

# Evaluation of Umbilical Coiling Index and Perinatal Outcomes: A Prospective Analysis

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**Abstract:** ***Objectives:** To evaluate the perinatal outcome with the abnormal umbilical cord coiling index. **Study Design:** This prospective study was carried out in the Department of OBG at Dr RPGMC Kangra at Tanda, Himachal Pradesh, India. Six-hundred women who were in active labour with term gestations, irrespective of their parities, and who were either delivered by vaginal or LSCS irrespective of type of anesthesia used were included in the study. Umbilical cord coiling index was calculated and it was correlated with various perinatal parameters like birth weight, meconium stained liquor, Apgar score etc. Odds ratio were calculated. **Results:** There was a significant correlation between the abnormal coiling (UCI >90<sup>th</sup> or <10<sup>th</sup> percentile) with meconium staining ( $p < 0.001$ ), Apgar score at 1 min of <4 ( $p$  value 0.007 and NICU admissions ( $p = 0.003$ ). **Conclusion:** Abnormal coiling is associated with meconium stain, Apgar score and NICU admissions*

**Keywords:** Umbilical cord coiling index, Hypercoiling umbilical cord, Hypocoiling umbilical cord, LSCS, Anesthesia

## 1. Introduction

Umbilical cord is vital to the development, well-being, and survival of the fetus, yet this is vulnerable to kinking, compressions, traction, and torsion which may affect the perinatal outcome. Mathematically, the vessels of the cord are wound as cylindrical helices, rather than spirals, but both terms are used interchangeably to avoid confusion.<sup>1</sup> The coiling of the umbilical vessels develops as early as 28 days after conception and is present in about 95% of fetuses by 9 weeks of conception. The helices may be seen by ultrasonographic examination as early as during the first trimester of pregnancy.<sup>2</sup>

The number of twists seen in first trimester is roughly the same as that seen in term cords. The total number of coils seen is between 0 and 40. Umbilical coiling appears to confer turgor to the umbilical unit, producing a cord that is strong, yet flexible. Since lengthening of the cord occurs from the fetal end, perhaps coiling of the cord represents a long-term record of fetal well-being.<sup>3</sup>

A coil is of 360-degree spiral course of umbilical vessels. Umbilical cord index (UCI) is defined as the total number of coils divided by the total length of the cord in centimeters. A frequency distribution of umbilical cord index (UCI) was done by Rana et al. (1995).<sup>4</sup> They grouped the UCI as follows: <10<sup>th</sup> percentile-hypocoiled; 10<sup>th</sup>- 90<sup>th</sup> percentile normocoiled; >90<sup>th</sup> percentile-hypercoiled.

The difference in coiling was described as a marker identifying fetus at risk. Majority of the studies on UCI have been done postnatally. Although UCI can be calculated antenatally by ultrasonography, limited data is available as to its accuracy. Our present study aimed to evaluate the relationship between UCI, hypo and hypercoiled umbilical cord and maternal age, parity, neonatal weight, amniotic fluid index (AFI), Apgar score, meconium in amniotic fluid and delivery intervention including LSCS under any type of

anesthesia due to foetal distress and maternal diabetes and hypertension.

## 2. Subjects and Methods

This was a prospective study carried out in the Department of Obstetrics & Gynaecology at Dr R.P.G.M.C Kangra at Tanda. Women admitted in labour room /Obstetrics ward irrespective of their parity were included in the study. Subjects were included if healthy women with intrauterine singleton pregnancy, live baby, term gestation (between to 40 weeks), regular antenatal check-up, willing for institutional delivery, maternal age between 20 to 35 years, delivery both vaginal and caesarean section, and/or fetal anatomic survey at 28-32 weeks period of gestation. Following were the exclusion criteria: smoking and drug abuse, ruptured membranes, multi-fetal pregnancy, malpresentation, vaginal bleeding and placenta previa or probable placental abruption, intrauterine fetal death, single umbilical artery, anomalous foetus, and/or preterm deliveries.

