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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/14915
DOI URL: http://dx.doi.org/10.21474/IJAR01/14915

RESEARCH ARTICLE

UMBILICAL COILING INDEX AND ITS RELATIONSHIP WITH PERINATAL OUTCOMES

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Manuscript Info

Manuscript History
Received: 18 April 2022
Final Accepted: 20 May 2022
Published: June 2022

Key words:-
Hypocoiled Umbilical Cords, Perinatal Outcome, Umbilical Cord Coiling Index

Abstract

Aim: To evaluate any adverse perinatal outcomes associated with abnormal coiling of umbilical cord.

Introduction: The primary objective of antenatal and intrapartum fetal surveillance both in early and late pregnancy is to prevent fetal death. One of the most important parts of the fetoplacental unit is the umbilical cord. It is now being studied in predicting the perinatal outcome.

Materials and methods: This prospective study was conducted in Obstetrics and gynaecology department of a tertiary care hospital in Smt. Kashibai navale medical college and general hospital Narhe, Pune.Three hundred and fifty (350) umbilical cords of babies delivered either by vaginally or by lower segment caesarian section were examined. The umbilical coiling index was calculated by dividing the total number of coils by the length of the cord in cms. Subjects with umbilical coiling index below 10th percentile, between 10th and 90th percentile and above 90th percentile were defined as hypocoiled, normocoiled and hypercoiled respectively. It was then correlated with the following pregnancy outcomes: mode of delivery, preterm delivery, birth weight, meconium staining, Apgar score at 1 and 5 minutes, and neonatal intensive care unit (NICU) admissions. Hypocoiled cords were those having umbilical cord coiling index (UCI) less than 10th percentile and hypercoiled cords were those having UCI >90th percentile Statistical analysis was done . The results were statistically analysed by chi-square test. The p value ≤ 0.05 was considered statistically significant for all the analyses.

Result: The mean UCI was 0.61 ± 0.16. The hypocoiled umbilical cords (UCI < 10th percentile) were significantly associated with low birth weight, meconium staining, low Apgar score at 1 minute, and increased NICU admissions with a p-value < 0.05.

Conclusion:Abnormall UCI(hypocoiling) are significantly associated with adverse perinatal outcome.

Introduction:-

The umbilical cord or the “funis” is vital to the development, well-being and survival of the foetus. It is a trivascular conduit which allows the fetal blood to flow in to and from the placenta. A coil is defined as complete 360 degree spiral courses of umbilical vessels around the Wharton’s jelly. About 95% of the umbilical cords have coils and the origin of the coiling is unknown. Edmonds HW et al. quantified the umbilical coiling by dividing the total number of

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coils with umbilical cord length and called it as "The Index of Twist"[1] . The positive and negative scoring was assigned to clockwise and anticlockwise coiling of the umbilical cord. But Strong TH et al. simplified this classification by eliminating these directional scores and renamed it as "The UmbilicalCoiling Index" (UCI) [2].Hypocoiled and hypercoiled cords were defined as coils having UCI less than 10th percentile and more than 90th percentile respectively. Various reports have shown that abnormal coiling index is associated with adverse perinatal outcomes .[3-6] As there are inadequate studies to support this hypothesis in an Indian scenario, this study was undertaken to find out the umbilical coiling index and its relationship with perinatal outcomes.

The objective of this study is to correlate the UCI and its relationship with perinatal outcome.

