

Original Article

Efficacy of USG in Measurement of Umbilical Cord Thickness, Cross-Sectional Area and Coiling Index

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ABSTRACT:

Introduction- The umbilical cord is a conduit between the developing embryo or fetus and the placenta. The present study was conducted to evaluate the value of umbilical cord thickness, cross-sectional area, and coiling index with Ultrasonography (USG). **Materials & Methods:** The present study was conducted in the department of Radiodiagnosis on 140 pregnant women who underwent USG. Gestational age was based on a reliable last menstrual period or the earliest USG examination before 20 weeks of gestation. In all patients USG was performed using a 3.5-MHz convex transducer. Umbilical cord thickness, cross-sectional area, and coiling index were measured in a free-floating loop of umbilical cord using the software in the USG unit. **Results-** Mean gestational age at delivery was 38.65 ± 2.4 weeks, mean birth weight was 3456 ± 483 grams, low birth weight was seen in 24 children, meconium stained amniotic fluid was observed in 5 cases and there was no intrauterine death. Mean thickness of umbilical cord was 1.52, 10th centile was 1.3, 90th centile was 1.9, area was 1.92, 10th centile was 1.2, 90th centile was 2.8 and coiling index was 0.5, 10th centile was 0.25 and 90th centile was 0.56. Thickness <10th was 53%, 10-90th was 46%, area < 10th was 56%, 10-90th was 43%, coiling index <10th was 22% and 10-90th was 74% and >90th was 3%. **Conclusion-** Umbilical cord thickness and cross-sectional area are easy to measure in a free loop of umbilical cord and both are correlated with LBW and meconium staining in the second half of gestation. USG proves to be beneficial in uterine examination in pregnant women.

Key words- Coiling index, Ultrasonography, Umbilical cord.

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INTRODUCTION

The umbilical cord is a conduit between the developing embryo or fetus and the placenta. During prenatal development, the umbilical cord is physiologically and genetically part of the fetus and normally contains two arteries and one vein buried within Wharton's jelly. The umbilical vein supplies the fetus with oxygenated, nutrient-rich blood from the placenta.¹

The umbilical cord develops from and contains remnants of the yolk sac and allantois. It forms by the fifth week of development, replacing the yolk sac as the source of nutrients for the embryo. The cord is not directly connected to the mother's circulatory system, but instead joins the placenta, which transfers materials to and from the maternal blood without allowing direct mixing the length of the umbilical cord is approximately equal to the crown-rump length of the fetus throughout pregnancy. The umbilical cord in a full term neonate is usually about 50 centimeters long and about 2 centimeters in diameter. This diameter decreases rapidly within the placenta.²

A lean umbilical cord was reported to be associated with small-for-gestational-age (SGA) neonates. Researchers have found significant differences in mean gestational age, mode of delivery, birth weight, and adverse perinatal outcome

between fetuses with umbilical cord thickness below the 5th centile vs. those with umbilical cord thickness above the 5th centile in the first and early second trimesters of gestation. In a study on fetuses with sonographically measured low umbilical cord cross-sectional area, Ghezzi et al³, found a significant relationship between umbilical vein cross-sectional area below the 10th percentile and adverse neonatal outcome. The present study was conducted to evaluate the value of umbilical cord thickness, cross-sectional area, and coiling index with Ultrasonography (USG).

MATERIALS & METHODS

The present study was conducted in the department of Radiodiagnosis. It comprised of 140 pregnant women who underwent USG. All were informed regarding the study and written consent was obtained. Ethical clearance was obtained before the study.

The inclusion criteria were singleton gestation, gestational age > 20 weeks at the time of USG, amniotic fluid index between 8–24 cm, and presence of a three-vessel umbilical cord. Gestational age was based on a reliable last menstrual period or the earliest USG examination before 20 weeks of gestation.

In all patients USG was performed using a 3.5-MHz convex transducer. Umbilical cord thickness, cross-sectional area, and coiling index were measured in a free-floating loop of umbilical cord using the software in the USG unit.

Measurements were performed by marking the outer edges of the umbilical cord for thickness and by encircling the outer edge of the cord in transverse section for cross sectional area. UCI was calculated as a reciprocal value of the distance between the inner edge of one artery to the

outer edge of the same artery at the adjacent umbilical twist along the ipsilateral cord side. The newborns were considered as low birth weight (LBW) when the birth weight was below 2500 g. Umbilical cord diameter, cross-sectional area, and coiling index were considered low if below the 10th centile and high if above the 90th centile. Results were tabulated and subjected to statistical analysis using chi- square test. P value less than 0.05 was considered significant.

RESULTS

Table I Parameters in patients

Parameters	Value
Gestational age at delivery (mean± S.D) weeks	38.65± 2.4
Birth weight (mean± S.D) grams	3456± 483
Low birth weight	24
Meconium stained amniotic fluid	5
Intrauterine death	0

