ORIGINAL RESEARCH PAPER

Obstetrics & Gynaecology

EVALUATION OF UMBILICAL COILING INDEX AS A SCREENING TOOL FOR FETUSES AT RISK

KEY WORDS: Hypocoiled Hypercoiled Normocoiled Perinatal outcome

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ABSTRACT

BACKGROUND: The umbilical cord is the lifeline of the foetus as it supplies water, nutrients, and oxygen. Protection of these blood vessels is needed and provided by Wharton's Jelly, amniotic fluid and the helical pattern, or coiling, of the umbilical cord vessels.

OBJECTIVES: To establish the relationship between antenatal umbilical cord coiling index (aUCI) measured at 16–20 weeks along with level II USG and adverse perinatal outcomes.

METHODS: A cross-sectional study was conducted on 302 antenatal women, enrolled at the time of fetal anatomic survey, and their cord coiling index (aUCI) was measured, and its association with perinatal outcomes was observed. Umbilical coiling index was classified as Hypocoiled if UCI <10th percentile, hypercoiled >90th percentile, normocoiled between 10th and 90th percentile.

RESULTS: 302 antenatal women were enrolled for the study. Mean aUCI was 0.43 ± 0.30 (normocoiled group), 0.18 ± 0.4 (hypocoiled), and 0.53 ± 0.05 (hypercoiled group). The average gestational age at delivery in hypocoiled group was 36.8 ± 2.34 weeks, and it was shorter than 38.3 ± 1.82 weeks of the normocoiled group and 38.9 ± 1.72 weeks of the hypercoiled group. Mean birth weight observed was 2055 ± 744 (hypocoiled group), 3049 ± 564 (hypercoiled), and 3102 ± 564 (normocoiled) p<0.001. Preterm births 52 (59%) and low birth weight 76 (69%) were significantly associated with hypocoiling. **CONCLUSION:** Abnormal umbilical cord coiling index, detected at the fetal ultrasound anatomic survey. In the second trimester (16–20 weeks), can be used potentially used as a screening or as a predictive tool for adverse antenatal or perinatal events.

INTRODUCTION

'umbilical coiling index' (UCI), which is the number of coils in the cord divided by the cord length in cm. Various studies have been done on umbilical coiling index postnatally, and the association was established between hypocoiled and hypercoiled cord defined as UCI <10th percentile and >90th percentile, respectively, with adverse perinatal outcomes . Hypocoiled cord was associated with increased incidence of fetal demise, intrapartum fetal heart rate deceleration, operative delivery for fetal distress, low Apgar score, structural and chromosomal abnormalities, chorioamnionitis, and preterm delivery. Hypercoiling of the cord was associated with fetal growth retardation, intrapartum fetal acidosis and asphyxia, vascular thrombosis, and cord stenosis by predisposing to compression mediated flow reduction and possible predisposition to the development of fetoplacental vascular thrombosis .Thus, it appears that abnormal coiling is a chronic state established in early gestation that may have chronic and acute effect on the fetus.

AIMS AND OBJECTIVES:

To evaluate the relationship of sonographic measurements of umbilical coiling index in second trimester (16–20 weeks) with the perinatal outcome.

MATERIALS AND METHODS:

A cross-sectional study was conducted on all booked pregnant women attending the Obstetric OPD ,Narayana medical college and Hospital, Nellore for regular antenatal checkup between 16 and 20 weeks and planned to deliver at our Hospital.302 patients fulfilling the inclusion criteria and gave consent for USG scan were recruited for study.

Inclusion Criteria

1. Singleton pregnancy of any parity.
2. Gestational age between 16 and 20 weeks.
3. Normal amniotic fluid.
4. Presence of three vessel umbilical cord.
5. Consenting to participate in the study.

Exclusion Criteria

1. Multiple pregnancy.
2. Fetal congenital anomaly.
3. Maternal medical disorders like diabetes mellitus and hypertension that could interfere with fetal growth.
4. If the patient could not be followed till delivery for any reason.
5. Any umbilical cord or placental anomaly.
6. Inadequate longitudinal image of the cord to allow accurate coiling index measurement/antenatal or labor data and inappropriate cross-sectional image of the fetal abdomen.

