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Study of umbilical cord Coiling Index and Perinatal outcome at tertiary care hospital

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Abstract
Introduction: The umbilical cord is Vital for the Development, Wellbeing and Survival of the Foetus and Yet, It is Vulnerable to Kinking, Compressions, Traction and Torsion, Which may affect the Perinatal Outcome. Vessels are the most Vulnerable part of the Foetal Anatomy.
Material and Methods: This was a Prospective study hich Was Carried Out in the Department of Obstetrics & Gynaecology at B R Ambedkar Medical College, Bangalore, Karnataka, India, from January 2016 To January 2018. 100 Patients Who Were in Active Labour with Term Gestations, Irrespective of Their Parities, Who had Singleton Pregnancies with live babies who were either delivered by vaginal or Lscs were included in the study. Patients were observed in second and third stages of Labour. After separating baby from umbilical cord, the cord was tied and cut as close to baby as Possible. The umbilical cord was measured in Its Entireity, Including the length of the Placental end of the cord and umbilical stump on the Baby. Number of complete coils or spirals were counted from Neonatal end towards the Placental end of Cord and it was expressed in Cm. After this, UCI was calculated by dividing the total Number of Coils by the total length of cord in Cm. Then, perinatal factors like meconium staining, Foetal Weight, Apgar score and Ponderal index were correlated with UCI. Thus, the effect of umbilical vascular coiling on perinatal outcome was carried out. All patients and babies were followed till they were discharged.
Results: UCI Which Was < 10th Percentile < 0.06, was considered as Hypocoiling whereas UCI which was > 90th Percentile > 0.48 was considered as Hypercoiling. 56 Cords showed normal coiling, 14 showed Hypocoiling, and 22 showed Hypercoiling. 22 babies weighed < 2.5kg. Meconium staining liquor was present in 35 cases. An apgar score at 1 Min of < 4 was observed in 31 Cases and that of > 4 was seen in 69 Cases. Apgar score at 5 Min was <7 Min in 28 Cases and it was > 7 Min in 72 Cases. The Twist of the cord was Dextral in 27 Cases and it was Sinistral in 73 Cases. 25 Babies were admitted to the Nicu. 65 were males and 35 were females.

Keywords: UCI, Hypo Coilinig, Hypeer Coiling

Introduction
The umbilical cord is essential for the development, wellbeing and survival of the foetus and, it is vulnerable to kinking, compressions, traction and torsion, which may affect the intra uterine life and perinatal outcome. The total number of coils for any particular cord is believed to be established early in gestation. The pattern of coiling develops during second and third trimesters, presumably due to snashes in the cord and this coiling changes as pregnancy advances. The three blood vessels pass along the length of the cord in helical or coiled fashions [1]. The helical fusion of these umbilical vessels is termed as spiral course [2]. The umbilical cord is the vital link between the fetus and placenta which carries oxygenated blood to the fetus via the umbilical vein and removes deoxygenated blood via the umbilical arteries. One of the most characteristic gross features of the umbilical cord is its helical coiling pattern. On average, the umbilical cord has about one coil every 5 cm as defined by the Umbilical Coiling Index (UCI). Hypercoiled umbilical cords with a coiling index greater than 0.3 coils/cm are not uncommon, with incidence reportedbetween 6 and 21% of pregnancies [2, 3]. Pregnancies with hypercoiled umbilical cords have increased incidence of pregnancy complications], and adverse outcomes, such as fetal demise.
A coil is defined as having completed a 360 spiral course of umbilical vessel around Wharton's jelly. Coiling property of umbilical cord was described by Berengarius in1521 [1]. In 1954, umbilical coiling was first quantified by Edmonds who divided the total number of coils by umbilical cord length in centimetres and called it "Index of twist". [1, 3]. Later, Strong *et al*

simplified it by eliminating three directional score and named it "The umbilical cord coiling index" [1, 4]. An abnormal umbilical cord coiling index includes both hypocoiled cords (cords with an umbilical cord coiling index which is < 10th percentile) and hypercoiled cords (cords with an umbilical cord coiling index which is > 90th percentile).