Materials and Methods:-

This prospective study was conducted in Obstetrics and gynaecology department of a tertiary care hospital in , Smt. Kashibai navale medical college and general hospital narhe, pune. Pregnant ladies of ≥ 28 weeks of gestation having singleton live baby irrespective of parity and the mode of delivery were included in study. The pregnant women with multi foetal gestation and having history of congenital malformed babies were excluded. Based on the selection criteria Three hundred and fifty (350) pregnant women were taken in to the study. After taking informed consent, a detailed history and clinical examination was done on 350 patients with gestational age > 28 weeks, singleton pregnancy without any medical or obstetric complications, and a live fetus.After separating the baby from the umbilical cord, the cord was tied and cut closed to the placenta. Without being stretched, the cord was examined initially on the examination table. The entire umbilical cord was measured in centimeter including thelength of the placental end of the cord and the umbilical stump on the baby. The numbers of complete coils (360 degree spiral course) were counted from the neonatal end towards the placental end of the cord. Then the umbilical coiling index (UCI) was calculated by the formula (the total number of coils / total length of cord in centimeters). The centile values of the umbilical coiling index were calculated. The UCI less than 10th percentile and more than 90th percentile were considered as hypocoiled and hypercoiled respectively. The different perinatal factors such as, mode of delivery, preterm delivery, birth weight, meconium staining, Apgar score, and NICU admission were studied. Gestational age was calculated by the first day of the last menstrual period and/or from the first trimester ultrasound report.APGAR score of less than seven at 5 minutes was considered low. The data obtained were analysed using Chi-square test. The p value ≤ 0.05 was considered statistically significant for all the analyses.Hypocoiled or hypercoiled umbilical cords werethosewith corresponding coiling index values <10th or >90th percentiles respectively. The relationship between UCI and perinatal outcome was evaluated. Correlation of hypocoiling and hypercoiling with the perinatal outcome was based on the variables, such as mode of delivery, preterm delivery, birth weight, meconium staining, Apgar score, and NICU admission.

The test of statistical signifcance that was used to analyze the parameters was chi-square test.

Results:-

The total number of cases studied was 350. The maximum patients were in the age group between 21 and 25, i.e., 179 cases. The number of primigravida and multigravida was almost equal, i.e., 51 and 49% respectively.The mean UCI in our study was 0.61 ± 0.16. UCI of < 0..29 is considered as hypocoiling and seen 10..91 % of umblical cords in our study and UCI of > 0.93 is considered as hypercoiling and seen in 12.32 % of cords of our study group. The distribution of cord UCI in the study population is presented in Table 1.

Table 1:- Distribution of UCI

UCI	Neonate
Normal (0.29-0.93)	284
Hypocoiling (< 0.29)	31
Hypercoiling (> 0.93)	35
Total	350

Table 2:- Correlation between mode of delivery, preterm delivery, and birth weight of the neonate with UCI.

Mode of Delivery	**Normal**	**%**	**Hypo**	**%**	**p-value**	**Hyper**	**%**	**p-value**
Vaginal delivery	231	81.34%	22	70.97%	0.16	28	80.00%	0.84
LSCS	53	18.66%	9	29.03%		7	20.00%	
Total	284	100.00%	31	100.00%		35	100.00%	

Duration								
Preterm	46	16.20%	8	25.81%	0.17	4	11.43%	0.46
Term	238	83.80%	23	74.19%		31	88.57%	
Total	284	100.00%	31	100.00%		35	100.00%	
Birth weight								
<2.5	95	33.45%	21	67.74%	0.0017	10	28.57%	0.56
2.5-4.0	189	66.55%	10	32.26%		25	71.43%	
Total	284	100.00%	31	100.00%		35	100.00%	

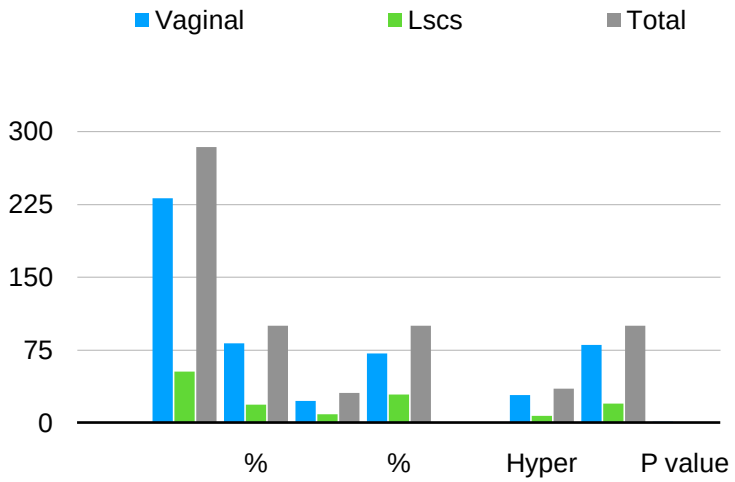
Table 3:- Association of Meconium staining with UCI.

