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Association of postnatal umbilical coiling index with maternal & perinatal outcome

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Abstract
Objective: To measure umbilical coiling index (UCI) postnatally and to study the association of normocoiling, hypo coiling and hyper coiling to maternal and perinatal outcome.
Method: Two hundred antenatal women who went into labour were studied and umbilical coiling index calculated at the time of delivery. UCI was determined by dividing the total number of coils by the totalumbilicalcordlengthincentimetres.Itsassociationwithselected maternal risk factors and fetal outcome were noted. The statistical tests were the Chi-square test and assessed with SPSS version 13.0 software and statistically analysed. P value of less than 0.05 was regarded as statistically significant.
Results: The mean umbilical coiling index was found to be 52.87 + 9.40 cms. The mean number of coils per umbilical cord was found to be 10.19 + 1.38. The mean UCI was 0.19+0.1 coils/cm. The cut off for 10th percentile was 0.05and 19 patients (9.5%) had Hypocoiled Umbilical Cord. The cut off for 90th percentile was 0.32 and 20 patients (10.0%) had Hypercoiled Umbilical Cords. Hypocoiled cords were associated with Postdated Gestations, Oligohydramnios, Meconium stained liquor, Intrapartum fetal distress. While hypercoiling was associated with Pregnancy induced hypertension, Abruptio placentae, Fetal Growth Restriction, low birth weight, low APGAR scores & NICU admissions. There was no significant association between Maternal age, Gravidity, Maternal Anaemia, Gestational Diabetes Mellitus, Hypothyroidism, Polyhydramnios, PROM& mode of delivery.
Conclusion: Postnatal umbilical coiling index serves as a significant indicator of maternal risk factors and fetal outcome and therefore antenatal determination of UCI can help identify high risk pregnancies to be managed with greater vigilance and monitoring.

Keywords: umbilical coiling index (UCI), normocoiled, hypocoiled, hypercoiled, maternal risk factors

Introduction
The umbilicus, actually a scar, is the only visible memento of the close connection of a baby with his mother before birth. This was by means of the umbilical cord, which determined not only our welfare, but our very existence. The umbilical cord is the life line of fetus as it supplies water, nutrients and oxygen. At birth, Placenta & the umbilical cord are the organs which die to begin a life. Inside the uterus, umbilical cord is vulnerable to kinking & compressions which may affect the perinatal outcome [23].
The three blood vessels of cord i.e. two arteries & one vein, pass along the length of the cord in a coiled fashion. The umbilical cord vessels are protected by Wharton's jelly, amniotic fluid. The origin of umbilical cord coiling is not known properly. Hypotheses include active or passive embryonal & fetal movements or, fetal hemodynamic forces, differential growth rates of umbilical vessels and the arrangements of muscular fibres in the umbilical arterial wall. Of the many characteristics of the human umbilical cord, the most mysterious and intriguing one is the twisting or the spiral course of its blood vessels. Umbilical coiling confers turgor to the umbilical unit producing a strong yet flexible cord.
The coiling of the umbilical vessels develops by about 28 days post conception and is present in about 95% of fetuses by around 9 weeks of conception. The helices of the umbilical cord are visible ultrasonographically as early as during the first trimester of pregnancy [10].
Berengarius first recorded the spiral course of the umbilical vessels in 1521. It was then confirmed by Columbus in 1559 and by Arantius in 1564. Fabricius in 1600, demonstrated that both right (dextral) and left (sinistral) helices exist in the umbilical cord [24].
In 1954 Umbilical coiling was first quantified by Edmonds who divided total no of coils by umbilical cord length in cm and called it "Index of twist". Later Strong named it as "Umbilical

Coiling Index"
A coil is of 360-degree spiral course of umbilical vessels. Umbilical cord index (UCI) by definition is the total number of coils of cord divided by the total length of the cord in centimetres.

Umbilical Coiling Index (UCI) =

$$\frac{\text{Total no. Of complete (360 °) vascular coilings}}{\text{Total length of cord in cm}}$$

Rana *et al*. [8] grouped the UCI as follows:
<10th percentile—hypocoiled;
10th–90th percentile—normocoiled;
>90th percentile—hypercoiled

Objective
To measure the postnatal Umbilical coiling index & study the prevalence of normocoiled, hypocoiled & hypercoiled umbilical cord & its association with selected maternal risk factors &fetal outcome.

