

Correlation of the abnormal postnatal umbilical coiling index and adverse perinatal outcome: A non-interventional cross sectional observational study

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Citation this Article: Anurupa Nayak, Prof. Shailesh J. Kore, “Correlation of the abnormal postnatal umbilical coiling index and adverse perinatal outcome: A non-interventional cross sectional observational study”, IJMSIR - January - 2024, Vol – 9, Issue - 1, P. No. 92 – 100.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Umbilical cord is lifeline connecting mother & fetus. About 96% of the umbilical cords have coils. Coiling can be Normocoiled, Hypocoiled or hypercoiled. Adverse perinatal outcome is likely to be associated with abnormal coiling. Hence, this study was an attempt to find the correlation of the abnormal postnatal umbilical coiling index and the perinatal outcome.

Methods: This study was a cross sectional, non-interventional, observational study, conducted at the department of Obstetrics and Gynaecology in a tertiary care, teaching hospital for 18 months. In our study 200 pregnant women more than 34 weeks gestation meeting inclusion criteria delivering at our hospital were included in study after obtaining consent. After delivery, umbilical Coiling Index (UCI) was calculated by dividing the total number of coils by the umbilical cord length in centimetres.

Result: Mean post-natal coiling index was 0.468. In our study, majority (163) were Normocoiled. Abnormal

umbilical indices were significantly associated with LSCS, pregnancy induced hypertension (50% amongst Hypocoiled), meconium stained liquor, IUGR (52.63% amongst hypercoiled) and low APGAR score.

Conclusion: Our study showed that abnormal umbilical coiling index is associated with adverse perinatal outcome. Also there is now emerging evidence of good correlation between antenatal and postnatal coiling index. This could be used to predict women at risk of having adverse antenatal or perinatal events.

Abbreviations: LSCS- lower segment caesarean section; IUGR-intrauterine growth retardation;

Keywords: Postnatal umbilical coiling index, Perinatal outcome, LSCS, Pregnancy induced hypertension, IUGR, APGAR score.

Introduction

The umbilical cord is the major fetomaternal unit that provides connecting link between the mother/placenta and foetus of the many characteristics of the human umbilical cord, the most mysterious and intriguing one is

the twisted or spiral course of its component blood vessels.

The umbilical coiling was first quantified by Edmonds in 1954 who divided the total numbers of coils in the umbilical cord by the length of the cord in centimetres and called it "The Index of twist". He assigned positive and negative scores to clockwise and anticlockwise coiling respectively. Strong et al later simplified by eliminating the directional scores and named it 'The Umbilical Coiling Index.'

The mechanism by which physiological coiling occurs still, however, remains undetermined, with speculation that it may be related to early fetal activity and hemodynamic factors.

At full term the umbilical cord has an average length of 55cm (the usual range is 30-100cm). The helical course of the umbilical vessels is clearly visible from 7wks post conception in 95% of fetuses. An umbilical coil is defined as one complete spiral of 360 degrees of the umbilical vessels around each other.

Coiling is a universal phenomenon. About 95% to 96% of the umbilical cords have coils. Though Coiling is a universal phenomenon, coiling can be Normocoiled, Hypocoiled or hypercoiled. Incidence of Hypocoiled & hypercoiled is 10.8-14% and 10-30% ^(3,4), respectively. Adverse perinatal outcome is likely to be associated with hypocoiling and hypercoiling. An abnormal coiling index has been shown to be related to adverse fetal outcomes. It was seen that the risk of small for gestational age (SGA) at birth and a need for intervention due to non-reassuring fetal status were higher in the presence of an abnormal coiling index, but the confidence intervals (CIs) around the risk estimates were very wide, leading the authors to conclude that larger studies would be needed to confirm useful predictive potential.

Since coiling level is often associated by adverse prenatal outcomes such as intra uterine growth restriction, fetal distress during labour and intrauterine fetal death. Hence if the coiling index could be measured antenatally by ultrasonogram, it would act as a marker of adverse perinatal outcome and the obstetricians and paediatricians would be prepared to handle the situation. Hence, this study was an attempt to find the correlation of the abnormal umbilical coiling index in the new-born and the perinatal outcome.

