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The assessment of perinatal outcome by evaluation of umbilical coiling index in Bihar region population

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Abstract
The "Umbilical coiling index", which is the ratio of the twists to the length of the cord irrespective of the direction of the coils. An abnormal coiling index has been reported to be related to adverse fetal outcomes. However at present enough data on UCI and its relationship with perinat al outcome is not available in India. This study is an attempt to find out the umbilical coiling index in Indian babies and the perinatal outcome.
The present study was planned in the Department of Paediatrics, Sri Krisna Medical College and Hospital, Muzaffarpur, Bihar. The study was performed from March 2018 to December 2018. A total number of 25 pregnant women were randomly chosen by a single observer from those who got admitted to the labour ward. Deliveries occurring after 28 weeks of gestation with singleton, cephalic presentations were included in the study.
Several antenatal and perinatal adverse features were associated with abnormal UCI. There are adverse antenatal and neonatal features are associated with abnormal UCI. The association shows wide variations among the various studies done so far. Antenatal study of UCI should be followed, to confirm diagnosis at an earlier gestational age.

Keywords: umbilical coiling index, UCI, perinatal outcome, Bihar population, etc

Introduction
The umbilical cord is a narrow tube-like structure that connects the developing baby to the placenta. The cord is sometimes called the baby's "supply line" because it carries the baby's blood back and forth, between the baby and the placenta. It delivers nutrients and oxygen to the baby and removes the baby's waste products. The umbilical cord begins to form at 5weeks after conception. It becomes progressively longer until 28 weeks of pregnancy, reaching an average length of 22 to 24 inches [1]. As the cord gets longer, it generally coils around itself. The cord contains three blood vessels: two arteries and one vein.
In placental mammals, the umbilical cord (also called the navel string [2], birth cord or funiculus umbilicalis) is a conduit between the developing embryo or fetus and the placenta. During prenatal development, the umbilical cord is physiologically and genetically part of the fetus and (in humans) normally contains two arteries (the umbilical arteries) and one vein (the umbilical vein), buried within Wharton's jelly. The umbilical vein supplies the fetus with oxygenated, nutrient-rich blood from the placenta. Conversely, the fetal heart pumps low oxygen containing blood, nutrient-depleted blood through the umbilical arteries back to the placenta.
The umbilical cord develops from and contains remnants of the yolk sac and allantois. It forms by the fifth week of development, replacing the yolk sac as the source of nutrients for the embryo [3]. The cord is not directly connected to the mother's circulatory system, but instead joins the placenta, which transfers materials to and from the maternal blood without allowing direct mixing. The length of the umbilical cord is approximately equal to the crown-rump length of the fetus throughout pregnancy. The umbilical cord in a full term neonate is usually about 50 centimeters (20 in) long and about 2 centimeters (0.75 in) in diameter. This diameter decreases rapidly within the placenta. The fully patent umbilical artery has two main layers: an outer layer consisting of circularly arranged smooth muscle cells and an inner layer which shows rather irregularly and loosely arranged cells embedded in abundant ground substance staining metachromatic. The smooth muscle cells of the layer are rather poorly differentiated, contain only a few tiny myofilaments and are thereby unlikely to contribute actively to the process of post-natal closure [4].
The umbilical cord contains Wharton's jelly, a gelatinous substance made largely from mucopolysaccharides which protects the blood vessels inside. It contains one vein, which carries oxygenated, nutrient-rich blood to the fetus, and two arteries that carry deoxygenated, nutrient-depleted blood away [5]. Occasionally, only two vessels (one vein and one artery) are present in the umbilical cord. This is sometimes related to fetal abnormalities, but it may also occur without accompanying problems.
It is unusual for a vein to carry oxygenated blood and for arteries to carry deoxygenated blood (the only other examples being the pulmonary veins and arteries, connecting the lungs to the heart). However, this naming convention reflects the fact that the umbilical vein carries blood towards the fetus's heart, while the umbilical arteries carry blood away.
The blood flow through the umbilical cord is approximately 35 ml / min at 20 weeks, and 240 ml / min at 40 weeks of gestation. Adapted to the weight of the fetus, this corresponds to 115 ml / min / kg at 20 weeks and 64 ml / min / kg at 40 weeks [6].

The "umbilical coiling index", which is the ratio of the twists to the length of the cord irrespective of the direction of the coils. An abnormal coiling index has been reported to be related to adverse fetal outcomes [7-8]. However at present enough data on UCI and its relationship with perinatal outcome is not available in India. This study is an attempt to find out the umbilical coiling index in Indian babies and the perinatal outcome.

Methodology

The present study was planned in the Department of Paediatrics, Sri Krisna Medical College and Hospital, Muzaffarpur, Bihar. The study was performed from March 2018 to December 2018. A total number of 25 pregnant women were randomly chosen by a single observer from those who got admitted to the labour ward. Deliveries occurring after 28 weeks of gestation with singleton, cephalic presentations were included in the study.

1-3 min after delivery, the umbilical cord was clamped at the fetal end and cut with scissors taking care not to milk the cord (as the latter might affect the UCI). The placenta was allowed to separate spontaneously. At the fetal end, the cord was cut 5 cm from the fetal insertion. The rest of the cord from the cut end to the placental insertion was measured (in cm). 5 cm was added to the length of the measured cord. At the end of sample collection, the mean UCI was calculated.

A coil is of 360-degree spiral course of umbilical vessels. Umbilical cord index (UCI) is defined as the total number of coils divided by the total length of the cord in centimeters. A frequency distribution of umbilical cord index (UCI) was done by Rana *et al*. (1995) [9].

They grouped the UCI as follows: <10th percentile—hypocoiled; 10th–90th percentile—normocoiled; >90th percentile—hypercoiled.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following is the inclusion and exclusion criteria of the present study.

