

Abnormal Umbilical Cord Coiling Index and Its Relation to Adverse Perinatal Outcome

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Abstract: *Background:* The umbilical cord is vital to the development, well being and survival of the fetus. A coil of the cord is defined as a complete 360 degree spiral course of umbilical vessels around Wharton's jelly. Sonographically, the Umbilical Coiling Index (UCI) is defined as the reciprocal of the average distance between a pair of coils. Hypocoiled cords are those with UCI < 10th centile while hypercoiled cords are those with UCI > 90th centile. *Methods:* The study was conducted in the Department of Obstetrics and Gynaecology, Nalanda Medical College, Patna, Bihar. Hundred patients attending GOPD were selected for the study over a period of one year (October 2015 – October 2016). The effect of Umbilical cord coiling index on the antenatal outcome. (Presence of gestational hypertension & IUGR) and fetal outcome (Presence of meconium stained liquor, APGAR Score at birth and requirement of NICU admission) was studied. *Results:* Hypocoiled cords (UCI < 10th centile) were found to be associated with adverse fetal outcomes like presence of MSL and low APGAR score at 1 & 5 min. Hypercoiled cords (UCI > 90th centile) were found to be associated with a higher incidence of gestational hypertension in mother and IUGR in fetus.

Keywords: Umbilical artery Coiling Index, Gestational Hypertension, Meconium Stained Liquor, IUGR, APGAR Score

1. Introduction

The umbilical cord is the lifeline of the fetus as it supplies water, nutrients and oxygen to the growing fetus. The average length of the cord is 55 cm with the usual range of 30 – 100 cm. Its diameter varies from 0.8 – 2 cm. Its thickness is not uniform but foldings and tortuosity of the vessels create modulations on the surface of the cord. In no other part of fetoplacental unit, the vital blood vessels are so vulnerable to kinking, compression, traction and torsion. A coil is defined as a complete 360 degree spiral course of umbilical vessels around the wharton's jelly. The origin of coiling of umbilical cord vessels is not known but hypothesis include fetal movements, active or passive torsion of the embryo, different umbilical vascular growth rates, fetal hemodynamic forces and arrangement of muscular fibres in the umbilical arterial vessels. Sonographically, the umbilical coiling index is calculated by measuring the distance between two adjacent coils from the right outer surface of the vascular wall to its next twist. The "Umbilical Cord Coiling Index" is defined as the reciprocal of the average distance between a pair of coils. Abnormal UCI includes both Hypocoiled cords (UCI < 10th centile) and Hypercoiled cords (UCI > 90th centile).

2. Aims and Objectives

- To find out whether abnormal UCI is related to adverse fetal outcome (IUGR, Meconium Stained Liquor, Low APGAR Score)
- To find out whether abnormal UCI has any adverse effect on mother (Increased incidence of gestational hypertension)
- To identify the fetuses "at risk" and their timely management so as to reduce perinatal morbidity and mortality

3. Methods and Materials

The work was carried out on 100 patients attending GOPD of Nalanda Medical College and Hospital, Patna over a period of one year, October 2015 to October 2016 with the following inclusion criteria:

- Patients with singleton live pregnancy without any congenital abnormality
- Patients with history of gestational hypertension in present or previous pregnancies
- Patients with history of delivery of previous SGA/ IUGR babies

The following patients were excluded from the study :

- Multifetal gestation
- Known congenital anomalies in the fetus suffering from any medical / surgical illness which would have an untoward effect on the growth of the fetus
- Inadequate or an inappropriate longitudinal images of umbilical cord to allow an accurate antenatal umbilical coiling index measurement

Detailed history taking and general as well as routine obstetrical examination was done. All routine antenatal investigations were done. Ultrasonography along with colour Doppler studies to note the umbilical cord coiling pattern and to find the UCI was done from 24 wks gestation onwards according to reliable LMP and sonologic confirmation of first trimester.

The pitch of one complete vascular coil was measured by ultrasonography in a midsection of umbilical cord. The mean of upto 3 coils from different segments of the umbilical cord was used for analysis. Measurement of this pitch, defined as distance in cm from the inner edge of the arterial wall to the outer edge of the same arterial wall of the next coil ipsilaterally was taken. If UCI was too low to

measure one complete coil in view, we measure the largest segment of cord without a complete coil.

The antenatal UCI (aUCI) was calculated as the reciprocal value of the mean of the three measurements of the pitch of one complete coil, or as the reciprocal value of the largest length of umbilical cord without one complete coil.

The distance between two pairs of coils in a normocoiled cord is 2.61 cms.

