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Research Article

Unwinding the Umbilical Cord in Evaluating Pregnancy Outcome at a Tertiary Hospital

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Abstract

Aims & Objectives: To assess the relationship of ultrasound measurements of cord thickness, cross sectional area and coiling index in the second trimester (18 to 24 weeks) with perinatal outcome.

Material & Methods: This study was conducted on 100 pregnant women visiting the obstetric outpatient department at Prince Bijey Singh Memorial hospital, Bikaner, Rajasthan during the period of November 2016 to November 2017, for antenatal check-up and scheduled to deliver in the same hospital. The cord thickness, cross sectional area and antenatal coiling index were studied by ultrasound during 18-24 weeks of gestation. The study to assess the relationship between these parameters and perinatal outcome in relation to the gestational age at the time of delivery, mode of delivery, birth weight of the baby, Meconium Stained Amniotic Fluid (MSAF) and NICU admission of the baby was carried out and statistically compared.

Results: There was a significant correlation between the hypo coiled cord (aUCI less than 10th percentile) with the preterm labor (p value 0.035) and low birth weight (p value<0.001). There was a significant correlation between the hyper coiled cord (aUCI more than 90thpercentile) with MSAF (p value<0.001). There was a statistically significant correlation between umbilical cord thickness and cross-sectional area with preterm labor (p values 0.002 and 0.012), low birth weight (p values <0.001 and <0.001) and NICU admission (p values 0.005 and <0.001) respectively.

Conclusion: Hypo coiled cords are associated with spontaneous preterm labor and low birth weights while hyper coiled cords are associated with MSAF. The umbilical cord thickness and cross-sectional area are also associated with preterm labour, low birth weights and NICU admission of the baby.

Keywords: Area; Coiling; Prenatal; Thickness; Ultrasound

Introduction

The umbilical cord is the life line of the fetus as it provides the nutrients, oxygen and fluids necessary for life in utero. The protection of the cord is provided by the Wharton's jelly, the amniotic fluid and the helical pattern or the coiling of the umbilical vessels [1]. The cord and its constituent's tissues, an outer layer of amnion, porous Wharton's jelly, two arteries and one vein are designed to provide and maintain blood flow to the developing fetus. Cord represents the most vulnerable link between the fetus and the mother, since it lies freely in the amniotic fluid and may be easily damaged [2]. Coiling makes the umbilical cord flexible, strong and at the same time provides resistance to external forces that could compromise blood flow to the fetus [3] coiling property of the umbilical cord was first described by Berengaria's in 1521 [4]. In 1954, umbilical coiling was first quantified by Edmonds. He divided the total number of coils by the umbilical cord length in centimeters and called it "the index of twist". He suggested positive and negative scores to clockwise and anticlockwise coiling respectively [5]. Later, Strong et.al, simplified these by eliminating directional scores (Figure 1) and named it "The umbilical cord coiling index" [6].

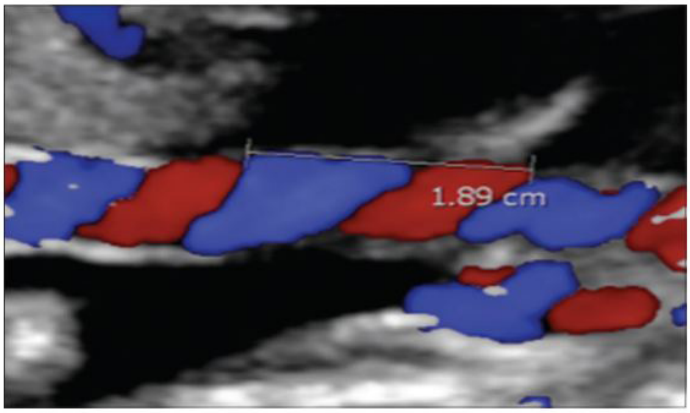


Figure 1: Shows the measurement technique of antenatal umbilical coiling index (a UCI) with doppler shown as above.