An abnormal umbilical coiling index has been reported to be related to adverse perinatal outcomes [1, 2, 5-7].

The present study aimed to evaluate the perinatal outcomes with abnormal umbilical cord coiling indices.

Material and Methods

This was a prospective study which was carried out in the Department of Obstetrics & Gynaecology at B R Ambedkar Medical College, Bangalore, Karnataka, India, from January 2016 to January 2018. Ethical committee clearance was obtained from the Institute's Research Council and Ethics Committee. 100 patients who were in active labour with term gestations, irrespective of their parities, who had singleton pregnancies with live babies who were either delivered by vaginal or LSCS were included in the study. Patients were observed in second and third stages of labour.

After separating baby from umbilical cord, the cord was tied and cut as close to baby as possible. The umbilical cord was measured in its entireity, including the length of the placental end of the cord and umbilical stump on the baby. Number of complete coils or spirals were counted from neonatal end towards the placental end of cord and it was expressed in cm. After this, UCI was calculated by dividing the total number of coils by the total length of cord in cm.

Then, perinatal factors like meconium staining, foetal weight, Apgar score and ponderal index were correlated with UCI. Thus, the effect of umbilical vascular coiling on perinatal outcome was carried out. All patients and babies were followed till they were discharged.

Results

Among 100 women who were studied, 69 were booked and 31 were unbooked. Primigravida were 65 and multigravida were35. 55 delivered vaginally, 34 delivered by LSCS, 10 had vaccum deliveries and 1 had an outlet forceps delivery. 35 women who had undergone either LSCS or instrumental deliveries had indications of foetal distress.

In the present study, UCI which was < 10th percentile < 0.06, was considered as hypocoiling whereas UCI which was > 90th percentile > 0.48 was considered as hypercoiling. 56 cords showed normal coiling, 14 showed hypocoiling, and 30 showed hypercoiling. 22 babies weighed < 2.5kg. Meconium staining liquor was present in35 cases. An Apgar score at 1 min of < 4 was observed in 31 cases and that of > 4 was seen in 69 cases. Apgar score at 5 min was <7 min in 28 cases and it was > 7 min in 72 cases. The twist of the cord was dextral in 27 cases and it was sinistral in 73 cases. 25 babies were admitted to the NICU. 65 were males and 35 were females.

Correlation of Meconium Staining, Apgar score, NICU admission, IUGR and Ponderal index with UCI.

Table 1: (In row A, B, C, D) show correlation of meconium staining, Apgar scores at 1 min, Apgar scores at 5 min and NICU admissions with UCI respectively.

Baby details	UCI			P value
	Normal	Hypo coiling	Hyper coiling	
A. Meconium staining				
Yes	8(10.89%)	24(100%)	2(9.5%)	<0.001
No	56(89.11%)	0(0%)	9(90.5%)	
B. Apgar score at 1 min				
<4	23(14.7%)	7(30.4%)	1(4.8%)	0.072
>4	58(85.3%)	5(69.6%)	6(95.2%)	
C. Apgar score at 5 min				
<7	1(12.2%)	3(30.4%)	1(9.5%)	0.065
>7	60(87.8%)	16(69.6%)	19(90.5%)	
D. NICU admission				
Yes	9(12.2%)	5(43.5%)	3(28.6%)	<0.001
No	68(87.8%)	7(56.5%)	8(71.4%)	
E. IUGR				
Yes	5(3.2%)	0(0%)	17(81%)	<0.001
No	75(96.8%)	0(100%)	3(3.8%)	No
F. Ponderal index				
<2.5	55(69.2%)	7(65.2%)	10(95.2%)	0.022
>2.5	24(30.8%)	3(34.8%)	1(4.8%)	

This being statistically significant, it suggests that hypocoiled cords are more associated with meconium staining, low Apgar scores and more NICU admissions of babies. [Table 1] (In row E and F) show correlation of IUGR and ponderal indices with UCI respectively. These are statistically significant, suggesting that hypercoiled cords are associated with IUGR and low ponderal indices.