Immediately after delivery, the umbilical cord was evaluated for complete vascular coiling and the umbilical cord length was measured with tape, from its insertion into the placenta up to the neonatal umbilicus. A complete vascular coil was defined as a 360-degree complete round coiling of the vasculature, and the total numbers of these complete vascular coils were determined. Then, the total number of vascular coils were divided by the total length of the cord in centimeter in order to determine the umbilical coiling index (UCI). All study subjects were followed till discharge.

### Statistical analysis

Data were presented as mean, standard deviation (SD), frequency, and percentage. Univariate logistic regression analysis was performed to measure odds ratio. The variables with  $P > 0.1$  were entered into multivariate analysis.  $P$  value <0.05 was considered significant. Statistical analysis was performed using SPSS v21.0.

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### 3. Results

#### Coiling

Mean UCI in our study was  $0.32 \pm 0.09$ . In this study, 10<sup>th</sup> percentile and 90<sup>th</sup> percentile of UCI was 0.18 and 0.44. On this basis, 8.7% were hypocoiling and 9.83% were hypercoiling.

#### Association between abnormal coiling and maternal characteristics

Table 1 shows association between abnormal coiling and maternal characteristics. We observed that age  $\geq 35$  years, booking status, multigravida, gestational diabetes and hypertension, and caesarean section (LSCS) were not significantly associated with abnormal coiling ( $P > 0.05$ ).

**Table 1:** Univariate analysis between abnormal coiling and maternal characteristics

|                          | Hypo or Hyper coiling (n=111) | Normocoiling (n=489) | P value | OR (95% CI)      |
|--------------------------|-------------------------------|----------------------|---------|------------------|
| Age (years)<br>$\geq 35$ | 14                            | 66                   | 0.805   | 0.93 (0.50-1.71) |
| Booking status<br>Booked | 2                             | 21                   | 0.231   | 0.41 (0.09-1.77) |
| Parity<br>Multi          | 51                            | 257                  | 0.209   | 0.77 (0.51-1.16) |
| Gestational diabetes     | 1                             | 10                   | 0.430   | 0.43 (0.05-3.44) |
| Gestational hypertension |                               | 15                   | 0.839   | 0.88 (0.25-3.08) |
| Mode of delivery<br>LSCS | 10                            | 63                   | 0.262   | 0.67 (0.33-1.35) |

#### Association between abnormal coiling and maternal characteristics

Table 2 shows association between abnormal coiling and neonatal characteristics.

**Table 2:** Univariate analysis between abnormal coiling and neonatal characteristics

|                           | Hypo or Hyper coiling (n=111) | Normocoiling (n=489) | P value | OR (95% CI)        |
|---------------------------|-------------------------------|----------------------|---------|--------------------|
| Meconium stained<br>Yes   | 39                            | 20                   | <0.0001 | 12.72 (7.02-22.99) |
| Birth weight (Kg)<br><2.5 | 31                            | 100                  | 0.086   | 1.51 (0.94-2.41)   |
| Apgar (1 min)<br>>4       | 103                           | 479                  | 0.007   | 0.269 (0.1-0.70)   |
| Apgar (5 min)<br>>7       | 103                           | 464                  | 0.384   | 0.69 (0.30-1.58)   |
| IUGR<br>Yes               | 29                            | 96                   | 0.130   | 1.45 (0.90-2.34)   |
| NICU admission<br>Yes     | 12                            | 18                   | 0.003   | 3.17 (1.48-6.79)   |

We observed that meconium stained (OR 12.72 [7.02-22.99]), Apgar score at one min (OR 0.269 [0.1-0.70]), and NICU admission (OR 3.17 [1.48-6.79]) were significantly associated with abnormal coiling ( $P < 0.05$ ). Multivariate analysis shows adjusted OR (aOR) of 14.34 of meconium staining with abnormal coiling (Table 3).