Hypo coiled cords are mainly associated with increased incidence of structural and chromosomal abnormalities, fetal anomalies [7], abnormal insertion [8-9], intrauterine death [10-12], preterm delivery [13-15], operative delivery for fetal distress and low APGAR score [16] which marks the underlying intrinsic abnormal development and increased risk of acute reduction in blood flow due to kinking [17-19].

Hyper coiling of the cord was also associated with IUGR, intrapartum fetal acidosis and asphyxia, vascular thrombosis and cord stenos is by predisposing to compression mediated flow reduction and possible predisposition [20] to development of feto placental vascular thrombosis [21]. Thus, it appears that presence of abnormal coiling indicates a chronic state established in early gestation that may have acute and chronic effects on the fetus [22].

The detection of umbilical cord cross sectional (Figure 2) area<10th percentile in 2nd trimester was associated with 12-fold increased risk of subsequent delivery of small for gestational infants (Figure 3). An association between the small diameter of the umbilical cord and the presence of oligohydroamnios, me conium stained amniotic fluid or both or without low APGAR scores is found (Figure 4) [23] marked segmental thinning of the umbilical cord vessels is an infrequent finding of undetermined origin. Its significance may be associated wi` increased congenital anomalies and prenatal problems (Figure 5) [24].

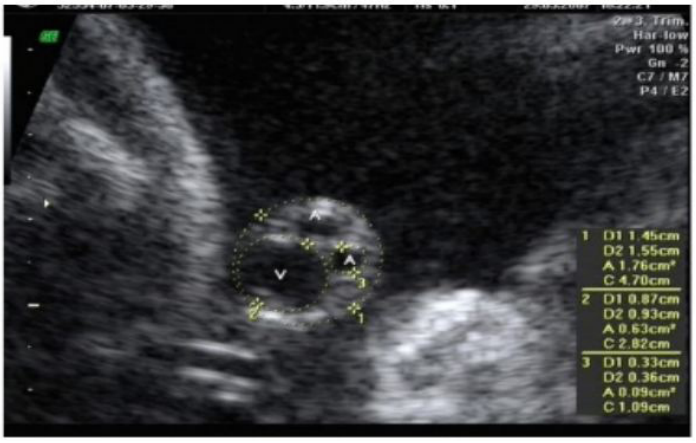


Figure 2: Shows a Trans abdominal image on USG of an umbilical cord showing the cross-sectional area measurement technique antenatal (In yellow calipers).

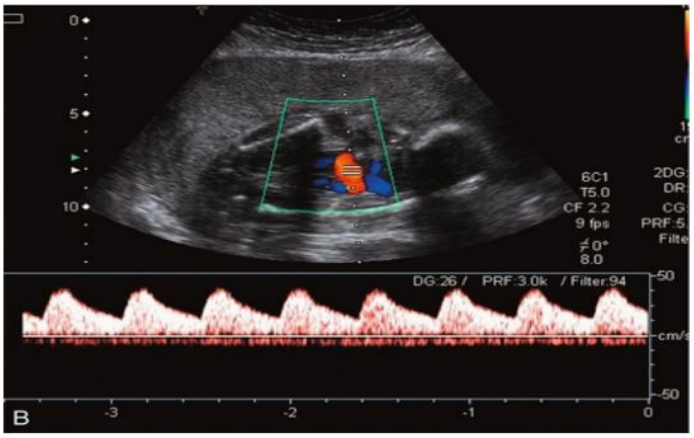


Figure 3: Shows a Trans abdominal USG image depicting the umbilical arterial and venous waveforms consistently being normal in a 16-week-old fetus.

