

Study of Abnormal Umbilical Coiling Index and its Outcome in Rural Area

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Abstract: *Objective:* To evaluate relationship between umbilical coiling index (UCI) and perinatal outcome. *Material & Methods:* Present prospective study was conducted on 384 term patients with singleton live pregnancy in rural area at Kamineni Institute of Medical Sciences, Narketpally. UCI was determined by dividing total number of complete vascular coiling by umbilical cord length in centimeters. Then relationship between abnormal UCI and intrapartum fetal heart rate (FHR), mode of delivery and neonatal outcome like birth weight, meconium stained liquor and APGAR score were evaluated. *Results & Discussion:* Mean UCI was $0.21 + 0.78$ coils per cms. It is divided into three groups- hypocoiled (UCI <10th percentile), normocoiled (UCI between 10th-90th percentile and hypercoiled (UCI >90th percentile). Normocoiled were predominant in 75.7% (291), 14.6%(56) cases were hypocoiled and 9.7% (37) were hypercoiled. Hypocoiled cords were associated with pregnancy induced hypertension, abruptio placenta, oligohydramnios, intrapartum foetal heart rate abnormalities, instrumental vaginal delivery, increased operative delivery, meconium staining, low APGAR scores, more NICU admissions and low birth weight (P value <0.05). while hypercoiling was significantly associated with gestational diabetes mellitus, polyhydramnios, foetal heart rate abnormalities during labour and low birth weight (P value <0.05). *Conclusion:* Abnormal UCI is associated with adverse perinatal outcome. UCI can be used as antenatal marker for identifying fetus at risk and by early intervention one can reduce perinatal morbidity.

Keywords: Hypercoiling umbilical cord, Hypocoiling umbilical cord, Fetal distress, Perinatal outcome, Umbilical cord coiling index (UCI)

1. Introduction

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 foetus and yet, it is vulnerable to kinking, compressions and traction which may adversely affect perinatal outcome. A coil is defined as having completed a 360 spiral course of umbilical vessel around Wharton's jelly. The total number of coils in cord is established as early as 28 days after conception and is present in about 95% of fetuses by 9 weeks. The helices may be seen by ultrasonography as early as in first trimester of pregnancy (1). The pattern of coiling develops during second and third trimesters, presumably due to snashes in cord and these coiling changes as pregnancy advances. It may vary between 0- 40. Also length of umbilical cord is one of reflections of fetal activity. It is dependent on fetal movements, with an active fetus having a longer cord than inactive fetus. Thus, umbilical cord length may reflect in utero environment and activity of fetus. Cord length at term varies ranging from no cord (achordia) to 300 cm. At birth, cord is about 50-60 cm in length.(2)

Umbilical Cord Coiling was first describe by Berengarius in 1521 [3]. while it is first quantified by Edmonds as "Index of twist".[4] Later Strong et al named it as "Umbilical cord coiling index(UCI)" [5]. It is defined as total number of coils divided by total length of cord in centimeters. It is classified into three groups [6].: <10th percentile-hypocoiled, 10th-90th percentile-normocoiled; >90th percentile—hypercoiled. Normal UCI is 0.17 spiral per cm. Complete cord occlusion often leads to fetal demise while intermittent obstruction is associated with intrauterine brain damage. Compression and vasospasm in utero are important factors in fetal distress. Thus abnormal UCI is associated with adverse pregnancy outcome. Therefore, present study was

undertaken to evaluate perinatal outcomes with abnormal UCI in rural area.

2. Material & Methods

Present study was conducted in Kamineni Institute of Medical Sciences, Narketpally, Nalgonda District, Telangana, India from July 2013 to October 2014. It was a prospective study conducted on 384 pregnant women who were in active labour.

Inclusion Criteria

- Patients with term gestation (37-40 week gestational age)
- Singleton live fetus

Exclusion Criteria

- Refusal for participation in study
- Preterm gestation
- Multiple gestation
- Congenital anomalies
- Intrauterine death

All patients were informed in detail about aim, objectives of study and written consent was taken. A detailed obstetrics history was obtained and maternal high risk factors like pregnancy induced hypertension, gestational diabetes mellitus, abruptio placenta, oligohydramnios, polyhydramnios etc were noted. 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.

Umbilical cord was examined to note any loop around neck, trunk, shoulder etc., number of loops, tight or loose loop, presence of (true or false) knots. Immediately after delivery, cord was clamped and cut taking care not to milk it (as it may affect UCI). Umbilical cord length was measured including its length of placental end and umbilical stump on baby with flexible tape in cm. Number of coils in the cord was counted. UCI was calculated by following formula.

$$UCI = \frac{\text{Number of coils}}{\text{Total length of cord in cms}}$$

Patients were divided into three groups normocoil, hypocoil and hypercoil

Neonatal factors like APGAR, birth weight, admission to neonatal intensive care unit (NICU) were noted. All patients and babies were followed till discharge. Statistical analysis was done with Chi-Square test. p value < 0.05 was considered as significant.

