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Original Article

Obstetrics and Gynaecology Section

Coils in Umbilical Cord and their Perinatal Significance in North Indian Population: A Cross-sectional Study

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ABSTRACT

Introduction: Umbilical Coiling Index (UCI) is defined as number of coils present per centimeter of cord. Abnormal coiling index (hypocoiled/hypercoiled) has been studied previously and found to be associated with adverse perinatal outcome. There is limited literature available on Indian population

Aim: To analyze association between UCI and maternal and fetal risk factors and to evaluate how hypocoiling, normocoiling and hypercoiling are linked to materno-fetal outcome in a North Indian population.

Materials and Methods: A cross-sectional study was conducted on 500 antenatal women who were enrolled in their active phase of labour and UCI calculated after delivery. UCI was determined by formula- number of coils/length of cord in centimeters (cm). Normocoiling, hypocoiling and hypercoiling were determined and its association with various maternal risk factors and perinatal outcome was noted.

Results: On an average 0.2±0.09 coils were found per cm of coil. Hypocoiling was found to be significantly associated with anaemia, abruption, prematurity, Premature Rupture of Membranes (PROM), meconium stained liquor, instrumental delivery and APGAR at 5 minutes <7. Hypercoiling was found to be associated with diabetes and post datism.

Conclusion: Post delivery umbilical coiling index serves as a significant indicator of perinatal outcome and therefore antenatal determination of UCI can help identify high risk pregnancies.

Keywords: High risk pregnancy, Maternal-fetal outcome, Postnatal women, Umbilical coiling index

INTRODUCTION

The goal of obstetrics is to provide healthy mother and baby. Umbilical cord is the connecting bond between mother and fetus which through its three vessels performs all metabolic functions of fetus. In 1521 Barengius first reported coiling in umbilical cord [1]. Four years later it was first quantified by Edmonds [2] who called it 'Index of Twist'. Clockwise and anti clockwise coiling were given positive and negative scores respectively. Hypocoiling (<10th percentile), normocoiling (10th to 90th percentile) and hypercoiling (>90th percentile) were defined by Rana J et al., [3]. Umbilical coiling index, the term first used by Strong TH et al., [4] conveys the number of coils present per centimeter of cord. Hypocoiling and hypercoiling has been linked to various maternal factors and fetal outcomes. Several studies [1,3,5-9] have been done which show relation between umbilical cord coiling to poor perinatal outcomes. But there are very few studies done in North India.

The present study attempts to fill up this void in literature by taking a large sized North Indian population and comparing maternal-fetal outcome in hypo-hyper-coiled cords with normocoiled cords. North India has most disturbing maternal and fetal statistics; if such an association is found between UCI and maternal fetal outcome it will go a long way in identifying high risk cases early and thus altering the outcome.

MATERIALS AND METHODS

A cross-sectional study was conducted in University College of Medical Sciences, Delhi, India, over a period of six months (April 2015 to September 2015). Study was approved by Institutional Ethical Committee of Human Research. Informed consent was taken from all participants. Patient information sheet was provided to them. A total number of 540 pregnant women were randomly selected from our labour ward with period of gestation beyond 28 weeks, cephalic singleton presentation and in active labour. Exclusion criteria were multiple gestation, malpresentation and caesarean sections. Caesarean sections were excluded to avoid multi-observer bias. Forty patients underwent caesarean section and were excluded from the study.

After vaginal delivery the attending resident would cut the umbilical cord at 5 cm from the baby. The length of cord noted

and number of coils were counted and noted. A coil with full 3600 spiral turn was considered complete. UCI calculated by formula- Number of coils / Total length of cord + 5 cm.

In the mother – Age, parity, anaemia, pre-eclampsia, prematurity, diabetes mellitus, PROM, post datism, abruption, liquor abnormalities were recorded. During delivery any use of forceps or ventouse, fetal heart abnormality and meconium staining were recorded. In the neonate APGAR score at 5 minutes and Post Partum Hemorrhage (PPH) were recorded.

After taking 500 cases mean UCI, 10th and 90th percentile limit was calculated. Maternal-fetal factors were analysed in association with hypocoiled group (<10th percentile value) and hypercoiled group (>90th percentile value).

STATISTICAL ANALYSIS

Statistical analysis was done by Chi square test Fischer's exact test and 't'-test.

Variables	No. of Patients
Age Group (in years)	
20-25	332 (66.4%)
26-30	133 (26.6%)
31-35	29 (5.8%)
>35	6(1.2%)
Parity	
Primi	210 (42%)
Multipara	290 (58%)

[Table/Fig-1]: Age and parity distribution.