The distance between a pair of coils will be measured in 'cm' from the inner edge of an arterial or venous wall to the outer edge of the next coil along the ipsilateral side of the umbilical cord, the direction being from the placental end to the fetal end.

The coiling index is calculated as the reciprocal value of this distance (Fig. 1) (UCI = 1/distance between the inner edge of an arterial or venous wall to the outer edge of the next coil).

These women were then followed till term to note the various parameters like

(a) Gestational age at delivery.
(b) Presence of meconium stained amniotic fluid.
(c) Mode of delivery.
(d) Apgar score at 5 min.
(e) Neonatal birth weight.
(f) Small for gestational age/FGR/other complications.
(g) NICU admissions.

Umbilical coiling index was considered low if below the 10th percentile and high if above 90th percentile, and normal [10th and 90th] percentile was calculated for each parameter using the data collected in the study.

Statistical Analysis:

The data was analysed using t test and Chi square test and multivariate regression tests.

RESULTS:

302 antenatal women were enrolled for the study but 12 women were lost to follow up, so remaining 290women were

considered for the study. 146 (50.9%) women were primigravidas and 144 (49%) women were multigravidas p = 0.054 (NS).Women were grouped into Hypocoiled 58 (20.5%), normocoiled 135 (46%), and hypercoiled group 97 (33.3%). Mean maternal age was 22.9 ± 4.41umbilical coiling index (aUCI) was 0.43 ± 0.30 in (normocoiled group), 0.18 ± 0.4 (hypocoiled), and 0.53 ± 0.05 (hypercoiled group). The average gestational age at delivery in hypocoiled group was 36.8 ± 2.34 weeks, and it was shorter than 38.3 ± 1.82 weeks of the normocoiled group and 38.9 ± 1.72 weeks of the hypercoiled group, p<0.001 (Table 1). meconium staining associated with hypocoiling and normocoiling was 3 (13.3%) in each group but a significant correlation was found with hypercoiling 15 (73.33%), p<0.001. Abruption was documented in 16 (3.9%) women. Abruption in 11 (75%) women was significantly associated with hypocoiling p<0.001. Normocoiling 2 (12.5%) and hypercoiling 2 (12.5%) had no significant correlation with abruption. Fetal distress was observed in 7 (2.4%) women, and however, no significant correlation was found between intrapartum fetal heart rate abnormalities and abnormal cord coiling. 3 (20%) hypocoiled, 9 (60%) normocoiled, and 3 (20%) hypercoiled group, p = 0.648 (Table 2). 250(86%) women had normal vaginal delivery, and 25 (8.8%) had instrumental deliveries. A significant correlation was found between hypocoiling 17 (66.6%) and instrumental delivery. v2 = 53.74; p<0.001. No association was seen in normocoiled 5 (22.2%) or hypercoiled groups 3 (11.1%). LSCS was not associated with abnormal umbilical coiling index (Table 3)

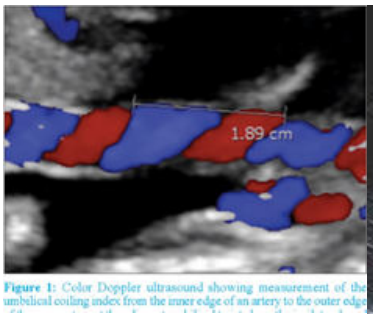

Figure 1: Color Doppler ultrasound showing measurement of the umbilical coiling index from the inner edge of an artery to the outer edge