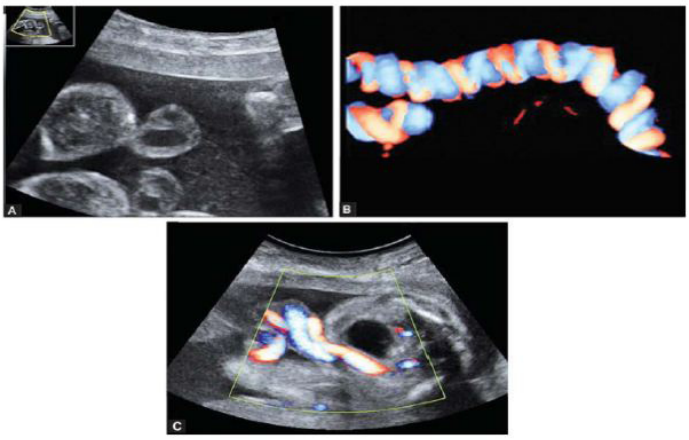


Figure 4: Shows three Trans abdominal USG images (A-C) depicting, A- transverse section of the triple vessel cord, B- color Doppler of the cord in longitudinal section & C- the insertion of the cord into the abdominal wall.

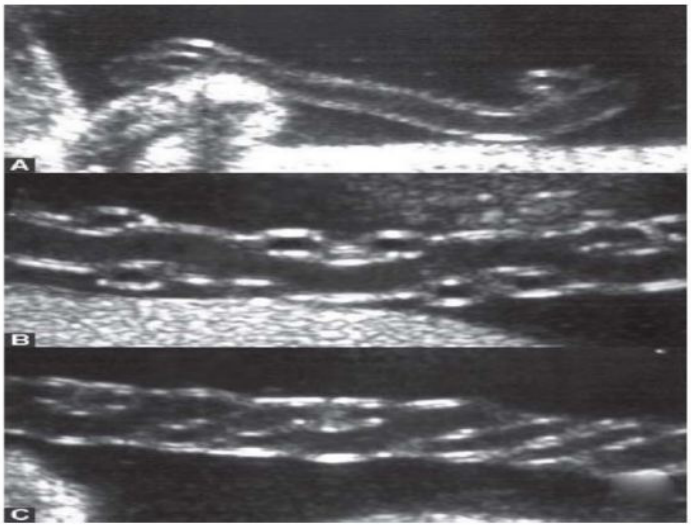


Figure 5: Shows three Trans abdominal USG images (A-C) depicting, A- hypo coiled cord, B- normoicoiled cord & C- hyper coiled cord.

Material & Methods

The present prospective observational study was conducted in Prince Bijey Singh memorial hospital (P.B.M), Bikaner, Rajasthan to correlate the antenatal assessment of the umbilical cord thickness, cross sectional area and coiling index at 18-24 weeks of gestation and perinatal outcome in relation to gestational age at the time of delivery, mode of delivery, birth weight of the baby, APGAR score, MSAF and NICU admission of the baby.

- **Study design** : Prospective observational study
- **Study period** : November 2016 to November 2017
- **Statistical method** : T test

The present study is conducted on 100 pregnant women referred to the department of Radio diagnosis, outpatient department for antenatal assessment between 18-24 weeks from the department of Obstetrics and scheduled to deliver at P.B.M hospital, Bikaner, Rajasthan Between November 2016 to November 2017.

Method of Collection of Data

All booked consenting pregnant women attending the Radio Diagnosis O.P.D for regular antenatal fetal surveillance between 18-24 weeks were included in the study. All sonographic examination was performed by a single radiologist using standard USG machine with color Doppler (HitachiAloka Prosound Alpha A7) and convex transducer of 3.5 to 5.0 MHz

Inclusion Criteria

1. Singleton pregnancy irrespective of parity.
2. Reliable gestational age between 18-24 weeks at the time of sonography.
3. Normal amniotic fluid.
4. Presence of three vesseled umbilical cords.

Exclusion Criteria

1. Multiple pregnancies.
2. Fetal congenital anomaly.
3. Maternal complications like diabetes mellitus, hypertension that could interfere with fetal growth.
4. If the patient could not be followed till delivery for any reason.
5. Any umbilical cord or placental anomaly.