[Table 2] shows correlation of UCI with mode of delivery. Hypocoiled cords were significantly associated with incidence of more LSCS.

Table 2: Shows Correlation of UCI with Mode of delivery

Maternal variables	UCI		p value
	Normal	Hypo coiling	Hyper coiling
Mode of delivery			0.008**
FTVD/ FTVMD/ FTVOD	55(55%)	7(30.4%)	13(61.9%)
LSCS	34(34.0%)	7(69.6%)	17(38.1%)

Discussion

In the present study, UCI was compared with various parameters. On comparing UCI with parity, it was found that there was no statistical significance between primigravida and

multigravida and that there was no statistical significance between the dextral and sinistral twists of cord. In the present study, hypocoiled cords were significantly associated with LSCS. In the present study, it was observed that meconium staining was significantly associated with UCI which was <10th percentile. 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 [1]. 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 [4]. 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 [8].

In the present study, Apgar score at 1 min of < 4 was found with UCI which was < 10thpercentile. Gupta S *et al*., studied 107 umbilical cords and found that in hypocoiled cords, low Apgar scores were present [1]. 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 [8].

In the present study, Apgar score at 5 min of < 7 in relation to UCI was seen with < 10thpercentile. Monique WM *et al*., studied 885 cases and found that hypocoiling was associated with low Apgar scores [9]. 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 [1]. Padmanabhan LD *et al*., studied 130 umbilical cords and found that hypocoiled group was associated with low Apgar scores of < 7 [8].

In the present study, it was observed that IUGR was significantly associated with UCI which was >90th percentile. In a similar study which was done by Monique WM *et al*., 885 patients were studied and it was found that hypercoiling was associated with small for gestational age infants [9]. Georgiou AM *et al*., studied 34 cords and it was found that hypercoiled cords were associated with IUGR [10].

In the present study, babies who were admitted to NICU were significantly associated with UCI which was < 10th percentile. Monique WM *et al*., studied 885 cases and it was concluded that hypocoiling of the cord was associated with NICU admissions of foetal death [8]. Strong TH *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 [11].

In the present study, cords with UCI which was >90th percentile had low ponderal indices. As ponderal index is low in foetal growth restriction, hypercoiled cords are associated with both foetal growth restriction and low ponderal indices. Gupta S *et al*., studied 107 cords and it was concluded that there was no statistically significant difference between the hypocoiled group and hypercoiled group in association with ponderal indices [1].

