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Assessment of umbilical coiling index as a marker of perinatal outcome

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Abstract
The coiling of the umbilical vessels develops as early as 28 days after conception and is present in about 95% of fetuses by 9 weeks of conception. The helices may be seen by ultrasonographic examination as early as during the first trimester of pregnancy.
The study was planned in the Department of Gynecology and Department of Radiology in Katihar medical college and hospital. The data from the 50 patients were collected and presented as below. UCI was calculated by dividing total number of coils by the total length of the cord in centimeters.
The short umbilical coiling index is an marker of adverse perinatal outcome. It is related with low apgar score, meconium staining, and pregnancy induced hypertension. Consequently, antenatal detection of coiling index can identify fetus at risk.

Keywords: hypocoiling umbilical cord, hypercoiling umbilical cord, sonography, umbilical coiling index

Introduction

In placental mammals, the umbilical cord (also called the navel string [1]. 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 deoxygenated, nutrient-depleted blood through the umbilical arteries back to the placenta.

The umbilical cord enters the fetus via the abdomen, at the point which (after separation) will become the umbilicus (or navel). Within the fetus, the umbilical vein continues towards the transverse fissure of the liver, where it splits into two. One of these branches joins with the hepatic portal vein (connecting to its left branch), which carries blood into the liver. The second branch (known as the ductus venosus) bypasses the liver and flows into the inferior vena cava, which carries blood towards the heart. The two umbilical arteries branch from the internal iliac arteries, and pass on either side of the urinary bladder into the umbilical cord, completing the circuit back to the placenta [6].

A coil is defined as having completed a 360 spiral course of umbilical vessel around Wharton's jelly. Coiling property of umbilical cord was described by Berengarius in 1521 [1]. In 1954, umbilical coiling was first quantified by Edmonds who divided the total number of coils by umbilical cord length in centimetres and called it "Index of twist". He assigned positive and negative scores to clockwise and anticlockwise coiling, respectively [1, 3]. Later, Strong *et al* simplified it by eliminating three directional score and named it "The umbilical cord coiling index" [1, 4]. An abnormal umbilical cord coiling index includes both hypocoiled cords (cords with an umbilical cord coiling index which is < 10th percentile) and hypercoiled cords (cords with an umbilical cord coiling index which is > 90th percentile). An abnormal umbilical coiling index has been reported to be related to adverse perinatal outcomes [1, 2, 5].

The coiling of the umbilical vessels develops as early as 28 days after conception and is present in about 95% of fetuses by 9 weeks of conception. The helices may be seen by ultrasonographic examination as early as during the first trimester of pregnancy [2].

The spiral course of the umbilical vessels was first recorded by Berengarius in 1521. It was then confirmed by Columbus in 1559 and by Arantius in 1564. In 1600, Fabricius demonstrated that both right (dextral) and left (sinistral) helices of the umbilical cord exists [3]. If umbilical cord twists were to be determined randomly, one would expect both forms of twists to be equal in incidence. However, many investigators have found that majority of the cords have a left-sided twist [1, 2, 4].

The number of twists seen in first trimester is roughly the same as that seen in term cords. The total number of coils seen is between 0 and 40. Umbilical coiling appears to confer turgor to the umbilical unit, producing a cord that is strong, yet flexible. Since lengthening of the cord occurs from the fetal end, perhaps coiling of the cord represents a long-term record of fetal well-being [4].

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) [5].

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

There is no adequate data available on the UCI and its relationship with perinatal outcome in India. This study was undertaken to find outthe UCI in Indian babies.

Methodology

The study was planned in the Department of Gynecology and Department of Radiology in Katihar medical college and hospital. The data from the 50patients were collected and presented as below. The approval of the institutional ethic committee had been taken before the study. All the patients were informed consent. The aim and the objective of the study are conveyed to all patients. UCI was calculated by dividing total number of coils by the total length of the cord in centimeters.

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

Result & Discussion

The data from the 50 patients were collected and presented as below. UCI was calculated by dividing total number of coils by the total length of the cord in centimeters.

Table 1: Type of UCI

Type of UCI	No. of cases
Hypocoiled	6
Normocoiled	39
Hypercoiled	5

Table 1: Umbilical coiling index and neonatal / perinatal outcome

Type of UCI	Hypocoiled	Normocoiled	Hypercoiled
No. of Cases	6	39	5
Pregnancy induced hypertension	2	5	1
Apgar < 7	2	5	0
Meconium present	4	15	1
Birth weight < 2500g	2	12	2
Intrauterine growth retardation	2	8	2
Gestational age <37weeks	1	9	1
Ponderal index (<2.5)	2	23	2

Table 2: Mean umbilical coiling index and perinatal factors

Perinatal factors	Number
Gestation age	
<37wks	10
≥37 wks	40
Sex	
Female	29
Male	21
Direction	
Anticlockwise	42
Clockwise	8
Pregnancy induced hypertension	
Absent	45
Present	5
Apgar	
<7	6
≥7	44
Intrauterine growth retardation	
Absent	41
Present	9

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 [6, 7]. The pattern of coiling develops during the second and third trimesters, presumably due to snarls in the cord, and this 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 [8]. 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 [7, 9].

Our study highlights that lower UCI in new borns is associated with PIH in mother, meconium staining, and low apgar score. The vessels of the cord like all hollow cylinders are prone totorsion, compression, tension, and subsequent interruption of the blood flow. This risk is minimiszed by their elicaldis position. The coiled umbilical cord, perhaps because ofits elastic properties, is able to resist external forces that might compromise the umbilical vascular flow. The coiled umbilical cord acts like a semierectile organ that is more resistant to snarling torsion, stretch, and compression than non coiled one. This is referred to as "spontaneous internal ballottement" and likened to the action of a concertina [7].Workers found higher incidence of operative intervention for fetal distress [8], preterm delivery, growth retardation, oligohydramnios, operative delivery and meconium staining [10], fetal heart rate distrubances, and low cord pH [11] among fetuses with hypocoiled cords. These findings are in agreement with the present study. A recently published study showed no statistical difference for apgar score at 1 and at 5minutes, higher prevalence of interventional deliveries, and the meconium stained amniotic fluid in labor between the groups with normal and abnormal coiling [12].

Conclusion

The short umbilical coiling index is an marker of adverse

perinatal outcome. It is related with low apgar score, meconium staining, and pregnancy induced hypertension. Consequently, antenatal detection of coiling index can identify fetus at risk.

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