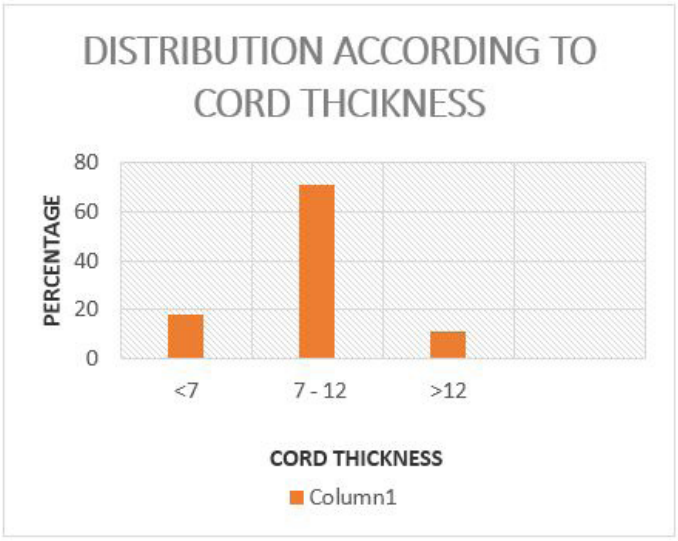
Results

100 women who fulfilled the inclusion criteria were taken in the study. The umbilical cord thickness, cross sectional area and coiling index were calculated during 18-24 weeks of gestation and women were followed till delivery and the perinatal outcome was correlated with regards to gestational age at delivery, mode of delivery, birth weight, APGAR score at 1st and 5th minute, presence of MSAF and NICU admission of the baby (Table1, Graph 1).

	No. of patients	%
<7	18	18.0

7-12	71	71.0
>12	11	11.0
Mean ± SD : 8.89±2.14		

Table 1: Distribution according to cord thickness.

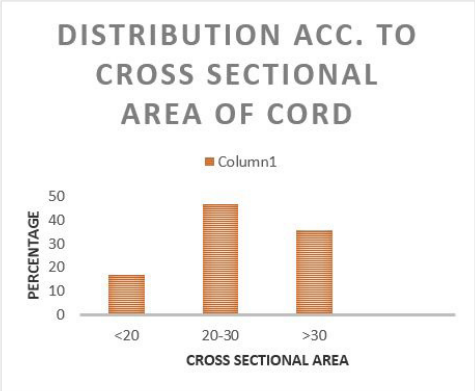


Graph 1: Distribution according to cord thickness.

The number of patients with umbilical cord thickness <7mm are 18 (18%), those between 7-12 mm are 71 (71%) and cord thickness ≥12 mm is 11 (11%). The cross-sectional area (Table 2 &Graph 2) of the umbilical cord less than 20 mm^2 is seen in 17 (17%); those between 20-30mm^2 is seen in 47 (47%) and more than 30mm2 in 36 (36%) patients.

Cross sectional area in mm^2	No. of patients	%
<20	17	17.0
20-30	47	47.0
≥30	36	36.0
Mean ± SD :25.03±7.48		

Table 2: Distribution according to cross sectional area of cord.

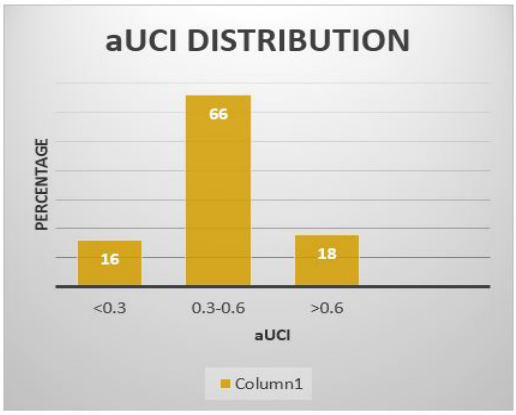


Graph 2: Distribution according to cross sectional area of cord.

