

## Umbilical Coiling Index & the Perinatal Outcome

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### Abstract

**Objectives** To correlate the perinatal outcome by noting the umbilical coiling index.

**Methods** The umbilical cords of the babies born to 100 women, who delivered either vaginally or by lower segment cesarean section, were examined and umbilical coiling index was calculated.

**Results** There was significant correlation ( $p$  value 0.003) between the hypercoiled cords (UCI >90th percentile) and intrauterine growth restriction of the babies. Apgar score at 1 min <4 and 5 min <7 was highly significant ( $p < 0.001$ ) with hypocoiled cords. Meconium staining was significantly ( $p$  value 0.001) associated with the hypocoiled cords (UCI <10th percentile) in the present study.

**Conclusion** The hypocoiled cords or UCI <10th percentile is associated with the meconium staining, Apgar score at 1 min <4 and Apgar score at 5 min <7. The hypercoiled cord or UCI >10th percentile is associated with intra uterine growth restriction.

**Keywords** Hypocoiling umbilical cord · Hypercoiling umbilical cord · Umbilical coiling index

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### Introduction

The umbilical cord or funis forms the connecting link between the fetus and the placenta. A coil is defined as complete 360° spiral courses of umbilical vessels around the Wharton's jelly. Strong et al. [2] simplified by eliminating these directional scores and named it, "The umbilical coiling Index" (UCI). An abnormal UCI includes both hypocoiled cords (i.e.; cords with UCI <10th percentile) and hypercoiled cords (i.e.; cords with UCI >90th percentile). An abnormal UCI has been reported to be related to adverse perinatal outcome.

### Methods

Main source of data for this study, were pregnant women from three hospitals attached to J.J.M. Medical College namely,

- Bapuji Hospital, Davangere.
- Chigateri General Hospital, Davangere.
- Women and Children Hospital, Davangere.

### Inclusion criteria:

- Healthy women with term gestation irrespective of parity.
- Singleton pregnancy.
- Live baby.
- Delivery both vaginal and LSCS.

## Methodology

Duration of study was from January 2007 to August 2008. Hundred pregnant women with term gestation with singleton pregnancy, irrespective of their parity, who were in active labour and admitted to the labor room, were taken for the study. Each woman was observed in second and third stage of labor. After separating the baby from the umbilical cord, the cord was tied and cut as close to placenta as possible. The umbilical cord was measured in its entirety, including the length of the placental end of the cord and the umbilical stump on the baby. The number of the complete coils or spirals were counted from the neonatal end towards the placental end of the cord and expressed in centimeters. The UCI was calculated, by dividing the total number of coils by the total length of cord in centimeters.

$$\text{UCI} = \frac{\text{Number of coils}}{\text{Total length of cord in cms}}$$

After calculating the UCI, perinatal factors like meconium staining, fetal weight, Apgar score, Ponderal index was correlated with it. Ponderal index was calculated using the formula: Birth weight in grams/(length in centimeters)<sup>3</sup> × 100. All the women and babies, including babies admitted in NICU, were followed till discharge.

## Results

Among 100 women studied, 86 were booked and 14 were unbooked. Multigravida were 43 and primigravida were 57. 47 were in the age group of 21–25 years, while 20 women delivered by LSCS, 80 delivered vaginally. 44 women, who delivered by either LSCS or instrumental delivery had indication of fetal distress. 73 umbilical cords showed normocoiling, 15 hypercoiling and 12 had hypocoiling. 46 babies, weighed <2.5 kg. Meconium staining liquor was present in 12 cases, Apgar score at 1 min <4 was observed in 35 cases and >4 in 65 cases. Apgar score at 5 min was <7 in 73 cases and >7 in 27 cases. The twist of the cord was dextral in 15 and sinistral in 75 cases 48 were female and 51 male babies. 15 babies admitted in NICU and three died among them.

Table 1 Shows meconium staining in relation UCI—meconium staining was present in 51 (51 %) cases out of which 12 (100 %) had hypocoiling, 39 (53.4 %) had normal coiling & none had hypercoiling. 49 (49 %) cases out of 100 had meconium staining, of which 34 (46.6 %) had normal coiling and 15 (100 %) had hypercoiling. Chi square value is 14.75, *p* value of 0.001 is significant.

Table 2 Shows Apgar score at 1 min in relation to UCI—35 (35 %) babies had Apgar score at 1 min <4.

**Table 1** Meconium in relation to UCI

Meconium staining	UCI group			
	Hypocoiling	Normocoiling	Hypercoiling	Total
Present	12 (100 %)	39 (53.4 %)	0	51 (51 %)
Absent	0	34 (46.6 %)	15 (100 %)	49 (49 %)
Total	12 (100 %)	73 (100 %)	15 (100 %)	100
‘t’	14.75			
‘p’	0.001			

**Table 2** Apgar score at 1 minute

Apgar 1 min	UCI group			
	Hypocoiling	Normocoiling	Hypercoiling	Total
<4	12 (100 %)	22 (30.10 %)	1 (6.7 %)	35 (35.0 %)
>4	0	51 (69.9 %)	14 (93.3 %)	65 (65.0 %)
Total	12 (100 %)	73 (100 %)	15 (100 %)	100
‘t’	28.33			
‘p’	0.001			

Among them 12 (100 %) cases had hypocoiling, 22 (30.1 %) normocoiling and 1 (6.7 %) had hypercoiling. 65 (65 %) babies had Apgar score >4. Among them 14 (93.3 %) had hypercoiling and 51 (51 %) had normocoiling and none had hypocoiling. Chi square value is 28.33, *p* value of 0.001 which is statistically highly significant.

