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CORRELATION OF ANTENATAL UMBILICAL ARTERY COILING INDEX AT SECOND TRIMESTER ULTRASOUND SCAN WITH PERINATAL FETAL OUTCOME

Radio-Diagnosis

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ABSTRACT

Aims and Objectives: To evaluate the perinatal fetal outcome in correspondence with the second-trimester scan umbilical artery coiling index in uncomplicated singleton pregnancies. **Methods:** Participants were recruited in the ultrasound unit at the Vani-Vilas hospital, Bangalore medical college & research institute All ultrasound examinations were performed using a 6-MHz transabdominal transducer, with multihertz and harmonic capability.The evaluation of the umbilical cord mid-segment (free loop) that included recording of longitudinal cord images for the assessment of cord coiling. The antenatal UCI was calculated as the reciprocal of the distance between a pair of coils.After calculating the UCI, perinatal factors like meconium staining, fetal weight and Apgar score were followed till discharge. For the classification of newborns as SGA, gestational age-specific centiles were used. **Results:** The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of abnormal coiling for predicting SGA were 20%, 75%, 9.8%, and 87.4%, respectively.The odds ratio (OR) for the association between abnormal coiling index versus SGA at birth was 0.7 (95% CI: 0.3–1.6, P = 0.445. There was no significant change in the above estimate with an OR of 0.6 (95% CI: 0.32–1.4, P = 0.26). Total of 19 cases which had meconium liqour, 3 (20.0%) had normocoiling, 14 (74%) had hypocoiling, 2 (4%) had hypercoiling. 135(88.0%) cases did not have meconium stained liquor. Out of them 116(95.4%) had normocoiling, 7 (26%) had hypocoiling and 12 (96.0%) had hypercoiling, which was statistically strongly significant with P value being <0.001 (P <0.01) is strongly significant. Meconium staining was more in the hypocoiled group. Apgar score at 1 minute and 5 minutes of < 7 was found with UCI which was < 10th percentile. **Conclusion:** The abnormal umbilical coiling index is associated with adverse perinatal outcomes. UCI which is < 10th percentile is termed as hypocoiling and it is associated with meconium staining and low Apgar scores. Therefore, an antenatal detection of the coiling index can identify fetuses who are at risk and thus help in further management.

KEYWORDS

Umbilical cord coiling index, Hypercoiling umbilical cord, Hypocoiling umbilical cord

INTRODUCTION

Coiling of the umbilical cord has been the subject of anatomical and sonographic study. In modern literature, Edmonds was the first to consider the anatomy and described it as an "index of twist".[1]

Based on a concept that abnormal vasculogenesis and/or development of the Wharton's jelly ground substance might be a marker for adverse fetal growth and obstetric outcomes, several studies of cords examined postnatally have explored possible associations between coiling and outcomes.

As a basis for such studies, the normal range for coiling at birth following uncomplicated singleton pregnancies was established Extending the concept into the antenatal period, a detailed review considered the development and structure of the umbilical cord and examined the rationale and potential to take advantage of sonography to identify abnormal coiling in utero as a marker of fetal compromise. The antenatal umbilical coiling index (UCI) is calculated as the reciprocal value of the distance between a pair of coils[2]

UCI = 1/DISTANCE IN CMS

An antenatal UCI below the 10th or above the 90th centile has been reported to be associated with a higher prevalence of non-reassuring fetal status in labor and small-for-gestational-age SGA neonates.4

The aim of this study was to evaluate whether a relationship exists between aberrant umbilical coiling patterns in the second trimester and to elucidate a possible mechanism that associates antenatal UCI with adverse perinatal outcomes.

AIMS AND OBJECTIVES:

To evaluate the perinatal fetal outcome in correspondence with second-trimester scan umbilical artery coiling index in uncomplicated singleton pregnancies

METHODOLOGY

Source Of Data:

Participants were recruited in the ultrasound unit at the Vani-Vilas hospital, Bangalore medical college & research institute

Study Design: This was a prospective study.

Study Period: Jul 2021 to Dec 2021

Sample Size: 154 cases.

All ultrasound examinations were performed using a 6-MHz transabdominal transducer, with multihertz and harmonic capability. The evaluation of the umbilical cord mid-segment (free loop) that included recording of longitudinal cord images for the assessment of cord coiling.