The women included in the study were in the age group of 18-40 years. Majority of the women were in the age group of 20-30(88%), mean age group being 22.78±3.36 years. There was no statistical significance (Table 3 and Graph 3).

aUCI	No. of patients	%
<0.3	16	16.0
0.3-0.6	66	66.0
>0.6	18	18.0
Mean ±S.D : 0.44 ±0.15		

Table 3: aUCI distribution.



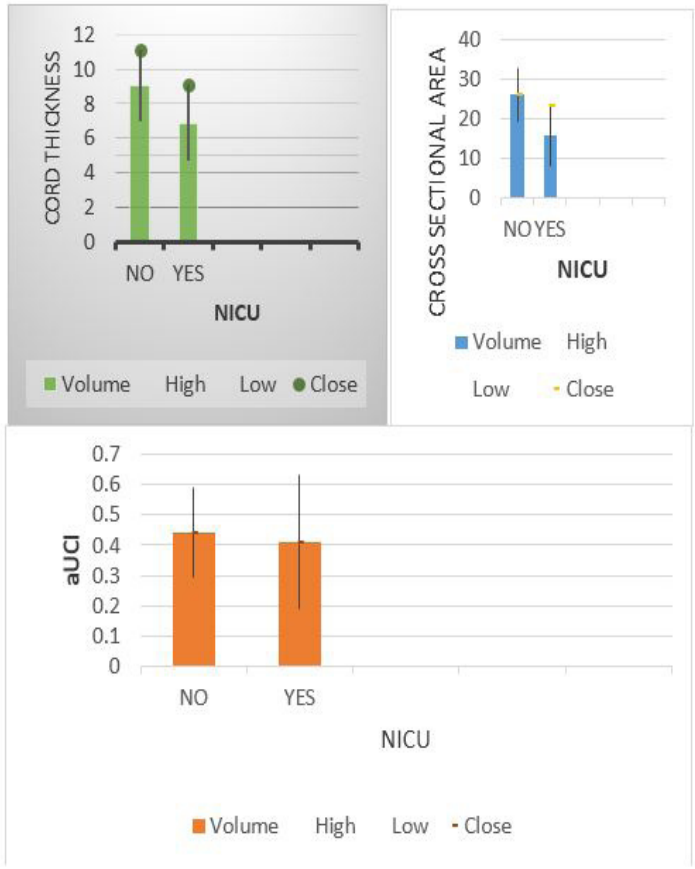
Graph 3: aUCI distribution.

aUCI of less than 0.3 is present in 16(16%) patients; between 0.3to 0.6 in 66 (66%) patients and more than 0.6 is present in 18 (18%) patients. Out of the 100 patients, 56% women were primigravida and 44% are multi gravida. The cord thickness of less than 7 mm was observed in 18%, between 7-12 mm it was observed in 71% and more than 12 mm of cord thickness was observed in 11%. The mean cord thickness being 8.81±2.14 mm, which correlates with the study conducted by Morteza Tahamasebi and Aligambari R (10.54mm). The cross-sectional area of the umbilical cord was less than 20mm^2 in 17%, between 20-30mm^2 in 47% and more than 30mm^2 in 36%. The mean cross-sectional area in our study is 25.03±7.48 mm^2. This correlates with the study conducted by Degani et al. (29±5mm^2). In our study, aUCI <0.3 was present in 16%, 0.3-0.6 in 66% and more than 0.6 in 18%. The mean aUCI was 0.44±0.15. It was similar to the studies conducted by Morteza Tahamasebi [9], Aligambari R [8] and Sharma B et al. [1]. Out of the 100 patients studied 10% were hypo coiled, 11% hyper coiled and 79% patients were norm coiled. Out of several similar studies, the coiling distribution in our studies correlates with the study by Sharma B. et al [25]. In our study, 6% of three patients delivered before 37 weeks of gestation, 78% women delivered at term (37-40 weeks of gestation) and 16% patients delivered between 40-41 weeks [25]. The mean cord thickness in the preterm delivered patients is 6.33±1.51 mm while in term delivery patients it is 9.05±2.07 mm. The p value is 0.002 and there is a statistically significant correlation between the cord thickness and preterm delivery. Thin cords are associated with preterm delivery (Table 4, Graph 4).

