ORIGINAL ARTICLE

Sonographic Estimation of Gestational Age by Umbilical Cord Diameter and its Relationship with Bi-Parietal Diameter and Femur Length in Second and Third Trimester in Lahore, Pakistan

ZUNAIRA SARWAR, SYED AMIR GILANI, ROMANA LATIF*, *FAISAL NADEEM KHAN, NAWAZ ANJUM*

ABSTRACT

Background: Umbilical cord is an intra-amniotic structure through which fetus is connected to the placenta. Accurate estimation of gestational age of fetus is very important for obstetricians and radiologists. Ultrasound is primary imaging modality used by which we can accurately determine or predict the age of fetus. In this study umbilical cord diameter of fetus in 2nd and 3rd trimester is noted, BPD & FL are also noted and the findings are then related with each other.

Aim: To estimate the gestational age measured by Umbilical cord diameter and its relationship with bi-parietal diameter and femur length in second and third trimester by ultrasound.

Methodology: A cross-sectional study of 384 pregnant females was conducted in their 2nd and 3rd trimester by using simple random sampling technique. This study was done in Radiology Department of Shalamar Hospital Lahore, Pakistan. MINDRAY Ultrasound machine was used with 3.5 MHz convex transducer.

Results: The results of study showed that a significant correlation is observed between umbilical cord diameter and gestational age measured by BPD and FL in 2nd and 3rd trimester of pregnancy. Correlation coefficient measured by umbilical cord diameter & gestational age measured by BPD & FL are 0.953 and 0.953 respectively.

Conclusions: Umbilical cord diameter is a useful parameter for estimation of gestational age. Gestational age measured by BPD and FL in 2nd and 3rd trimester is related to umbilical cord diameter.

Keywords: Gestational age, 2nd trimester, 3rd trimester. Umbilical cord diameter

INTRODUCTION

The umbilical cord is a tubular structure which is helical in appearance by which fetus is connected to the placenta. It is fully developed in 12th week of intra-uterine life[1]. It normally contains one umbilical vein and two umbilical arteries. These vessels are contained in a meshwork of mucopolysaccharides known as Wharton's jelly[2]. In routine obstetric ultrasounds, focus is mostly on identification of how many vessels are present in umbilical cord, either there are two vessels or three vessels and its site of insertion at placenta and fetus[3]. The development of umbilical cord starts between 4th to 8th week of gestation. This rudimentary umbilical cord develops from body stalk[4]. Blood flow starts within umbilical cord at the end of 5th week[5]. The estimation of gestational age by ultrasound is based on the relationship between fetal age and size[6]. The average length of umbilical cord is 50 to 60 cm. Range of normal cord length is between 30 to 100 cm. Studies say that the crown-rump length is approximately equal to length of umbilical cord of the fetus in first trimester[7]. Cords less than 30 cm are termed as short cords and cords more than 100 cm long are termed as long cords. Excessively long cords are associated with major problems such as prolapse of cord, entanglement of cord, cord around neck, fetal distress and fetal demise[8]. On the contrary excessively short cords are associated with problems of delayed descent of fetus, premature separation of placenta, IUGR babies, congenital abnormalities, fetal distress and demise[9]. Umbilical cord is twisted like a coil. This coiling is due to movement of the baby. This coiling pattern is established in 9th week and this pattern is in a counterclockwise direction. The approximate flow of blood by umbilical cord is around 35 ml per min at the end of 20th week and 240 ml per min at 40 week. Umbilical cord in adult life is commonly known as belly button. This is an entry point for umbilical cord in fetal life. Placenta is a highly vascular structure which is attached to the uterine wall, which is further connected to the maternal blood supply. From umbilical cord, blood and nutrients can be exchanged between mother and fetus[13]. After entering into the fetus the umbilical cord is divided into two branches, one branch joins the portal vein in the liver and other branch which is also known as ductus venosus is connected to the heart through Inferior Vena Cava. Ductus venosus in adult life is known as ligamentum venosum. The umbilical cord carries oxygenated blood and nutrients from mother to the fetus through placenta. Umbilical cord is attached to the fetal abdomen where navel forms. It is also used for transfer of deoxygenated blood & wastes from fetus back towards placenta. At the time of birth, umbilical cord is cut close to the baby's body. Accurate estimation of gestational age of fetus is very important for obstetricians and radiologists. Because it can affect care and can help in deciding when is the accurate time for delivering the baby. Accurate estimation of gestational age is very important because prematurity and post maturity can result in increased risk of perinatal mortality and morbidity. Approximate duration of gestation is about 40 weeks which are 280 days. Initially gestational age was calculated from the first day of last menstrual period (LMP) in a regular 28 day menstrual cycle. But this method is not reliable for those women who are unsure of dates and for those women whose cycle is not regular. In first trimester

