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Evaluation of umbilical coiling index as an indicator of perinatal outcome

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Abstract
Both hypocoiled and hypercoiled umbilical cords are associated with adverse perinatal outcome such as intrauterine deaths, preterm delivery, repetitive intrapartum fetal heart deceleration, operative delivery for fetal distress, meconium staining and chromosomal abnormalities. The purpose of this study is to evaluate antenatal umbilical cord coiling index obtained during fetal anatomic survey in the second trimester as a predictor of adverse pregnancy outcome.
The 100 patients identified with the UCI were enrolled in the study from the Anugrah Narayan Magadh Medical College and Hospital. UCI was calculated by dividing total number of coils by the total length of the cord in centimetres. The study was planned in the Department of Gynecology with Department of Radiology in Anugrah Narayan Magadh Medical College and Hospital.
Our study concluded that antenatal evaluation of umbilical cord coiling could be considered as a useful tool for predicting adverse pregnancy outcome, without significantly increasing the ultrasound evaluation time. Observation of abnormal coiling patterns and thereafter interventions to reduce fetal hypoxemia can help in improving perinatal morbidity and mortality.

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

Introduction
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 [1].
The coiled umbilical cord is able to resist external forces that might compromise umbilical vascular flow. The coiling of umbilical vessels develop as early as 28 days after conception and is present in 95% of foetuses by 9 weeks of conception. The helices may be seen on ultrasonography examination as early as during the first trimester of pregnancy [2]. The coiling property of vessels was first described as early as 1521 by Brengarius. 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'. Edmond assigned positive and negative scores to clockwise and anticlockwise coiling respectively [3]. Later Strong *et al* simplified it by eliminating three directional score and named it "The Umbilical Cord Coiling Index" [4]. The cord shows a spiral twist from left to right as early as 12th week around the arteries. There are proposed theories to explain umbilical cord twisting. The hypothesis include fetal movement, active or passive torsion of embryo, differential vascular growth rates, fetal haemodynamic forces and arrangement of muscular fibres in the umbilical arterial wall [5]. It is 50-60cm long at term and its three blood vessels course through Wharton's jelly in helical fashion completing 10-11 coils between fetal and placental insertion sites.
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 [6]. 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 [5].
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 [7].
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) [8].

They grouped the UCI as follows
<10th percentile-hypocoiled;
10th–90th percentile-normal coiled;
>90th percentile-hypercoiled.

The purpose of this study is to evaluate antenatal umbilical cord coiling index obtained during fetal anatomic survey in the second trimester as a predictor of adverse pregnancy

outcome.

Methodology

The 100 patients identified with the UCI were enrolled in the study from the Anugrah Narayan Magadh Medical College and Hospital. UCI was calculated by dividing total number of coils by the total length of the cord in centimetres. The study was planned in the Department of Gynecology with Department of Radiology in Anugrah Narayan Magadh Medical College and Hospital. 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.

The Inclusion criteria includes the Women with term gestation irrespective of parity, Singleton pregnancies, live baby, Spontaneous onset of labour, Women in active labour, Cephalic presentation etc. The women observed with twin gestation, Preterm delivery and Intrauterine death were excluded from the study.

Result & discussion

The data from the 100 patients having UCI were collected and presented as below. UCI was calculated by dividing total number of coils by the total length of the cord in centimetres.