Materials & Methods

Aim of this study was to study correlation of the abnormal postnatal umbilical coiling index and adverse perinatal outcome. It was a single-centric, cross sectional, non-interventional, observational study was done, conducted at department of Obstetrics and Gynaecology in a tertiary care, teaching hospital for the duration of 18 months. In our study 200 pregnant women more than 34 weeks delivering at our hospital were included after approval from the Institutional Ethical Committee & after taking informed consent.

Patients were selected based on criteria such as; women registered antenatally with us i.e. minimum 3 antenatal visits during entire pregnancy, giving voluntary consent to participate in the study, delivering either vaginally or abdominally after 34 completed weeks of gestation.

Those women who were unregistered, with past or present history of anomalous baby, requiring iatrogenic premature delivery due to reasons like placenta previa, preterm premature rupture of membranes, presenting with multiple pregnancies, malpresentations or undergoing elective caesarean section, were excluded from the study.

All the patients meeting the inclusion criteria were selected after obtaining informed consent. The age, obstetric score, presence of pregnancy induced

hypertension, medical disorders and labor details like gestational age at delivery, fetal heart rate patterns on a cardiotocograph, color of liquor, mode of delivery, birth weight, Ponderal index, APGAR at 1 min and 5 mins were noted. The selected patients' first, second and third stages were managed as per unit protocol. After delivery, placenta and umbilical cord were examined carefully.

Length of the placental portion of umbilical cord was measured starting from placental end up to the cut end. Length of fetal portion of the umbilical cord was measured from the cut end up to the umbilicus of the baby.

Total cord length was calculated by adding fetal portion length and placental portion length.

The number of complete coils or spirals counted from the neonatal end towards the placental end of the cord and expressed per centimeter.

Umbilical Coiling Index (UCI) was calculated by dividing the total number of coils by the umbilical cord length in centimeters.

The frequency distribution of postnatal umbilical coiling index (pUCI) was charted. Median umbilical coiling index was calculated for the study population followed by the 10th and 90th percentiles.

Depending on these values, cases were divided into three groups;

Normocoiled: 10th–90th percentile

Hypercoiled: >90th percentile

Hypocoiled: <10th percentile

Appropriate statistical analysis was applied for comparing the incidence of adverse events and other complications. Proportions were compared using Chi-Square test of significance. Kolmogorov – Smirnov (K-S) test and Shapiro – Wilk test is used to examine if the observed data follow a normal distribution. In the entire above test the “p” value of less than 0.05 was accepted as

indicating statistical significance. Data analysis was carried out using Statistical Package for Social Science (SPSS, V 28) package.

Results

In our study, 163 (81%) subjects are Normocoiled with the mean Coiling Index 0.232, 18 (9%) subjects were Hypocoiled with the mean coiling index 0.118, 19 (10%) were hypercoiled with the mean coiling index 0.468.

The various parameters like the age, parity, presence of hypertensive disorders of pregnancy, gestational age at delivery, meconium stained liquor, fetal distress, intra-uterine growth retardation, birth weight, ponderal index and APGAR score were compared with the umbilical coiling index.

On comparing the age group based on coiling index, majority of the subjects in the Normocoiled, Hypocoiled and hypercoiled groups, belonged to 21-25 years(38.65%).(Table 1)

On analyzing using Kruskal Wallis test there was no significant difference between the groups. In our study, age of the subjects didn't have an impact on the coiling Index.

On analyzing using Chi square test, it was found that there was a significant association between parity and coiling index. In our study majority of the Hypocoiled are primi and majority of the hypercoiled are multiparous.(Table 2)

In our study majority of the study subjects delivered between 37-40 weeks. The preterm was more common in Hypocoiled group. On comparing with the coiling index with gestational age at delivery, there was no statistical significance.(Table 3)

In our study on comparing the coiling index and pregnancy induced hypertension, it was found that prevalence of PIH is higher among Hypocoiled(50%) followed by hypercoiled(15.79) and Normocoiled(10.43).