The antenatal UCI was calculated as the reciprocal of the distance between a pair of coils.

After calculating the UCI, perinatal factors like meconium staining, fetal weight and Apgar score were followed till discharge. For the classification of newborns as SGA, gestational age-specific centiles were used. The mean antenatal UCI was 0.40 with 10th and 90th centiles of 0.20 and 0.60, respectively[3] ANTENATAL UCI = 1/DISTANCE IN CMS [2]

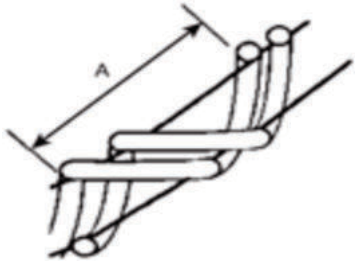


Figure 1. The distance between the coils was measured from the inner edge of an arterial wall to the outer edge of the same artery along the ipsilateral side of the umbilical cord.

Statistical Analysis

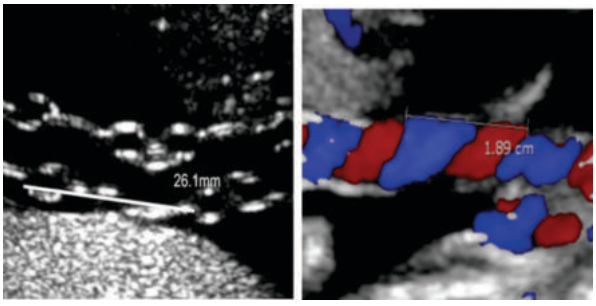
Data were entered and managed in the Microsoft Excel 2010 spreadsheet. Variables were tabulated and summarized into means or

medians for continuous variables and percentages for categorical variables.

The baseline characteristics of maternal age and parity were compared between groups with normal and abnormal cord coiling to ascertain their comparability.

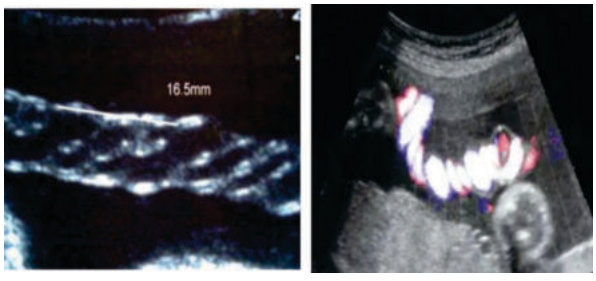
The prevalence of SGA and preterm birth was calculated and presented as a percentage for each group with the relative risk and associated 95% CI. The sensitivity, specificity, and predictive value of UCI for SGA and preterm birth were estimated as a guide to the potential clinical usefulness of the index.

Furthermore, the risk differences between the two groups were adjusted for potential differences in their baseline characteristics. Chi-square test was used to determine the significance of differences between categorical variables and t-test was used to compare means, all using a 5% significance level.



2A. Normal Umbilical artery

2B. Hypocoiled Umbilical artery



2C. Hypercoiled Umbilical artery

Figure 2 – Gray scale and Color Doppler ultrasound images of A. Normal, B. Hypocoiled and C. Hypercoiled Umbilical artery.

RESULTS:

Of the 200 patients initially included, 32 were excluded from the study on the basis of

- Delivery at other institutions (17 patients)
- Multifoetal gestation (08 patients)
- Presence of gross fetal anomalies (04 patients),
- Presence of two-vessel umbilical cord (03 patients).
- Inadequate sonographic umbilical cord image, and/or all maternal demographic, antenatal and labor data and Intrauterine death were excluded (14 patients)

Thus 154 patients formed the final study group. The mean+/- SD gestational age at the time of the fetal anatomical ultrasound survey was 20.3 +/- 0.9 weeks and the mean maternal age was 24.4+/- 4.2 years. The majority of patients delivered at term, and the mean gestational age at delivery was 39.5+/- 1.8 (range, 30–41) weeks of gestation.

The mean antenatal UCI was 0.40 with 10th and 90th centiles of 0.20 and 0.60, respectively.