**Table 3:** Multivariate logistic regression between abnormal coiling and neonatal characteristics

|                           | aOR   | 95% CI     |
|---------------------------|-------|------------|
| Meconium stained<br>Yes   | 14.34 | 7.27-28.27 |
| Birth weight (Kg)<br><2.5 | 1.08  | 0.63-1.86  |
| Apgar (1 min)<br>>4       | 0.27  | 0.09-1.59  |
| NICU admission<br>Yes     | 1.58  | 0.52-4.79  |

### 4. Discussion

Several studies in the past have evaluated the relationship between perinatal outcomes and the UCI. In the present study, abnormal coiling was compared with various

parameters. On comparing abnormal coiling with parity, it was found that there was no statistical significance between primigravida and multigravida.

In the present study, abnormal coiling was not significantly associated with LSCS. In the present study, it was observed that meconium staining was significantly associated with abnormal coiling. Gupta et al. found that in hypocoiled group, meconium staining was significantly higher than in those with normocoiled group.<sup>9</sup> Strong et al. studied 100 cases and they found that meconium staining was associated with UCI values of less than 10<sup>th</sup> percentile, with a p value of 0.03.<sup>10</sup> Another study by Padmanabhan et al., found that meconium staining was significant in hypercoiled group.<sup>11</sup>

In the present study, Apgar score at 1 min of  $< 4$  was found with abnormal coiling. Gupta et al., studied 107 umbilical cords and found that in hypocoiled cords, low Apgar scores were present.<sup>9</sup> In another study which was done by Padmanabhan et al., 130 umbilical cords were studied and it was found that in hypocoiled group, there were significantly low Apgar scores.<sup>11</sup>

In the present study, Apgar score at 5 min of  $< 7$  in relation to UCI was not significant. Monique et al. studied 885 cases and found that hypocoiling was associated with low Apgar scores.<sup>12</sup> Gupta 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  $> 7$ .<sup>9</sup>

In the present study, it was observed that IUGR was not significantly associated with abnormal UCI. In a study which was done by Monique et al. 885 patients were studied and it was found that hypercoiling was associated with small for gestational age infants.<sup>12</sup> Georgiou et al., studied 34 cords and it was found that hypercoiled cords were associated with IUGR.<sup>13</sup>

In the present study, babies who were admitted to NICU were significantly associated with abnormal UCI. Monique et al. studied 885 cases and it was concluded that hypocoiling of the cord was associated with NICU admissions of foetal death.<sup>12</sup> Strong et al. studied 687 cases and it was found that incidence of foetal death in non coiled group was significantly greater, with a p value of  $< 0.05$ .<sup>10</sup>

One of the limitations of our study is small sample size. The other limitation is we did not study various other maternal characteristics like nutritional factors, CMF etc. We also did not evaluate the association on the basis of hypo or hypercoiling. Rather, we used the abnormal coiling

## 5. Conclusion

In conclusion, this comprehensive study highlights the significant correlation between abnormal umbilical cord coiling and various perinatal outcomes. Our findings reveal that abnormal coiling, defined as either hypo or hypercoiling, is significantly associated with increased risks of meconium staining, low Apgar scores at 1 minute, and NICU admissions. These associations underscore the importance of monitoring umbilical cord coiling as a potential marker for adverse perinatal outcomes. However, our study also recognizes certain limitations, such as the relatively small sample size and the lack of consideration for additional maternal factors, which may influence these outcomes. Further research is warranted to explore these associations in greater depth, considering a wider array of maternal and fetal characteristics. This study contributes to the growing body of literature on umbilical cord coiling and its implications for fetal health, offering valuable insights for obstetric care and management. In futuristic point of view, measurement of UCI should be made in intrauterine period so reduce the perinatal complications.

### Conflict of interest:

None

### Financial disclosure:

Nil

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