Results & Discussion

Among 384 women, 202 were booked and 182 were unbooked. Mean length of umbilical cord was $51.72 + 11.71$ cms. Mean number of coils per umbilical cord was $11.37 + 4.74$. Mean UCI was $0.21 + 0.78$ coils per cms which was similar to study done by Strong et al. [5], Rana et al. [6], Nivedita [7]

Normocoiled were predominant in 75.7 % (291), 14.6 % (56) cases were hypocoiled and 9.7% (37) were hypercoiled. In present study, among antenatal risk factors, there was association of hypocoiling with pregnancy induced hypertension, abruptio placenta & oligohydramnios. While gestational diabetes mellitus & polyhydramnios were associated with hypocoiling. They are in agreement with studies done by Ezimokhai et al. [8], Gupta et al. [3]. Machin et al. (9), Kashanian et al. [10]

Umbilical cord coil has elastic properties. Therefore it can resist external forces that might compromise umbilical blood flow. This explains association of hypocoiling with preeclampsia. [1,3]. Probably, high association of preeclampsia with abruption contributes to this finding. According to Edmond's hypothesis [4] twist of umbilical cord is due to rotary movement of fetus and hence more the amniotic fluid, more is fetal rotary movement and more will be coiling. The converse will be true for oligohydramnios.

Table 1: Distribution of patients according to variation in fetal heart rate (FHR)

UCI	Normal FHR	Bradycardia	Tachycardia
Normal coiling (n=291)	227 (78%)	52(17.9%)	12(4.12%)
Hypocoiling (n=56)	29 (51.8%)	20 (35.7%)	7(12.5%)
Hyper coiling(n=37)	20(54%)	11(29.7%)	6(16.2%)

($p < 0.05$)

There is higher incidence of variability in fetal heart rate with abnormal UCI which was statistically significant ($p < 0.05$). Similar association was found by several authors [5] [6] [8], [11] [12]. Hypocoiled and hypercoiled cords are less flexible & more prone to kinking and torsion which makes them less tolerant to withstand stress of labour.

Also coiling provides turgor and compression resistant properties to the cord which become compromised as the cord becomes hypocoiled.

Table 2: Associated between UCI and mode of delivery

Mode of delivery	Normal coiling (n=291)	Hypocoiling (n=56)	Hyper coiling (n=37)
Vaginal delivery	203(69.8%)	16(28.6%)	20(54.1%)
LSCS	88(30.2%)	40(71.4%)	17(45.9%)

p value < 0.05

In present study, 239 women delivered vaginally out of which 19 had vacuum deliveries and 13 had an outlet forceps delivery. 145 delivered by LSCS. Women who had undergone instrumental deliveries had indications of fetal distress. Hypocoiled cords were significantly associated with incidence of more LSCS. Similar positive association between operative delivery, especially for fetal distress and abnormal UCI has been found by [5,6,12]. In present study, caesarean sections was done for all obstetric indications including cord complication & fetal distress.

Table 3: Correlation of Neonatal outcome with Umbilical cord coiling index (UCI)

Parameters	UCI		
	Normal (n=291)	Hypo coiling (n=56)	Hyper coiling (n=37)
A. Meconium staining			
Yes	102(35.1%)	48(85.7%)*	4(10.81%)
No	189(64.9%)	8(14.3%)	33(89.2%)
B. APGAR score at 1 min			
<4	52(17.9%)	43(76.8%)*	9(24.3%)
>4	239(82.1%)	13(23.2%)	28 (75.7%)
C. APGAR score at 5 min			
<7	64(22%)	49(87.5%)*	11(29.7%)
>7	227(78%)	7(12.5%)	26(70.3%)
D. NICU admission			
Yes	43(14.8%)	45(80.4%)*	7(18.9%)
No	248(85.2%)	11(19.6%)	30(81.1%)
E. Birth weight			
<2.5kg (Low Birth Weight)	17(5.8%)	31(55.4%)*	26(70.2%)*
>2.5kg	274(94.2%)	25(44.6%)	11(29.8%)

* p value < 0.05

In present study, among neonatal outcome, there was statistically significant association of hypocoiling with meconium staining, low APGAR scores and more NICU admissions. Hypercoiled group showed statistically significant correlation of LBW with UCI. Similar results were noted by [3]. [5][13] (14) (15) [10].

Percentage of perinatal asphyxia was more in both hypocoiled and hypercoiled groups as compared to normocoil group as excessive traction will cause spasm of umbilical vessel, premature separation of placenta which leads to increased risk of birth asphyxia and early neonatal death [16, 17]

This was explained by an experiment by Georgious et al. [15] in which venous perfusion was measured in cords subjected to standardized tight encirclement force. A significant inverse relationship was found between coiling index and minimum weight required to occlude venous perfusion. So, hypocoiling may cause kinking and

compression, whereas, hypercoiling may cause occlusion in cases with cord entanglement. This helps to explain, association of low APGAR score in hypocoiled cords

Adequate coiling prevents compression of cord, hypocoiling in long run, results in reduced fetoplacental circulation, thus resulting in low birth weight. Similarly hypercoiled predisposes to more kinking and torsion of cord, again interfering in fetoplacental circulation and low birth weight. (17)

3. Conclusion

Abnormal umbilical coiling index is associated with several adverse neonatal outcomes. Present study shows utility of umbilical vascular coiling, as antenatal marker for identifying fetus at risk, therefore helps in delivery of healthy baby. This is prime duty of all obstetrician to decrease perinatal morbidity and mortality by early diagnosis and its management.

4. Future Scope

Ultrasonographic evaluation of UCI at an earlier gestational age may become an integral part of fetal assessment in high-risk pregnancies and early diagnosis will help in early intervention and good outcome.

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