Meconium Staning	**Normal**	**%**	**Hypo**	**%**	**p-value**	**Hyper**	**%**	**p-value**
Yes	28	9.86%	14	45.16%	0.00001	7	20.00%	0.07
No	256	90.14%	17	54.84%		28	80.00%	
Total	284	100.00%	31	100.00%		35	100.00%	

Table 4:- Association of Apgar score at 1 minute, 5 minutes, and NICU admission with UCI.

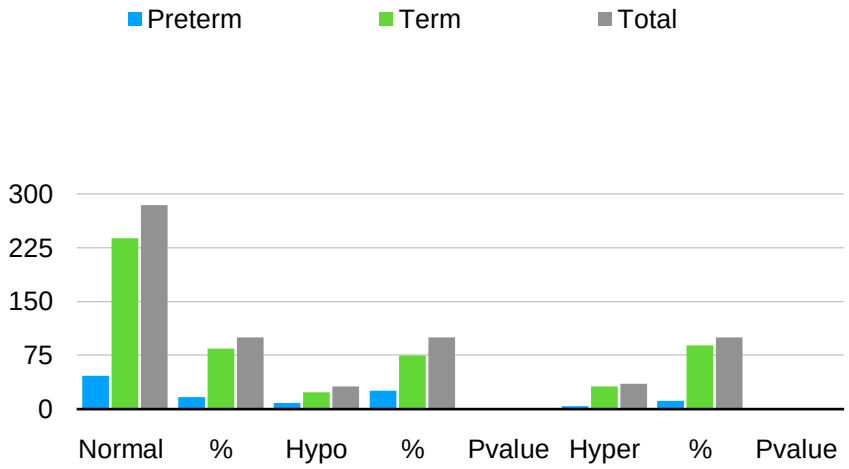
	Normal	**%**	**Hypo**	**%**	**p-value**	**Hyper**	**%**	**p-value**
Apgar score at 1 min								
<7.0	14	4.93%	10	32.26%	0.00001	4	11.43%	0.11
>7.0	270	95.07%	21	67.74%		31	88.57%	
Total	284	100.00%	31	100.00%		35	100.00%	
Apgar score at 5 min								
<7.0	4	1.41%	0	0.00%	0.5	0	0.00%	0.47
>7.0	280	98.59%	31	100.00%		35	100.00%	
Total	284	100.00%	31	100.00%		35	100.00%	
NICU admission								
Yes	14	4.93%	10	32.26%	0.00001	0	0.00%	0.17
No	270	95.07%	21	67.74%		35	100.00%	
Total	284	100.00%	31	100.00%		35	100.00%	

Graph 1:-



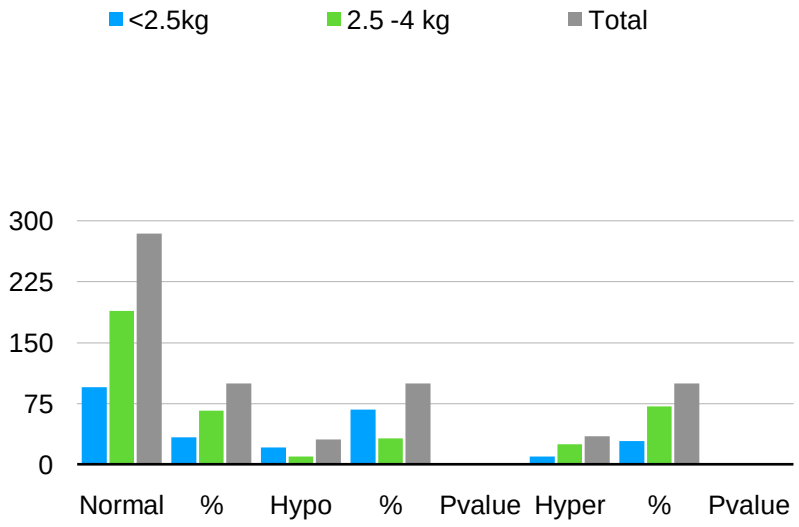
Depicted in Table 2 and in Graph 1 is the correlation between mode of delivery, preterm delivery, and birth weight of the neonate with UCI. Majority of patients delivered vaginally, i.e., 80% followed by lower segment cesarean section (LSCS) in 20% cases. However, no statistical significance of UCI with mode of delivery was observed.

