Significance of umbilical coiling index in antenatal period and its association with perinatal outcome

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Abstract:

Objective: To correlate umbilical coiling index (UCI) and perinatal outcome. **Material & methods**: Present prospective study was conducted on 582 antenatal mothers in second trimester with singleton live pregnancy in Kamineni Institute of Medical Sciences, Nalgonda. During growth scan UCI was measured. UCI between 10th - 90th percentile was considered as normocoiled, less than 10th percentile as hypocoiled and more than 90th percentile as hypercoiled. Then UCI was correlated with maternal and neonatal outcome. **Results**: Mean UCI was 0.24 ± 0.78 coils per cms. Maximum were normocoiled in 59 %, 22.5% were hypocoiled and 18.5% were hypercoiled. Abnormal UCI was associated with pregnancy induced hypertension, abnormal partogram, increased operative delivery, low APGAR scores, more NICU admissions and low birth weight which were statistically significant (p value <0.05). **Conclusion:** Abnormal UCI is associated with adverse perinatal outcome. Therefore it is good tool for identifying fetus at risk and thereby improving perinatal outcome by appropriate intervention. As it is done during growth scan, there will be no additional economical burden to patient.

Keywords: Perinatal outcome, umbilical cord coiling index (UCI).

Ian Donald said that "baby's life hangs by a cord"[1]. Umbilical cord is the conduit from placenta to fetus. It contains vessels which carries oxygen and nutrients to fetus. Thus, it is vital in development, wellbeing and survival of fetus and yet, it is vulnerable to kinking, compressions and traction which may adversely affect perinatal outcome [2]. Even its abnormal length is also associated with complications. Short cords are associated with a delay in the second stage of labour, irregular FHR, placental abruption, inversion of uterus, birth asphyxia [1]. Long cords are associated with cord around the neck of fetus, its prolapse, torsion and true knot [1]. A coil is defined as 360 spiral course of umbilical vessel around Wharton's jelly [3]. It may be seen by ultrasonography as early as in first trimester [4]. The pattern of coiling develops during second and third trimesters. Cord length at birth, is about 50–60 cm [5].

Umbilical cord coiling was first described by Berengarius in 1521 [6], while it is first quantified by Edmonds as, Index of twist [7]. Later Strong et al [8] named it as umbilical cord coiling index (UCI). It is defined as total number of coils divided by total length of cord in centimeters. It is classified into three groups [9] : <10th percentile - hypocoiled, 10th – 90th percentile - normocoiled; >90th percentile - hypercoiled. Complete cord occlusion is associated with fetal

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demise while intermittent obstruction is associated with fetal distress [10]. Therefore, present study was undertaken to study perinatal outcomes with abnormal UCI.

Materials and methods

Present study was conducted in Kamineni Institute of Medical Sciences, Nalgonda district, in department of OBG with collaboration of department of Radiodiagnosis, from June 2018 to August 2021. It was a prospective study conducted on 582 pregnant women after obtaining institutional ethical clearance.

Inclusion criteria: Antenatal women at 28 weeks with singleton live fetus.
Exclusion criteria: Refusal for participation in study
Multiple pregnancy
Congenital anomalies

All patients were informed in detail about study and written consent was taken. A detailed obstetrics history was obtained. At the time of growth scan, coiling index was measured using 3.5 MHz transabdominal transducer. Longitudinal images of the umbilical cord which was freely floating in amniotic fluid was taken [11]. UCI was measured by using the formula -

$$UCI = \frac{\text{Total number of complete coils}}{\text{Total length of cord (cm)}}$$

Patients were divided into three groups - normocoil, hypocoil and hypercoil. Among 635 patients, there was difficulty in calculating the coiling index in 21 women due to inability to achieve appropriate imaging of umbilical cord, 32 women did not come to our institute for delivery.

Medical disorder complicating pregnancy, Intrapartum partogram and strict fetal heart rate (FHR) monitoring by intermittent auscultation was done. Abnormalities in FHR, meconium stained liquor and mode of delivery vaginal or cesarean, were noted. Neonatal factors like APGAR score, birth weight, admission to neonatal intensive care unit (NICU) were noted.

Statistical analysis: All data was tabulated and analysed using SPSS version 18 and was analysed using Chi-Square test. P value <0.05 was considered as significant.

Results

In present study, mean length of umbilical cord was 54.1 ± 16.8 cms (table 1). Maximum were normocoiled in 59% (343), 22.5% (131) were hypocoiled and 18.5% (108) were hypercoiled. Increased age of mother was associated with abnormal UCI which was statistically significant ($p < 0.05$) (table 2).

Table 1: Umbilical coil characteristics (N =582)

Umbilical coil characteristics	Minimum	Maximum	Mean ± SD
Length (cms)	28	102	54.1 ± 16.8
Number of coils	4	34	31 ± 7.8
Umbilical coiling index (coil per cms)	0.14	0.34	0.24 ± 0.78

Table 2: Correlation of age wise distribution with umbilical cord coiling

Age (N= 582)	Umbilical coiling index (UCI)		
	Normocoiled (n=343)	Hypocoiled (n=131)	Hypercoiled (n=108)
21- 25 (n=98)	48 (48.9%)	45(45.9%)	5 (5.2%)
26 – 30 (n=335)	251 (74.9%)	21(6.2%)	63(18.8%)
30-35 (n=108)	36 (33.3%)	48 (44.4%)	24(22.8%)
36 – 40 (n=41)	8 (19.5%)	17(41.4%)	16(39%)
p value	>0.05	<0.05	<0.05

Hypocoiling was associated with pregnancy induced hypertension and gestational diabetes mellitus which was statistically significant ($p<0.05$) (table 3). Abnormal UCI was associated with variability in fetal heart rate, which was statistically significant ($p < 0.05$) (table 4).