RESULTS

Total 500 women who fulfilled the inclusion criteria were enrolled in the study. Majority of the women that is 332 (66.4%) belonged to 20-25 years of age group. Out of 500, 210 (42%) were primiparous and 290 (58%) were multi gravidas, which was statistically not significant in relation to UCI [Table /Fig-1].

The mean length of umbilical cord was found to be 50.67±10.12 cm and the mean number of coils per umbilical cord was found to be 11.26±4.38. Mean UCI was 0.2±0.09 coils per cm. Normocoiled group had UCI between 0.05-0.41 and were present in 79.4% cases. Hypocoiled (UCI <0.05) and hypercoiled (UCI>0.42) coils were 10.6% and 10% respectively.

Among maternal factors studied anaemia was detected in 29 (5.8%) women and 14 (48.3%) were associated with hypocoiling (p=0.001). Out of 56 (11.2%) preterm pregnancies 11 (19.6%) belonged to hypocoiled group (p=0.017). Abruptio was observed in 10 (2%) women and of these 4 (40%) were linked to hypocoiling (p=0-005). Out of 48 (9.6%) women with PROM 1 (1.9%) belonged to hypocoiled group (p=0.047). Among 90 post dated pregnancies 23 (25.7%) had hypercoiling (p=0.001) which was highly significant. There were 3 (0.6%) diabetic patients with 2 (66.6%) having hypercoiling. Pre eclampsia, liquor abnormalities and chorioamnionitis were found to have no significant association with UCI [Table /Fig-2].

Among intrapartum factors a high statistical significance was found between instrumental delivery and hypocoiling

Maternal Factors	Total No. of Cases	Hypocoiled	p-value (P1)	Normocoiled	Hypercoiled	p-value (P2)
Anaemia	29 (5.8%)	14 (48.3%)	<0.001	14 (48.3%)	1 (3.4%)	NS
Preeclampia	99 (19.8%)	8 (8.1%)	NS	81 (81.8%)	10 (10.1%)	NS
Preterm	56 (11.2%)	11 (19.6%)	0.017	39 (69.6%)	6 (10.7%)	NS
Diabetes	3 (0.6%)	0	NS	1 (33.3%)	2 (66.7%)	0.002
PROM	48 (9.6%)	1 (2.1%)	0.047	41 (85.4%)	6 (12.5%)	NS
Post-dated	90 (18%)	5 (5.6%)	NS	62 (68.9%)	23 (25.7%)	<0.001
Abruption	10 (2%)	4 (40%)	0.0O5	6 (60%)	0 (0%)	NS
Liquor abnormalities	21 (4.2%)	5 (23.8%)	NS	16 (76.2%)	0 (0%)	NS
Chorio-amnionitis	10 (2%)*	0 (0%)	NS	9 (90%)	1 (10%)	NS

[Table/Fig-2]: Association of UCI with maternal factors.
P1=p-value calculated between hypocoiled and normocoiled cords
P2=p-value calculated between hypercoiled and normocoiled cords
*Remaining 134 patients had no maternal complication and had no significant association with hypocoiling or hypercoiling

Maternal Factors	No. of Cases	Hypocoiled	p-value (P1)	Normocoiled	Hypercoiled	p-value (P2)
Instrumental Delivery	15 (3%)	5 (33.3%)	0.008	10 (66.7%)	0	NS
Fetal Heart Rate Abnormalities	18 (3.6%)	1 (5.6%)	NS	14 (77.8%)	3 (6%)	NS
Meconium Stained Liquor	23 (4.6%)	8 (34.8%)	<.001	14 (60.9%)	1 (4.3%)	NS

[Table/Fig-3]: Association of UCI with intrapartum factors.
P1=p-value calculated between hypocoiled and normocoiled cords
P2=p-value calculated between hypercoiled and normocoiled cords

Maternal Factors	No. of Cases	Hypocoiled	p-value (P1)	Normocoiled	Hypercoiled	p-value (P2)
APGAR (<7)	49 (9.8%)	26 (53.9%)	<0.001	21 (42.9%)	2 (4%)	NS
Post Partum Hemorrhage	22 (0.04%)	1 (4.5%)	NS	21 (95.4%)	0	NS

[Table/Fig-4]: Association of UCI with neonatal factors.
P1=p-value calculated between hypocoiled cords and normocoiled cords
P2=p-value calculated between hypercoiled and normocoiled cords

(p=0.008). Meconium staining was seen in 23 (4.6%) women and 8 (34.8%) had hypocoiled cords (p=0.001). No association was found between UCI and abnormal fetal heart rate pattern [Table /Fig-3].