Table 1- Maternal demographic and neonatal birth-weight data stratified according to antenatal umbilical cord coiling index results

CHARECTERISTIC (MEAN+/-SD)	UMBILICAL ARTERY COLILING		
	HYPOCOILING (<10 CENTILE)	NORMOCOILING	HYPERCOILING (>90 CENTILE)
N	21	119	14
MATERNAL AGE (YRS)	24.8+/-4.2	25.6+/-5.0	25.8+/-5.1
GESTATIONAL AGE AT ULTRASOUND(WKS)	20.7+/-0.4	20.2+/-0.8	20.1+/-0.7
GESTATIONAL AGE AT DELIVERY(WKS)	39.5+/-1.2	39.3+/-1.7	39.4+/-1.1

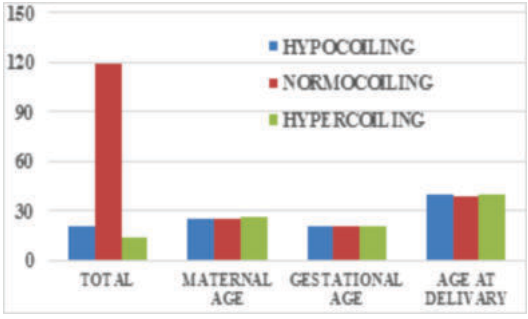


Figure 3– Graph demonstrates the maternal demographic data stratified according to the antenatal UCI. There was no significant difference between the groups when stratified by umbilical cord coiling.

1. Correlation of Weight for Gestational age at birth and antenatal UCI Category

WEIGHT FOR GESTATIONAL AGE AT BIRTH	ANTENATAL UMBILICAL ARTERY COILING INDEX CATEGORY			
	HYPOCOILING	NORMAL	HYPERCOILING	TOTAL
SMALL	10	6	4	23
NORMAL	9	99	8	113
LARGE	2	14	2	18
TOTAL	21	119	14	154

Table 2 - Using the intergrowth newborn weight for gestational age standards, 23 (14.9%) of the neonates were classified as SGA, 113(73.4%) as normal for gestational age (NGA), and 18(11.6%) as large for gestational age (LGA). The distribution of the SGA, NGA, and LGA in the normocoiled, hypocoiled, and hypercoiled groups is shown.

The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of abnormal coiling for predicting SGA were 20%, 75%, 9.8%, and 87.4%, respectively. The odds ratio (OR) for the association between abnormal coiling index versus SGA at birth was 0.7 (95% CI: 0.3–1.6, P = 0.445). After adjusting for potential confounders using multivariable logistic regression models, there was no significant change in the above estimate with an OR of 0.6 (95% CI: 0.32–1.4, P = 0.26).

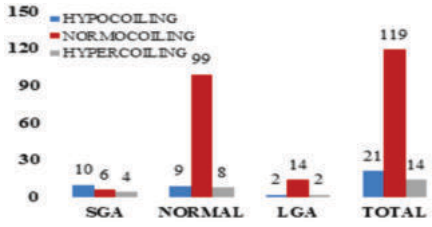


Figure 4 – Graph showing the distribution of the SGA, NGA, and LGA

in the normocoiled, hypocoiled, and hypercoiled groups is shown.

2. Correlation of antenatal UCI Category and Meconium stained liquor

Out of 154 cases studied 19 (12.4%) had meconium stained liquor.

Out of 19 cases, 3 (20.0%) had normocoiling, 14 (74%) had hypocoiling, 2 (4%) had hypercoiling. 135(88.0%) cases did not have meconium stained liquor. Out of them 116(95.4%) had normocoiling, 7 (26%) had hypocoiling and 12 (96.0%) had hypercoiling, which was statistically strongly significant with P value being <0.001 (P <0.01) is strongly significant. Meconium staining was more in the hypocoiled group

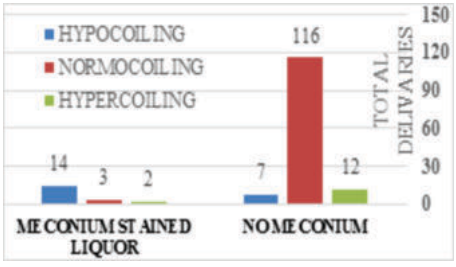


Figure 5 – Graph showing the distribution of the Meconioum stained liquour in the hypocoiled, normocoiled and hypercoiled groups is shown.