Table 3: Association between medical disorders complicating pregnancy and umbilical cord coiling index

Medical disorders complicating pregnancy (N=219)	Umbilical coiling index(UCI)			
	Out of normocoiled (n=343) ,87 with medical disorders	Out of hypocoiled (n=131), 94 with medical disorders	Out of hypercoiled (n=108) , 38 with medical disorders	p value
Pregnancy induced hypertension (n=69)	9 (10.3%)	43 (43.9%)	17 (44.7%)	<.05
Gestational diabetes mellitus (n=47)	8 (9.2%)	29 (30.9%)	10 (26.3%)	<.05
Anemia (n=53)	39 (44.8%)	9 (9.6%)	5 (13.2%)	>.05
Cardiac disease (n=17)	9 (10.3%)	5 (5.3%)	3 (7.9%)	>.05
Hypothyroid (n=26)	17 (19.5%)	7 (7.4%)	2 (5.3%)	>.05
Epilepsy (n=7)	5 (5.7%)	1 (1.1%)	1 (2.6%)	>.05

Table 4: Distribution of patients according to variation in fetal heart rate

Umbilical coiling index (UCI)	Fetal heart rate	
	Normal (n=472)	Abnormal (n=110)
Normocoiled (n=343)	282 (59.7%)	61 (55.5%)
Hypocoiled (n=131)	89 (18.6%)	42 (38.2%)
Hypercoiled (n=108)	101 (21.4%)	7 (6.4%)

Table 5: Associated between UCI and mode of delivery

Umbilical coiling index (UCI)	Mode of delivery	
	Vaginal delivery (n=430)	Caesarean section (n=152)
Normocoiled (n=343)	280 (65.1%)	63 (41.4%)
Hypocoiled(n=131)	85(19.8%)	46 (30.3%)
Hypercoiled (n=108)	65 (15.1%)	43 (28.3%)
$p < 0.05$		

Table 6: Correlation of perinatal outcome with umbilical cord coiling index (UCI)

Perinatal outcomes		Umbilical cord coiling index (UCI)		
		Normocoiled (n=343)	Hypocoiled(n=131)	Hypercoiled (n=108)
1.	**Meconium staining**			
	Yes	108 (31.5%)	87 (66.4%)*	67 (62%)*
	No	235 (68.5%)	44 (33.6%)	41 (38%)
2.	**APGAR score at 1 min**			
	<7	50 (14.6%)	81 (61.8%)*	61 (56.5%)*
	>7	241(70.3%)	50 (38.2%)	47 (43.5%)
3.	**NICU admission**			
	Yes	95 (27.7%)	69 (52.7%)*	48 (44.4%)*
	No	248 (72.3%)	62 (47.3%)	60 (55.6%)
4.	**Birth weight**			
	Normal birth weight	69 (20.1%)	57 (43.5%)	47 (43.5%)
	Low birth weight	274 (79.9%)	74 (56.5%)*	61 (56.5%)*
*p<0.5				

Out of 430 normal vaginal delivery, 34.9% had abnormal UCI. Out of 152 caesarean section, 58.6% had abnormal UCI (table 5). Abnormal umbilical cord coiling index was associated with meconium staining, low APGAR scores at 1min (<7), more NICU admissions and low birth weight. This was statistically significant ($p < 0.05$) (table 6).

Discussion

Mean length of umbilical cord of present study was similar to study by Padmanabhan LD et al [2] and Biradar A et al [3]. Mean number of coils per umbilical cord was similar to study by Biradar A et al [3] and Chitra T et al [4]. Mean UCI was similar to other studies [2,4,6,8,9,12].

Percentage of normocoiled, hypocoiled and hypercoiled were similar to study done by Padmanabhan LD et al [2], Biradar A et al and Najarajan G et al[10]. Association between increased age of mother and abnormal UCI is similar to results quoted by Chitra T et al [4], Najarajan G et al[10] and Ezimokhai M et al [13]. Association of hypocoiling with pregnancy induced hypertension and gestational diabetes mellitus are in agreement with other studies [3,6,10,13-16].

The coiled umbilical cord, because of its elastic properties, is able to resist external forces that might compromise its vascular flow. This explains association of hypocoiling with preeclampsia. According to Edmond's hypothesis [7] twist of umbilical cord is due to rotary movement of fetus and therefore coiling will be directly proportional to amount of amniotic fluid.

Association of abnormal UCI and variability in fetal heart rate and therefore caesarean section of present study is similar with several authors [2,3,8,10,16]. Hypocoiled and hypercoiled cords are less flexible and more prone to kinking and cord complication and fetal distress.

Abnormal umbilical cord coiling index was associated with meconium staining, low APGAR scores at 1min (< 7), more NICU admissions and low birth weight. This results was in agreement with the results of previous studies [2,3,6,8,10,14,18,19].

Hypocoiling may cause kinking and compression whereas, hypercoiling may cause kinking, torsion of cord and occlusion in cord around neck. Thus they interfere in fetoplacental circulation in turn low birth weight[19] and low APGAR score.

Limitation of the study: It was done in a single hospital therefore sample may not be representative of all Indian women. Therefore we recommend a cross-sectional multicentric study.

Future scope: As abnormal UCI is associated with pre-eclampsia; further studies can be done to predict pre-eclampsia with UCI.

Conclusion

Abnormal UCI is associated with adverse perinatal outcome. Therefore it is good tool for identifying fetus at risk and thereby improving perinatal outcome by appropriate intervention. As it is done during growth scan, there will be no additional economical burden to patient.

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