Among the postnatal factors low apgar score was found in 49 (9.8%) babies, out of which 26 (53.9%) had hypocoiling (p<0.001). Postpartum haemorrhage had no significant association with abnormal UCI [Table /Fig-4].

DISCUSSION

Umbilical coiling whether under coiling or over coiling was found to be significantly associated with maternal fetal outcome variables in North Indian population. Our study shows that the factors which have serious implications on North Indian maternal and fetal morbidity and mortality like anaemia, preterm labour, abruption, meconium staining and low APGAR score has strong association with hypocoiling. This was a cross sectional study done by a single observer who knew the correct methodology of UCI measurement; hence all recordings were taken correctly.

The mean UCI in our study was comparable to other studies [1,3-6] done so far [Table /Fig-5].In our study the demographic variables of age and parity were not found to be significantly associated with UCI.

In previous studies Chitra T et al.,[1] found association between elderly gravida and both hypocoiled and hypercoiled coils. Ezimokhai M et al.,[5] found hypercoiling to be associated with extremes of maternal age.

Our study found that hypocoiling is detrimental for both mother and baby. In our study hypocoiling was found to be significantly associated with anaemia, abruption, preterm labour, meconium stained liquor, instrumental delivery and low apgar score. Chitra T et al.,[1] found significant association between hypocoiling and hypertensive disorders, abruption, preterm labour, oligohydramnios and fetal heart rate abnormalities. Umbilical venous coiling index was calculated by Ohno Y et al.,[6] and they found hypocoiling association with fetal heart rate abnormality, operative delivery and nuchal cord entanglement. Rana J et al., found Fetal Heart Rate (FHR) decelerations to be significantly associated with hypocoiling [3]. Patil NS et al., also found hypocoiling to be associated with meconium stained liquor, low apgar score and NICU admission [7]. Rabiee M et al., also found significant association between hypocoiling and fetal heart rate late deceleration [8]. Coetzee AJ et al., found zygosity to have no role in umbilical coiling induction [9].

Study	Mean UCI
Chitra T et al., [1]	0.24±0.09
Rana J et al., [3]	0.19±0.1
Strong TH et al., [4]	0.21±0.07
Ezimokhai AM et al., [5]	0.26±0.09
Ohno Y et al., [6]	0.13±0.08

[Table/Fig-5]: Mean UCI of various studies.

This strong association of hypocoiling and fetal jeopardy can be explained by analyzing 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 [10]. This property is perhaps due to the elasticity imparted by coiling [1]. 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 [11].

Our study also found association of hypercoiling with post datism and diabetes. Chitra T et al., also found association of hyercoiling with diabetes mellitus, polyhydramnios, caesarean delivery, congenital anomalies and respiratory distress of newborn [1]. Rana J et al., found significant association between hypercoiling and preterm labour. They considered that due to excessive fetal hemodynamic changes the umbilical cord gets excessively coiled and that initiates premature contractions [3].

Mittal A et al.,[12] and Patil NS et al.,[7] found hypercoiling to be associated with Fetal Growth Retardation (FGR). Shobha T et al., found association of hypercoiling with low birth weight, low apgar score, neonatal intensive care admission and fetal growth retardation [13]. Most likely hypercoiling causes increased blood flow due to` local pulsometer effect [11] 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 [14].

Antenatal detection of this hypocoiling or hypercoiling by ultrasound can help to identify high risk pregnancies. Studies highlighting the association of antenatal sonographic UCI [11,15-18] with perinatal outcome have been done on small populations and are few. Further research involving large population and prospective cohort is required to establish the association between antenatal and postnatal UCI. Quantifying

postnatal UCI is of significance only if the concept can be applied in antenatal period. Therefore, more prospective cohort studies are required which follow antenatal UCI in various trimesters upto postpartum and assess its relation to maternofetal outcome.

LIMITATION

Our study included only normal vaginal deliveries hence it fails to define relation of indicators of caesarean section (viz malpresentation, placenta praevia, contracted pelvis) with umbilical coiling. Further, in our study antenatal UCI was not measured and hence not correlated postnatally, which would have given it more practical importance.

CONCLUSION

Post delivery umbilical coiling index serves as a significant indicator of maternal high risk factors and perinatal outcome in North Indian population. As the number of coils seen in first trimester is roughly the same as seen in term cords; in future umbilical coiling may become a routine part of antenatal fetal evaluation to screen high risk pregnancies and thus decrease high maternal and neonatal morbidity and mortality of the area.

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