Obstetrics; *Maternal-Fetal Medicine and Perinatology*

The Diagnostic Value of the Umbilical Cord Diameter Thickness in Second Trimester Congenital Anomaly Screening

İrem ŞENYUVA[1], Cüneyt TANER[2]

Çanakkale, Turkey

OBJECTIVE: Diagnostic value of the umbilical cord thickness second trimester congenital anomaly screening.

STUDY DESIGN: Eighty-three pregnant women in the study. Patients were examined by dividing them into 3 groups. The first group was comprised of 50 healthy individuals which exhibited no chromosomal or sonographic fetal anomaly. The second group consisted of 8 cases which displayed chromosomal anomaly by amniocentesis. The third group included 25 cases with fetal anomaly detected by USG.

RESULTS: The first group mean cord diameter was 7.06±1.6 mm (4.50-11.80 mm). Second group was 8.32±2.2 mm (4.60-11.0 mm), third group was 7.24±1.5 mm (4.70-10.50). No significant difference was determined between the results (p>0.05).

CONCLUSION: Umbilical cord diameter was not found to be a valuable sonographic finding in the congenital anomaly screening.

Key Words: Chromosomal anomaly second trimester, Umbilical cord diameter

Gynecol Obstet Rebrod Med;15:3 (133 - 137)

Introduction

The evaluation of the umbilical cord is limited to determination of the number of vessels and measurement of umbilical artery and vein blood losses by Doppler ultrasound. Parameters like thickness of the umbilical cord diameter and number of coils along the umbilical cord, gain importance in sonographic assessment of fetus in cases such as chromosomal anomalies, early loss of pregnancies, preeclampsia, gestational diabetes (GDM), intrauterine growth retardation (IUGR), and small fetus for gestational age.

Majority of the studies which include evaluation of the umbilical cord diameter value for detection of congenital anomalies, have been carried out during the first trimester. In the present study, we aimed to investigate the diagnostic value of umbilical cord thickness as a sonographic finding for congenital anomaly screening.

[1]Ministery of Health, Biga State Hospital Çanakkale

[2]Ministery of Health, Aegean Maternity Research and Education Hospital İzmir

Correspondence Author: *İrem Şenyuva*
Departmens of Obstetrics&Gyneacology
Ministery of Health, Biga State Hospital
Çanakkale,
iremsenyuva@yahoo.com

Submitted for Publication: *07.03.2009*
Accepted for Publication: *26.05.2009*

Material and Method

In the present study, 83 pregnant women at 16-24 gestational weeks who presented to our hospital between September 2005 – January 2007, were enrolled. Patients were examined by dividing them into 3 groups. The first group was comprised of 50 healthy individuals which exhibited no chromosomal or sonographic fetal anomaly. The second group consisted of 8 cases which displayed chromosomal anomaly by amniocentesis. The third group included 25 cases with fetal anomaly detected by USG.

The cases included in the control group had been subjected to triple test between the 16-20th gestational weeks, showed no increase of risk in the results, and displayed no pathologic finding sonographically in the fetal anomaly screening. The age of the patients varied between 18-32. Because some of the patients failed to remember their last menstruation period, the determination of the gestational age of the cases was carried out according to the biparietal diameter (BPD) measurements. The measurements were realized by measuring the distance between exterior margin of the anterior parietal bone and interior margin of the posterior parietal bone. According to the BPD measurements determined as 32.9-62.6mm, gestational ages were calculated as 16-24 weeks. Umbilical cord diameters were measured at a point 0.5cm proximal to the insertion of the umbilical cord to the abdominal wall, in a way to include Wharton's jelly and umbilical vessels on the transversal section of the fetal abdomen. The measurements were repeated once and the their mean value was calculated.

The second group consisted of 8 cases that were subjected to amniocentesis between 16-20th gestational weeks due to advanced age (>35 age) or elevated risk in triple test (1/270) which revealed chromosome anomaly. Seven of the cases showed trisomy 21, whereas one case displayed 47XXX. Regarding the ultrasonographic results of the cases having trisomy 21, 1 case exhibited right ventricular hyperechoic focus and another case showed an echogenic focus in the left ventricle. The USG results of the remaining cases demonstrated no pathologic findings. The age of the patients varied between 18-36. According to the BPD measurements calculated as 52.5-56.2mm, gestational weeks were determined as 21w+1 day – 22w+1 day.

