

A Prospective Study to the Evaluate Umbilical Coiling Index as a Marker of Maternal Outcome

Asna Aafreen¹, Apoorv Pankaj², Aprajita Pankaj³

Received on: 07 March 2022; Accepted on: 17 August 2023; Published on: 04 December 2023

ABSTRACT

Aim: A prospective study to evaluate the umbilical coiling index as an indicator of maternal outcome. Research is being undertaken to calculate the abnormal coiling index (hypercoiling or hypocoiling) and determine its adverse pregnancy outcomes.

Materials and methodology: Prospective observational research was done in the Department of Gynaecology & Obstetrics at Lilavati Hospital, India, from February 2018 to March 2019. The sample size was 141 (patients admitted to the hospital for delivery).

Results: Abnormal cord coiling is hypocoiled or hypercoiled. The present study reveals that abnormal cord coiling is not associated with a period of gestation at delivery, age of the mother, mode of delivery, chronic hypertension (HTN), pregnancy-induced hypertension (PIH), or gestational diabetes in the mother.

Conclusion: Abnormal cord coiling causes adverse outcomes. The reason for this abnormal coiling is not identified. Not many studies have been undertaken to determine the coiling index and its pregnancy outcome. Thus, prospective studies should be carried out to find the reason for abnormal umbilical cord coiling, and thus, to find means for preventing adverse pregnancy outcomes. Umbilical cord coiling index (UCI) assessment antenatally can also become an important variable to be assessed. This can help us in identifying patients who may have adverse outcomes.

Clinical significance: Abnormal umbilical coiling index is linked with poor pregnancy outcomes and its antenatal as well as postnatal determination should be incorporated into clinical practice.

Keywords: Abnormal coiling index, Hypercoiling, Hypocoiling, Maternal outcome.

Journal of South Asian Federation of Obstetrics and Gynaecology (2023): 10.5005/jp-journals-10006-2350

INTRODUCTION

The umbilical cord connects the fetus and the placenta. The cord is formed by the 12th week period of gestation and contains two arteries and a single vein, surrounded by Wharton's jelly.¹ The rudimentary umbilical cord is formed by the amnion and the omphalomesenteric duct.^{1,2} Blood flow is established by the fifth week.^{1,3}

The umbilical cord measures 50–60 cm at term.⁴ The most characteristic feature of the cord is its helical coiling pattern.^{1,5} The cord may be susceptible to compression or torsion leading to interference with the flow of blood. The coiling of the umbilical cord, therefore, protects the fetus against the harmful effects of such compression or torsion.⁵ The reason for umbilical coiling is not identified.⁵ The effect of umbilical cord coiling is not clear.⁶

Studies show that abnormal umbilical cord coiling may cause fetal distress and chronic intrauterine growth retardation (IUGR). The cause is not known.⁷ The umbilical cord may be hypocoiled or hypercoiled; both may be associated with adverse neonatal and maternal outcomes such as intrauterine deaths, preterm delivery, higher rates of neonatal intensive care unit (NICU) admission, operative delivery for fetal distress, meconium staining, small for gestational age baby, pregnancy-induced hypertension (PIH), chronic hypertension (HTN), gestational diabetes mellitus (GDM), mode of delivery whether cesarean delivery or vaginal delivery and chromosomal abnormalities.

Abnormal cord coiling and its neonatal and maternal effects have not been studied in much detail. This work is undertaken to evaluate the abnormal coiling index as an indicator of maternal outcome. More studies are needed to look for ways to identify

¹⁻³Department of Obstetrics & Gynecology, Integral Institute of Medical Sciences & Research, Lucknow, Uttar Pradesh, India

Corresponding Author: Aprajita Pankaj, Department of Obstetrics & Gynecology, Integral Institute of Medical Sciences & Research, Lucknow, Uttar Pradesh, India, Phone: +91 7080802044, e-mail: aprajita.pankaj29@gmail.com

How to cite this article: Aafreen A, Pankaj A, Pankaj A. A Prospective Study to the Evaluate Umbilical Coiling Index as a Marker of Maternal Outcome. *J South Asian Feder Obst Gynae* 2023;15(6):654–657.

Source of support: Nil

Conflict of interest: None

abnormal cord coiling antenatally, and thus determine ways to prevent adverse pregnancy outcomes.

METHODS

- Study site: Department of Gynaecology & Obstetrics, Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India.
- Study population: All patients admitted to the hospital for delivery.
- Study design: Prospective observational research will be carried out in the Department of Gynaecology & Obstetrics, Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India.
- Sample size: One hundred and forty-one subjects.
- Study duration: February 2018 to March 2019.
- Ethical consideration: All the patients/legal guardians were explained about the study, particularly the risks of abnormal

coiling with respect to pregnancy complications and maternal outcomes. They were also explained that this study would not involve any special intervention/procedure apart from the routine treatment that the patient was getting and it would not cause any financial burden to the patients. If she/he agreed, only then the patient would be selected for this work. Informed written consent was taken. All details of subjects (personal or clinical) were kept confidential.

