

Estimation of Fetal Age in Relation to Parity by Sonographic Assessment of Umbilical Cord Diameter.

Swagata Bhattacharya¹, Debabrata Maity², Anirban Sadhu³, Senjuti Khanra⁴

¹Senior Resident (Anatomy), I.P.G.M.E.R., Kolkata, West Bengal, India.

²Post Doctorate Trainee in Plastic and Reconstructive Surgery, R.G.Kar Medical College and Hospital, West Bengal, India.

³Associate Professor, Department of Anatomy, R.G.Kar Medical College and Hospital, West Bengal, India.

⁴Assistant Professor, Institute of Engineering and Management, Kolkata, West Bengal, India.

Received: September 2018

Accepted: September 2018

Copyright: © the author(s), publisher. It is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The Sonographic cross sectional study was to determine the curve for umbilical cord diameter with respect to fetal age in primi and multi gravida separately. **Methods:** 100 uneventful pregnancies of second and third trimester were studied. SPSS, v17, IBM, Chicago, were used for statistical analysis and polynomial regression equations were calculated. **Results:** The regression equation of umbilical cord diameter to Gestational Age : $y = -0.018x^2 + 1.290x - 9.418$ ($R^2 = 0.585$) in primigravida . For multigravida cord diameter to Gestational Age : $-6.020 + 0.990x - 0.012x^2$ ($R^2 = 0.613$) , where x is fetal age in weeks , y is cord diameter in millimetres. **Conclusion:** The diameter increased significantly with fetal age upto 32 weeks, thereafter a plateau was seen.

Keywords: Gestational age, Parity, Umbilical cord.

INTRODUCTION

The umbilical cord forms the connecting stalk between the fetus and placenta. It extends from the fetal umbilicus to the fetal surface of the placenta. Fetal blood flows to and from the placenta through this. Evaluation of post partum umbilical cord has been performed for many years. With ultrasonographic studies we are now able to study it intra partum. The decreased thickness of umbilical cord has been associated with adverse pregnancy outcome. Significant differences were also observed in mean gestational age, mode of delivery, birth weight also with umbilical cord thickness. Measurement of the diameter may reveal risk of antenatal and prenatal complications. We have simply tried here to show the umbilical cord diameters and their relationship to that of fetal age in uneventful pregnancies of primi and multigravida in a part of West Bengal, India. Our objective was to find if there is any relationship between umbilical cord diameter to gestational age separately for primi and multigravida.

Name & Address of Corresponding Author

Dr. Debabrata Maity
Post Doctorate Trainee in Plastic and
Reconstructive Surgery,
R.G.Kar Medical College and Hospital,
West Bengal, India.

MATERIALS AND METHODS

Prior to initiation, the mothers fulfilling the inclusion criteria were provided with information and nature of study. The women who agreed to participate signed an informed consent.

The cross sectional study was carried out in a private clinic in West Bengal, between February 2016 to July 2016, in a total of 100 pregnant women, who had referred to this clinic for a routine ultrasonographic scan at different gestational ages of an uneventful pregnancy.

Inclusion criteria

Comprised of a single pregnancy, living fetus, gestational age previously established according to the date of last menstrual period when reliable or according to an ultrasonic scan performed in the 1st trimester, intact membranes, normal amniotic fluid index and no maternal illness like lupus, nephropathy or previously pregnancies with IUGR, and macrosomia.

Exclusion criteria

Comprised of maternal diabetes mellitus, arterial hypertension of any etiology, fetal malformations oligohydramnios or polyhydramnios, fetuses with signs of intra uterine growth retardation or small for gestational age or large for gestational age or signs of fetal macrosomia and morphological abnormalities of umbilical cord.

The examinations were performed using two ultrasonographic machines – DC-7 MINDRAY-Color Doppler MX-4C006581 and DC-7 MINDRAY-Color Doppler MX-13001826 , using 3.5 MHZ transducer.