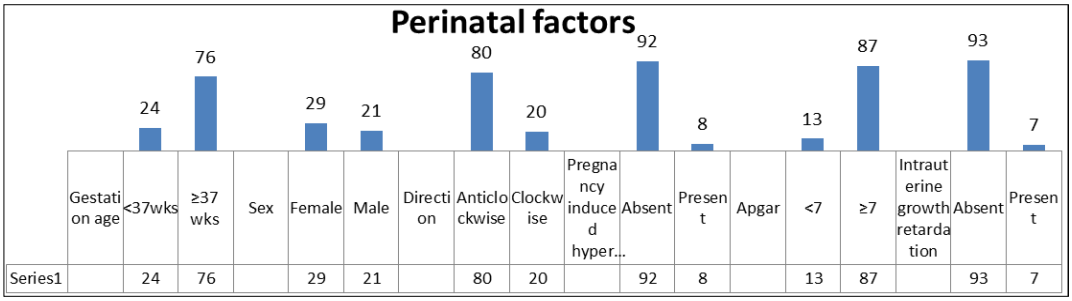


Fig 1; Mean umbilical coiling index and perinatal factors

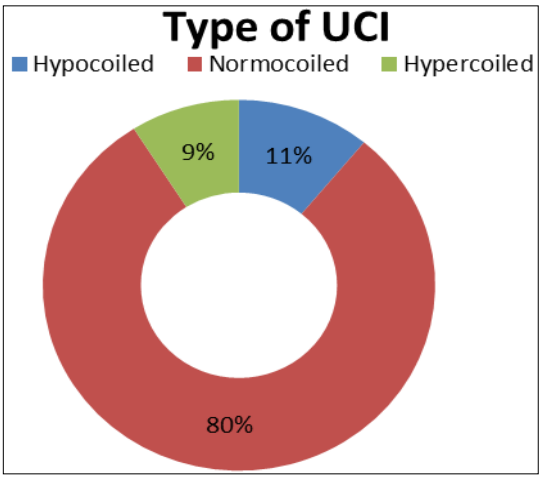
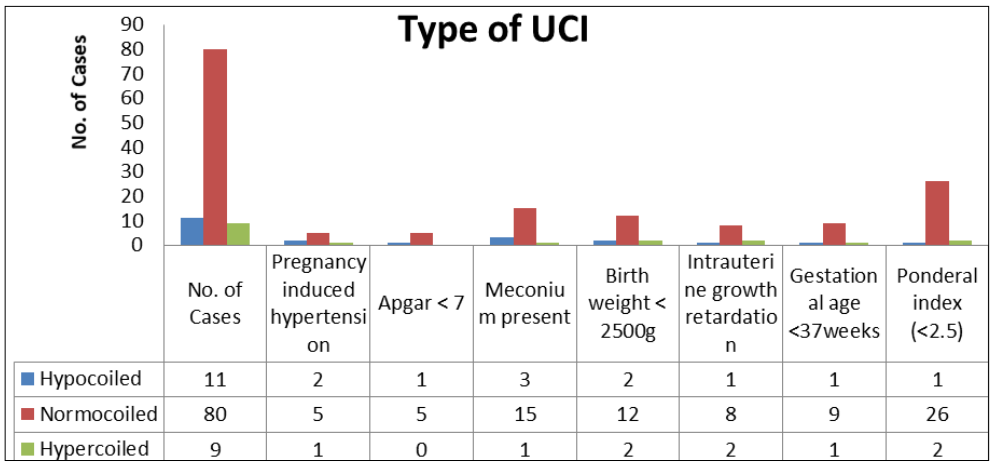


Fig 2: Type of UCI



	No. of Cases	Pregnancy induced hypertension	Apgar < 7	Meconium present	Birth weight < 2500g	Intrauterine growth retardation	Gestational age <37weeks	Ponderal index (<2.5)
Hypocoiled	11	2	1	3	2	1	1	1
Normocoiled	80	5	5	15	12	8	9	26
Hypercoiled	9	1	0	1	2	2	1	2

Fig 3: Umbilical coiling index and neonatal / perinatal outcome

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 [9, 10]. 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 [4]. 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 [10].

The findings of the present study point out that low UCI is an indicator of perinatal complications. Antenatal detection of this abnormal coiling index by ultrasound can lead to identification of fetus at risk. Thus while UCI can be measured easily and reliably in the second trimester, these estimates do not accurately reflect the UCI at term. Clearly, quantitating the degree of umbilical vascular coiling cannot be of significant use unless the technic can be applied to the antepartum period. Therefore, more prospective studies are required to have detailed information on the role and mechanism of umbilical coiling and its impact on the new-born.

Conclusion

Our study concluded that antenatal evaluation of umbilical cord coiling could be considered as a useful tool for predicting adverse pregnancy outcome, without significantly increasing the ultrasound evaluation time. Observation of abnormal coiling patterns and thereafter interventions to reduce fetal hypoxemia can help in improving perinatal morbidity and mortality.

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