Then aUCI was calculated as
 $aUCI = 1/\text{distance in cms} = 1 / 2.6 = 0.38$

- **Normocoiled cord:** 0.38 ± 0.11 coils/cm
- **Hypocoiled cord :** < 0.27 coils/cm
- **Hypercoiled cord :** > 0.49 coils/cm

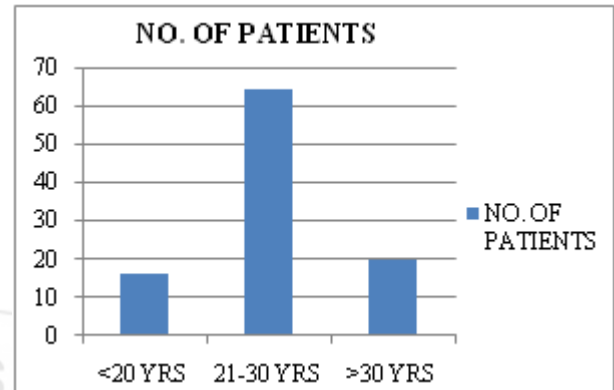
Patients were followed till delivery. Umbilical cord was examined post delivery and was correlated to UCI calculated antenatally. Baby was examined, APGAR at 1 and 5 min were taken. Birth weight of the baby and requirement for NICU admission was noted. All babies were followed until they were either discharged from the hospital or they succumbed. Results were presented as numbers and percentages. Chi square was used to analyze categorical data. A p value of 0.05 or less was considered to be

statistically significant. SPSS was used for statistical analysis.

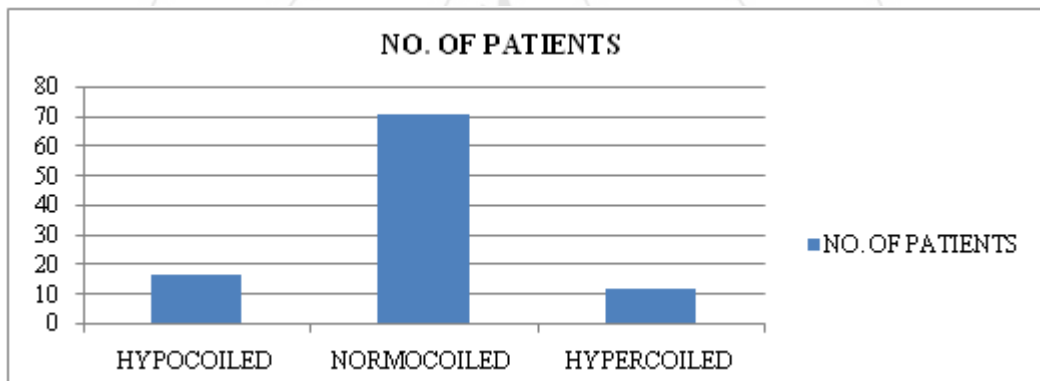
4. Observation

Demographic Factors

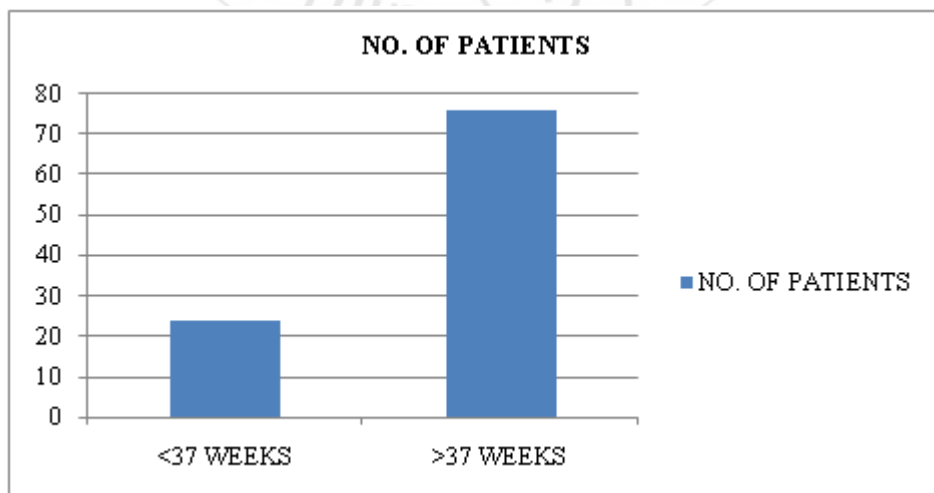
1) Age Wise Distribution of Patients



2) Umbilical Coil Coiling Index



3) Gestational Age at Delivery



4) Correlation of Gestational Hypertension with UCI

Gestational Hypertension	Hypocoiled	Normocoiled	Hypercoiled
Present	05	09	07
Absent	12	62	05
P Value	0.5		0.002

