



## STUDY THE ASSOCIATION BETWEEN ANTENATAL UMBILICAL CORD COILING INDEX AND PERINATAL OUTCOME

### Obstetrics & Gynaecology

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### ABSTRACT

**Background:** Umbilical cord is a vital structure of maternal-fetal life that can be used to evaluate pregnancy outcomes. The various studies reported that the abnormal umbilical coiling index (UCI) is associated with adverse perinatal outcomes. The present study was designated to study the association between UCI and perinatal outcomes. **Methods:** This was an observational, prospective study included 120 antenatal women between 18-24 weeks of gestation from the period of 7th June 2019 to 31st May 2020. UCI was measured by ultrasound, based on ultrasound subject were divided in to Hypercoiled, Hypocoiled and Normocoiled groups. All subjects were followed up till delivery and pregnancy outcomes were noted. **Results:** The majority of subjects (78.33%) belonged to Normocoiling group, 13.33% belonged to Hypocoiling group and 8.33% belonged to Hypercoiling group. Abnormal perinatal outcome was significantly higher among subjects with Hypercoiled (8.33%) and Hypocoiled (16.33%) cords. There was statistically significant correlation ( $P=0.000$ ,  $P=0.018$ ) of Hypercoiled UCI with IUGR and LBW respectively as compared to Hypocoiled and Normocoiled UCI. There was statistically significant correlation of Hypocoiled UCI with pre-term delivery ( $P=0.000$ ), MSL ( $P=0.000$ ), Fetal distress ( $P=0.000$ ), Low APGAR at 5min ( $P=0.037$ ), NICU admissions ( $P=0.0018$ ) as compared to Hypercoiled and Normocoiled UCI. Statistically significant difference was found in parity of the subjects of different UCI groups ( $P=0.01$ ). **Conclusion:** Antenatal UCI is an important parameter to be studied during second trimester which may help to screen patients at risk of adverse perinatal outcome and therefore needs to be monitored vigilantly for development of complications and timely interference to improve perinatal outcome.

### KEYWORDS

Umbilical cord; Coiling index; Hypocoiled; Hypercoiled; Normocoiled; Meconium-stained liquor; APGAR score

### INTRODUCTION

The umbilical cord is the essential lifeline of the foetus as it supplies water, nutrients, and oxygen. It is a tri-vascular conduit which allows the fetal blood to flow in to and from the placenta. The trivascular conduit is well protected by Whartons jelly, amniotic fluid and the helical pattern, or coiling of the umbilical cord vessels. Coiling makes the umbilical cord more flexible and stronger and also provides resistance to the external force that could compromise the blood flow to the foetus [1]. The coiling property of umbilical cord was first described by Berengarius in 1521 and first quantified by Edmonds in 1954 [2]. The term umbilical cord coiling index was introduced by Strong et al [3]. An abnormal umbilical coiling index includes both hypo coiled cord and hyper coiled cord. The term "hypocoiling of the cord" refers to abnormal decrease in the coiling of the umbilical cord with an UCI < 10th percentile and "hypercoiling" refers to the abnormal increase in coiling of the cord with an UCI > 90th percentile [4].

The coiling of the umbilical cord is thought to increase the cord's ability to withstand external forces such as tension, compression, stretching, and entanglement and also enhances flexibility. The tensile strength of the cord is directly proportional to the birth weight of the baby by approximately 2.5 times. Umbilical cord without coils appears in about 5% of fetuses, and this seems to put the fetus at increased risk for adverse outcomes such as stillbirth, fetal growth retardation, oligohydramnios, meconium-stained amniotic fluid, low Apgar scores, and intrapartum fetal distress [5].

Normal coiling index is approx 1 coil/5 cm of umbilical cord length. Antenatal UCI is calculated as a reciprocal value of the distance between a pair of coils 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 placental end to foetal end [6].

The final value is the average of three readings at different segments of umbilical cord. It is assumed that the umbilical coiling is completely developed by the end of first trimester and does not change thereafter but rather that the cord lengthens between the established coils [2], the true UCI should be predictable from the ultrasonography assessment in the second trimester [7]. Studies have established correlation between second trimester Umbilical coiling index (UCI) with adverse

perinatal outcome. The present study was conducted to study the association between umbilical cord coiling index at 18-24 weeks Period of gestation and perinatal outcome.