All the mothers of more than fourteen weeks of gestation, the diameter of umbilical cord were measured within a maximum distance of 2.0 cm ,adjacent to its insertion in the fetal abdominal wall .The diameter of the cord was measured in a free loop of cord adjacent to its insertion into the fetal abdominal wall, placing the markers at its outer borders and with maximum image magnification ,along its longitudinal axis, like the technique described by Ghezzi et al.^[14]

In addition to other parameters routinely seen in pregnancies, the fetal age was measured according to biparietal diameter, abdominal circumferences and the length of femur.

Statistical analysis

The data was collected in predesigned Microsoft Office 2007 Excel worksheet, Washington. The data were compared between primigravida and multigravida pregnant women attending in a private clinic in West Bengal in single cross-sectional study using SPSS, v17, IBM, Chicago. The independent continuous variable was fetal age in weeks. The dependent variables was umbilical cord diameter (mm) .

Sample size: Determination for regression analysis study.

Literature search was done on articles pertaining to regression analysis between fetal growth and umbilical cord structures parameters. Using sample size calculation statistical software G*Power 3.1.9.2, with α error probability 0.05 power (1- β) 0.95 and effect size f^2 – 0.15 (medium), the sample size to test the regression analysis between fetal age in weeks and umbilical cord diameter in mm for primigravida and multigravida patients would stand for 89 in each arm.

Regression analysis modeling

Based on available literature review on regression analysis, polynomial regression analysis was used to develop a quadratic equation for predicting relationship between dependent and independent variables separately for primigravida and multigravida women. The relevant data were first analyzed using “explore data” and creating “scatter plots” to check for linearity. Accordingly polynomial regression analysis using default method “Enter” was used. P value < 0.05 was taken as significant test.

RESULTS

The tables show a mild increase in all parameters in group B(multigravida) than in group A (primigravida) but, excepting mothers age, the values are not significant.

Table 1: Mother’s Statistics

| | Group | N | Mean | Std. Deviation | Std. Error Mean | P VALUE* |
|-------------------|-------|----|---------|----------------|-----------------|----------|
| Mother_age years | A | 54 | 20.96 | 3.047 | 0.415 | <0.001 |
| | B | 46 | 24.91 | 4.082 | 0.602 | |
| Mother_weight kgs | A | 54 | 52.8519 | 5.85165 | 0.79631 | 0.159 |
| | B | 46 | 54.8478 | 8.17847 | 1.20585 | |

Table 2: Fetal Statistics

| | Group | N | Mean | Std. Deviation | Std. Error Mean | P VALUE* |
|----------|-------|----|---------|----------------|-----------------|----------|
| B.P.D cm | A | 54 | 27.1296 | 7.46829 | 1.01631 | 0.373 |
| | B | 46 | 28.4130 | 6.75796 | 0.99641 | |
| A.C cm | A | 54 | 26.8148 | 7.36405 | 1.00212 | 0.422 |
| | B | 46 | 27.9348 | 6.36100 | 0.93788 | |
| F.L cm | A | 54 | 26.9815 | 7.36255 | 1.00192 | 0.552 |
| | B | 46 | 27.8261 | 6.66768 | 0.98310 | |

Table 3: Fetal age and umbilical cord diameters

| | Group | N | Mean | Std. Deviation | Std. Error Mean | P VALUE* |
|-----------------------|-------|----|---------|----------------|-----------------|----------|
| Fetal_age_wks | A | 54 | 27.2407 | 7.74337 | 1.05374 | 0.524 |
| | B | 46 | 28.1739 | 6.67101 | 0.98359 | |
| Umbilical_diameter_mm | A | 54 | 10.7111 | 2.71791 | 0.36986 | 0.070 |
| | B | 46 | 11.7065 | 2.68919 | 0.39650 | |

Regression model results description

For A subset of individuals, y (umbilical cord diameter mm)= -9.418+ 1.290 x – 0.018 x², where x is fetal age in weeks (R² 0.585, p value <0.001). Likewise for B subset of individuals, y (umbilical cord diameter mm)= -6.020 + 0.990 x – 0.012 x², where x is fetal age in weeks (R² 0.613, p value <0.001). [Figure 1]

The figures show the curve lines of the values of the umbilical cord diameter, [Figure 1] according to gestational age in primigravida (A) and multigravida (B).