On applying Chi square test there was statistically significant association between Coiling index and PIH.(Table 4)

In our study majority of the Normocoiled (68%) had Vaginal delivery, majority of Hypocoiled (61.11%) and hypercoiled (73.68%) had emergency LSCS.(Table 5)

It was found that subjects with Hypocoiled and hypercoiled had increased chance of emergency LSCS and it was statistically significant on applying Chi square test.

In our study, majority of the meconium stained amniotic fluid was among hypocoiled (16.67%) followed by hypercoiled (10.53%) and no statistical significance was found.(Table 6)

On comparing IUGR in relation to coiling Index, it was found that subjects with hypercoiled (52.63%) had increased prevalence of IUGR and it is statistically significant.(Table 8)

In our study, It was found that patients with Normocoiled had better APGAR score compared to Hypocoiled (mean APGAR score 6.32) and hypercoiled (mean APGAR score 6.56) and on analyzing it was found to be statistically significant.(Table 9)

Discussion

A non-interventional cross sectional observational study was done at our tertiary care teaching hospital, among 200 women who met the inclusion criteria. They were divided into 3 groups based on the umbilical coiling index as Normocoiled, Hypocoiled and hypercoiled. The various parameters like the age, parity, presence of hypertensive disorders of pregnancy, gestational age at delivery, meconium stained liquor, foetal distress, intra-uterine growth retardation, birth weight, ponderal index and APGAR score were compared with the umbilical coiling index.

Study	Normocoiled	Hypocoiled	Hypercoiled
Current	81.5%	9%	9.5%
Citra et al	78.3%	11.7%	10%
Chholak D et al	79%	10.8%	10.2%
Nivedita S. Patil et al	78%	11.5%	10.5%
G Subasini et al	72.5%	13.5%	14%

In our study, majority (40%) of the study subjects were in the age group of 21-25 years of age, similar to the studies conducted by **Ruchi Monga et al¹²** and **Chholak D et al³**. Also these studies concluded that there was no significant difference in coiling index with relation to the age group.

In our study on comparing the coiling index and Pregnancy induced hypertension. 10.43% of the Normocoiled had PIH, 50% of Hypocoiled had PIH and 15.79% of hypercoiled was diagnosed with PIH. It was found that prevalence of PIH is higher among Hypocoiled followed by Hypercoiled and Normocoiled and it was statistically significant. Our study was in concurrence to the study conducted by **Chitra et al⁴** that hypocoiling was significantly associated with pregnancy induced hypertension.

In our study majority (68%) of the Normocoiled had vaginal delivery, majority of Hypocoiled (61.11%) and Hypercoiled (73.68%) had emergency LSCS.

It was found that subjects with hypercoiled had increased chance of emergency LSCS and it was statistically significant on applying Chi square test.

In a study conducted by **Enasadnan et al⁵**, it was found majority of the LSCS was conducted among hypercoiled (19%) and Hypocoiled (18%). Similar to our study, LSCS was done more among hypercoiled. Also studies conducted by **G. Subasini et al⁶**, **Chitra et al⁴**, and **Chholak D et al³**, were in concurrence to our study.

In our study on comparing the coiling index and Pregnancy induced hypertension. 10.43% of the

Normocoiled had PIH, 50% of Hypocoiled had PIH and 15.79% of hypercoiled was diagnosed with PIH. Studies conducted by **Chitra et al⁴** and **ABiradar et al²**, found that the prevalence of pregnancy induced hypertension was higher among hypocoiled compared to hypercoiled and it was statistically significant.

In our study, majority of the meconium stained amniotic fluid was among Hypocoiled (16.67%) followed by Hypercoiled (10.53%) and (9.29%) among Normocoiled. In a study conducted by **Chholak D et al³**, 74% of the meconium stained was seen among patients with Hypocoiled compared to 22% among hypercoiled. Study concluded that there was significant association between Hypocoiled and meconium stained liquor.

