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Original Research Article

HOSPITAL BASED PROSPECTIVE OBSERVATIONAL STUDY OF UMBILICAL COILING INDEX AND PERINATAL OUTCOME

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ABSTRACT

Background: It has been estimated that normal value of umbilical coiling is 0.07-0.30 coils/cm. When it is <0.07coils/cm it is hypo-coiling, and >0.30 coils/cm is hyper-coiling. It was observed that there is increased incidence of death of fetus, low scores of APGAR, and other adverse perinatal outcomes in those with hypo-coiling. **Objective:** To study perinatal outcomes associated with the umbilical coiling index. **Materials and Methods:** Prospective Observational Study was carried out among 100 Pregnant women with term gestation, irrespective of parity. Umbilical cord was measured as per standard guidelines. Number of complete coils or spirals were counted and the direction of coils noted. Umbilical coiling index was calculated by total number of coils divided by total length of cord in centimetres. **Result:** Most belonged to 22-26 years (47%). Booked cases were majority (78%). Majority (66%) were multigravida. Most (63%) delivered by LSCS mode. Majority (78%) had normal umbilical coiling index. Incidence of hypo-coiling was 12% and that of hyper-coiling was 10%. In most (46%) length of umbilical cord was between 48-56 cm. In majority (40%), number of coils were between 20-26. Most (64%) had sinistral direction of twist of umbilical cord. Incidence of low birth weight was 16%. 17% had low APGAR score at 1min of <4 and 12% had APGAR score of <7 at 5min. Incidence of IUGR was 11%. 19% needed NICU admission. Age of mother, parity, booked status, mode of delivery, APGAR score at 1&5min, IUGR and direction of twist of umbilical cord were not significantly associated with abnormal umbilical coiling index (p>0.05). But low birth weight and NICU admission was significantly associated with abnormal umbilical coiling index (p<0.05). **Conclusion:** The abnormal umbilical coiling index is associated with adverse perinatal outcome.

INTRODUCTION

The alternate name of the umbilical cord is funis. It connects the fetus with the placenta. It extends from the chorionic plate to the umbilicus of the fetus. It is considered as the nutrition tube of the fetus. Because it supplies everything needed for life and growth like oxygen, water and nutrition.[1]

It contains three blood vessels which are coiled. Because of coiled position of the three blood vessels, it is called as spiral course. This was first described in 1521 by Berengarious. Edmond in 1954 was the first person to quantify this coiling of the umbilical cord. He divided the "total number of coils by umbilical cord length". The measurement was recorded in centimetres. This is known an index of twist. If it was clockwise, it was given a positive value and if it was anti-clockwise, it was given a negative value. The normal coiling index was established as 0.20 to 0.24 coiled/cm.[2-4]

This was bit complicated to understand. Hence, Strong et al tried to simplify it. He suggested to eliminate the directional scores. He called it "The umbilical coiling index." It was found that if the umbilical coiling index is abnormal, then the chances of adverse perinatal outcome also increase.[2]

The umbilical cord is present in the amniotic fluid freely. This makes it riskier for compression, torsion, kinking etc. What exactly causes coiling remains elusive. It has been postulated that it may be due to movement of the fetus. It can also be due to passive or the active torsion of the embryo. Sometimes it can be attributed to differential umbilical vascular growth rates. Typical arrangement of muscle fibres in the walls of the artery of the cord may be responsible for coiling. There is one umbilical vein along with two

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arteries in the cord. On an average the length of the umbilical cord is around 55 cm. In some cases, it may be as short as 30 cm and as long as 100 cm. diameter can vary from 0.8-2 cm.[5,6]

It has been estimated that the normal value of the umbilical coiling is between 0.07-0.30 coils/cm. When the value is less than 0.07 coils/cm it is called as hypo coiling. When the value is more than 0.30 coils/cm it is called as hyper coiling. Monique WM (2006) observed that there is increased incidence of death of the fetus, low scores of APGAR, and other adverse perinatal outcomes in those with hypo coiling.[7]

With this background, present study was carried out to study the perinatal outcomes associated with the umbilical coiling index.