Radiology Department of Shalamar Hospital Lahore
**Department of Obstetrics & Gynaecology, Social Security Hospital, Lahore*
Correspondence to Dr. Zunaira Sarwar,
Email: umc195@gmail.com cell: 0307-4012222

gestational age was calculated from crown-rump length. The length of the umbilical cord is approximately equal to the crown-rump length of the fetus throughout pregnancy. As pregnancy advances, gestational age can be calculated by measuring different parameters of fetus i.e. bi-parietal diameter (BPD), femur length (FL), head circumference (HC) and abdominal circumferences. BPD is not a reliable indicator for estimation of gestational age in third trimester as BPD is affected by shape and size of head.[21] Similarly FL is unreliable for estimation of gestational age in later stage of pregnancy because in some cases, femur appear foreshortened and therefore may not give accurate estimation of gestational age. There is another parameter which is used for assessment of gestational age and that parameter is measurement of umbilical cord size.

METHODOLOGY

Analytical cross-sectional study was done in pregnant patients in their 2nd and 3rd trimester by using simple random sampling technique. Questionnaire was used to collect the data from 384 pregnant patients in their 2nd and 3rd trimester. This study was conducted in Shalamar hospital, Lahore. BPD, FL and UCD were measured. Gestational age was calculated from BPD and FL. The findings were then related with UCD. Pregnant patients in 2nd and 3rd trimester, patients with single gestation and with normal umbilical cord were included in the study. Total time duration for the study was 9 months. After collecting data, it was analyzed through SPSS version 21.0. Descriptive statistics (mean, standard deviation and maximum, minimum) were used to analyze variables i.e., BPD, FL, UCD. Regression was observed between variables.

RESULTS

Mean gestational age of 384 patients calculated from BPD in their 2nd and 3rd trimester was 177.92 ± 51.82 as shown below in table 1

Table 1:

	Mean	Std. Deviation	N
BPD age in days	177.92	51.820	384
UCD	11.6374	3.50747	384

Mean gestational age of 384 patients calculated from FL in their 2nd and 3rd trimester was 177.32 ± 51.56 as shown below in table2

Table 2:

	Mean	Std. Deviation	N
FL age in days	177.32	51.563	384
UCD	11.6374	3.50747	384

The mean umbilical cord diameter of 384 patients included in the study in 2nd and 3rd trimester was 11.63 ± 3.50 as shown below in table 3.

Table 3:

	Mean	Std. Deviation	N
UCD	11.6375	3.50747	384
Valid N (list wise)			384

A regression model is observed between umbilical cord diameter and gestational age measured by FL in 2nd and 3rd trimester. This model 95% clearly depicts the explained variation in dependent variable. The results can be predicted by the following equation

