

The Umbilical Cord Nomogram in 11-15 Weeks of Pregnancy

Arzu Özdemir, Fikret Gökhan Göynüner, Öznur Gökçen, Gamze Yetim, Işın Karaaslan

Sağlık Bakanlığı İstanbul Göztepe Eğitim ve Araştırma Hastanesi, Kadın Hastalıkları ve Doğum Kliniği, İstanbul

Abstract

Objective: To establish umbilical cord nomogram of the first and early second trimester and to determine its relationship with other fetal biometric parameters.

Methods: In a cross sectional study during a routine antenatal examination, umbilical cord diameter was measured in 128 singleton cases which were selected prospectively, between the 110-146 weeks of pregnancy. The mean and standard deviations for gestational weeks were calculated, and correlations between cord measurements and gestational week, BPD and CRL were analysed for statistical significance.

Results: Umbilical cord diameter was measured 3.02 ± 0.35 mm at the 110 gestational weeks, 5.03 ± 0.32 mm at the 146 gestational weeks. The correlation between cord diameter (CD) and gestational week (GW) was formulated as: $CD = 0.69 \times GW - 4.76$ ($r:0.84$; $p < 0.001$). In addition, statistically significant linear correlations were found between cord diameter and BPD and CRL ($r:0.77$; $r:0.81$). Conclusion: Umbilical cord diameter increases linearly according to gestational week, BPD and CRL during 110-146 weeks of pregnancy.

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Keywords: Umbilical cord diameter, gestational week, CRL, BPD.

Gebelikte 11-15 Hafta Umbilikal Kord Çapı Nomogramı

Amaç: İlk ve erken ikinci üç aya ait umbilikal kord çapı nomogramı oluşturmak ve bu çapın fetal biyometrik parametrelerle ilişkisini ortaya çıkarmak.

Yöntem: Rutin antenatal kontrol için başvuran gebeler arasından prospektif kesitsel olarak seçilen 128 tekil olguda, gebeliğin 110-146 haftaları arasında umbilikal kord çapı ölçüldü. Bulunan değerlerin haftalara göre ortalama ve standart sapma dağılımları ile gebelik haftası, BPD ve CRL değerleri ile korelasyonu istatistiksel olarak hesaplandı.

Bulgular: Umbilikal kord çapı gebeliğin 110 haftasında 2.87 ± 0.52 mm, 146 haftada ise 5.03 ± 0.32 mm bulundu. Kord çapı ile gebelik yaşı arasındaki korelasyon: $Kordon\ çapı = 0.69 \times Gebelik\ haftası - 4.76$ formülü ile gösterildi ($r:0.84$; $p < 0.001$). Ayrıca kord çapı ile CRL ve BPD arasında da istatistiksel olarak anlamlı doğrusal korelasyon saptandı ($r:0.77$; $r:0.81$).

Sonuç: Çalışmamızda ilk ve erken ikinci üç ayda, gebelik yaşı ile birlikte artan fetal biyometrik ölçümlere paralel olarak, umbilikal kord çapının progresif olarak büyüdüğünü ve nomogramının yapılabileceğini saptadık.

Anahtar Sözcükler: Umbilikal kordon çapı, gebelik haftası, CRL, BPD.

Introduction

The umbilical cord although seems as structurally and functionally simple, is critically a vital organ for fetal life that connects placenta to the fetus. Umbilical cord is a structure always visible at the ultrasound in the late first trimester, in most cases it is visualized entirely. Sonographically measured umbilical the cord diameter in the first trimester correlation with the growth of embryo is investigated in the literature. The amount of Wharton's Jelly in the first and early second trimesters is lower than the third trimester. The increase in the size of the umbilical cord in early gestation is due to mainly a progressive enlargement of the umbilical cord vessels. The aim of our study is to establish umbilical cord nomogram of the first and early second trimester and to determine its relationship with other fetal biometric parameters.