### MATERIALS AND METHODS

This hospital based prospective observational study was conducted in Department of Obstetrics and Gynaecology of Shri Balaji Institute of Medical Sciences Pvt. Ltd., Mowa, Raipur during a period from June 2019 to May 2020. A total of 120 pregnant women (singleton pregnancy primigravida and multigravida) attending the antenatal clinic of the hospital between 18 to 24 weeks of gestation and patients willing for monthly follow up and delivery at the same hospital were randomly selected for the study. Women with multiple gestation, malformed fetus, single umbilical artery, pregnant women with associated medical illness like diabetes, chronic hypertension, renal disorders, thrombophilia and patients' refusal to participate in study were excluded.

Patient information sheet was provided to all the subjects and written informed consent was taken. A detailed history was taken including menstrual, obstetric and family history. Thorough general physical examination along with detailed systemic and obstetric examination was done. Apart from routine antenatal investigations, umbilical cord coiling index between 18-24 weeks of pregnancy using ultrasound was measured. The coiling index was measured using 3.5 MHz transabdominal transducer. Longitudinal images of the umbilical cord were taken. That part of the cord which was freely floating in the amniotic fluid was taken, and the coiling index was calculated using the method suggested by Degani et al []. The distance between the coils was measured, along 1 side of the umbilical cord from outer edge of the arterial or venous wall to the next coil. The reciprocal of this distance in cm gives the antenatal coiling index. Depending on the UCI, study subjects were grouped as: 1) Normocoiled; 2) Hypocoiled: It is defined as UCI < 10th percentile [8-10] and 3) Hypercoiled: It is defined as UCI > 90th percentile [8-10].

Comparative analysis was done between study groups- Normocoiled, Hypocoiled and Hypercoiled cords. All subjects were followed up till delivery and at the end of pregnancy outcomes were noted. The fetal outcome variables in relation to different UCI groups were noted were gestational age at delivery, LBW, IUGR, meconium-stained liquor, fetal distress, APGAR score at 1 and 5 minutes, mode of delivery and

NICU admissions. The babies being admitted to NICU for various reasons like respiratory distress, low birth weight and prematurity were noted.

**Statistical Analysis**

Statistical analysis was done using descriptive and inferential analysis. Continuous variables were presented as mean±SD, and categorical variables were presented as absolute numbers and percentage. To establish association tests namely chi square test, t test and odds ratio were used. Statistical package for the social science system SPSS© for windows TM Vs 20, IBM TM Corp NY and Microsoft excel TM 2007, Microsoft ® Inc USA was used to perform the statistical analysis and results were tested at 5% Level of significance and Graph pad prism 5.0 version. Level of significance P value <0.05 was considered as statistically significant.

**OBSERVATIONS AND RESULTS**

Out of total 120 subjects, majority of the subjects 94 (78.33%) had Normocoiling of the cord, 16 (13.33%) had Hypocoiling of the cord while only 10 (8.33%) had Hypercoiling of the cord. It was observed that incidence of hypercoiling 7 (70%) and hypocoiling 12 (75%) of the cord was higher in the age group of 18-20 years. Whereas incidence of normocoiling of the cord 70 (74.47%) was higher in the age group of 21-30 years. Statistically significant difference was found in the parity of the subjects of different UCI groups (P=0.01). There was statistically significant correlation of Hypocoiled UCI (<90th percentile) with pre-term delivery (P= 0.000) and MSL (P=0.000) as compared to Hypercoiled and Normocoiled UCI. While no statistical association was found between abnormal UCI and mode of delivery (P= 0.057) as shown in table 1.