Graph 2:-



Depicted in table 2 and graph 2:
Among 350 mothers recruited, 58 had preterm delivery, out of which 46 had normal coiling, 4 hypocoiling, and 4 hypercoiling. No statistically significant association was observed of preterm delivery with UCI.

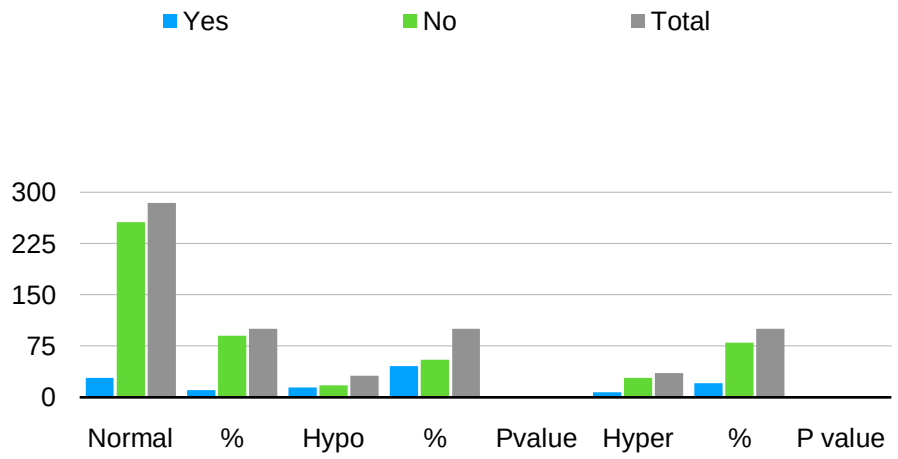
Graph 3:-



Depicted in table 2 and graph 3:
126 neonates had birth weight less than 2.5 kg out of which 21 had hypocoiled cords. Association of hypocoiling with low birth weight

Is statically significant with p-value 0.0017.

Graph 4:-



Graph 5:-

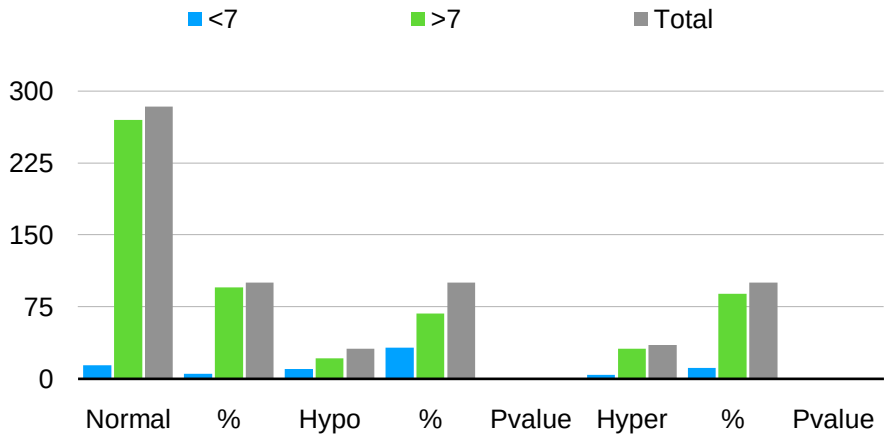


Table 3 and graph 4 reflects the statistical significance of meconium staining and hypocoiled cords with p-value 0.00001.