Method & Material
It was an Observational Study Carried out in Dept of Obstetrics & Gynaecology at a tertiary centre over 200 patients. All indoor antenatal patients who had got admitted at Sri Aurobindo Medical College & Postgraduate Institute for delivery & who fulfilled the inclusion criteria were taken for the study. Informed written consent was taken. Umbilical coiling Index was calculated postnatally. UCI was determined by dividing the total number of coils by the total length of umbilical cord in centimetres. It's Association with selected maternal and perinatal risk factors were noted.
Inclusion Criteria had Patients with age above 18 yrs of age, period of gestation > 37 completed weeks, singleton pregnancy, cephalic presentation, spontaneous onset of labour or Induced labour, mode of delivery- Normal/Assisted vaginal delivery, uncomplicated gestation or associated with medical complications.
Exclusion Criteria included patients with POG < 37 weeks, Multifetal gestation, Malpresentation &patients who had cesarean section.
Maternal factors taken into consideration were Maternal age, Gravidity, Gestational age, Anaemia in pregnancy, Hypertension during Pregnancy, Gestational Diabetes Mellitus, Hypothyroidism during pregnancy, Liquor abnormalities (Oligohydramnios/ Polyhydramnios) & other maternal medical disorder during pregnancy. Intrapartum Factors included, Prelabour Rupture of membranes (PROM), Meconium staining of liquor, Fetal heart abnormalities (Bradycardia, tachycardia, early or late or variable decelerations) & Mode of delivery – NVD/ Assisted Vaginal Delivery. Neonatal Factors included were APGAR score at 1min & 5 min, Birth weight & Admission to NICU.
The statistical test used was the Pearson's Chi-square test and was assessed with SPSS version 13.0 software and statistically analysed. Statistical significance was defined as p-value<0.05.

Observations

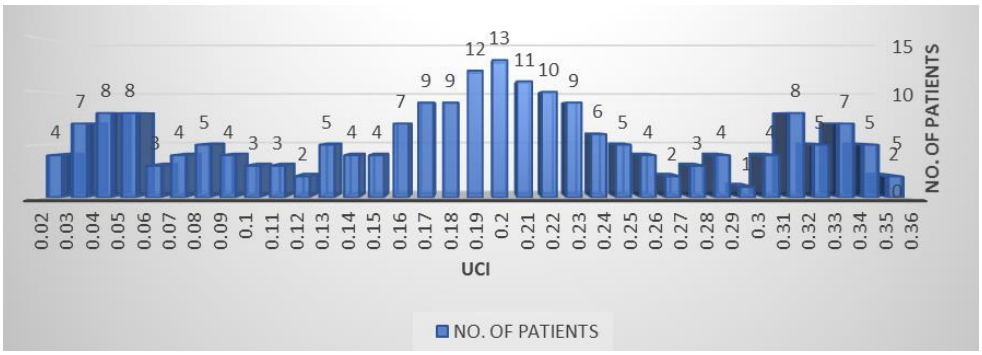

Fig 1: No of patients

Table 1: Calculation of Mean UCI & its prevalence

UCI	Hypocoiled, N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Total No. of Cases	19(9.5%)	161(80.5%)	20(10%)	200

Table 2: Distribution frequencies of the three groups according to the maternal factors.

Period Of Gestation (Weeks)	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Term Gestation (37-40.0)	8 (5.8%)	119 (86.8%)	10 (7.2%)	137 (100%)
Postdated Gestation (>40.0)	11 (17.4%)	42 (66.6%)	10 (15.8%)	63 (100%)
Total	19	161	20	200

PIH	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	1(3.1%)	18(56.25%)	13(40.62%)	32(100%)
Absent	18(10.7%)	143(85.1%)	7(4.16%)	168(100%)
Total	19	161	20	200

Abruption	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	2 (22.2%)	1 (11.1%)	6 (66.6%)	9 (100%)
Absent	17 (8.9%)	161 (84.2%)	13 (6.8%)	191 (100%)
Total	19	162	19	200

Maternal Anaemia	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	8 (17.7%)	30 (66.6%)	7 (15.5%)	45 (100%)
Absent	11 (7.05%)	131 (83.9%)	12 (7.6%)	156 (100%)
Total	19	162	19	200

GDM	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	1 (16.6%)	4 (66.6%)	1 (16.6%)	6(100%)
Absent	18 (9.27%)	157 (80.9%)	19 (9.7%)	194(100%)
Total	19	161	20	200

Hypothyroidism	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	3 (14.2%)	14 (66.6%)	4 (19.0%)	21 (100%)
Absent	16 (8.9%)	147 (82.1%)	16 (8.9%)	179 (100%)
Total	19	161	20	200