The mean cross-sectional area of the umbilical cord in patients delivered preterm is 17.67±7.23mm^2 while in the term delivery patient it is 22.50±7.28 mm^2 and the p value is 0.012. So, there is a statistically significant correlation between the umbilical cord cross sectional area and gestational age at delivery. As the cord cross sectional area reduces there is increased risk of preterm delivery.

Variables	NICU		Total	P Value
	No	Yes		
Cord thickness	9.07±2.05	6.88±2.17	8.89±2.14	0.005
Cross sectional area	25.86±6.91	15.50±7.58	25.03±7.48	<0.001
aUCI	0.44±0.15	0.41±0.22	0.44±0.15	0.556

Table 4: Comparison of cord thickness, cross sectional area and aUCI in relation to NICU admission.

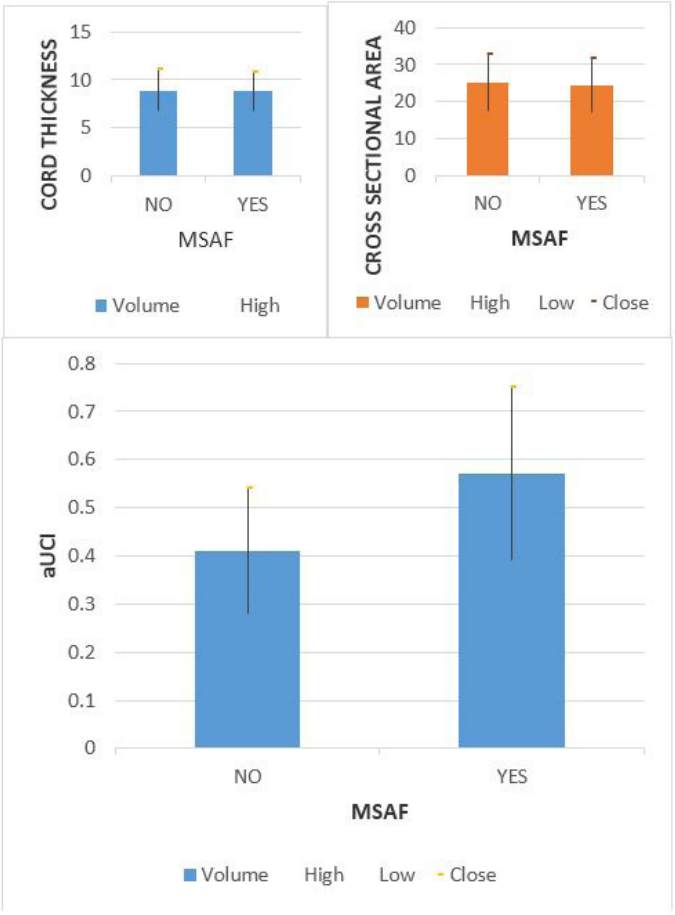


Graph 4: Comparison of cord thickness, cross sectional area and aUCI in relation to NICU admission.

Cord thickness of less than 7 mm and cross-sectional area of the cord has a statistically significant relation with NICU admissions. P value being 0.005 and 0.001 but aUCI has no statistical correlation with NICU admissions' value being 0.556 (Table 5, Graph 5).

Variables	MSAF		TOTAL	P VALUE
	NO	YES		
Cord thickness	8.91±2.18	8.80±1.99	8.89±2.14	0.834
Cross sectional area	25.18±7.57	24.45±7.29	25.03±7.48	<0.700
aUCI	0.41±0.13	0.57±0.18	0.44±0.15	<0.001**

Table 5: Comparison of cord thickness, cross sectional area and aUCI in relation to MSAF.