Inclusion Criteria: Women with term gestation irrespective of parity; Singleton pregnancies; Live baby; Spontaneous onset of labour; Women in active labour; Cephalic presentation.

Exclusion Criteria: Twin gestation; Preterm delivery; intrauterine death.

Results & Discussion

The umbilical cord and its vital blood vessels are one of the most vulnerable parts of the fetal anatomy and one of its distinctive features is its coiling pattern. The total number of coils for any particular cord is believed to be established early in pregnancy, and several studies have been done for explaining the twisting of the umbilical cord, including those that explain it as a result of active and passive rotation of the fetus. The role of this coiling is not clear but it is believed to be playing a role of protecting the umbilical cord from external forces such as tension, pressure, stretching or entanglement [10].

The UCI is an indicator of perinatal outcome. The aim of this study was to find the relationship between UCI and various antenatal and perinatal factors. The data from the 25 patients were collected and presented as below. UCI was calculated by dividing total number of coils by the total length of the cord in centimetres.

Table 1: Type of UCI

Type of UCI	No. Of Cases
Hypocoiled	5
Normocoiled	18
Hypercoiled	2

Table 2: Umbilical coiling index and neonatal / perinatal outcome

Type of UCI	Hypocoiled	Normocoiled	Hypercoiled
No. of Cases	5	18	2
Pregnancy induced hypertension	1	3	1
Apgar < 7	1	2	0
Meconium present	2	7	1
Birth weight < 2500g	1	6	1
Intrauterine growth retardation	1	4	1
Gestational age <37weeks	1	5	1
Ponderal index (<2.5)	2	14	2

Table 3: Mean umbilical coiling index and perinatal factors

Perinatal factors	Number
Gestation age	
<37wks	7
≥37 wks	18
Sex	
Female	15
Male	10
Direction	
Anticlockwise	21
Clockwise	4
Pregnancy induced hypertension	
Absent	22
Present	3

Apgar	
<7	2
≥7	23
Intrauterine growth retardation	
Absent	21
Present	4

Agarwal S *et al.* [11] Devaru D *et al.* obtained no association of hypocoiling with NICU admissions [13]. On the other hand, when hypercoiling occurs, there is compression of the vein and increased turbulence in the arteries which as a result decreases both arterial and venous flow [12-14]. Increased NICU admission was also seen in babies having hypercoiled cords as seen in the study by Agarwal S *et al* [11]. Here Devaru D *et al.* also found no association between hypercoiling and NICU admission [13].

Umbilical cord coiling prevents compression of the umbilical vessels, thus hypocoiling in the long run predisposes to decreased fetoplacental circulation thus resulting in intrauterine growth restriction. Significant results were obtained with hypercoiling and IUGR in concordance with study done by Agarwal S *et al*. 25% of the babies with hypercoiled cords had IUGR as compared to only 7.8% of normocoiled babies. In the study done by Agarwal S *et al*, 80.8% of the babies with hypercoiled cords had IUGR compared to only 3.3% of the babies with normocoiled cords. Hypercoiling by predisposing to increased kinking and torsion of the cord interferes with the fetoplacental circulation. [11]

In addition studies by Predanic M *et al*. have shown excellent correlation between antenatal and postnatal coiling index. With proper training on a reasonably good USG machine it is possible to measure coiling index in antenatal sonography scan with accuracy [15].

Tahmasebi and Alighanbari [16] Department of radiology, Jundishapur medical university, Ahvaz, Iran conducted a study of evaluation of umbilical cord thickness, cross-sectional area and coiling index as predictors of pregnancy outcome. A statistically significant correlation was observed between small umbilical cord thickness, cross-sectional area and low birth weight. However, no statistically significant correlation was found between umbilical cord coiling index and low birth weight, 5 min Apgar score, and meconium staining.

Jo *et al*. [11] also observed, preterm delivery was significantly increased in pregnant women who showed the hypocoiling (OR 9.6, 95% CI 2.0944.07), and low birth weight and admission to NICU were not statistically significant.

Goynumer *et al.* [18] found significant differences in mean gestational age, mode of delivery, birth weight, and adverse perinatal outcome between fetuses with umbilical cord thickness below 5th centile (lean umbilical cord) vs those with umbilical cord thickness above the 95th percentile (non-lean cord) in the first and early second trimester of gestation. He concluded that the umbilical cord thickness correlated with birth weight, and therefore, a lean umbilical cord thickness at first and early second trimester should prompt the physician a strict monitoring of pregnancy.

The umbilical cord and its vital blood vessels are the most vulnerable part of the fetal anatomy. The total number of coils for any particular cord is believed to be established early in the gestation [19-20]. The pattern of coiling develops during the second and third trimesters, presumably due to snarls in the cord, and these coiling changes as the pregnancy advances. Despite the belief that umbilical vascular coiling occurs early in gestation, it is not yet known whether this coiling is a genetic or acquired event. Several theories have been proposed to explain the umbilical cord twist including those that interpret the twist as inherent to the cord itself, and those that explain the twist as a result of active or passive rotation of the fetus. Regardless of its origin, umbilical coiling appears to confer turgor to the umbilical unit, producing a cord that is strong but flexible [21]. In consideration of the abnormal versus normal coiling distribution in our study, we observed that 10th and 90thpercentiles for UCI were in agreement with the previous studies [20, 22].

Conclusion

Several antenatal and perinatal adverse features were associated with abnormal UCI. There are adverse antenatal and neonatal features are associated with abnormal UCI. The association shows wide variations among the various studies done so far. Antenatal study of UCI should be followed, to confirm diagnosis at an earlier gestational age.

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