The third group consisted of 25 cases which exhibited fetal anomaly in the ultrasonographic screening realized between 16-20th gestational weeks, but did not display chromosomal anomaly in the amniocentesis. The age of the patients varied between 20-40 age. Only 6 cases displayed an increase of risk in triple test (above 1/270). While BPD measurements were 32.4-57.5 mm (18-23 weeks) among the group including central nervous system anomalies, the same measurements were 39.7-47.5 mm (20-22 weeks) for the group having 3 cases with gastrointestinal system and anterior abdominal wall defect anomalies, 40.6-47.5 mm (20-22 weeks) for the group including 3 cases with genitourinary system anomalies, 48.9-62.6 mm (23-24 weeks) for the group including 4 cases with skeletal system anomalies, 42 mm (21 weeks) for 1 case with cardiovascular system anomaly. The detected fetal anomalies were hydrocephalus, Dandy-Walker malformation, unilateral choroid plexus cyst, neural tube defect, anencephaly, encephalocele, gastroschisis, fetal abdominal mass, diaphragmatic hernia, pyelectasia, polycystic kidney, pes equinovarus, achondroplasia, and cardiac echogenic focus.

Kruskal-Wallis test, a nonparametric analyse, was employed in independent groups for average values of more than 2 groups. $p<0.05$ was recognized as significant. Mann-Whitney test, a nonparametric analyse, was applied for average values of 2 groups. $P<0.05$ was recognized as significant.

Results

Control group consisted of 50 patients. The mean age of the patietns was 25±4.3 (18-34). While 19 (38%) patients were multiparous, 31 (62%) were primiparous. The diameters of umbilical cords varied between 4.50-11.80 in the control group and their mean value was 7.06 ± 1.6.

Chromosomal anomaly group consisted of 8 patients. The mean age of the patients was 31 ± 6.6 (18-38). While 6 (75%) cases were multiparous, 2 (25%) were primiparous. The umbilical cord diameter of the patients included in this group varied between 4.60-11.00 and the mean value was found to be 8.32 ± 2.2. Four (50%) cases were ≥ 35 age. All the cases aged above 35, were detected to have trisomy 21 by amniocentesis. A case which had an elevated risk in the triple test, was determined to be 47 XXX by amniocentesis. Two of the trisomy 21 cases ultrasonographically exhibited cardiac anomaly.

Third group, which included the cases with fetal anomaly detected by USG, consisted of 25 patients. The mean age of the patients was 25.9±4.7 (20-40). While 15 (60%) cases were multiparous, 10 (40%) were primiparous. The umbilical cord diameters of the patients included in this group varied between 4.70-10.50 and the mean value was found to be 7.24±1.5. Two cases were ≥5 age and had no elevation of risk in the triple test alongside demonstrating normal amniocentesis results. USG revealed pyelectasia and NTD. Six (24%) cases showed elevated risk in triple test and exhibited fetal anomalies in the USG such as hydrocephalus, unilateral choroid plexus cyst, echogenic focus in the left ventricle, abdominal mass, and bilateral polycystic kidney. Their karyotypes were normal.

The umbilical cord diameters of all the groups are shown in Table 1.

Table 1: Umbilical cord diameters of the groups

Group	Umbilical cord diameter values (mm)	Mean values (mm)
Control group	4.50-11.80	7.06±1.6
Chromosomal anomaly group	4.60-11.00	8.32±2.2
The group with fetal anomalies detected by USG	4.70-10.50	7.24±1.5

The comparison of cases in the control group with the chromosomal anomaly group and the group with fetal anomalies detected by USG in terms of the umbilical cord diameter, revealed no statistically significant difference; $p=0.236$ ($p>0.05$).

The comparison of chromosomal anomaly group and the group with fetal anomalies detected by USG in terms of umbilical cord diameter, showed no statistically significant difference; $p=0.185$ ($p>0.05$).

The comparison of the umbilical cord diameters of individuals in the group with fetal anomalies detected by USG in terms of central nervous system, gastrointestinal system, genitourinary system, skeletal system, cardiovascular system anomalies, displayed no statistically significant difference between their umbilical cord diameters; $p=0.50$ ($p>0.05$).