Graph 6:-

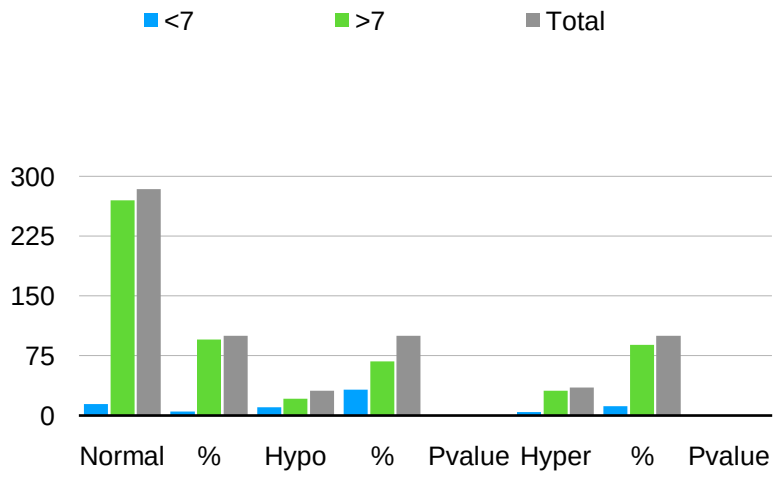


Table 4 graph 5 and 6 reflects 28 babies had Apgar score at 1 minute of 7 or less, out of which 10 had hypocoiled cords, so it was statistically significant with a p-value of 0.00001. Apgar score observed at 5 minutes was less than 7 in only 4 baby, who had normocoiling and so, it was not statistically significant .

Graph 7:-

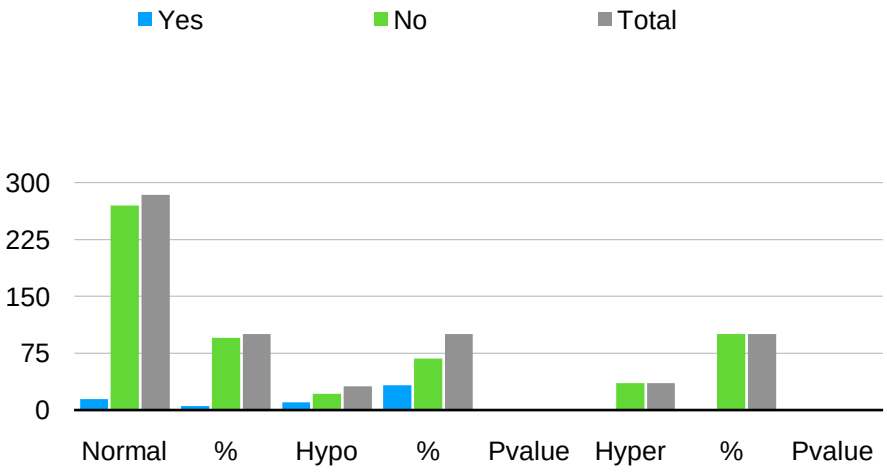


Table 4 and graph 7 depicts among 24 NICU admissions, 14 had normocoiling, 10 hypocoiling, and none hypercoiled cords. Association of NICU admissions with hypocoiling was statistically significant with p-value of 0.00001.

Note – Very small P-values are approximated to 0.00001

Discussion:-

The umbilical cord is a trivascular conduit. It allows the foetal blood to flow to and from the placenta. About 95% of the umbilical cords have coils. The umbilical coiling has been observed as early as eight weeks of gestation . The total number of coils in any particular cord is believed to be established early in the gestation . [8,9]The origin of the

coiling is unknown. There is lack of consensus regarding the origin of the coiling whether it is genetic or an acquired event. So there are proposed theories to explain umbilical cord twisting. The hypotheses include foetal movements, active or passive torsion of the embryo, differential umbilical vascular growth rates, foetal haemodynamic forces and the arrangement of the muscular fibers in the umbilical arterial wall . [1]Despite the lack of knowledge about the origin of the coiling, umbilical coils appear to reinforce the cord, producing a cord that is strong, yet flexible .[10] While considering the distribution of umbilical coiling index (UCI) among the study group, we observed that the 10th and 90th percentile were in agreement with the previous studies.[5,6,10]

The mean UCI in our study was 0.61 ± 0.16. It was higher as compared with other studies done in the past.

There may be a possibility of a dynamically evolving UCI with advancing gestational age. Most of the patients recruited in other studies were in the early gestational age, whereas we have recruited most of our patients in advanced gestational age.