In a study conducted by **Nivedita S. Patil et al¹⁰**, it was found that all cases Hypocoiled were associated with meconium stained and it was statistically significant.

In a study conducted by **Chholak D et al³**, the prevalence of Low birth weight < 2.5 Kg was 43% among hypercoiled and 22.2 % among Hypocoiled. In a study conducted by **Anubha Bansal et al¹**, the mean birth weight among hypercoiled was 2.47 kgs and 2.55 kgs among hypocoiled. Intrauterine growth restriction and low birth weight babies were significantly higher in hypercoiling group.

On comparing IUGR in relation to coiling Index, it was found that the prevalence of IUGR was higher 52.63% among hypercoiled followed by 38.89% among Hypocoiled and 11.04% among Normocoiled.

It was found that subjects with hypercoiled had increase incidence of IUGR and it is statistically significant.

In a study conducted by **Anubha Bansal et al¹**, the cases of IUGR was more among patients with hypercoiling and it was statistically significant. Similarly in the study conducted by **Chholak D et al³**, IUGR was more prevalent among hypercoiled ones. The findings in

studies conducted by **Anubha Bansal et al¹** & **Chholak D et al³**, were in concurrence to our study concluding that the prevalence of IUGR is more among Hypercoiled. In our study, the mean APGAR Score at 5 minutes among Normocoiled was 7.25 followed by hypercoiled (6.56), followed by hypocoiled (6.32) and on analysis, it was found to be statistically significant. In a study conducted by **Enasadnan et al⁵**, the APGAR score was lower among abnormal umbilical cord index compared to normal index. In a study conducted by **Chholak D et al³**, the APGAR score < 7 was 66.7% among hypocoiled compared to 23.5% among hypercoiled. In a study conducted by **Nivedita S. Patil et al¹⁰**, the APGAR score < 7 was 30.4% among hypocoiled compared to 9.5% among hypercoiled. **Shayesta Rahi et al¹²**, conducted a study and found out that 40% of babies with hypocoiling cords had APGAR at 1 minute <4 and APGAR score at 5 minutes <7. Our study was in concurrence to the studies conducted by **Enasadnan et al⁵**, **Chholak D et al³**, **Shayesta Rahi et al¹²** and **Nivedita S. Patil et al¹⁰**, concluding that the APGAR score is lower in hypocoiled.

Limitation: It's a single-centric study. Since our sample size was small, further larger-scale multi-centric studies are required to confirm the findings. In our study, UCI was measured once during postnatal period, studies must be conducted antenatally at various trimesters to predict the adverse perinatal outcome.

Conclusion

Our present study was an attempt to find out whether abnormal cord coiling index bear any correlation with adverse perinatal outcome.

From analysis of our study & review of literature on the subject, we concluded that hypocoiling is associated with pregnancy induced hypertension and Meconium stained amniotic fluid. Hypercoiling of the cord showed a significantly increased incidence of Intrauterine growth

retardation. Both hypocoiling and hypercoiling were seen to be significantly associated with low APGAR score. Our study thus shows that abnormal umbilical coiling index is associated with adverse perinatal outcome. Also there is now emerging evidence that there is good correlation between antenatal and postnatal umbilical coiling index. With proper training on good machine, it is possible to measure coiling index in antenatal ultrasonography scan with reasonable accuracy. This finding then could be used as an antenatal, sonographic marker to predict women at risk of having adverse antenatal or perinatal events.