MATERIALS AND METHODS

Prospective Observational Study was carried out over a period of 18 months from January 2020 to June 2021 among 100 Pregnant women with term gestation, irrespective of parity admitted in Labour room at department of Obstetrics and Gynecology at Malla Reddy Institute of Medical Sciences, Suraram Hyderabad.

Those women with pregnancy with term gestation irrespective of parity, singleton pregnancy, live baby, delivery both normal vaginal delivery and caesarean section, cephalic Presentation and pregnant women willing to give consent were included in the present study. Those with twin gestation, preterm delivery, intrauterine death, ante partum Hemorrhages, anomalous baby, post-dated pregnancy and severe Pre-eclampsia, Gestational Diabetes Mellitus were excluded from the present study.

Institutional ethics committee (IEC) approval was obtained before the initiation of the study. Pregnant women in labour room fulfilling the study criteria were included. Informed consent was obtained from participants. Pregnant women with term gestation, irrespective of parity, with singleton pregnancies with live fetus admitted in labour room were observed.

Immediately after delivery, the umbilical cord was clamped and cut 5cms away from fetal insertion with scissors taking care not to milk the cord (as the latter might affect the UCI). The placenta was allowed to separate spontaneously. The umbilical cord was measured including both the placental end of the cord and 5cms from umbilical stump on the baby side was measured by using thread and then the length of thread was measured by using measuring tape in centimetres. No excessive traction exerted on the cord at the time of measurement. A coil was taken as one complete 360-degree spiral course of the umbilical vessels. Number of complete coils or spirals were counted and the direction of the coils noted from the placental end by placing the umbilical cord vertically. If the direction of the vessels on the anterior surface of the cord was towards the left-hand side of the observer it is noted as left sided coiling and right sided coiling if the direction of the coils is towards right. After this Umbilical coiling index was calculated by total number of coils divided by the total length of the cord in centimetres.

Materials used were Mayo scissors, umbilical cord clamp, thread and measuring tape. The perinatal parameters like birth weight, APGAR score at 1 minute and 5 minutes, meconium staining, NICU admission, fetal growth restriction were correlated with umbilical coiling index. Thus, the effect of umbilical coiling on perinatal outcome was carried out. All women and baby were followed till discharge (7days after birth).

Statistical Analysis: Data analysis was carried out using the statistical package for social sciences (SPSS) software version 26. Descriptive statistics was done to show the composition of the study population. For continuous variables, mean values, standard deviation and distribution of data was described. For categorical variables, frequencies and percentages were described. In the analysis, a probability value less than or equal to 0.05 was considered statistically significant. To assess the relations, cross tabulations were used for categorical variables and chi square test and Fischer exact test was done.

RESULTS

Table 1: Socio-demographic and obstetric characteristics

Characteristics		Number	%
Age (years)	17-21	20	20%
	22-26	47	47%
	27-31	29	29%
	32-36	4	4%
Booked status	Booked	72	78%
	Unbooked	28	28%
Parity	Primigravida	34	34%
	Multigravida	66	66%
Mode of delivery	NVD	37	37%
	LSCS	63	63%

Most of the women belonged to the age group of 22-26 years i.e. 47%. Booked cases were majority i.e. 78%. Majority (66%) were multigravida. Most of the women (63%) delivered by LSCS mode. (Table 1)

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Table 2: Distribution as per Umbilical cord characteristics

Characteristics		Number	%
Umbilical coiling index	Normal	78	78%
	Hypo-coiling	12	12%
	Hyper-coiling	10	10%
Length of umbilical cord (cm)	32-40	4	4%
	40-48	1	1%
	48-56	33	33%
	56-64	46	46%
	64-72	9	9%
	72-80	4	4%
	80-88	3	3%
Number of coils	2-8	19	19%
	8-14	3	3%
	14-20	10	10%
	20-26	40	40%
	26-32	23	23%
	32-38	5	5%
Direction of twist	Dextral	36	36%
	Sinistral	64	64%

Majority of the cases (78%) had normal umbilical coiling index. The incidence of hypo-coiling was 12% and that of hyper-coiling was 10%. In most of the cases (46%) the length of the umbilical cord was between 48-56 cm. In majority of the cases (40%), the number of coils were between 20-26. Most of the cases (64%) had sinistral direction of twist of the umbilical cord. (Table 2).