No significant association was observed between UCI and age of the patient. Findings are consistent with those of Feyl-Woboso and Omo-Aghoja.[11] However, this is different than the study by Chitra et al [12] who found an association between elderly gravida (35 years) and both hypocoiled and hypercoiled cords. Ezimokhai et al[13] also found hypercoiled cords to be associated with extremes of maternal age. This is in contrast to our study in which all patients recruited were less than 35 years as our hospital treats rural and poor population who marry and conceive at an early age.

Correlation of UCI with gravidity in our study did not show any statistical significance, which is inconsistent with the study by Chitra et al.[12]

Association of UCI with mode of delivery was studied and is statistically not significant. This is consistent with the study done by Strong et al[2] who showed no association of UCI with mode of delivery. However, this is different than the study of Rana et al[6] and De Laat et al[14] who found association of cesarean section with hypocoiling.

Low birth weight was associated with hypocoiling which is statistically significant with a p-value of 0.00017, whereas no statistically significant association of hypercoiling with low birth weight was observed in our study. This is comparable to the study of Chitra et al[12] in which birth weight of the babies was compared with UCI and it was found that low birth weight, i.e., <2.5 kg, was significantly associated with both hypocoiled and hypercoiled cords. Studies by Rana et al,[6] and De Laat et al[14] have also shown an association of hypercoiling and low birth weight. This is in contrast to findings of our study in which no association of low birth weight with hypercoiling was observed.

Strong et al[2] and De Laat et al[14] showed association of preterm labor and hypocoiling, whereas Rana et al[6] found hypercoiling to be signifcantly associated with preterm labor. They believed that hyprecoiling was an adaptive response to fetal hemodynamic changes, which initiates preterm labor on reaching a certain threshold. But no statistically significant association between preterm labor and hypocoiling or hypercoiling was observed in our study. In our study, 58 patients had preterm deliveries out of which only 8 had hypocoiled cords and 4 hypercoiled cord. Out of the remaining 46 cases, maximum had bacterial vaginosis as a cause for preterm labor.

Association of meconium staining with hypocoiling is statistically significant with a p-value of 0.00001. The results are similar to the study by Gupta et al.[15] They studied 107 umbilical cords and found that in the hypocoiled group, meconium staining was signifcantly higher than in those with normal coiled cords. The findings are also consistent with the study by Strong et al[2] where 100 caseswere studied, and they found that meconium staining was associated with UCI values less than 10th percentile with p-value of 0.03, which is highly signifcant. Padmanabhan et al[16] also studied 130 cases, where they found that meconium staining was signifcant among hypocoiled cords.

The mechanism by which this could be mediated includes the possibility that undercoiled cords may bemore susceptible to acute kinking and therefore abrupt and marked cessation of blood flow.

Association of UCI with Apgar score at 1 minute was studied and has shown an association of low Apgar score with hypocoiled cords, which is statistically significant with a p-value of 0.00001. This is inconsistent with a similar

study by Gupta et al[15] who studied 107 umbilical cords and found that in hypocoiled cords, low Apgar score at 1 minute was present. In another study by Padmanabhan et al,[16] 130 umbilical cords were studied and it was observed that in hypocoiled cords, there was significant low Apgar score.

Apgar score at 5 minutes and its association with UCI were also studied, but we did not find any statistically significant correlation. This was not consistent with the study by De Laat et al[14] who studied 885 patients and found that hypocoiling was associated with low Apgar score less than 7 at 5 minutes. Gupta et al[15] found that babies with Apgar scores of <7 had signifcantly lower UCIs than those with Apgar scores of >7. Padmanabhan et al[16] studied 130 umbilical cords and found that hypocoiling was associated with low Apgar score of <7 at 5 minutes.

Good Apgar score at 5 minutes in our study may be due to timely intervention, as all cases were monitored by continuous cardiotocography (CTG)and hence there is no prolonged hypoxia in utero and immediate effective resuscitation improved the babies' Apgar score at 5 minutes, as they never went into secondary apnea.