Table 3: Distribution frequencies of the three groups according to the USG factors

Oligohydramnios (AFI<5cm)	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	11 (42.3%)	13 (50%)	2 (7.6%)	26(100%)
Absent	8 (4.5%)	148 (85.5%)	18 (10.3%)	174(100%)
Total	19	161	20	200

Polyhydramnios (AFI>15cm)	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	0	4 (80%)	1 (20%)	5(100%)
Absent	19 (9.7%)	157 (80.5%)	19 (9.7%)	195(100%)
Total	19	161	20	200

FGR	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	2 (8.3%)	18 (75%)	4 (16.6%)	24(100%)
Absent	17 (9.6%)	144 (18.8%)	15 (8.5%)	176(100%)
Total	19	161	20	200

Table 4: Distribution frequencies of the three groups according to the intrapartum factors.

PROM	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	3 (12%)	20 (80%)	2 (8%)	25 (100%)
Absent	16 (9.1%)	142 (81.1%)	17 (9.7%)	175 (100%)
Total	19	161	20	200

Meconium Staining Of Liquor	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	10 (40%)	14 (56%)	1 (4%)	25(100%)
Absent	9 (5.1%)	147 (84.0%)	19 (10.8%)	175(100%)
Total	19	161	20	200

Fetal Distress	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
Present	9 (31.0%)	16 (55.1%)	4 (13.7%)	29 (100%)
Absent	10 (5.8%)	145 (84.7%)	16 (9.3%)	171 (100%)
Total	19	161	20	200

Table 5: Distribution frequencies of the three groups according to the neonatal factors

Birth Weight	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
<2.5 KG	5 (10.6%)	31 (65.9%)	11 (23.4%)	47(100%)
>2.5 KG	14 (9.1%)	130 (84.9%)	9 (5.8%)	153(100%)
TOTAL	19	161	20	200

Apgar Score At 1 min	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
<7	13 (18.3%)	43 (60.5%)	15 (21.1%)	71 (100%)
>7	6 (4.6%)	118 (91.4%)	5 (3.8%)	129 (100%)
Total	19	161	20	200

Apgar Score At 5 Min	Hypocoiled N (%)	Normocoiled N (%)	Hypercoiled N (%)	Total
<7	13 (22.8%)	29 (50.8%)	15 (26.3%)	57 (100%)
>7	6 (4.1%)	132 (92.3%)	5 (3.4%)	143 (100%)
Total	19	161	20	200

Nicu Admission	Hypocoiled N (%)	Normocoiled N, (%)	Hypercoiled N (%)	Total
Yes	8 (17.7%)	28 (62.2%)	9 (20%)	45
No	16 (10.3%)	127 (81.9%)	11 (7.09%)	155
Total	24	156	20	200

Result

In our observational study, the mean length of the umbilical cord was found to be 52.87 + 9.40 cms. The mean number of coils per umbilical cord was found to be 10.19 + 1.38. The mean UCI was 0.19+0.1 coils/cm. The cut off for 10th percentile was 0.05. There were 19 patients with UCI below 10th percentile i.e. Hypocoiled Umbilical Cord. The cut off for 90th percentile was 0.32. There were 20 patients with UCI above 90th percentile i.e. Hypercoiled Umbilical Cords. Larger no. of values were centred around the mean UCI with tapering towards the ends. Normocoiled were predominant in 81.5%. 9.5% cases were hypocoiled with UCI < 10th percentile.10.0% were hypercoiled with UCI>90th percentile.

With the increasing maturity of fetus there was an increase in proportion of abnormally coiled umbilical cords. This ratio was (17.4%) hypocoiled & (15.8%) hyper coiled with Postdated Gestations (>40.0 weeks). This was a significant association between Postdated Gestation & Hypocoiled UCI (p-value 0.003). No significant association was observed between abnormal UCI and maternal age and gravidity.

Pregnancy Induced Hypertension was one of the important Maternal Risk factors to be evaluated. In cases with PIH (3.1%) had Hypocoiled & 13 (40.6%) had Hypercoiled cords. It was found that Gestational Hypertension was present in 25%cases &Preeclampsia was found in 65.5%. Eclampsia was seen in 9.5% cases &majority of these had Hypercoiled Umbilical Coiling Index. There was a significant & strong association between PIH & Hypercoiled UCI, the p-value was 0.0001.