Methods

This prospective cross - sectional study was performed in Department of Perinatology of Education and Research Hospital. Between September 2003-March 2005, among 14000 pregnant women who underwent antenatal examination 128 consecutive pregnant women which is appropriate for our criteria included in our study. Inclusion criteria in this study were: singleton pregnancy, regular menstrual period (of 26-30 days), 110 - 146 gestational weeks, intact membrane, 3 vessel cord, and alive fetus. Chronic conditions (e.g. hypertension, diabetes, thyroid dysfunction) and chromosome abnormalities present at time of the ultrasound constituted exclusion criteria. The demographic data of the pregnant women were obtained and recorded. The gestational age was determined according to the last menstrual period and ultrasonographic CRL measurements taken at early stages of the pregnancy. A Siemens

Sonoline L 3.5 MHz sector probe and a General Electric Logic Pro5 3.5 MHz convex probe were used as ultrasonographic equipment. The biometric parameters obtained as BPD (biparietal diameter), CRL (Crown rump length), amniotic volume, placental localization, and fetal presentation were recorded prospectively during each examination. Transverse section of the free loop of the umbilical cord was examined for the number of vessels it contained. The umbilical cord diameter at the longitudinal plane, was measured at maximum magnification from the outer edge to the outer edge twice, and the mean was recorded for statistical evaluation. The informed consent of each pregnant woman was taken and was included in the study. To avoid differences among and between observations the evaluations were done by a single person. During evaluation of the data, besides descriptive statistical methods (mean, standard deviation, frequency), when comparing quantifiable data, in the comparison of parameters with normal distribution Between groups the Onaway ANOVA test was used. When comparing parameters not showing a normal distribution. In between groups Kruskal Wallis test was used. The relation between the dependent and independent variables was evaluated with Spearman correlation analysis. The results were evaluated at a 95% confidence interval and the p value was less than <0.05 .

Results

The ages of cases (n:128) ranged from 19 to 41 and the mean age was found to be 28.07 ± 4.10 . The mean gravida was found to be 2.60 ± 1.25 , and the mean parity 1.05 ± 0.80 . The correlation between the umbilical cord and the age of the pregnant woman is shown by this formula: The cord diameter = $0.69 \times \text{gestational week} - 4.76$ ($r: 0.845$). There is a considerably high and significant statistical difference

Table 1. The mean of umbilical cord diameter in 11-14 gestational weeks.

Gestational week	Diameter of umbilical cord			
	Mean	SD	5. Percentil	95. Percentil
11. Week	2.87	0.52	2.66	3.08
12. Week	3.66	0.53	3.42	3.90
13. Week	4.19	0.39	4.09	4.29
14. Week	5.03	0.32	4.90	5.16