References

1. Dr.Anubha Bansal, Dr.Swati Garg, Dr.Urvashi Sharma, Dr.Samta Bali Rathore. Correlation of Antenatal and Postnatal Umbilical Coiling Index for Determining the Perinatal Outcome. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 15, Issue 1 Ver. I (Jan. 2016), PP 125-131 www.iosrjournals.org.
2. Aruna Biradar, Shreedevi Kori, Neelamma Patil, SR Mudanur. Umbilical coiling index and its association with perinatal mortality and morbidity in a low resource tertiary care hospital of northern Karnataka - a prospective observational study. The New Indian Journal of OBGYN. 2020 (July-December); 7(1). doi -10.21276/obgyn.2020.7.3.
3. Chholak, Deepika &Khajotia, Santosh. Study to evaluate association of umbilical coiling index and perinatal outcome. International Journal of Reproduction, Contraception, Obstetrics and Gynecology.2017;6.10.18203/23201770.ijrcog20170 025.
4. Chitra T, Sushanth YS, Raghavan S. Umbilical coiling index as a marker of perinatal outcome: an analytical study. ObstetGynecol Int. 2012;2012:213689. doi:10.1155/2012/213689.
5. Enas Adnan Abdulrasul. Umbilical coiling index as a predictor of adverse perinatal outcome Int. J. of Adv. Res. (2014), Volume 2, Issue 2, 101-107. www.journalijar.com.
6. Gopinath Subashini, Christina Anitha, Ganesan Gopinath, and K Ramyathangam. A Longitudinal Analytical Study on Umbilical Cord Coiling Index as a Predictor of Pregnancy Outcome. Cureus. 2023 Mar; 15(3): e35680. doi: 10.7759/cureus.35680.
7. Kashanian M, Akbarian A, Kouhpayehzadeh J. The umbilical coiling index and adverse perinatal outcome. Int J Gynaecol Obstet. 2006 Oct;95(1):8-13. doi: 10.1016/j.ijgo.2006.05.029. Epub 2006 Jul 24. PMID: 16860802.
8. Lacro RV, Jones KL, Benirschke K. The umbilical cord twist :origin, direction and relevance. Am J obstetGynecol 1987; 157 : 833-8. DOI: 10.1016/s0002-9378(87)80067-4.
9. Ndolo JM, Vinayak S, Silaba MO, Stones W. Antenatal Umbilical Coiling Index and Newborn Outcomes: Cohort Study. J Clin Imaging Sci. 2017;7:21. Published 2017 May 22. doi:10.4103/jcis.JCIS_111_16.
10. Nivedita S. Patil, Sunanda R. Kulkarni, and Renu Lohitashwa. Umbilical Cord Coiling Index and Perinatal Outcome. J Clin Diagn Res. 2013 Aug; 7(8): 1675-1677. doi: 10.7860/JCDR/2013/5135.3224
11. Rahi S et al. Relationship of umbilical coiling index and perinatal outcome. Int J Reprod Contracept Obstet Gynecol. 2017 Oct;6(10):4433-4436.
12. Ruchi Monga, Jai K Goel, Sipra Bagchi, Shanti Sah, Ruchica Goel. Correlation of Antenatal Umbilical Cord Coiling Index with Perinatal Outcome. Journal

of South Asian Federation of Obstetrics and Gynaecology. 10.5005/jp-journals-10006-1574.

13. Sharma R, Radhakrishnan G, Manchanda S, Singh S. Umbilical Coiling Index Assessment During Routine Fetal Anatomic Survey: A Screening Tool for Fetuses at Risk. J ObstetGynaecol India. 2018 Oct;68(5):369-375. doi: 10.1007/s13224-017-1046-8. Epub 2017 Sep 14. PMID: 30224841; PMCID: PMC6133785.

14. Singh, Sujata & Pai, Swati & Sahu, Barsha. (2020). Study of umbilical coiling index and perinatal outcome. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 9. 3977. 10.18203/2320-1770.ijrcog20204021.

15. Strong Jr. TH ,Elliott JP Radin TG, non-coiled umbilical blood vessel : a new marker for fetus at risk. Obst &gyne 1993,81(3):409-411.