Discussion

Umbilical cord can easily be monitored by USG towards the end of the first trimester. First trimester umbilical cord measurement is correlated with embryologic growth.[1] Prenatal

morphologic evaluation of the umbilical cord is limited with the determination of the number of umbilical vessels, and other parameters such as cord diameter, Wharton's jelly amount, number of coils are not routinely analyzed.[2] By the third trimester, the sonographic assessment of the umbilical cord is hampered by the large space occupied by the fetus, however, because during the second trimester the amniotic fluid exhibits a higher volume compared to the fetal volume, it can be examined more easily.[3]

The measurement of umbilical cord diameter bears a growing importance in cases such as aneuploid, intrauterine growth retardation (IUGR), feti small for gestational age (SGA), gestational diabetes (GDM), and preeclampsia. Moreover, the diameter of the umbilical cord and the vein have been used for assessment of fetal distress in prolonged pregnancies and pregnancies complicated with Rh hemolytic anemia.[4]

The helical nature of the human umbilical cord is its unique attribute. Absent or lesser coiled structure are known to be predisposing factors for fetal morbidity. Strong et al. reported lesser than normal number of coils in feti with anatomic and karyotypic anomalies. [3-5]

Molpos, Symonds, and Cullen reported development of the helical structure of the umbilical cord of embryo as early as 8th gestational week and noted similar number of coils in the first and third trimesters. They also mentioned that umbilical cord length reachs its limit by increasing between two coils. The vascular structure of the umbilical cord, and the formation of arteries around the veins, have been observed to take place during the first half of the initial trimester where umbilical cord growth accelerates and during the 6th week when umbilical cord reaches a lenghth of 5mm and the 24th week when it reaches a length of 33-35cm. After that point, the growth rate of the umbilical cord is known to be 3-6 cm each month and the umbilical coiling index is not influenced much.[6-9]

Umbilical vascular helix is affected by fetal movement, umbilical growth rate, and fetal hemodynamic force.[6,10-12] The helical structure is under genetic control and a primary defect occuring at embryogenesis is the underlying reason for any possible disorder. Studies show a correlation between absent or low umbilical coiling index and aneuploidy. Absence or lower number of coils in single umbilical artery compared to the contralateral one, is encountered more frequently and it is believed to occur as a result of an early embryologic defect of the atypic coiling structure. Normal arteries undergo secondary atrophy in early pregnancies.[13]

Wharton's jelly plays a supportive and protective role for the adventitia of the umbilical vessels. Due to underdevelopment of Wharton's jelly and therefore inadequate protection of the vessels, vessels can be easily compressed. Carlos et al. reported that absence of Wharton's jelly around the umbilical cord vessels, leads to acute fetal distress and perinatal death. As the gestational age advances, the amount of Wharton's jelly is reduced. Thus, prolonged pregnancies are under higher risk for compression of the cord.[14] Silver et al. examined 68 patients all of which had a gestational age above 41 weeks. The patients who were monitored twice a week by USG and NST, showed a mean value of 1.6 cm for the thickness of the umbilical cord diameter and the mean amniotic fluid volume was found to be 3.8 cm. A significant correlation was found between lean umbilical cord and reduced amnion fluid. Moreover, prolonged pregnancies have been reported to be under higher risk regarding the cord compression of those 2 parameters.[15] The study conducted by Richard et al. showed a correlation between the amniotic fluid index and the cord diameter. Lean umbilical cord, diameter showing correlation with oligohydramniosis and associated with reduced Wharton's jelly amount, plays a role in fetal dismaturity, IUGR, and high incidence of fetal distress during birth.[4,15]

Ghezzi et al. reported a significant correlation between the area of Wharton's jelly and umbilical cord area, and fetal biometry until the 32th week. Beginning with this week, as a result of the water loss from Wharton's jelly, cord diameter becomes lean.[16] Slaper et al. found the amount of Wharton's jelly significantly less at term compared to the preterm, and progression was determined to advance from 30th week to term.[17] Bruch et al. made similar studies, as well.[18] Schumann and Hall described a decrease in the Wharton's jelly amount and a decreased area of umbilical vessels.[19]

Assessment of the umbilical cord structure provides important information in screening of fetal anomalies at the second trimester. It was described by single umbilical artery, absence of helical structure, short umbilical cord, various chromosomal anomalies, and genetic syndromes. Several morphologic attributes of the umbilical cord (short umbilical cord, noncoiled umbilical cord, large umbilical cord diameter), are seen more frequently in Down syndrome.[12]