Table 3: Distribution as per new born characteristics

Characteristics		Number	%
Birth weight (kg)	<2kg	0	-
	2.0-2.50kg	16	16%
	2.50-3.50	78	78%
	>3.50kg	6	6%
Apgar score-1min	<4	17	17%
	>4	83	83%
Apgar score-5min	<7	12	12%
	>7	88	88%
Intra uterine growth retardation	Yes	11	11%
	No	89	89%
NICU admissions	Yes	19	19%
	No	81	81%

The incidence of low birth weight was 16% in this study. 17% had low APGAR score at one min of less than four and 12% had APGAR score of less than seven at five min. the incidence of IUGR was 11%. Some 19% needed NICU admission. (Table 3)

Table 4: Association of various factors with abnormal umbilical coiling index

Factors		Umbilical coiling index		P value
		Abnormal (hyper or hypo coiling	Normal	
Age of mother (years)	< 26	12	52	0.427
	> 26	10	26	
Parity	Primi	6	28	0.618
	Multi	16	50	
Booked status	Booked	15	57	0.855
	Un-booked	7	21	
Mode of delivery	LSCS	12	51	0.496
	NVD	10	27	
Birth weight	Low	**8**	5	**0.0008**
	Normal	14	73	
APGAR score at 1 minute	< 4	7	10	0.0861
	> 4	15	68	
APGAR score at 5 minutes	< 7	3	9	0.619
	> 7	19	69	
IUGR	Yes	1	3	0.636
	No	21	75	
Direction of twist	Dextral	6	30	0.475
	Sinistral	16	48	
NICU admission	Yes	**10**	9	**0.0011**
	No	12	69	

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Age of mother, parity, booked status, mode of delivery, APGAR score at one and five min, IUGR and the direction of the twist of the umbilical cord were not found to be significantly associated with the abnormal umbilical coiling index ($p>0.05$). But low birth weight was found to be significantly associated with the abnormal umbilical coiling index ($p<0.05$). Similarly, NICU admission was also found to be significantly associated with the abnormal umbilical coiling index ($p<0.05$). (Table 4)

DISCUSSION

In the present study, most of the women belonged to the age group of 22-26 years i.e. 47%. Booked cases were majority i.e. 78%. Majority (66%) were multigravida. Most of the women (63%) delivered by LSCS mode. Majority of the cases (78%) had normal umbilical coiling index. The incidence of hypo-coiling was 12% and that of hyper-coiling was 10%. In most of the cases (46%) the length of the umbilical cord was between 48-56 cm. In majority of the cases (40%), the number of coils were between 20-26. Most of the cases (64%) had sinistral direction of twist of the umbilical cord. The incidence of low birth weight was 16% in this study. 17% had low APGAR score at one min of less than four and 12% had APGAR score of less than seven at five min. the incidence of IUGR was 11%. Some 19% needed NICU admission. Age of mother, parity, booked status, mode of delivery, APGAR score at one and five min, IUGR and the direction of the twist of the umbilical cord were not found to be significantly associated with the abnormal umbilical coiling index ($p>0.05$). But low birth weight was found to be significantly associated with the abnormal umbilical coiling index ($p<0.05$). Similarly, NICU admission was also found to be significantly associated with the abnormal umbilical coiling index ($p<0.05$).

Patil NS et al,[8] carried out a prospective study among 200 patients. They calculated the umbilical coiling index. They tried to correlate it with different parameters. The authors found that there was a significant association between hyper-coiled cord with the IUGR, low ponderal index. There was a significant association between hypo-coiled cords with meconium staining. Hypo-coiled cord was also associated with APGAR score of <4 at 1min. LSCS was more common among those with hypo-coiling. Similarly, NICU admission was rate was more common among those with hypo-coiling.