In general, it may be said that the values increase consistently and uniformly until 33 weeks in primigravida, after which they attend a plateau in case of diameter. In multigravida ,it may be said in

general the diameter increases with fetal age till 35 weeks thereafter it attends a steady state.

Polynomial (quadratic) regression analysis was done to develop equations for establishing relationships among umbilical cord diameter and fetal age parameters separately for primigravida and multigravida pregnant women.

Umbilical Cord Diameter Graphs

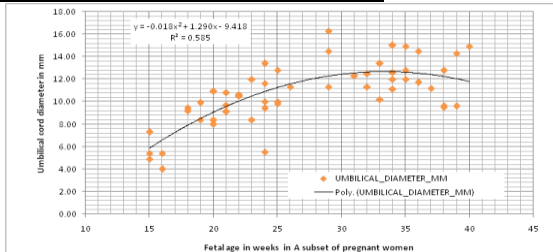


Figure 1: For A subset of individuals, y (umbilical cord diameter mm) = $-9.418 + 1.290x - 0.018x^2$, where x is fetal age in weeks (R^2 0.585, p value <0.001).

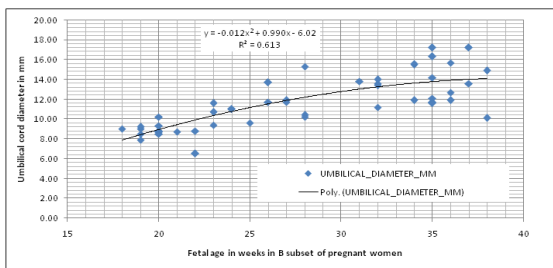


Figure 2: For B subset of individuals, y (umbilical cord diameter mm) = $-6.020 + 0.990x - 0.012x^2$, where x is fetal age in weeks (R^2 0.613, p value <0.001).



Figure 3: Measurement of umbilical cord diameter with color Doppler.



Figure 4: Measurement of umbilical cord without color Doppler.

DISCUSSION

Thin cords are related to complications in outcome of pregnancies or low birth weight for quite a long time and were also described in literature by Raio et al.^[8] With the advent of sonography initially umbilical cord of early pregnancies were studied. Weissman et al,^[5] reported maximum cord diameter to be around at 38 weeks, later than those of our studies. Though it also depicted a correlation. Studies by Predanic et al,^[15] supported that of Raio et al.^[7]

In our present our study we have the umbilical cord diameter increasing with gestational age upto 33 weeks then becoming plateau like upto 35 weeks. The reason may be upto 33 weeks there was rapid increase in growth of fetus after that rate of increase in fetal size fell gradually reaching a plateau upto 35 weeks. After which we observed a decline in the diameter may be due to change in shape or compromise in fetal circulation & starting switch over of circulation.

There has been mild increase in mean parameters in multigravida and also attending a plateau stage at a later gestational age than that of a primigravida. A bigger passage of birth for the baby may be the probable reason. Though no positive linear relationship was found between umbilical cord parameters to that of parity, existence of which would complicate the scenario.

Limitations of the study being observer bias, small period of study, small sample size.

CONCLUSION

Umbilical cord diameter and cross-section area help to predict the gestational age correctly in cases of difficulty in measuring BPD, HC, AC, FL, like anencephaly, hydrocephalus, achondroplasia, small for age fetus. The increase in cord diameter attends a plateau at a later gestational age in multigravida than primigravida.

REFERENCES

1. FitzGerald DE, Drumm JE. Non-invasive measurement of human fetal circulation using ultrasound: a new method. BrMed J1977;2:1450-1451.
2. Trudinger BJ, Giles WB, Cook CM, Bombardieri J, Collins L. Fetal umbilical artery flow velocity waveforms and placental resistance: clinical significance. Br J Obstet Gynaecol 1985;92:23-30.
3. Maulik D, Yarlagadda P, Youngblood JP, Ciston P. Comparative efficacy of the umbilical arterial Doppler indices for predicting adverse perinatal outcome. Am J of Obstet Gynecol 1991; 164: 1434.
4. Bonnin P, Bailliart O, Kedra W, Ciraru-Vigueron N, Niang E, Savin E, Martineaud JP. Relationship between birth weight and umbilical doppler blood flow velocity waveforms during the third trimester of pregnancy. Eur J Med 1993;2:219-222.