Abruptio Placentae was another important Maternal high risk Factor taken into consideration. It was observed that of the patients who presented with Abruption of placenta, 22.2% had Hypocoiled while 66.6% had Hypercoiled Umbilical cords. There was a significant & strong association between Abruptio Placentae & Hypercoiled Umbilical Cords (p-value was 0.0001)

There was no significant association between Maternal Anaemia (p value0.052) &Gestational Diabetes Mellitus (p-value 0.619) & abnormally coiled UCI. Also, the association of Abnormal UCI & Hypothyroidism was found out to be nonsignificant (p-value0.654).

Antenatal Assessment also included measurement of Amniotic Fluid Index where<5cm in USG documentation was taken as Oli gohydramnios. 42.3% had Hypocoiled while 7.6%had Hypercoiled Umbilical Cord. There was a significant & strong association between Hypocoiled UCI & Oligohydramnios, the p-value was 0.0002.No such significant association was found with Polyhydramnios (p value 0.899)

Perinatal Outcome was also compared on the basis of presence & absence of FGR, as per the USG findings. It was observed that out of 24 USG documented cases of FGR, 2 (8.3%) had Hypocoiled while 4 (16.6%) had Hypercoiled Umbilical Cord. FGR was found to be significantly associated with Hypercoiled UCI (p-value was 0.0138)

Intrapartum evaluation was also done on the basis of Presence & absence of Prelabour Rupture of Membranes (PROM). With p-value of 0.859, PROM was not found to be significantly associated with either Hypocoiled or Hypercoiled UCI.

Intrapartum assessment included examination of Liquor as well. Meconium Stained liquor was found in 25% cases. Of these 10 (40%) had hypocoiled while 1 (4%) had Hypercoiled cord. There was a significant association between meconium stained liquor & Hypocoiled UCI (Pvalue 0.003).

Intrapartum evaluation was also done on the basis of CTG findings of Fetal Distress as Early, Late & Variable Decelerations & Tachycardia (>180 beats /min) & Bradycardia (<110beats/min). Out of 29 cases which had developed intrapartum Fetal Distress, 9 (31.0%) had hypocoiled while 4 (13.7%) had Hypercoiled cord. Fetal distress was found to have a significant association with Hypocoiled UCI. By Pearson Chi Square Test, the p-value was 0.026 There was no significant association between Abnormally coiled & Mode of Delivery(p value 0.977) While comparing the association of Birth weight with Umbilical Coiling Index, it was found out that babies born with weight less than 2.5 kg, 10.6% had hypocoiled & 23.4% had hypercoiled umbilical cords. The association between Low birth weight (<2.5Kg) and Hypercoiled UCI was significant (p-value 0.016) on studying the Perinatal Outcome, it was observed that, 35.5% babies born had APGAR Score <7 at 1min. Of which18.3% had Hypocoiled & 21.1% had Hypercoiled Umbilical Cords. Low APGAR Score (<7) at 1min of birth and Hypercoiled UCI Pearson Chi square test were found to be significantly& strongly associated with a p-value of 0.001 Also, it was found that 28.5% babies had APGAR Score <7 at 5 min. Of these 22.8% had Hypocoiled & 26.3% had Hypercoiled Umbilical Cords. And this association was also significant with a p-value of 0.0001.

23% newborns required NICU Admissions. Amongst them, 17.7% had hypocoiled & 20.0% had Hypercoiled umbilical cords. Thus, there was a significant association between NICU Admissions and Hypercoiled Umbilical Cords (p-value 0.008)

Discussion

The mean UCI of our study was 0.19+0.14 coils/cm, which is almost similar to findings of Rana *et al*. [8] where the mean UCI was 0.19. Monique W.M. De Laati, Arie Franx *et al*. [9] had calculated the mean UCI to be 0.17 coils/cm. In the study done by Ecral *et al*. the mean UCI was 0.20 [15] & that in the study of Strong *et al*. was 0.21 [10].

Table: Mean UCI in various studies.

Study by	UCI
Strong *et al*.[10]	0.21 + 0.07
Rana *et al*.[8]	0.19 + 0.1
Ercal *et al*.[15]	0.20 + 0.1
Ezimokhai *et al*.[17]	0.26 + 0.09
de Laat *et al*.[9]	0.17 + 0.009
Present study	0.19 + 0.14

The umbilical coiling index has been found to be an effective indicator of antenatal maternal high-risk factors & perinatal outcome. The aim of this study was to find the relationship between UCI and various maternal high-risk factors and fetal outcome.