**Table 1: Association of UCI with demographic and obstetric characteristics**

Characteristics		Hypercoiling	Hypocoiling	Normocoiling	P value
Age group (Years)	18-20	07 (70%)	12 (75%)	13 (13.83%)	0.000 S
	21-30	02 (20%)	02 (12.50%)	70 (74.47%)	
	31-36	01 (10%)	02 (12.50%)	11 (11.70%)	
	Mean ± SD	21.6±5.7	21.9±6.1	25.7±4.2	
Gravida	Primigravida	03 (30%)	05 (31.25%)	60 (63.82%)	0.010 S
	Multigravida	07 (70%)	11 (68.75%)	34 (36.2%)	
Mode of delivery	NVD	03 (30%)	04 (25%)	50 (53.19%)	0.057 NS
	LSCS	07 (70%)	12 (75%)	44 (46.81%)	
Gestational age at delivery	Term	07 (70%)	07 (43.75%)	92 (97.87%)	0.000 S
	Pre-term	03 (30%)	09 (56.25%)	02 (2.13%)	
MSL	Present	02 (20%)	12 (75%)	08 (8.51%)	0.000 S
	Absent	08 (80%)	04 (25%)	86 (91.49%)	

MSL- Meconium-stained liquor

Abnormal perinatal outcome was significantly higher among subjects with Hypercoiled (8.33%) and Hypocoiled (16.33%) cords. There was statistically significant correlation (P=0.000, P=0.018) of Hypercoiled UCI (>90th percentile) with IUGR and LBW respectively as compared to Hypocoiled and Normocoiled UCI. There was statistically significant correlation of Hypocoiled UCI (<90th percentile) with Fetal distress (P=0.000), Low APGAR at 5min (P=0.037) and NICU admissions (P=0.0018) as compared to Hypercoiled and Normocoiled UCI. No statistical association was found between abnormal UCI and Low APGAR at 1min (P=0.255), (Table 2).

**Table 2: Association of UCI with Neonatal characteristics**

Characteristics		Hypercoiling	Hypocoiling	Normocoiling	P value
Birth weight (Kg)	<2.5	06 (60%)	06 (37.5%)	20 (21.28%)	0.018 S
	≥2.5	04 (40%)	10 (62.5%)	74 (78.72%)	

IUGR	Yes	07 (70%)	02 (12.50%)	05 (5.32%)	0.000 S
	No	03 (30%)	14 (87.50%)	89 (94.68%)	
APGAR score at 1min	<7	02 (20%)	06 (37.5%)	18 (19.15%)	0.255 NS
	≥7	08 (80%)	10 (62.50%)	76 (80.85%)	
APGAR score at 5min	<7	01 (10%)	06 (37.5%)	12 (12.77%)	0.037 S
	≥7	09 (90%)	10 (62.5%)	82 (87.23%)	
Fetal distress	Yes	05 (50%)	11 (68.75%)	12 (12.77%)	0.000
	No	05 (50%)	05 (31.25%)	82 (87.23%)	
NICU admission	Yes	02 (20%)	08 (50%)	12 (12.77%)	0.0018
	No	08 (80%)	08 (50%)	82 (87.23%)	

**DISCUSSION**

In the present study, the majority (78.3%) of patients belonged to Normocoiling group which was similar to studies conducted by Rahi S et al [11], Ndolo JM et al [12] and Najarajan G et al [13]. There was no major difference in the incidence of Hypercoiling and Hypocoiling of cord. Overall, the majority (61.67%) of study subjects fall under 21-30 years of age group with mean age of 24.87±4.86 years. Hypocoiling was significantly associated with 18-20 years of age (75%) as compared to Hypercoiling and Normocoiling. Whereas majority (74.47%) of study subjects belonged to Normocoiling group were in 21-30 years of age group. It is observed that incidence of abnormal UCI was higher in younger age group (18-20 years). Whereas other studies [10, 13] found that abnormality of UCI increases with increasing maternal age.