Another study conducted by Ghezzi et al. examined 784 healthy pregnancies between 1-14th weeks. Fetal or placental anomalies such as trisomy 21, 45XO, 47XXY, and placental mosaism were detected in 17 patients. Mean umbilical cord diameter increases with the gestational age. Mean umbilical cord diameters of the feti which exhibited chromosomal anomalies, were determined to be thicker than normal and their NT thicknesses were found to be elevated, as well. The mean umbilical cord diameter value was 5.3mm at the 10th week of gestational week and 7.6mm at the 14th gestational week.[20]

Raio et al. studied umbilical cord diameters of 439 feti between 8-15th gestational weeks. They reported a significant

correlation between gestational age CRL and BPD measurements and umbilical cord diameter values, however, they also mentioned an umbilical cord diameter as 2SD lower than normal in cases of abortus and preeclampsia. Moreover, they underscored the importance of the correlation between fetal growth and umbilical cord diameters and further underlined the fact that values below normal might be a marker of abortus and preeclampsia.[1]

Another study conducted by Raio et al. measured the umbilical cord diameters of 557 healthy pregnant women. The monogram produced by measuring a number of feti from 10th gestational week to 42nd gestational week, revealed the mean umbilical cord diameter as 3.19 ± 0.40 at 10th week and 14.42 ± 1.50 at 42nd week.[21]

Weismann et al. evaluated the mean fetal umbilical cord diameter in 368 healthy pregnant women. They carried out a number of measurements of fetal umbilical cord diameters from 8th to 42nd week of gestation. The resultant mean cord diameter values were 2.5 ± 0.5 at 8th week and 17.0 ± 1.2 at 42nd week.[4]

The examination of umbilical cord diameter provides important information on hypertensive disorders, gestational diabetes, fetal distress, and IUGR. During second and third trimesters, certain changes in the morphology of the umbilical cord may lead to intrapartum complication, umbilical vein blood flow alteration, and poor prenatal results.[20] The reduction in the diameter of the umbilical cord may be significant regarding SGA and intrapartum fetal distress. Ratio et al. detected lean umbilical cord in feti with IUGR, distress, and oligohydramnios[2] Diamond et al. determined similar results in their own studies, as well.[1] Ratio et al. carried out a study on 557 cases and reported an increase of umbilical cord diameter with the advance of gestational age which reaches peak level at the 32nd week followed by a decrease in the remaining weeks, and mentioned a correlation between their results and the study of Weismann et al. In the same study, a significant correlation was found between EFBW and the umbilical cord diameter.[16]

Conclusion

The thickness of the umbilical cord diameter does not provide a valuable diagnostic information in the fetal anomaly screening carried out during the second trimester. However, the assessment of the structure of the umbilical cord (number of vessels, absence of coils, lower or higher number of coils), bears a supportive attribute in terms of chromosomal anomaly. Moreover, the evaluation of the changes in cord diameter during measurements realized in those weeks, is valuable because it may be an indicator of IUGR, SGA, GDM, and hypertensive disorders.

İkinci Trimestir Konjenital Anomali Taramasında Umbilikal Kord Çapı Kalınlığının Tanısal Değeri

AMAÇ: İkinci trimestirde konjenital anomali taramasında sonografik bir bulgu olarak umbilikal kord kalınlığının tanısal değerini araştırmayı amaçladık.

GEREÇ ve YÖNTEM Çalışmaya 83 gebe dahil edildi Hastalar üç gruba ayrıldı. Birinci grup , kromozomal ya da ultrasonografik fetal anomali saptanmayan sağlıklı fetuslerden oluşan 50 olguluk kontrol grubu; ikinci grup, amniosentez sonucunda kromozomal anomali saptanan 8 olguluk grup ve üçüncü grup, ultrasonografik olarak saptanmış fetal anomaliye sahip 25 olgudan oluşan gruptu.

BULGULAR: Birinci grubun kord çapları (4.5-11.80 mm) ortalama 7.06±1.6 mm olarak saptandı.İkinci grubun kord çapları (4.60-11.0 mm) ortalama 8.32 ± 2.2 mm ve üçüncü grubun kord çapları (4.70-10.50 mm) ortalama 7.24±1.5 mm olarak saptandı.Gruplar arasında anlamlı bir farklılık saptanmadı.(p>0.05).

SONUÇ: İkinci trimestirde umbilikal kord çapı kalınlığı ölçümü konjenital anomali taramasında sonografik bulgu olarak değerli bulunmadı.