In our study we did not find any significant association between advanced maternal age & either Hypocoiled or Hypercoiled umbilical cords (p value 0.256). Among previous studies, Ezimokhai *et al* [21] found hypercoiled cords to be associated with extremes of maternal age (>35 years). T Chitra *et al*. [39] also found that maternal age of more than 35 years was found to

have a significant association with both hypocoiling and hypercoiling of umbilical cord. None of the other studies found age to be a significant factor.

Among the Maternal Risk Factors, our study found a significant association between Postdated Gestation (>40 weeks) and hypocoiled umbilical cords (P = 0.003). T Chitra *et al* [3] in their study found a significant association between preterm labour and hypocoiled. These findings were also observed by Strong *et al* [10] and de Laat *et al*. [9]. Both these authors, however, were unable to give a satisfactory explanation. Rana *et al* [8] found hypercoiled to be significantly associated with preterm labour. They believed that hypercoiled was an adaptive response for fetal hemodynamic changes and it initiates preterm labour when it reaches a certain threshold.

Primigravidity or Multigravidity were not significantly associated with abnormally coiled Umbilical cords (p-value 0.893). Nivedita S Patil *et al* [7] also found that there was no statistical significance between primi or multigravida and abnormally coiled cords.

Pregnancy induced hypertension was found to have a significant & strong association with hypercoiled Umbilical Cords (P = 0.0001). The coiling because of conferring elastic properties gives umbilical cord the ability to resist external forces that might compromise the umbilical vascular flow. The coiled umbilical cord acts like a semierectile organ that is more resistant to snarling torsion, stretch, and compression than the noncoiled one [4, 5]. This might explain the association of hypercoiling with Pregnancy induced hypertension. Most likelycoiling causes increased blood flow due to` local pulsometer effect [9] but if coiling is increased beyond a certain limit it decreases uteroplacental blood flow. Effect of hypercoiling on uteroplacental circulation has been further studied by Dutman and Nikkels who examined placentas of intrauterine died fetuses and found link between hypercoiling and fetal thrombosis [11].

Abruption was observed to have a significant and strong association with Hypercoiled Umbilical Cords (P=0.0001). The high association of preeclampsia with abruption has probably contributed to this finding. Abruptio placentae was also found to have a significant association with hypocoiled Umbilical Cord in the study by T. Chitra, Y.S. Sushant *et al* [3]

Kashanian *et al*. [21] found oligohydramnios to be significantly associated with both hypocoiled and hypercoiled. In our study, oligohydramnios was significantly associated with hypocoiled (P = 0.002), whereas polyhydramnios did not have a significant association with abnormally coiled umbilical cords (P = 0.899). This can be explained by Edmond's hypothesis[1] which states that twist of the umbilical cord is a result of the rotary movement imparted to the embryo, and hence more is the amniotic fluid, more is the rotary movement of the fetus and more will be the coiling of the cord. The converse will be true for oligohydramnios which is associated with Hypocoiling. Since in our study there were only 5 cases of Polyhydramnios significance of association cannot be commented upon.

In the present study, FGR was found to have a significant association with Hypercoiled Umbilical Cords (p value 0.0138). Poonam Bhojwani *et al* [12] found that Fetal growth restriction was significantly associated with hypercoiled cords. Monique *et al*. [14] found that hypocoiling was associated with small for gestational age infants. Chholak D *et al*. [2], Georgiou *et al*. [13], Shayesta Rahi *et al* [16], and Ezimokhai M *et al*. [17] obtained similar results in their studies

Meconium staining of the amniotic fluid was found to be associated with Hypocoiled Umbilical Cords (p value 0.003) in our study. Similar findings were noted in studies done by Strong *et al*. [10] and Ezimokhai *et al*. [17]. Probably that's because oligohydramniotic patients going into labour are more prone to develop Fetal Distress and thus Meconium staining of Liquor. The same observation can explain association of Post term gestations and Hypocoiled Umbilical cords.

In our study, patients with maternal high-risk factors which were taken for LSCS elective or Emergency were not included, probably because of this reason we could not analyse some risk factors that effectively as patients were taken for emergency LSCS. This may explain as to why in some studies operative delivery was associated with hypercoiled, whereas other authors found an association with hypocoiled [10, 18- 20].