$Y = \alpha + \beta (x)$

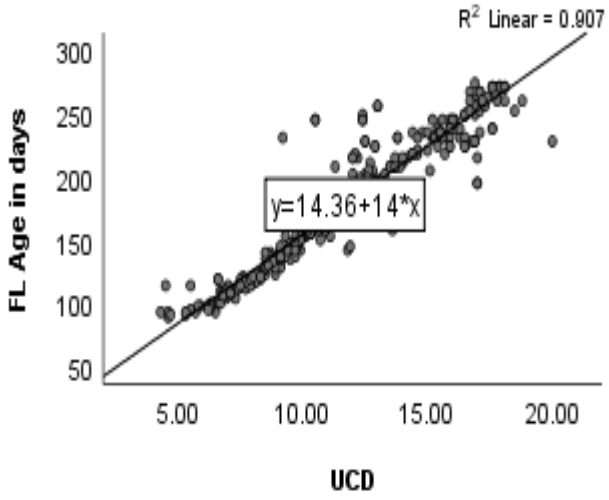
GA /FL = 14.359 + 14.003 (UCD)

Table 4: Coefficients[a]

		Model 1	
		Constant	UCD
Unstandardized coefficients	B	14.359	14.003
	Std. Error	2.783	.299
Standardized Coefficients	Beta		.953
Sig.		.000	.000
95.0% Confidence interval for B	Lower Bound	8.888	13.553
	Upper bound	19.830	14.453

a. Dependent Variable: FL age in days

Fig. 1:



The above mentioned equation shows that gestational age estimated by FL can be related with umbilical cord diameter. Umbilical cord diameter can significantly predict gestational age just like FL. It also shows that if there is one unit increase in umbilical cord diameter, the gestational age increases by 14. A regression model is observed between umbilical cord diameter and gestational age measured by BPD in 2nd and 3rd trimester. This model 95% clearly depicts the explained variation in dependent variable. The results can be predicted by the following equation

$Y = \alpha + \beta (x)$

GA /BPD = 14.088 + 14.078 (UCD)

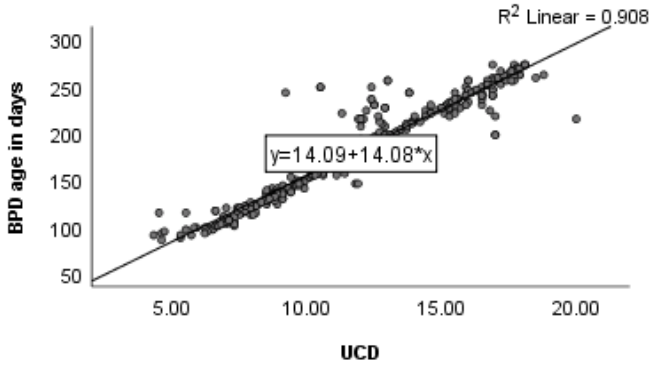
The above mentioned equation shows that gestational age estimated by BPD can be related with umbilical cord diameter. Umbilical cord diameter can significantly predict gestational age just like BPD. It also shows that if there is one unit increase in umbilical cord diameter, the gestational age increases by 14.

Table 5: Coefficients[a]

		Model 1	
		Constant	UCD
Unstandardized Coefficients	B	14.088	14.078
	Std. Error	2.786	.299
Standardized Coefficients	Beta		.953
t		5.056	61.402
Sig.		.000	.000
95.0% confidence interval for B	Lower Bound	8.609	13.627
	Upper Bound	19.567	14.529

a. Dependent Variable: BPD age in days

Fig. 2:



DISCUSSION

Accurate knowledge of gestational age is very important for obstetricians, as the decision of when the baby should be delivered is based on this. The well-known parameters for estimation of gestational age of fetus are crown-rump length (CRL) in first trimester and femur length (FL), bi-parietal diameter (BPD), abdominal circumference (AC), head circumference (HC) in 2nd and 3rd trimester. In this study we introduce a new parameter for gestational age estimation which is umbilical cord diameter (UCD). Gestational age is calculated from BPD and FL from ultrasound machine using Hadlock formula for gestational age estimation. Ultrasound machine cannot calculate gestational age from umbilical cord diameter.[24]The readings of umbilical cord diameter are related with readings of BPD and FL. It was found that relation was statistically significant between umbilical cord diameter and gestational age measured by BPD and it was found that there was a directly proportional linear relationship between umbilical cord diameter and gestational age measured by BPD depicted by following equation:

GA /BPD = 14.088 + 14.078 (UCD)