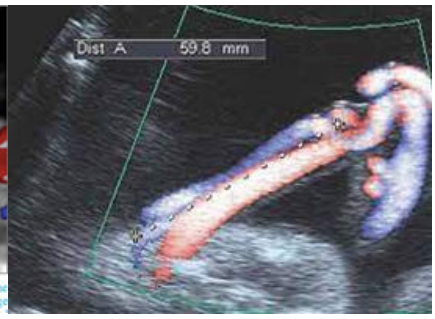

Fig1Measurement of umbilical coiling index

Fig2 large segment of cord without a complete coil

Table 1 Demographic characteristics

	Total	Hypocoiling	Normocoiling	Hypercoiling	Pvalue
N(%)	290 (100%)	58 (20.5%)	135(46%)	97(33.3%)zzz	
Maternal age	22.9 ± 4.41	24.6 ± 4.54	22.7 ± 4.35	23.1 ± 4.31	0.0042
Mean (years)					NS
Parity					0.054
Primi	146 (50.9%)	26 (18.2%)	76 (52%)	44 (30%)	(NS)
Multi	144 (49%)	33 (23%)	57 (40%)	54 (37%)	
aUCI mean –	-	0.18 ± 0.4	0.40 ± 0.30	0.53 ± 0.05	
Gestational age					
at delivery (weeks)	38.21 ± 1.92	36.8 ± 2.34	38.3 ± 1.82	38.9 ± 1.72	

Table 2 Intrapartum characteristics

	Total	Hypocoiling	Normocoiling	Hypercoiling	Pvalue
Meconium	21 (7.3%)	3(13.3%)	3 (13.3%)	15 (73.3%)	p<0.001
Abruption	11 (3.9%)	7 (75%)	2 (12.5%)	2 (12.5%)	p<0.001
Fetal distress	7 (2.4%)	1 (20%)	4 (60%)	2 (20%)	p=0.648

Table 3 Mode of delivery

	Total	Hypocoiling	Normocoiling	Hypercoiling
NVD	250 (86.2%)	40 (15.9%)	119 (47.7%)	91 (36.3%)
Instrumental		17 (66.6%)	5 (22.2%)	3 (11.1%)
delivery	25 (8.8%)	3 (20%)	9 (60%)	3 (20%)
LSCS	15 (4.9%)			

Table 4 Neonatal outcome

	Total	Hypocoiling	Normocoiling	Hypercoiling	Pvalue
Apgar at 5 min					
<7	135(46.5%)	51 (38%)	3 (2%)	81 (60%)	<0.001
>7	155 (53.4%)	10 (6.4%)	132 (85.3%)	13 (8.2%)	
Preterm birth	62 (21.5%)	37 (59%)	15 (25%)	10(15.9%)	<0.001
L.Bwt	78 (26.9%)	54 (69.0%)	17 (21.8%)	7 (9%)	<0.001
Mean B.wt	2055 ± 744	3102 ± 583	3049 ± 564		<0.001
NICU stay					
>24 h	88 (30.3%)	27 (30.6%)	31 (35.4%)	30 (33.8%)	<0.001

Table 5 Sensitivity, Specificity, Predictive values of significant variables

Parameters	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Preterm birth				
Hypocoiled	0.70 (0.61–0.78)	0.88 (0.85–0.91)	0.70 (0.61–0.78)	0.88 (0.85–0.91)
Hypocoiled	0.30 (0.19–0.45)	0.58 (0.56)	0.10 (0.06–0.152)	0.84 (0.81–0.87)
Low B.wt				
Hypocoiled	0.76 (0.7–0.80)	0.96 (0.93–0.98)	0.90 (0.83–0.95)	0.88 (0.86–0.91)
Hypocoiled	0.46 (0.37–0.55)	0.76 (0.72–0.80)	0.45–0.54 (0.36–0.54)	0.77(0.73-0.81)

NICU stay <24 h				
Hypocoiled	0.46 (0.37–0.55)	0.76 (0.72–0.80)	0.45 (0.36–0.54)	0.77 (0.73–0.81)
Hypocoiled	0.49 (0.39–0.58)	0.61 (0.57–0.64)	0.31 (0.25–0.37)	0.77 (0.73–0.81)

Hypocoiling was significantly linked to preterm births p<0.001. Mean birth weight observed was 2055 ± 744 (hypocoiled group), 3049 ± 564 (hypercoiled), and 3102 ± 583 (normocoiled) p<0.001. A strong association was found between hypocoiling and low birth weight. 54 (69%) low birth weight babies belonged to hypocoiled, 17 (21.8%) normocoiled, and 7 (9%) hypercoiled groups, p<0.001 (Table 4). Apgar less than 7 at 5 min was documented in 135 (46.5%) babies. 51 (38%) in hypocoiled and 3 (22.1%) in normocoiled groups. There was a significant correlation between hypercoiling 81 (60%) and low Apgar, p<0.001. NICU stay beyond 24 h was observed in 88 (30.3%) babies: hypocoiled 27 (30.6%), 31 (35.4%) normocoiled and 30 (33.8%) hypercoiled. Hypocoiling had specificity 0.76 (95% CI 0.72–0.80) and NPV 0.77 (95% CI 0.73–0.81). Hypercoiling had NPV 0.77 (95% CI 0.72–0.81) (Table 5).

