 gm
SD	± 349.73 gm

Table 4 shows a comparison between females and males birth weight. The mean birth weight for males (3436.1 ± 475.2 gm) was higher than that of females (3275 ± 244.6 gm). There was no statistical difference between the two . (P > 0.05).

Table 4: Birth Weight Measurements of Both Sexes Included in the Study .

	Female	Male
Mean Birth Weight	3275 om	3436.1 gm
Range	2600-3800 gm	2400-4600 gm
Median	3300 gm	3450 gm
SD	± 244.6 gm	± 475.2 gm
T	1.588	
P	0.199	

Studying the relationship between umbilical cord circumference and birth weight for the total sample using polynomial correlation shows thatthe umbilical cord circumference had a significant relation with birth weight. ($r = 0.8$, $P < 0.001$) in the gestational range studied. (Fig. **1).**

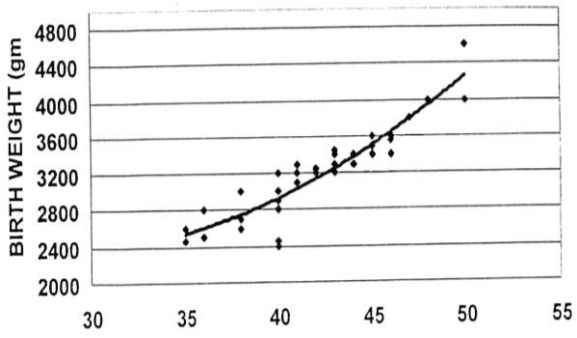
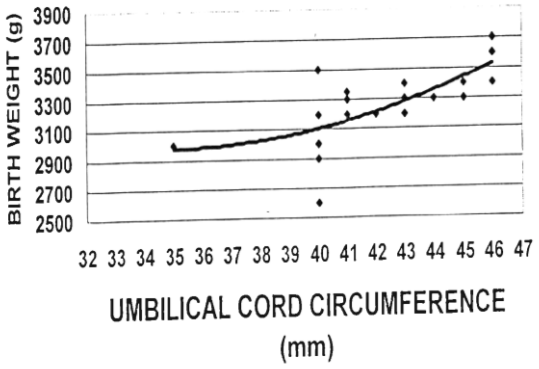


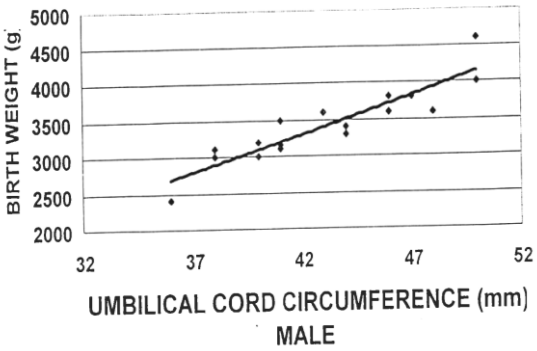
Figure (1): The relation between umbilical cord circumference and birth weight.

There was also a significant correlation between umbilical cord circumference and birth weight for each sex as shown in (Fig. 2) for females ($r = 0.63$, $P < 0.01$) and (Fig. 3) for males ($r = 0.9$, $P < 0.001$).



UMBILICAL CORD CIRCUMFERENCE (mm)

Figure (2): The relation between umbilical cord circumference and birth weight in female



MALE

Figure (3): The relation between umbilical cord circumference and birth weight in male.

From this relation one can verify an equation that can be used to predict the approximate fetal weight for a given umbilical cord circumference measured ultrasonically, and this equation is as follows :

Birth weight (gm) = C^2 + 35 C

Where C is the umbilical cord circumference in millimeters.

Studying the relation between umbilical cord circumference and gestational age, the study shows that no significant correlation exist between them. ($r=0.2$, $P>0.05$) (Fig4).