In our study Fetal Distress in the form of Early Deceleration, Late Deceleration, Variable Decelerations or Tachycardia or Bradycardia was found to have a highly significant association with hypocoiled (p value 0.026). Strong *et al* [10] and De Laat el al [9] found FHR decelerations to be associated with both hypocoiled and hypercoiled umbilical cords. They stated that hypocoiled and hypercoiled cords are less flexible or more prone to kinking and torsion which makes them less tolerant to withstand the stress of labour. Rana *et al*. [8] and Ercal *et al*. [15] found FHR decelerations to be significantly associated with hypocoiled.

Rana *et al*. [8] explained that coiling provides turgor and compression resistant properties to the cord which becomes compromised in hypocoiled cords. This strong association of hypocoiling and fetal jeopardy is thus explained by analysing anatomy of umbilical cord. Umbilical vessels can get compressed by torsion or external pressure but coils in umbilical cord most likely prevent umbilical vessels from any external compression [4]. This property is perhaps due to the elasticity imparted by coiling [3]. Another mechanism why coiling could be beneficial has been put forward by Reynolds. He proposed that there is a dynamic interaction between umbilical arteries and veins. Arterial coils around veins provide 'multiple variations of pressure' in an additive manner [9].

It was found that LBW (birth weight <2.5kg) was significantly associated with both hypercoiled (P = 0.016). Similar results were obtained by Rana *et al*. [8], Raio *et al*. [6], and de Laat *et al*. [9], Shayesta Rahi *et al*. [16] However, the authors were unable to give a satisfactory explanation for this casual association. On contrary Shalu Gupta, MMA Faridi *et al*. [4] did not find any significant relationship between UCI and birth weight, gestation and FGR

A low APGAR Score of <7 at both 1 minute & 5 minutes was significantly associated with Abnormally coiled, Hypercoiled cords (<0.001). Strong *et al*. [10] and Ezimokhai *et al*. [17] found Low APGAR Scores to be significantly associated with hypocoiled, although a satisfactory explanation was not forthcoming. Monique, De Laat *et al*. [9] also observed that hypercoiling was associated with low Apgar Score <7 at 5 min.

An experiment by Georgious *et al*. [13] was performed in which venous perfusion was measured in cords subjected to standardized tight encirclement force. A significant inverse relationship was seen 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. So, this can offer an explanation for the association of low Apgar score with hypercoiled cords. Gupta *et al*. [25] studied 107 cords and found that babies with Apgar score <7 had significantly higher UCI than the babies with Apgar score >7 (p value 0.05). Similar results were obtained in the

study done by Kashanian *et al.* [21].

This association NICU admission and Hypercoiled UCI was found out to be significant in our study (p value 0.008). Strong *et al*. [10] found that incidence of fetal death in noncoiled group was significantly more with p value 0.05. Poonam Bhojwani *et al*. [12] also found that there were more NICU admissions in babies with Hypercoiled UCI & it was significant. In the study by ShayestaRahi *et al*. [16] the percentage of NICU admission was more (40%) in both hypocoiled and hypercoiled groups as compared to normocoiled group. Dakshayini D *et al*. [22] also observed higher NICU admission in both hypocoiled and hypercoiled groups as compared to normocoiled group.

In our study,no significant association was found out between Abnormally coiled Umbilical Cords (either Hypocoiled or Hypercoiled UCI) & Maternal Anaemia (p value 0.052), Maternal Hypothyroidism (p value 0.654), Gestational Diabetes (0.619), maternal age (p value 0.260), gravidity (p value 0.893) Polyhydramnios (p value 0.899), Prelabour Rupture of membranes (p value 0.859), mode of Vaginal Delivery whether normal vaginal or assisted vaginal delivery. No significant association was found between Abnormal UCI and these factors in previous studies also.

Though some studies have demonstrated some correlation between Gestational Diabetes Mellitus & Hypocoiled Umbilical Cords. However, T Chitra *et al*. [3] in their study found diabetes mellitus to be significantly associated with hypercoiled while Ezimokhai *et al*. [17] found significant association of GDM with both hypocoiled and hypercoiled cords. The fact that cases of Gestational Diabetes Mellitus were found in only 3% of our study sample, this might be the reason for our observation.

Conclusion

Postnatal umbilical coiling index serves as a significant indicator of maternal risk factors and fetal outcome and therefore antenatal determination of UCI can help identify high risk pregnancies to be managed with greater vigilance and monitoring. In the present study, a sincere effort has been made to study the relationship between abnormal coiling of umbilical cord and adverse pregnancy outcome so that in the near future, a prediction for the same can be made, and appropriate preventive measures taken so that every pregnancy ends in a healthy mother and a healthy baby

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