The NICU admission with hypocoiling was statistically significant with a p-value of 0.00001.
Our studyis consistent with a similar study conducted by De Laat et al[14] who studied 885 cases and concluded that hypocoiling of the cord was associated with fetal distress and NICU admissions. Strong et al[2] found that incidence of fetal death in the noncoiled group was significantly greater.

With this study, it is inferred that in patients with no obvious risk factors, having hypocoiled cords thus abnormal UCI was associated with poor neonatal outcome. So, this identifies the subset of patients and underscores the need for vigorous monitoring.

Conclusion:-

There was a statistical significance of hypocoiling with meconium staining of liquor, low APGAR score and NICU admissions. So, antenatal UCI cases having hypocoiled cords require close antenatal monitoring by Doppler studies. Significantly higher incidence of meconium staining was observed with hypocoiled cords, requiring further close monitoring by CTG and so early artificial rupture of membranes is required in cases of abnormal UCI.

The present study concludes that abnormal coiling index is associated with adverse perinatal outcomes. Quantification of the degree of abnormal vascular coiling in the antepartum period is important. Antenatal detection of coiling index can identify the foetus at risk and can help in management.

References:-

[1] Edmonds HW. The spiral twists of the normal umbilical cord in twins and in singletons. Am J Obstet Gynecol. 1954; 67:102-20.
[2] Strong TH, Jarles DL, Vega JS, Feldman DB. The umbilical coiling index. AmJ Obstet Gynecol. 1994; 170:29-32.
[3] Lacro RV, Jones KL, Benirschke K. The umbilical cordtwist: origin, direction, and relevance. Am J Obstet Gynecol. 1987;157:833-38.
[4] Strong TH, Finberg HL, Mattox JH et al. Antepartumdiagnosis of noncoiledumbilical cords. Am J Obstet Gynecol. 1994;170:1729- 33.
[5] Ercal T, Lacin S, Altunyurt S, Saygili U, Cinar O, Mumcu A.umbilical coiling index: Is it a marker for the foetus at risk?Br J ClinPract. 1996; 50:254-56.
[6] Rana J, Ebert GA, Kappy KA .Adverse perinatal outcomein patients with an abnormal umbilical coiling index.Obstet Gynecol. 1995; 85:573-77
7] Battaglia FC, Lubchenco LO. A practical classification ofnewborn infants by weight and gestational age. J Pediatr1967; 71:159-63.
[8] Van Dijk CC, Franx A, De Latt MWM, Bruinse HW, VisserGHA, Nikkels PGJ. The umbilical coilingindex in normal pregnancy. J Matern Fetal Neonatal Med2002;11:280- 83.
[9] Machin GA, Ackerman J, Gilbert BE. Abnormal umbilical cord coilingis associated with adverse perinatal outcomes. PediatrDevPathol.2000;3:462-71.
[10] Strong TH, Elliot JP, Radin TG. Noncoiled umbilical bloodvessels: A new marker for the fetus at risk. Obstet Gynecol. 1993;81:409-11.

[11]Feyl-Woboso PA, Omo-Aghoja LO. Umbilical cord coiling index in women of south eastern Nigeria. J Womens Health Issues Care 2014;3(4).
[12]Chitra T, Sushanth YS, Raghuvan S. Umbilical coiling index as a marker of perinatal outcome: an analytical study. Obst Gynaecol Int 2012;Article ID 213689:1-6.
[13] Ezimokhai M, Rizk DE, Thomas L. Abnormal vascular coiling of the umbilical cord in gestational diabetes mellitus. Arch Physiol Biochem 2001 Jul;109(3):209-214.
[14]De Laat WM, Frank A, Bots M, Visser GH, Nikkels PG. Umbilical coiling index in normal and complicated pregnancies. Obstet Gynecol 2006 May;107(5):1049-1055.
[15] Gupta S, Faridi MMA, Krishnan J. Umbilical coiling index. J Obstet Gynaecol 2006 Jul-Aug;56(4):315-319.
[16] Padmanabhan LD, Mheskar R, Mheskar A. Umbilical vascular coiling and perinatal outcome. J O Obstet Gynaecol India 2001;51(6):45-44.