- Inclusion criteria:
 - Pregnant women, irrespective of the period of gestation and parity.
 - Single live intrauterine pregnancy.
 - Mode of delivery (caesarean or vaginal).
 - Live birth/intrauterine fetal demise (IUFD)/stillbirth.
- Exclusion criteria:
 - Multifetal gestation.
 - Abnormal fetus.
 - Single umbilical artery.
 - Smoking and drug abuse.

METHODOLOGY

This study was conducted in Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India from February 2018 to March 2019. A total of 141 subjects (singleton pregnancies) delivered in Lilavati hospital were included. History and examination were done. We recorded the following: Maternal age, gestational age, PIH, HTN, GDM, and mode of delivery. All the parameters were compared with the coiling index, obtained after the delivery of the baby.

The cord was clamped at 5 cm from the fetal insertion. The cord was not milked as it might affect the UCI. The placenta separated spontaneously. The total number of coils was counted from the fetal end toward the placental end. The length of the umbilical cord was measured after the placenta was delivered and 5 cm was added to the length of the measured cord. The total number of coils was divided by the total length of the cord in centimeters. This gave the value of the umbilical coiling index.

Umbilical coiling in less than the tenth percentile was hypocoiled cord, normocoiled cords are those above the tenth and below the 90th percentile, and above the 90th percentile were hypercoiled cords.⁸

The various parameters recorded were blood pressure (BP), blood sugar, gestational age, maternal age, and mode of delivery. All these parameters were correlated with the umbilical coiling index.

Statistical Methods

Statistical Package for Social Sciences (SPSS), version 15.0, was used to analyze the data. Chi-square tests were applied to compare percentages for categorical data; $p \leq 0.05$ was taken as the level of significance.

RESULTS

The females enrolled in the study were categorized according to their age as (A) less than or equal to 35 years and (B) above 35 years. A total of 111 females belonged to the first category and 30 to the second (Table 1). On applying Chi-square test, the value was found to be 0.38, showing no significant association between coiling index and maternal age in our study.

Of the 141 deliveries conducted, 107 females were delivered by a lower segment cesarean section (LSCS) and 34 females had a

Table 1: Association of maternal age with umbilical coiling index

Cord coiling	≤35 years	>35 years	Total
Hypocoiled	9 (8.1%)	5 (16.7%)	14 (9.9%)
Normocoiled	90 (81.1%)	22 (73.3%)	112 (79.4%)
Hypercoiled	12 (10.8%)	3 (10.0%)	15 (10.6%)
Total	111 (100.0%)	30 (100.0%)	141 (100.0%)

Table 2: Association of delivery with umbilical coiling index

Cord coiling	LSCS	Vaginal delivery	Total
Hypocoiled	11 (10.3%)	3 (8.8%)	14 (9.9%)
Normocoiled	84 (78.5%)	28 (82.4%)	112 (79.4%)
Hypercoiled	12 (11.2%)	3 (8.8%)	15 (10.6%)
Total	107 (100.0%)	34 (100.0%)	141 (100.0%)

Table 3: Association of gestational age with umbilical coiling index

Cord coiling	Term delivery (>37 weeks POG)	Preterm delivery (≤37 weeks POG)	Total
Hypocoiled	9 (9.3%)	5 (11.4%)	14 (9.9%)
Normocoiled	75 (77.3%)	37 (84.1%)	112 (79.4%)
Hypercoiled	13 (13.4%)	2 (4.5%)	15 (10.6%)
Total	97 (100.0%)	44 (100.0%)	141 (100.0%)

POG, period of gestation

Table 4: Association of PIH in mother with umbilical coiling index

Cord coiling	PIH present	PIH absent	Total
Hypocoiled	4 (20.0%)	10 (8.3%)	14 (9.9%)
Normocoiled	12 (60.0%)	100 (82.6%)	112 (79.4%)
Hypercoiled	4 (20.0%)	11 (9.1%)	15 (10.6%)
Total	20 (100.0%)	121 (100.0%)	141 (100.0%)

vaginal delivery (Table 2). Of the 107 LSCS, 11 (10.3%) had hypocoiling, 84 (78.5%) had normocoiling, and 12 (11.2%) had hypercoiling. Of the 34 vaginal deliveries, 3 (8.8%) had hypocoiling, 28 (82.4%) had normocoiling, and 3 (8.8%) had hypercoiling. On applying Chi-square test, p -value was found to be 0.88, showing no significant association between coiling index and mode of delivery in our study.

Of the 141 deliveries, 97 females had term delivery (delivery after 37 weeks period of gestation) and 44 had preterm delivery (Table 3); the p -value was found to be 0.28, showing no significant association between abnormal coiling index and gestational age in our study.

Of the 141 deliveries, 20 females had PIH while 121 females did not have PIH (Table 4); the p -value was found to be 0.067, showing no significant association between abnormal coiling index and PIH in mothers in our study. Chronic hypertension was present in 4 females out of 141 females enrolled; the p -value was found to be 0.58, showing no significant association between abnormal coiling index and chronic HTN in mothers in our study.