And the correlation coefficient r = 0.953

There was also found statistically significant relation between umbilical cord diameter and gestational age measured by FL and there is directly proportional linear relationship between umbilical cord diameter and gestational age measured by FL depicted by following equation:

GA /FL = 14.359 + 14.003 (UCD)

And the correlation coefficient r = 0.953

These equations can be used to estimate gestational age instead of BPD and FL in 2nd and 3rd trimester. In 2014, Elsafi Ahmed Abdalla et al found that there is a statistically significant relation between umbilical cord depth, width and gestational age and there is also unsubstantial relation between umbilical cord diameter and maternal age. This study showed that gestational age estimated by BPD is accurate between 12 and 26 weeks and age estimated by FL is accurate between 14 weeks and term. Whereas in my study gestational age measured by BPD and FL is accurate throughout 2nd and 3rd trimester of pregnancy. In 2014, Ezu et al found that there is a significant correlation between umbilical cord diameter and other parameters of fetus for fetal gestational age estimation. Umbilical cord grows at the rate of 1 mm / week. Whereas in my study when there is one unit increase in umbilical cord diameter, gestational age increases by 14.

CONCLUSION

It was concluded from the study that umbilical cord diameter is a useful parameter for estimation of gestational age. Gestational age measured by BPD and FL in 2nd and 3rd trimester is related to umbilical cord diameter. Gestational age measured by BPD and FL is almost approximately accurate and can be used to predict age estimated by UCD in normal single intrauterine pregnancy. The study showed that if there is one unit increase in umbilical cord diameter, gestational age increases by 14.

REFERENCES

1. A-T, Papageorghiou, B. Kemp, W.Stones ,E.O. Ohuma. Ultrasound-based gestational –age estimation in late pregnancy.Ultrasound in Obstetrics and Gynecology published by John Wiley and Sons Ltd 2016;48:719-726.
2. Monojit Chakrabarti, Supriya De Ray, Dibyendu Roy, Raj Mohan Ghosh, Arup Agarwal.Correlation of Umbilical Cord Thickness with Fetal Birth Weight- A Prospective Study in Rural Bengal. Journal of Evolution of Medical and Dental Sciences.2015;4(76):13170-13173
3. Morteza Tahmasebi,Reza Alighanbari.Evaluation of umbilical cord thickness,cross-sectional area,and coiling index as predictors of pregnancy outcome. Indian Journal of Radiology and Imaging.2011;21(3):195-198
4. C.Barbieri, J.G Cecatti,F.G.Surita E.F.Marussi and J.V.Costa. Sonographic measurement of the umbilical cord area and the diameters of its vessels during pregnancy.Journal of Obstetrics and Gynaecology.2012;32:230-236
5. Cristiane Barbieri, Jose G Cecatti, Fernanda G Surita, Maria L Costa,. Area of Wharton's jelly as an estimate of the thickness of the umbilical cord and its relationship with estimated fetal weight. Reprod Health. 2011; 8: 32.
6. Mukta Mital, Prashant Gupta, Vineet Nanda. “Fetal Gestational Age Estimation by Fetal Foot Length Measurement and Fetal Femur to Foot Length Ratio in Indian population- A Prospective study”. Journal of Evolution of Medical and Dental Sciences 2014; 3(10) 2620-2625.
7. Elsafi Ahmed Abdalla,Caroline Edward Ayad,Farida Ahmed Eisa. Estimation of fetal age sonographically using umbilical cord diameter in second and third trimester.American journal of health Research. 2014.68-72.
8. Eze CU, Ugwuja MC, Eze CU,Agwuna KK,Ugwu GO. Relationship between sonographic umbilical cord size and gestational age among pregnant women in Enugu, Nigeria.African health sciences.2014:14(2)
9. Susmita Senapati, Shashi Shankar Behera, Prafulla Kumar Chinara. Relationship of Umbilical Cord Size with Gestational Age: A Sonographic Study. Paripex - Indian Journal of Research. 2016; 5(4): 43