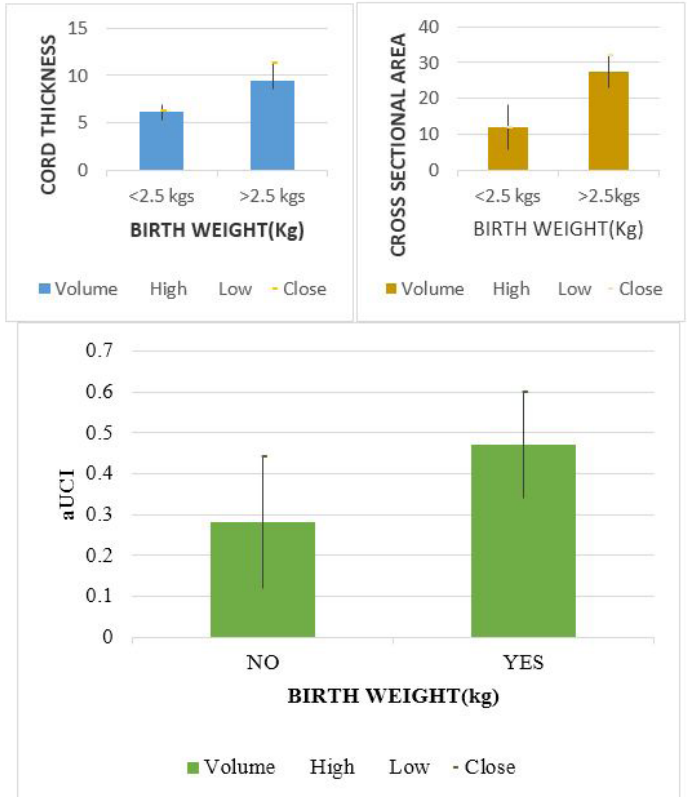
Graph 5: Comparison of cord thickness, cross sectional area and aUCI in relation to MSAF.

Cord thickness and cross-sectional area has no statistical correlation with MSAF. But hyper coiled cord has a statistically significant correlation with MSAF.P value being <0.001.

Pre-term delivery was present in 20% of the hypo coiled women and 5.15% of the norm coiled women. No preterm delivery was observed in the hyper coiled group. The mean aUCI is 0.31±0.15 in preterm patients and 0.45±0.15 in term patients. There was a statistically significant correlation between the hypo coiled cords and preterm delivery, the p value being 0.035 (Table 6 and Graph 6). Thus, hypo coiled cords were associated with preterm delivery.

Variables	Birth Weight (kg)		Total	P Value
	<2.5	>2.5		
Cord thickness	6.19±0.91	9.40±1.90	8.89±2.14	<0.001**
Cross sectional area	11.88±6.26	27.54±4.47	25.03±7.48	<0.001**
aUCI	0.28±0.16	0.47±0.13	0.44±0.15	<0.001**

Table 6: Comparison of cord thickness, cross sectional area and aUCI in relation to birth weight (kg).



Graph 6: Comparison of cord thickness, cross sectional area and aUCI in relation to birth weight (kg).