Anahtar Kelimeler: İkinci trimestir, Kromozomal anomali, Umbilikal kord çapı

References

1. Ghezzi F, Raio L, Di Naro E, Franchi M, Brühwiler H, D'Addario V, Schneider H First-trimester sonographic umbilical cord diameter and the growth of the human embryo Ultrasound Obstet Gynecol. 2001 Oct;18(4):348-51.
2. Predanic M, Perni SC, Chasen ST The umbilical cord thickness measured at 18-23 weeks of gestational age J Matern Fetal Neonatal Med. 2005 Feb;17(2):111-6.
3. Qin Y, Lau TK, Rogers MS. Second-trimester ultrasonographic assessment of the umbilical coiling index Ultrasound Obstet Gynecol. 2002 Nov;20(5):458-63
4. Weissman A, Jakobi P, Bronshtein M, Goldstein I. Sonographic measurements of the umbilical cord and vessels during normal pregnancies. J Ultrasound Med. 1994 Jan;13(1):11-4.
5. Strong TH Trisomy among fetuses with noncoiled umbilical blood vessels J Reprod Med. 1995 Nov;40(11):789-90.
6. Malpas P, Symonds EM. Observations on the structure of the human umbilical cord. Surg Gynecol Obstet. 1966 Oct;123(4):746-50
7. Cullen TS.Embryology,anatomy,and diseases of the umbilicus,together with diseases of the urachus. Philadelphia. Sounders;1916.
8. Winckel FKLW.Lehrbuch der geburtshilfe, 2nd ed.

Leipzig:Veit;1893.

9. Mills JL, Harley EE, Moessinger AC Standards for measuring umbilical cord length.
10. Lacro RV, Jones KL, Benirschke K. The umbilical cord twist: origin, direction, and relevance Am J Obstet Gynecol. 1987 Oct;157(4 Pt 1):833-8.
11. Roach MR.1987.The Umbilical vessels.In Perinatol Medicine;.The basic science underlying clinical practice.Goodwin JW.Godden JO.Chance GW.Williams &Wilkins:Baltimore,MD134-142.
12. Raio L, Ghezzi F, Cromi A, Cereda E, Passi A. Sonographic morphology and hyaluronan content of umbilical cords of healthy and Down syndrome fetuses in early gestation. Early Hum Dev. 2004 Apr;77(1-2):1-12
13. Cromi A, Ghezzi F, Duerig P, Travaglini M, Buttarelli M, Raio L. Sonographic atypical vascular coiling of the umbilical cord Prenat Diagn. 2005 Jan;25(1):1-6.
14. Labarrere C, Sebastiani M, Siminovich M, Torassa E, Althabe OAbsence of Wharton's's jelly around the umbilical arteries: an unusual cause of perinatal mortality Placenta. 1985 Nov-Dec;6(6):555-9.
15. Silver RK, Dooley SL, Tamura RK, Depp R Umbilical cord size and amniotic fluid volume in prolonged pregnancy. Am J Obstet Gynecol. 1987 Sep;157(3):716-20
16. Ghezzi F, Raio L, Di Naro E, Franchi M, Balestreri D, D'Addario VNomogram of Wharton's's jelly as depicted in the sonographic cross section of the umbilical cordUltrasound Obstet Gynecol. 2001 Aug;18(2):121-5
17. Sloper KS, Brown RS, Baum JD. The water content of the human umbilical cord. Early Hum Dev. 1979 Jul;3 (2):205-10
18. Bruch JF, Sibony O, Benali K, Challier JC, Blot P, Nessmann C. Computerized microscope morphometry of umbilical vessels from pregnancies with intrauterine growth retardation and abnormal umbilical artery Doppler. Hum Pathol. 1997 Oct;28(10):1139-45.
19. Raio L, Ghezzi F, Di Naro E, Franchi M, Maymon E, Mueller MD, Brühwiler H. Prenatal diagnosis of a lean umbilical cord: a simple marker for the fetus at risk of being small for gestational age at birth. Ultrasound Obstet Gynecol. 1999 Mar;13(3):176-80.
20. 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 Obstet Gynecol. 2002 Mar;19(3):235-9
21. Di Naro E, Ghezzi F, Raio L, Franchi M, D'Addario V. Umbilical cord morphology and pregnancy outcome. Eur J Obstet Gynecol Reprod Biol. 2001 Jun;96(2):150-7.