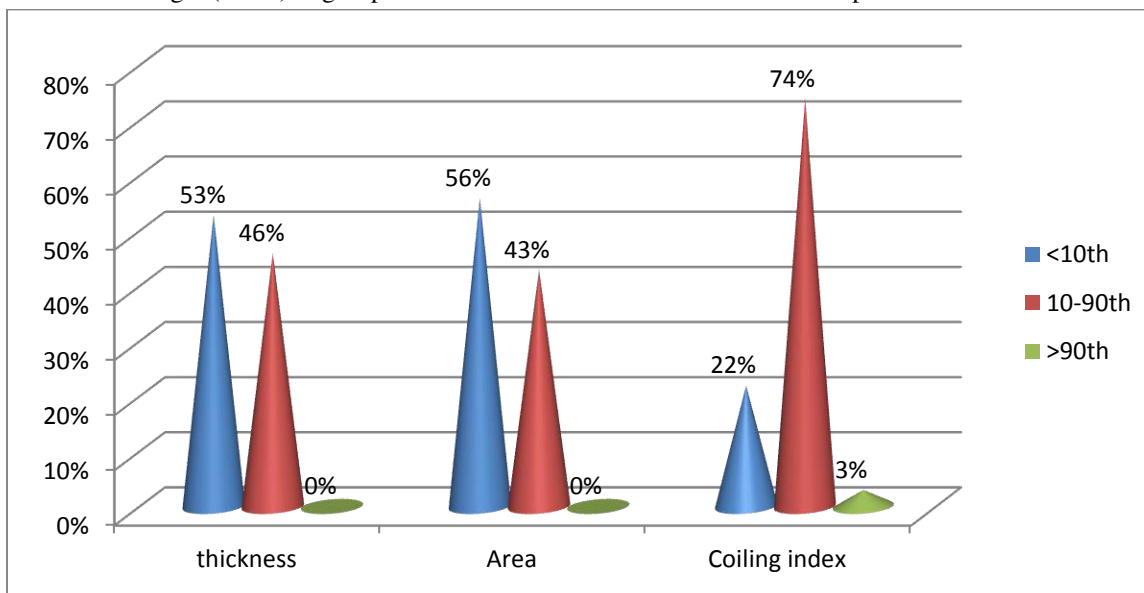
Table I shows that mean gestational age at delivery was 38.65± 2.4 weeks, mean birth weight was 3456± 483 grams, low birth weight was seen in 24 children, meconium stained amniotic fluid was observed in 5 cases and there was no intrauterine death.

Table II Umbilical cord anthropometric parameters

	Min	Max	Mean	10 th centile	90 th centile
Thickness	0.64	2.32	1.52	1.3	1.9
Area	0.35	4.37	1.92	1.2	2.8
Coiling index	0.15	0.87	0.5	0.25	0.56

Table II shows that mean thickness of umbilical cord was 1.52, 10th centile was 1.3, 90th centile was 1.9, area was 1.92, 10th centile was 1.2, 90th centile was 2.8 and coiling index was 0.5, 10th centile was 0.25 and 90th centile was 0.56.

Graph I Low birth weight (LBW) in groups with normal and abnormal umbilical cord parameters



Graph I shows that thickness <10th was 53%, 10-90th was 46%, area <10th was 56%, 10-90th was 43%, coiling index <10th was 22% and 10-90th was 74% and >90th was 3%.

DISCUSSION

The association between a low umbilical cord coiling index (UCI) and antenatal and perinatal complications was demonstrated by Gupta et al. In a study performed by Predanic et al⁴, abnormal umbilical cord coiling in the second trimester was associated with higher prevalence of SGA fetuses. Reduction in wall thickness of the umbilical cord arteries and vein has been found in intrauterine growth retardation (IUGR) infants with abnormal umbilical artery flow as compared to IUGR infants without increased umbilical artery resistance. The reduction in umbilical cord thickness and diameter can compromise fetal growth.

The fully patent umbilical artery has two main layers: an outer layer consisting of circularly arranged smooth muscle cells and an inner layer which shows rather irregularly and loosely arranged cells embedded in abundant ground substance staining metachromatic. The smooth muscle cells of the layer are rather poorly differentiated, contain only a few tiny myofilaments and are thereby unlikely to contribute actively to the process of post-natal closure.⁵

In present study, we evaluated the value of umbilical cord thickness, cross-sectional area, and coiling index in predicting pregnancy outcome. We found that mean gestational age at delivery was 38.65 ± 2.4 weeks, mean birth weight was 3456 ± 483 grams, low birth weight was seen in 24 children, meconium stained amniotic fluid was observed in 5 cases and there was no intrauterine death. This is in agreement with Ranna et al.⁶

In a study by Scott et al⁷ found statistically significant correlation between small umbilical cord thickness and cross-sectional area and low birth weight (LBW), with sensitivity of 52.9% and 57.9%, specificity of 95.0% and 94.4%, positive predictive value of 52.6% and 52.0%, and negative predictive value of 95.0% and 95.0%, respectively. Also noted was significant correlation between small umbilical cord thickness and cross-sectional area with meconium staining ($P < 0.001$). No significant correlation was seen between umbilical cord thickness and cross-sectional area with low 5-min Apgar score. There was no statistically significant correlation between umbilical cord coiling index and LBW, 5-min Apgar score, and meconium staining.

Degani et al⁸, showed statistical correlation of hypocoiled umbilical cord with SGA in the early second trimester. Predanic et al, showed an association between UCI and SGA, but did not find any correlation between UCI and a low 5-min Apgar score in the second trimester. Ezimokhai et al⁹, measured several segments. It can be postulated that coiling is not uniform throughout the cord length, and as a consequence occasionally, USG measured UCI is not a good indicator of the true coiling of the umbilical cord.

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CONCLUSION

Umbilical cord thickness and cross-sectional area are easy to measure in a free loop of umbilical cord and both are correlated with LBW and meconium staining in the second half of gestation. USG proves to be beneficial in uterine examination in pregnant women.

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Conflict of interest: None declared

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