DISCUSSION

The umbilical coiling index has been found to be an effective indicator of perinatal outcome.

Our study showed that meconium staining found a significant correlation with hypercoiling and abruption with hypocoiling, no significant correlation was found between intrapartum fetal heart rate abnormalities and abnormal cord coiling.

Significant correlation found between hypocoiling and instrumental delivery.LSCS not found association with abnormal coiling index.Strong association of hypocoiling with low birth wt. significant association between hypercoiling and low apgar Sharma et al. studied the association between antenatal umbilical coiling index (a UCI) and perinatal outcome. Thus, the study concluded that abnormal coiling is strongly correlated with low birth weight.

Tahmasebi and Alighanbari Department of radiology, Jundishapur medical university, Ahvaz, Iran conducted a study of evaluation of umbilical cord thickness, cross-sectional area and coiling index as predictors of pregnancy outcome. A statistically significant correlation was observed between small umbilical cord thickness, cross-sectional area and low birth weight.

Jo et al. also observed, preterm delivery was significantly increased in pregnant women who showed the hypocoiling (OR 9.6, 95% CI 2.0944.07), and low birth weight and admission to NICU were not statistically significant.

Goynumer et al. found significant differences in mean gestational age, mode of delivery, birth weight, and adverse perinatal outcome between fetuses with umbilical cord thickness below 5th centile (lean umbilical cord) vs those with umbilical cord thickness above the 95th percentile (non-lean cord) in the first and early second trimester of gestation

CONCLUSION

Abnormal umbilical cord coiling index, detected at the fetal ultrasound anatomic survey in the second trimester (16–20 weeks), is associated with a higher prevalence of fetuses at risks. This observation can be used potentially as a screening or a predictive tool for adverse antenatal or perinatal events so that appropriate preventive measures could be employed for the birth of a healthy baby.

REFERENCES

1. Sharma B, Bhardwaj N, Gupta S et al. Association of umbilical coiling index by colour Doppler ultrasonography at 18 to 22 weeks of gestation and perinatal outcome. J Obstet Gynecol India. 2012;62(6):650–4.
2. Muckle C, Feinberg E. Developmental abnormalities of the female reproductive organs. Glob Libr Women's Med. (ISSN: 1756-2228) 2008; doi:10.3843/GLOWM.10002.
3. De Laat MW, Nikkels PG, Franx A, Visser GH. The roach muscle bundle and umbilical cord coiling. Early Hum Dev. 2007;83:571–4.
4. Diwakar RK, Naik MM, Jindal MM. Umbilical cord coiling: case report and review of literature. BJR Case Rep. 2016;2:20150152.
5. Proctor LK, Fitzgerald B, Whittle WL, et al. Umbilical cord diameter percentile curves and their correlation to birth weight and placental pathology. Placenta. 2013;34(1):62–6.
6. Abdulrasul EA. Umbilical coiling index as a predictor of adverse perinatal outcome. Int J Adv Res. 2014;2:101–7.
7. Chitra T, Sushanth YS, Raghavan S. Umbilical coiling index as a marker of perinatal outcome: an analytical study. Obstet Gynecol Int 2012; 2012. Article ID 213689. doi:10.1155/2012/213689.
8. Sebire NJ. Pathophysiological significance of abnormal umbilical cord coiling index. Ultrasound Obstet Gynecol. 2007;30:804–6.
9. Clerici G, Antonelli C, Rizzo G, Kanninen TT, Di Renzo GC. Atypical hemodynamic pattern in fetuses with hypercoiled umbilical cord and growth restriction. J Matern Fetal Neonatal Med. 2013;26(6):558–62