Table 3 Shows Apgar score at 5 min in relation to UCI—among 100 cases, 27 (27 %) had Apgar score at 5 min >7, out of which 20(27.4 %) had normocoiling and none had hypocoiling. Among 73 (73 %) with Apgar score at 5 min <7, 12(100 %) had hypocoiling, 53 (72.6 %) had normocoiling and 8(53.3 %) had hypercoiling. This is statistically significant with *p* value 0.025.

Table 4 Shows association of IUGR in relation to UCI—IUGR was present in 48 (48 %) babies. Among them 11 (73 %) babies had hypercoiling, while only 1 (8.3 %) baby had hypocoiling and 36 (49.3 %) had normocoiling. IUGR was absent in 52 (52 %), among them 11 (91.7 %) had hypocoiling and 4 (26.7 %) had hypercoiling.

**Table 3** Apgar score at 5 min in relation to UCI

Apgar 5 min	UCI group			
	Hypocoiling	Normocoiling	Hypercoiling	Total
<7	12 (100 %)	53 (72.6 %)	8 (53.3 %)	73(73.0 %)
>7	0	20 (27.40 %)	7 (46.7 %)	27 (27.0 %)
Total	12 (100 %)	73 (100 %)	15 (100 %)	100
‘t’	7.38			
‘p’	0.025			

**Table 4** IUGR in relation to UCI

IUGR	UCI group			
	Hypocoiling	Normocoiling	Hypercoiling	Total
No	11 (91.7 %)	37 (50.7 %)	4 (26.7 %)	52 (52.0 %)
Yes	1 (8.3 %)	36 (49.3 %)	11 (73.3 %)	48 (48.0 %)
Total	12 (100 %)	73 (100 %)	15 (100 %)	100
't'	11.47			
'p'	0.003			

**Table 5** NICU in relation to UCI

NICU	UCI group			
	Hypocoiling	Normocoiling	Hypercoiling	Total
–	8 (66.7 %)	62 (84.9 %)	12 (80.0 %)	82 (82.0 %)
+	3 (25.0 %)	9 (12.3 %)	3 (20.0 %)	15 (15.0 %)
Died	1 (8.3 %)	2 (2.7 %)	0	3 (3 %)
Total	12 (100 %)	73 (100 %)	15 (100 %)	100
't'	3.43			
'p'	0.48			

Chi square is 11.47 % *p* value being 0.003 which is highly significant.

Table 5 Shows NICU admission in relation to UCI—15 Babies were admitted to NICU, out of them 3 (25 %) had hypocoiling, 9 (12.3 %) had normocoiling and 3 (20 %) had hypercoiling. Among three babies, who died, 1 (8.3 %) belonged to hypocoiling, 2 (2.7 %) normocoiling group. No baby died in hypercoiled group. Chi square value is 3.43, *p* value being 0.48 which is not significant.

## Discussion

Several trials in the past have correlated the relationship between perinatal outcome and the UCI. In the present study, UCI was compared with various parameters. Comparing umbilical cord length to parity, it was found that there was no statistical significance between primi and multi and no statistical significance was observed when umbilical coiling was compared with either the mode of delivery or birth weight of the baby.

In present study it was observed that meconium staining was significantly associated with UCI <10th percentile. Gupta et al. [1] studied 107 umbilical cords & found that in hypocoiling group, meconium staining was significantly higher than those with normal coiling group. Strong et al. [2] studied 100 umbilical cords and found that meconium staining was associated with UCI values <10th percentile, with the *p* value of 0.03 which is highly significant. Padmanabhan et al. [3] also conducted a study of 130 cases,

where they found that meconium staining was significant among the hypocoiled group.

In present study, Apgar score at 1 min <4 was found with UCI <10th percentile. Gupta et al. [1] and Padmanabhan et al. [3] also found that hypocoiled group was associated with Apgar score at 1 min >4. In present study, Apgar score at 5 min <7 in relation to UCI was seen with <10th percentile. Monique et al. [4] also observed that hypocoiling was associated with low Apgar <7 at 5 min. This was explained by an experiment by Georgious et al. [5] 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, where as, 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. Gupta et al. [1] studied 107 cords and found that babies with Apgar score >7 had significantly lower UCI than the babies with Apgar score >7 (0.05). Padmanabhan et al. [3] studied 130 umbilical cords and found that hypocoiled group was associated with low Apgar <7.

In the present study, while observing the association of IUGR with UCI, it was found that in hypercoiled group 11 babies (73 %) had intrauterine growth restriction and only one baby (8.3 %) belonging to hypocoiled group had IUGR which is statistically significant. Monique et al. [4] who studied 885 cases, found that hypocoiling was associated with small for gestational age infants. Georgiou et al. [5] studied 34 cases and found that IUGR was found in hypercoiled group.

In present study, there was no statistical significance about NICU admission and UCI. Monique et al. [4] observed that hypocoiling of the cord was associated with fetal death. Strong et al. [2] found that incidence of fetal death in non-coiled group was significantly more with *p* value 0.05.

## Conclusion

The conclusion drawn was UCI >90th percentile of the umbilical cord (hypercoiling) is associated with IUGR and the UCI <10th percentile of the cord (hypocoiling) is associated with low Apgar score at 1 min <4 and Apgar score at 5 min <7 and meconium staining.

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