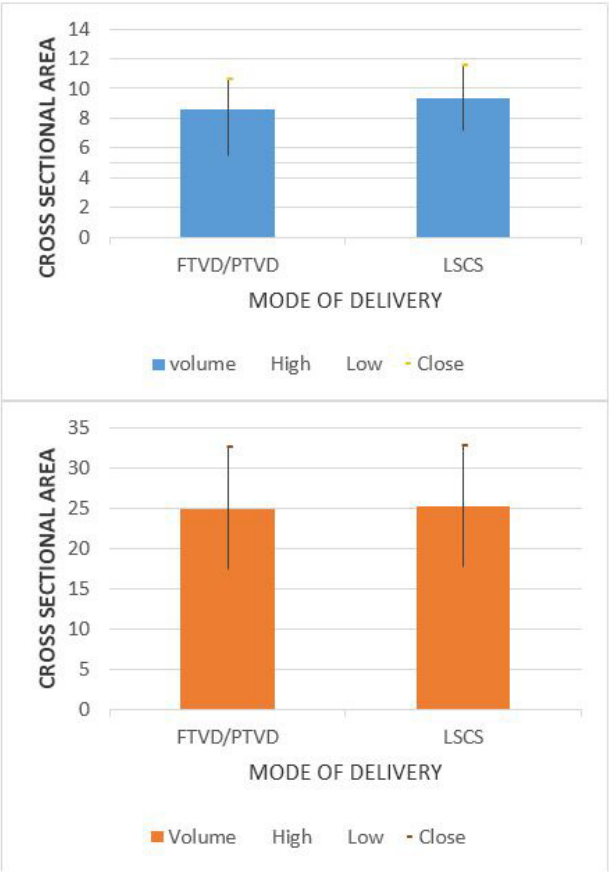
Umbilical cord thickness, cross sectional area and aUCI all have statistically significant correlation with birth weight. P values being <0.001 for all the three

In all these studies there is a significant correlation between Hypo coiling and preterm delivery. Our study correlates with the study by Chitra T [17]. In the study conducted by Sharma B et al. [1] to know the association of umbilical coiling index and perinatal outcome, Hypo coiling was observed in 15.67% cases and was associated with spontaneous preterm delivery (47.87%) with p value less than 0.001. Hyper coiling was also associated with spontaneous preterm delivery in 65.38%, but in our study no preterm delivery was seen in hyper coiled group. The study by Yun Sung Jo, Dong K J and Guisera L [16] in 226 patients,

hypo coiled cords were present in 8.9% patients. The incidence of preterm deliveries in hypo coiled group was significantly greater than the norm coiled group. In this study the preterm delivery in the hypo coiled group was 36.4%, in the norm coiled group 7.7% and 16.7% in the hyper coiled group. Thus, preterm deliveries are significantly associated with Hypo coiling of the cord with a p value of 0.041 (Table 7, Graph 7).

Variables	Mode of delivery		TOTAL	P VALUE
	FTND/PTVD	LSCS		
Cord thickness	8.56±2.07	9.33±2.17	8.89±2.14	<0.076
Cross sectional area	24.91±7.56	25.19±7.46	25.03±7.48	<0.857
aUCI	0.42±0.15	0.46±0.16	0.44±0.15	<0.217

Table 7: Comparison of cord thickness, cross sectional area and aUCI in relation to mode of delivery.



Graph 7: Comparison of cord thickness, cross sectional area in relation to mode of delivery.

Cord thickness, cross sectional area and aUCI has no correlation with mode of delivery. P value being 0.076, 0.857, 0.217 respectively in the study by Chitra T,Sushant Y S and Raghavan S [18]. Hyper coiling was present in 11.7% cases and preterm delivery was observed in 20.2% cases. This study also proved a statistically significant correlation between Hypo coiling and the preterm delivery with p value of 0.004. In another study by Monique W M Dee Last et al. [13] on umbilical cord coiling index in normal and complicated pregnancy, Hypo coiling of the cord was associated with spontaneous preterm delivery (OR 2.16, 95%C.I: 1.34-3.48).

Conclusion

Sonographic evaluation of the umbilical cord parameters during anomaly scan is very important but most neglected. It should be routinely performed along with other fetal parameters. Any abnormality in the umbilical cord cross sectional area, cord thickness or coiling index warrants a close monitoring of pregnancy. Timely reorganization of any abnormality, close monitoring of pregnancy and appropriate intervention can prevent untoward complications resulting in a safe pregnancy and healthy baby.

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