Legend Tables

Table 1: Age wise distribution of study subjects

Age (Yrs)	Normocoiled N (%)	Hypocoiled N (%)	Hypercoiled N (%)	Total N (%)	P Value (comparing the age group based on coiling index)
<=20	20 (12.27)	5 (27.78)	0	25 (12.5)	0.778+
21-25	63 (38.65)	6 (33.33)	11 (57.89)	80 (40)	
26-30	63 (38.65)	4 (22.22)	7 (36.84)	74 (37)	
31-35	14 (8.59)	2(11.11)	1 (5.26)	17 (8.5)	
>=36	3 (1.84)	1(5.56)	0	4 (2)	

+ Kruskal Wallis test

Table 2: Distribution of study subjects based on parity

Parity	Normocoiled N (%)	Hypocoiled N (%)	Hypercoiled N (%)	Total N (%)	P Value(On comparing the parity of the subjects with the coiling index)
Primiparous	87 (53.37)	15 (83.33)	2 (10.53)	104 (52)	< 0.001**
Multigravida	76 (46.63)	3 (16.67)	17 (89.47)	96 (48)	

** Chi Square test

Table 3: Classification of study subjects based on gestational age at delivery in relation to coiling index

Coiling Index	Gestational Age At Delivery				P Value (On comparing the coiling index with gestational age)
	< 37 Weeks N (%)	37-40 Weeks N (%)	> 40 Weeks N (%)	Total	
Normocoiled	18 (11.04)	144 (88.34)	1 (0.61)	163(81.5)	0.086**
Hypocoiled	5 (27.78)	13 (72.22)	0	18 (9)	
Hypercoiled	4 (21.05)	15 (78.95)	0	19 (9.5)	

** Chi Square test

Table 4: Distribution of study subjects diagnosed with pregnancy induced hypertension in relation to coiling index

Coiling Index	Pregnancy Induced Hypertension				P Value (On comparing the coiling index with PIH).
	Yes		No		
	Total	Percentage	Total	Percentage	
Normocoiled	17	10.43	146	89.57	< 0.001**
Hypocoiled	9	50.00	9	50.00	
Hypercoiled	3	15.79	16	84.21	

** Chi Square test

Table 5: Distribution of study subjects based on Mode of delivery in relation to coiling index

Coiling Index	Mode of Delivery			P Value (on comparing the coiling index with mode of delivery)
	Vaginal Delivery N (%)	Emergency LSCS N (%)	Total N (%)	
Normocoiled	111 (68.10)	52 (31.90)	163 (81.5)	< 0.001**
Hypocoiled	7 (38.89)	11 (61.11)	18 (9)	
Hypercoiled	5 (26.32)	14 (73.68)	19 (9.5)	

** Chi Square test

Table 6: Distribution of New-born diagnosed with Meconium stained amniotic fluid in relation to coiling index

Coiling Index	Meconium Stained Amniotic Fluid (MSAF)					P Value (On Comparing The Coiling Index With MSAF)
	Yes		No		Total	
	Total	Percentage	Total	Percentage		
Normocoiled	17	9.20	146	90.80	163	0.534**
Hypocoiled	3	16.67	15	83.33	18	
Hypercoiled	2	10.53	17	89.47	19	

** Chi Square test

Table 7: Distribution of Mean birth weight in relation to coiling index

Coiling Index	Birth Weight		P Value (On Comparing The Coiling Index With Birth Weight)
	Mean	SD	
Normocoiled	2843.5	302.25	< 0.001*+
Hypocoiled	2777.89	306.04	
Hypercoiled	2420.56	351.25	

*+ Pearson's Correlation

Table 8: Distribution of New-born diagnosed with IUGR in relation to coiling index

Coiling Index	IUGR				P Value (On comparing the coiling index with IUGR)
	Yes		No		
	Total	Percentage	Total	Percentage	
Normocoiled	18	11.04	145	88.96	< 0.001**
Hypocoiled	7	38.89	11	61.11	
Hypercoiled	10	52.63	9	47.37	

** Chi Square test

Table 9: Distribution of APGAR score among new-born at 5min in relation to coiling index

Parameters	Coiling Index	Mean	Std. Deviation	P Value (On comparing the coiling index with APGAR)
APGAR	Normocoiled	7.25	0.92	<0.001*+
	Hypo	6.32	1.38	
	Hyper	6.56	1.66	
	Total	7.1	1.11	

*+ Pearson's Correlation