5) Correlation of Fetal Risk Factors with UCI

Risk Factors		Hypocoiled	Normocoiled	Hypercoiled
IUGR	Present	04	13	07
	Absent	13	58	05
	P Value	0.793		0.009
MSL	Present	06	05	01
	Absent	11	66	11
	P Value	0.004		0.956
APGAR AT 1 MIN	< 4	12	19	04
	>4	05	52	08
	P Value	0.001		0.84
APGAR AT 5 MIN	< 7	10	15	02
	>7	07	56	10
	P Value	0.003		0.60

5. Results

Out of the total 100 patients studied, 16 patients were in the age group < 20 yrs, 64 were between 21 – 30 years and 20 patients were more than 30 years of age. Majority of the patients had normocoiled cords (71/100). Hypocoiled cords were seen in 17/100 patients and hypercoiled cords were seen in 12/100 patients. Out of the 100 patients studied, preterm delivery (gestational age < 37 wks) occurred in 24 patients while the remaining 76 patients delivered at term.

In our study, gestational hypertension was seen to be present in 21/ 100 patients. The correlation of gestational hypertension with abnormal UCI has been shown in Table 1. Hypercoiled cords have been associated with the presence of Gestational Hypertension with p value of 0.002 which was significant.

Among the fetal risk factors, IUGR was seen to be present in 24/100 patients. IUGR was seen to be present in 7 out of 12 patients with hypercoiled cords. The correlation showed a p value of 0.009 which was significant.

Meconium staining of liquor was present in 6 out of 17 patients with hypocoiled cords, 5 out of 71 patients with normocoiled cords and 1/12 patient with hypercoiled cord. Correlation of meconium stained liquor with hypocoiled cords showed a p value of 0.004 which was highly significant.

APGAR Score at 1 min <4 was present in 12 out of 17 patients with hypocoiled cords, 19 out of 71 patients with normocoiled cords and 4 out of 12 patients with hypercoiled cords. Correlation of low APGAR score at 1 min with hypocoiled cords showed p value of 0.001 which was significant.

APGAR score at 5 min <7 was seen in 10/17 patients with hypocoiled cords, 15/ 71 patients with normocoiled and 2 /

12 patients with hypercoiled cords. The correlation of low APGAR Score at 5 min with hypocoiled cords showed p value of 0.003 which was significant.

Hence both hypocoiled and hypercoiled cords were found to be associated with adverse maternal and fetal outcomes.

6. Discussion

The umbilical coiling index has been found to be an effective indicator of perinatal outcome. The aim of this study was to find the relationship between UCI and various maternal and perinatal factors. The mean UCI in our study was 0.24+0.09 which was similar to the study done by Ezimokhai et al.(2001)

Among previous studies, Ezimokhai et al. [9] found hypercoiled to be associated with extremes of maternal age (<20 and >35 years). None of the other studies found age to be a significant factor. Our study did not find any significant association with parity, anemia, Rh negative pregnancy, presence of heart disease, or infertility. No significant association was found between UCI and any of these factors in previous studies also.

Preeclampsia was found to have a significant association with hypercoiled (P=0.002). Ezimokhai et al. also demonstrated a significant association between hypercoiled cords and preeclampsia. Similar findings were found in studies done by Gupta et al. [10]. The coiled umbilical cord, because of its elastic properties, is able to resist external forces that might compromise the umbilical vascular flow. This might explain the association of hypercoiling with preeclampsia.

FHR variations were found to have a highly significant association with hypocoiled cords. Literature has found a consistent association between intrapartum FHR decelerations and abnormal UCI. Strong et al and de Laat et al found FHR decelerations to be associated with hypocoiled cords. According to them, hypocoiled cords are less flexible or more prone to kinking and torsion which makes them less tolerant to withstand the stress of labour. Rana et al and Ercal et al found FHR decelerations to be significantly associated with hypocoiled cords. Rana et al felt that coiling provides turgor and compression resistant properties to the cord which become compromised as the cord becomes hypocoiled.

An initial low APGAR (<4 at 1 minute) and (<7 at 5 minutes) was found to have a significant relationship with both hypocoiled cords in our study. The P values were 0.001 and 0.003, respectively. A similar result was obtained by Gupta et al. [10] and Kashanian et al.

Intrauterine growth retardation was shown to be significantly associated with hypercoiled cords, p value of 0.009. Literature has found a consistent association between hypercoiled and IUGR babies, as shown by Rana et al, Raio et al. and de Laat et al. However, the authors were unable to give a satisfactory explanation for this casual association.

Meconium staining of the amniotic fluid was found to have a significant association with both hypocoiled ($P=0.004$). Although similar findings were noted in studies done by Strong et al. and Ezimokhai et al, they did not offer a specific explanation for the observation.

7. Conflict of Interests

There was no conflict of interests among the authors of the study

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