Most of the patients (56.7%) were primigravida which was similar to the studies conducted by Patil NS et al [14] and Satoskar P et al [15]. The abnormal UCI was associated with Multiparity. Among multipara group 70% belonged to Hypercoiling group and 68.75% belonged to Hypocoiling group, whereas only 36.2% belonged to Normocoiling group. The difference was statistically significant with P value of 0.010. However, the majority of primigravida belonged to Normocoiled group (63.82%) which was similar to a study conducted by Najarajan G et al [13] and Satoskar P et al [15]. 63(52.5%) study subjects underwent LSCS for various indications. The incidence of LSCS was higher among abnormal UCI group which was 75% in Hypocoiling and 70% in Hypercoiling group whereas NVD was comparatively higher among Normocoiling (53.2%) group. There was no statistically significant association between UCI and mode of delivery (p=0.057) which is comparable with the other studies [13, 14]. The reason behind higher incidence of LSCS among abnormal UCI group was various maternal and fetal complications seen in these study subjects. Preterm delivery was significantly associated with Hypocoiling (56.2%) of the cords with P value of 0.000. Similar results were found in study conducted by Najarajan G et al [13] and Bhojwani P et al [16]. 18.33% of study subjects had Meconium-stained liquor of which majority (75%) belonged to Hypocoiling group. This shows statistically significant association between MSL and Hypocoiling with P value of 0.000 which is comparable with the previous studies [11, 14-16].

In the current study, it was observed that LBW was significantly associated with Hypercoiling of the umbilical cord (60%) with P value of 0.018. Similar results were seen in studies conducted by Rahi S et al [11] and Tripathy S et al [17]. However, the authors were unable to give a satisfactory explanation for this causal association. Also, we found a significant association between Hypercoiling and FGR (70%) with P value of 0.000 which is comparable with the earlier studies [11, 14, 16]. 20.83% babies had low APGAR at 1 min of which 37.5% of the babies were born to mothers who had Hypocoiled umbilical cords compared to Hypercoiled cords (20%) and Normocoiled cords (18.10%). There was no association between low APGAR at 1min and abnormal UCI with P value of 0.255. Similar results found in study conducted by Satoskar P et al [15]. 15.83% babies had low APGAR at 5 min of which 37.5% of the babies were born to mothers who had Hypocoiled umbilical cords. Thus, low APGAR score at 5 min was significantly associated with Hypocoiling of the umbilical cords with P value of 0.03. These findings are in accordance with the previous studies [11, 14, 17]. 23.33% subjects had fetal distress of which majority (68.75%) had Hypocoiling of the umbilical cord. Present study concludes fetal distress was significantly associated with Hypocoiling of the cord with P value of 0.000 which is comparable with the study done by Najarajan G et al [13]. It is believed to be due to the ability of the cord to resist vascular compression or torsion [18]. Hypocoiled cords are more prone to compression hence compromising the fetoplacental circulation. 18.33% babies born required NICU admissions for various

reasons like low APGAR score, MSL, fetal distress. Of which 50% of the babies were born to mothers with Hypocoiled cords. This shows statistically significant association between NICU admissions and Hypocoiled cords with P value of 0.001. These results are correlated with the study conducted by Patil NS et al [14] and Bhojwani P et al [16]. Thus, abnormal UCI was associated with several adverse neonatal outcomes. The association shows wide variations among the various studies done so far. Antenatal study of UCI should be further pursued to confirm diagnosis at an earlier gestational age to minimize fetal complications and improve perinatal outcome.

## CONCLUSION

The antenatal umbilical cord coiling index is an important parameter to be studied during second trimester which may help to screen patients at risk of adverse perinatal outcome and therefore need to be monitored vigilantly for development of complications and timely interference to improve perinatal outcomes.

## Recommendations

Further research with larger sample size recommended for substantiation of the results. We recommend screening of antenatal women, between 18 to 24 weeks of gestation with umbilical cord coiling index along with anomaly scan. In current study both Hypercoiling and Hypocoiling was found to be associated with adverse perinatal outcome. Therefore, high index of suspicion for development of complications would help in early diagnosis. Adverse impact of abnormal UCI on perinatal outcomes warrants vigilant fetal monitoring and timely intervention to improve perinatal outcomes. However, in the present study neonates of subjects with Hypocoiling of the cord had increased incidence of Preterm delivery, LBW, Fetal distress, MSL and Low APGAR at 1 & 5 minutes, we recommend that these patients should preferably delivered in a center where continuous electronic fetal monitoring and neonatal care facilities are available.

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