3. A) The correlation of Apgar score at 1 minute with UCI -

Out of total 107 patients who had their Apgar score >7 , 91 had normal UCI, 5 had hypo coiling while 11 had hyper coiling. In Apgar score <7 at 1 , minute out of total 47 (30.4%) patients, 28 had normal UCI while 16 had hypo coiling and 3 patients had hyper coiling. On applying chi square test, the difference was found statistically highly significant (p<0.001).

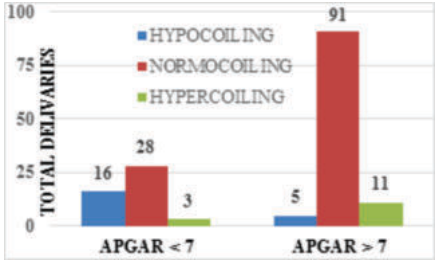


Figure 6 – Graph showing the distribution of the APGAR score at 1 minute in the hypocoiled, normocoiled and hypercoiled groups is shown.

3. B) Correlation of Apgar score at 5 minute with UCI-

Out of total 106 patients who had their Apgar score >7, 90 had normal UCI, 6 had hypo coiling while 10 had hyper coiling. In Apgar score <7 at 5 minute, out of total 48 patients, 29 had normal UCI while 15 had hypo coiling and 4 patients had hyper coiling. On applying chi square test, the difference was found statistically highly significant (p<0.001).

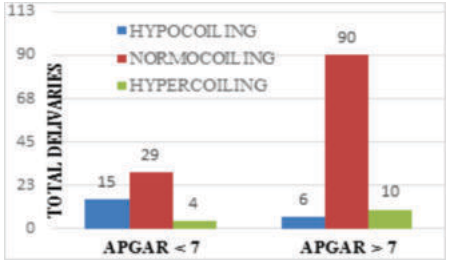


Figure 7 – Graph showing the distribution of the APGAR score at 5 minutes in the hypocoiled, normocoiled and hypercoiled groups is shown.

DISCUSSION -

In the past, few studies have correlated the relationship between perinatal outcomes and the UCI. In the present study, UCI was compared with various parameters such as Gestational weight, meconium staining and APGAR score.

In the present study, it was observed meconium staining was significantly associated with UCI which was <10th percentile. Previous studies by Gupta S et al., studied 107 umbilical cords and found that in hypocoiled group, meconium staining was significantly higher than in those with normocoiled group. [5] Strong TH et al., studied 100 cases and they found that meconium staining was associated with UCI values of less than 10th percentile, with a p value of 0.03, which was highly significant [6]. In another study which was done by Padmanabhan LD et al., 130 cases were studied, where they found that meconium staining was significant in hypercoiled group [7].

In the present study, Apgar score at 1 minute and 5 minutes of < 7 was found with UCI which was < 10th percentile. This was explained by an experiment by Georgious et al. in which venous perfusion was measured in cords subjected to standardized tight encirclement force. A significant inverse relationship was found between coiling index and the minimum weight required to occlude venous perfusion. So, hypocoiling may give way to kinking and compression, whereas, hypercoiling may give way to occlusion in cases with cord entanglement. This may help to explain, the association with low Apgar score in hypocoiled cords. [9]

Monique WM et al., studied 885 cases and found that hypocoiling was associated with low Apgar scores [8]. Gupta S et al., studied 107 cords and found that babies with Apgar scores of < 7 had significantly lower UCIs than the babies with Apgar scores of > 7 [5]. Padmanabhan LD et al., studied 130 umbilical cords and found that hypocoiled group was associated with low Apgar scores of < 7 [7] However with present study no statistical significance was noted with the antenatal umbilical cord coiling index and fetal weight with respect to its gestational age with insignificant p value. However past studies conducted by Monique et al. who studied 885 cases, found that hypo-coiling was associated with small for gestational age infants. Georgiou et al. studied 34 cases and found that IUGR was found in hyper-coiled group. In study by Patil NS et al. UCI which is > 90th percentile was associated with foetal growth restriction [10].

CONCLUSION

The abnormal umbilical coiling index is associated with adverse perinatal outcomes. UCI which is < 10th percentile is termed as hypocoiling and it is associated with meconium staining and low Apgar scores. Therefore, an antenatal detection of coiling index can identify fetuses who are at risk and thus help in further management.

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