Satoskar P et al,[9] enrolled 100 pregnant women in their prospective study. They used ultrasonography for measuring umbilical coiling index. They found that the incidence of normal coiling was 79% while that of hypo-coiling was 10% and that of hyper-coiling was 11%. The incidence of the pre-term delivery was 5%. Among those with abnormal coiling index, 10% had meconium-stained liquor.

Devaru D et al,[10] examined the umbilical cords in 100 cases. They observed that the IUGR was more common in those with hyper-coiling than those with normal coiling and the association was found out to be statistically significant. They observed that the APGAR score at 1min of <4 was more common in those with hypo-coiling than those with normal coiling and the association was found out to be statistically significant. They observed that the APGAR score at 5min of <7 was more common in those with hypo-coiling than those with normal coiling and the association was found out to be statistically significant. Incidence of meconium staining was also more in hypo-coiled cases than normal coiled cases.

Biradar A et al,[11] included 600 pregnant women with 28-40 weeks of gestation. The length of the umbilical cord was measured as per the standard guidelines. They measured the coiling index at the clamping of the cord irrespective of the mode of delivery. They compared three groups, normal coiled, hypo coiled, and hyper coiled. The incidence of various outcomes like hypertensive disorders, LSCS, LBW, IUGR, oligohydramnios, polyhydramnios was more in those with hypo coiled and hyper coiled cases than those with normal coiled cases.

Tripathy S et al,[12] studied 102 umbilical cords. If the umbilical coiling index was less than 10th percentile, then it was classified as hypo coiled. If it was between 10th to 90th percentile, it was normal coiled. And more than 90th percentile, was hyper coiled. They found significant association between pregnancy induced hypertension and hypo coiled cases. They also observed that preterm delivery rate was more in those with hypo coiled. The rate of low APGAR score at 5min was also significantly more in hypo coiled cases.

Chholak D et al,[13] examined 500 cases to calculate the umbilical coiling index. Like present study, they found that the rate of IUGR was more in those with hyper coiling. Meconium staining, low APGAR scores, high rate of LSCS and admission to the NICU was more common in those with hypo coiling compared to those with normal coiling.

Agarwal S et al,[14] compared the umbilical coiling index and the perinatal outcome in 500 cases. They compared the outcome in those with abnormal pregnancy and the normal pregnancy. They found that the rate of low birth weight was more in hypo coiling. IUGR is also more in those with hypo coiling compared to those with normal coiling. They recommended that color Doppler should be used to study the umbilical coiling index.

Limitations

Our study sample include only 100, among them 70(70%) showing normal coiling to get accurate results sample size should be increased and can go for comparative study. Study does not include previous pregnancy coiling index which cannot predict perinatal outcome. Neonates affected with IUGR had maximum of normal coiling. Our study does not measure antenatal UCI and hence not correlated postnatal, which would have given more practical importance.

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CONCLUSION

The abnormal umbilical coiling index is associated with adverse perinatal outcome. In current study 25% of sample have umbilical coiling index of 0.34, 50% and 75% of sample have umbilical coiling index 0.42 and 0.45 respectively. Umbilical coiling index measured as total number of coils in a cord/total length of cord in cm. In our study <0.06 considered as hypo-coiling and >0.45 considered as hyper-coiling. Among 100 study population,10(10%) sample had hyper-coiling, 12(12%) samples had hypo-coiling and rest all were having normal coiling. Based on the study, hyper-coiling (10%) of the umbilical cord is associated with Low birth weight and associated other neonatal parameters like APGAR score at 1 min and APGAR score at 5 min intrauterine growth restriction and meconium staining had statistically significant. Umbilical coiling index can be identified both antenatal and postnatal. Postnatal umbilical coiling index measurement serves as significant indicator for perinatal outcome. But number of coils seen in first trimester is almost constant at term. So antenatal detection of umbilical coiling index helps in identifying neonatal risk and help in further management.

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