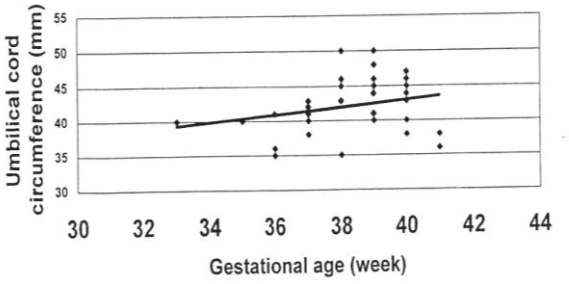


Figure (4) : The relation between umbilical cord circumference and gestational age.

Figure (4): The relation between umbilical cord circumference and gestational age.

Table 5 shows the actual and estimated birth weight calculated by using the suggested formula for both sexes with the results showing no significant difference of actual and estimated birth weight for both sexes according to each umbilical cord circumference measurement. **P** >0.05

Table —5 : The relation between umbilical cord circumference (u.c.c) and mean actual and estimated birth weight for both females and males*.

u.c.c	No.	+		>	
		Actual birth weight	Estimated birth weight	Actual birth weight	Estimated birth weight
35-36	2	2750	2800	2400	2550
37-38	"")	-	-	3050	3010
39-40	11	2900	3100	3100	3114
41-42	8	3200	3200	3250	3200
43-44	12	3350	3300	3400	3450
45-46	11	3500	3450	3700	3700
47-48	2	-	-	3700	3850
50	2	-	-	4200	4000

DISCUSSION

The four ultrasound measurements which are most frequently used to estimate fetal weight are head circumference (HC), Biparietal diameter (BPD), abdominal circumference (AC) and femur length (FL).

Two to four of these measurements are entered into various mathematical formulae that are used to calculate estimated fetal weight. Campbell and Wilkins [(9)] by using AC and BPD in certain regression equation, were able to predict fetal weight. Their equation was complex one, and some investigators, by adding (FL) in another equation, were able to decrease the errors that have been found in the previous equation by 70% .

Bruce and McCallum [(10)] by using only one variable in a simple equation were able to predict fetal weight. They have found that the estimates are within 10% of birth weight 75% of the time.

The equation is:
BW = 0.143x + 4.198
Where x is the sum of BPD, AC and FL

Some investigators have found a significant correlation between fetal thigh soft tissue thickness (FTSTT) and neonatal birth weight (r = 0.8601). They concluded that ultrasound measurement of FTSTT is a simple, accurate and valuable index in the estimation of fetal weight. They have found also that FTSTT correlated with gestational age (r =0.7). [(11)]

Thigh volume measurement using three-cross sectional images of femur by three-dimensional ultrasound was found by others to be a simple way and had better accuracy than Two-dimensional ultrasound for predicting fetal weight during the Third trimester of pregnancy. [(12)] Other investigators have found high resolution magnetic resonance imaging to be an accurate way in determining fetal volume and better than conventional ultrasound-based technique in estimating fetal weight. [(13)] Zlatnik M. et al. [(14)] found that cord circumference correlated withbirth weight, and that cord circumference was predictive of birth weight4250 gin. as well as 4500 gm. Sensitivity and specificity of a circumference 5 cm were, respectively, 100% and 71 % for predicting birth weight > 4250 gm and 100% and 68% for predicting birth weight4500 gm. In the present study, as there was a significant correlation between umbilical cord circumference and birth weight in the gestational age range that have been studied, a simple regression equation can be used be used to predict fetal weight, by using this equation 75% of the actual weight are within ± 150 gm. of the estimated weights. The equation as follows
Birth weight (gm) = C^2 + 3

By using this suggested formula there was no significant difference of actual and estimated birth weight for both sexes according to each umbilical cord circumference measurement. No relation was found between the cord circumference and the gestational age in the gestational age range studied. This result is comparable to what had been verified by Zlantnik M. et al. [(14)]

CONCLUSION

Umbilical cord circumference measured by ultrasound prior to delivery may be helpful in predicting birth weight. Combining this measurement with other data may improve detection of birth weight.

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