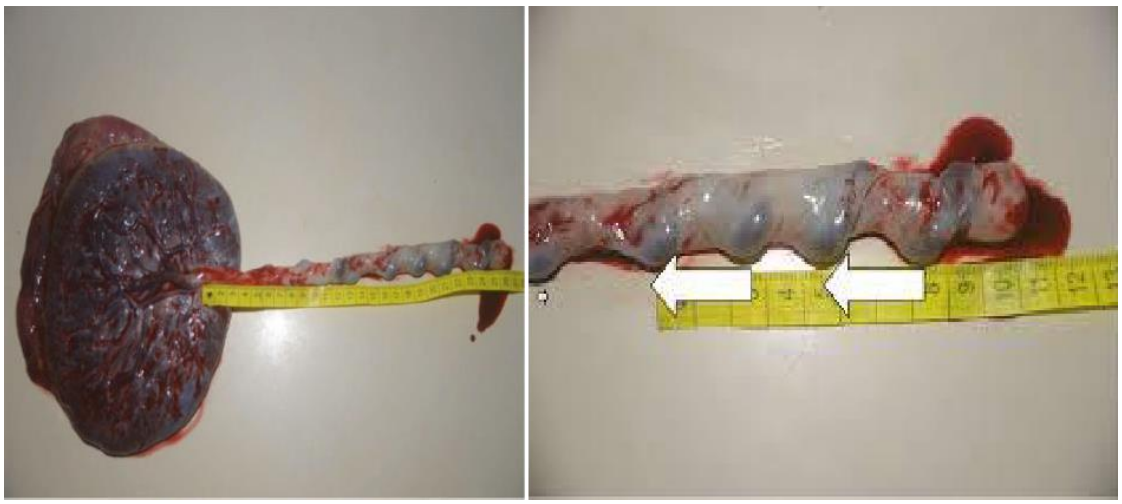

Fig 1: Measuring the umbilical cord coiling

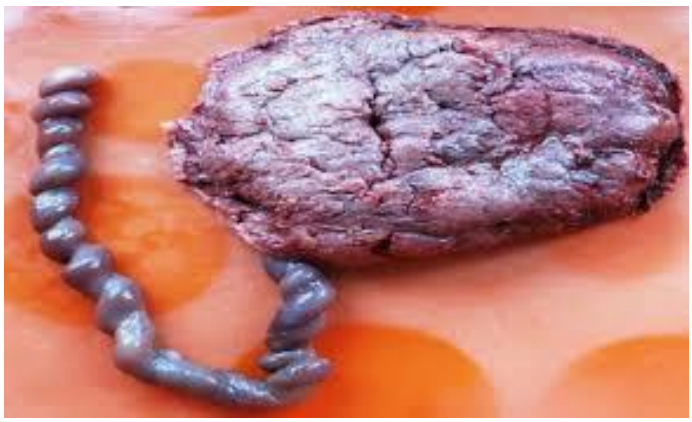

Fig 2: Hyper coiling of cord

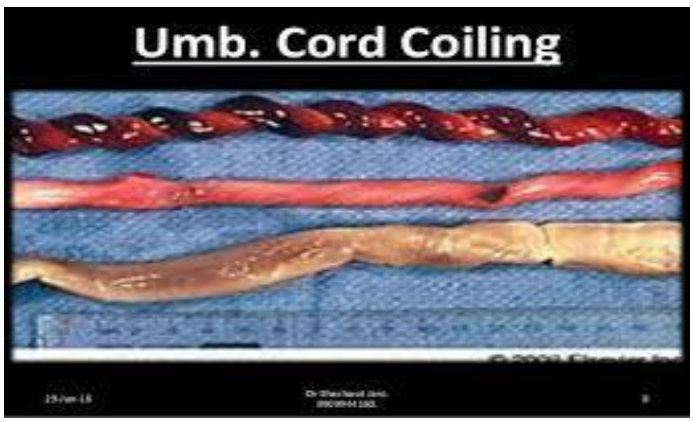

Fig 3: Umbilical cord coiling

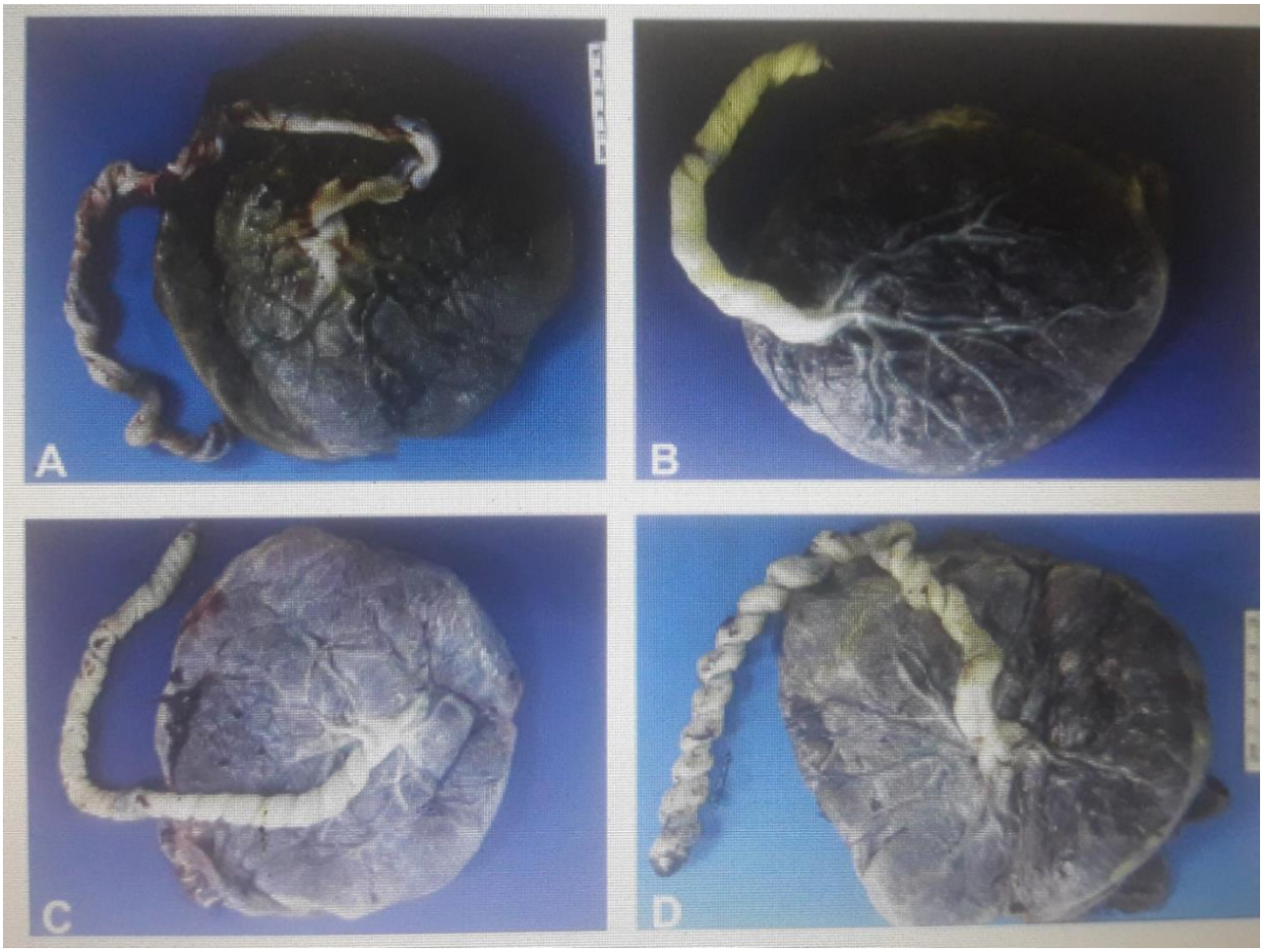

Fig 4: Placental images representing the four gross umbilical cord coiling patterns in the present syudy. A Undulating pattern, B. Rope pattern, C. Segmented pattern, D. Linked pattern

Conclusion

The abnormal umbilical coiling index is associated with adverse perinatal outcomes. UCI which is > 90th percentile is termed as hypercoiling and it is associated with foetal growth restriction. It was found that a ponderal index of < 2.5 was associated with hypercoiling of cord. UCI which is < 10th percentile is termed as hypocoiling and it is associated with meconium staining, low Apgar scores and NICU admissions of babies. Therefore, an antenatal detection of coiling index can identify fetuses who are at risk and thus help in further management.

Financial or Other Competing Interests

None.

Limitations

1. The outcome is not correlated with placental pathology
2. Cord pathology like edema, thrombus not evaluated in present study.
3. Undulating pattern, B. Rope pattern, C. Segmented pattern, D. Linked pattern needs to be evaluated by large sample study.

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