5. Weissman A, Jakobi P, Bronshtein M, Goldstein I. Sonographic measurements of the umbilical cord and vessels during normal pregnancies. *Journal of Ultrasound in Medicine*.1994;13:11 – 14.
6. Weissman A, Jakobi P. Sonographic measurements of the umbilical cord in pregnancies complicated by gestational diabetes. *Journal of Ultrasound in Medicine*.1997;16:691 – 694.
7. Raio L, Ghezzi F, Di Naro E, Gomez R, Franchi M, Mazor M et al. Sonographic measurement of the umbilical cord and fetal anthropometric parameters. *European Journal of Obstetrics, Gynecology, and Reproductive Biology* 1999a;83:131– 135.
8. Raio L, Ghezzi F, Di Naro E, Franchi M, Maymon M, Mueller MD et al. Prenatal diagnosis of a lean umbilical cord: a simple marker for the fetus at risk of being small for gestational age at birth. *Ultrasound in Obstetrics and Gynecology* 1999b;13:176 – 180.
9. Pharuhas C, Chanane W, Theera T. Umbilical Artery Doppler Waveform Indices in Normal Pregnancies. *Thai Journal of Obstetrics and Gynaecology* June 2000; 12:103-107.
10. Di Naro E, Ghezzi F, Raio L, Franchi M, D'Addario V. Umbilical cord morphology and pregnancy outcome. *Eur J Obstet Gynecol Reprod Biol*. June 2001;96(2):150-7.
11. Weissman A, Drugan A. Sonographic findings of the umbilical cord implications for the risk of fetal chromosomal anomalies. *Ultrasound in Obstetrics and Gynecology*.2001;17:536 – 541.
12. Ghezzi F, Raio L, Di Naro E, Franchi M, Buttarelli M, Schneider H. First-trimester umbilical cord diameter: a novel marker of fetal aneuploidy. *Ultrasound in Obstetrics and Gynecology*. 2002;19:235 – 239.
13. Raio L, Ghezzi F, Di Naro E, Franchi M, Bolla D, Schneider H. Altered sonographic umbilical cord morphometry in early-onset preeclampsia. *Obstetrics and Gynecology*.2002;100:311 – 316
14. Ghezzi F, Raio L, Gunter Duwe D, Cromi A, Karousou E, Dürrig P. Sonographic umbilical vessel morphometry and perinatal outcome of fetuses with a lean umbilical cord. *Journal of Clinical Ultrasound*.2005;33:18 – 23.
15. Predanic M, Perni SC, Chasen ST. The umbilical cord thickness measured at 18 – 23 weeks of gestational age. *Journal of Maternal-Fetal and Neonatal Medicine* .2005;17:111 – 116.
16. Togni FA, Araújo E Jr, Vasques FA, Moron AF, Torloni MR, Nardoza LM. The cross-sectional area of umbilical cord components in normal pregnancy. *International Journal of Gynaecology and Obstetrics*.2007;96:156 – 161.
17. Hasegawa J, Matsuoka R, Ichizuka K, Sekizawa A, Okai T. Ultrasound diagnosis and management of umbilical cord abnormalities. *Taiwanese Journal of Obstetrics and Gynecology*. 2009;48:23-27
18. Cristiane B, Jose GC, Fernanda GD, Jose VC. Sonographic measurement of the umbilical cord area and the diameters of its vessels during pregnancy. *Journal of Obstetrics and Gynaecology* April 2012;32:230-236.

How to cite this article: Bhattacharya S, Maity D, Sadhu A, Khanra S. Estimation of Fetal Age in Relation to Parity by Sonographic Assessment of Umbilical Cord Diameter. *Ann. Int. Med. Den. Res.* 2018; 4(6):AT01-AT04.

Source of Support: Nil, **Conflict of Interest:** None declared