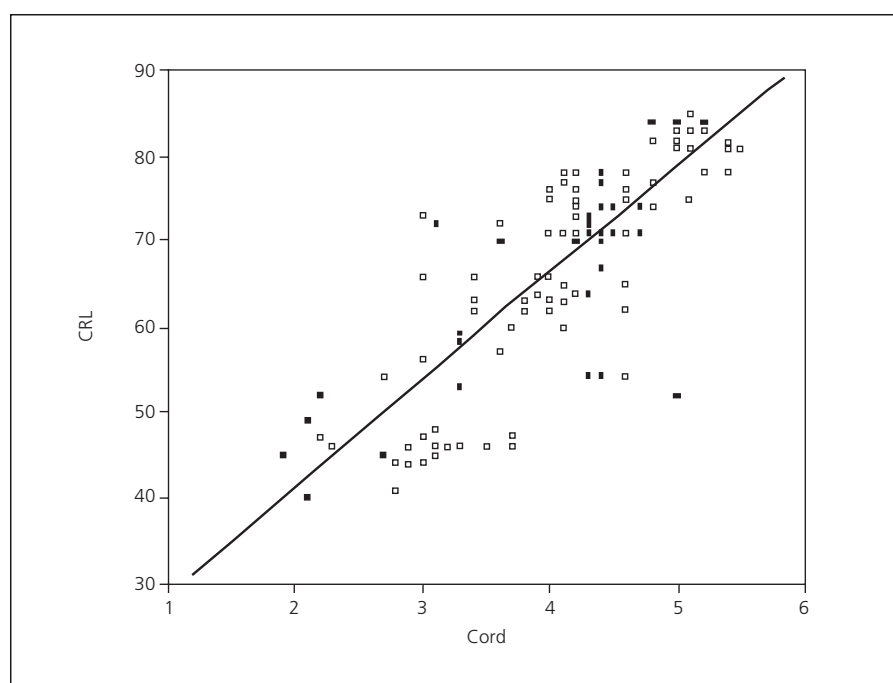
KW:87.85 p:0.001

between the cord diameter and the gestational week ($p < 0.01$). The cord diameter measured at the 14th week of gestation is considerably higher than the diameter measurements obtained at all the other gestational weeks ($p < 0.01$). The cord diameter at the 13th week of gestation is found statistically to be considerably higher than the diameters at the 11th and 12th weeks, and the cord diameter at the 12th week is considerably higher than that at the 11th week ($p < 0.01$). (Table 1). There is a statistically high and significant positive correlation between the

BPD and the umbilical cord diameter ($r: 77.4$) ($p < 0.01$). Similarly, there is a positive and statistically high and significant correlation between the umbilical cord and the CRL.) $r: 81.5$) ($p < 0.01$) (Figure 1).

Discussion

The umbilical cord is an organ belonging to the fetus that can be visualized by ultrasonography almost all the time during the first three months of the pregnancy. A significant relation between the sonographic umbilical cord length

**Figure 1.** Umbilical cord diameter and gestational week.

and the gestational age and CRL in the first three months of pregnancy has been determined by Hill et al.⁶ The increase in the size of the umbilical cord in the first and early second trimester is due mainly to a progressive enlargement of the umbilical cord vessels. The uteroplacental flow at the early first trimester has been studied by many researchers, however, the number of umbilical cord morphometric studies belonging to this stage of the pregnancy is quite low.^{7,8} The sonographic relation between the umbilical cord thickness and fetal growth has taken its place in literature only in the recent years. The first nomogram finding in our study is that the umbilical cord thickness increases progressively as the gestational age increases. Umbilical cord diameter was measured 3.02 ± 0.35 mm at the 110 – 116 gestational weeks, progressively increased to 5.03 ± 0.32 mm at the 146 gestational weeks. This finding is similar to the nomogram published by Weissman, Ghezzi, and Raio.^{4,9,10} In the last two studies, while the umbilical cord thickness median values at 12th, 13th, and 14th weeks are similar to the values in our study, the 11th week median umbilical cord thickness value is measured, to be ~ 0.70 mm less in our study. This difference may be caused by the measurement of the umbilical cord thicknesses at different distances from the fetal abdomen.¹¹ In all three of the studies, umbilical cord measurements encompass a wider range of gestational ages whereas our cases are between the 11th and 14th week of gestations. Especially, in Weissman's study, it is indicated that the umbilical cord measurements are found to be thicker than other studies due to differences in methods.¹¹ Also, in literature, it is indicated that the umbilical cord thickness increases until the 32-36th weeks in accordance with the gestational age, and after this, it decreases.^{9,12,13} In their studies, Predanic emphasizes this limit to be 32nd week, Weissman as 36th week, and Raio as 34th week

of gestation. Since our study was performed in the first and early second trimesters, we have not obtained such a finding. Although the faulty measurement of CRL is less frequent than the faulty measurement of the umbilical cord diameter, in pregnancies when the last menstrual period is not known, the cord diameter can be used as an additional parameter to determine the gestational age just like the gestational sac diameter.⁴ Hill et al. have reported that in the first and early second trimesters, there is a significant correlation between the umbilical cord length and the gestational age and CRL.⁶ The relation between the umbilical cord thickness and gestational age and CRL in the first trimester was first reported by Ghezzi et al.⁴ In our study, a significant correlation between the increase in CRL and umbilical cord thickness has been observed in accordance with literature. In our study, again in accordance with Ghezzi, Raio, Predanic et al.'s results^{6,9,10} measurement of the BPD which is one of the fetal biometric measurements, was found to have a significant positive correlation with the umbilical cord thickness. However, this correlation was found to be weaker than CRL and gestational week.

Conclusion

As a result, the visualization of the umbilical cord in the first and second trimesters with current ultrasonography devices can be done fast and easily. In our study, parallel to the fetal biometric measurements increasing together with the gestational age in the first and early second trimesters, we have detected the progressive growth of the umbilical cord diameter and found that a nomogram can be made.

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