Gestational diabetes mellitus was seen in 11 out of the 141 females enrolled in the study (Table 5); the p -value was found to be 0.17, showing no significant association between abnormal coiling index and GDM in mothers in our study.

DISCUSSION

An important risk factor affecting pregnancy from conception to delivery is maternal age. As stated by the International Federation

Table 5: Association of GDM in mother with umbilical coiling index

Cord coiling	GDM present	GDM absent	Total
Hypocoiled	1 (9.1%)	13 (10.0%)	14 (9.9%)
Normocoiled	7 (63.6%)	105 (80.8%)	112 (79.4%)
Hypercoiled	3 (27.3%)	12 (9.2%)	15 (10.6%)
Total	11 (100.0%)	130 (100.0%)	141 (100.0%)

of Gynecology and Obstetrics (FIGO), an elderly primigravida is defined as a female with the age of 35 years or greater at the time of first pregnancy. Such a pregnancy is a high-risk pregnancy and may have important risks for both mother and the baby.^{9–11} Chitra T et al.⁸ found an association between elderly gravida (>35 years) and abnormal cord coiling. However, our study did not find any significant association between maternal age and abnormal cord coiling.

Rana et al.¹² found that hypercoiling was responsible for preterm labor. However, our work did not demonstrate any significant association between the period of gestation and abnormal umbilical cord coiling.

Hypertension is diagnosed when blood pressure (BP) is greater than or equal to 140/90 mm Hg. Gestational hypertension is defined as raised BP readings occurring for the first time after 20 weeks of pregnancy in the absence of proteinuria. Blood pressure greater than or equal to 140/90 mm Hg prior to pregnancy, or before the 20th week of gestation is HTN. Hypertension and proteinuria of above or equal to 300 mg/24 hours after 20 weeks gestation, with or without indication of end-organ damage is preeclampsia/PIH. Eclampsia is preeclampsia with seizures; affects 0.1% of all pregnancies.¹³

Studies done by Kumar S and Chetty S;¹⁴ Tripathy S;¹⁵ Said AM and Mustafa SJ;¹⁶ Chitra T et al.,⁸ and Gupta et al.¹⁷ demonstrate an association between PIH and abnormal cord coiling, which is not seen in our study.

Our study did not show any significant association between HTN in mothers and abnormal coiling index.

Gestational diabetes is carbohydrate intolerance of variable severity with onset or recognized first time during pregnancy after 20-week period of gestation.¹⁸

Our study did not show any significant association between GDM and umbilical cord coiling. However, studies done by Kumar S and Chetty S,¹⁴ and Chitra T et al.⁸ showed a significant association between the same.

Delivery of a baby after 37 completed weeks and before 42 weeks without any instrumentation with or without episiotomy is termed as full-term normal delivery. Delivery of a baby vaginally using an instrument for assistance which includes forceps or vacuum-assisted delivery is termed instrumental delivery. A caesarean section includes emergency as well as elective LSCSs done for any maternal or fetal indication.

The aim of our study was to determine any association between mode of delivery and abnormal cord coiling. However, our study did not show any significant association for the same, which is the same as the results obtained by Kumar S and Chetty S.¹⁴ On the contrary, a study done by Chholak D et al.¹⁹ concludes that hypocoiling is associated with higher rates of lower segment cesarean section.

CONCLUSION

Abnormal coiling index is linked with poor outcomes such as a higher rate of delivery by cesarean section, admission of the baby

to NICU, birth weight being on the lower side, IUGR, meconium staining of liquor, low appearance, pulse, grimace, activity, and respiration (APGAR) score, PIH in mother, GDM in mother, and IUFD.

In this study, however, it is seen that abnormal coiling is not related to a higher rate of caesarean delivery, GDM in the mother, PIH in the mother, chronic HTN in the mother, and gestational age at delivery.

The antenatal measurement of UCI could be developed as a promising noninvasive tool to assess fetal well-being. Increased surveillance during pregnancy will give a better perinatal outcome. Antenatal as well as postnatal assessment of the coiling index should be inculcated in clinical practice.

ETHICAL APPROVAL

Prior approval from the Research Advisory Committee and Institutional Ethics Committee at Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India was taken for the study.

REFERENCES

- Spurway J, Logan P, Pak S. The development, structure and blood flow within the umbilical cord with particular reference to the venous system. *Australas J Ultrasound Med* 2012;15(3):97–102. DOI: 10.1002/j.2205-0140.2012.tb00013.x.
- Ma'ayeh M, McClennen E, Chamchad D, et al. Hypercoiling of the umbilical cord in uncomplicated singleton pregnancies. *J Perinatal Med* 2018;46(6):593–598. DOI: 10.1515/jpm-2017-0034.
- Cochard LR. *Netter's atlas of human embryology: Updated edition*. Elsevier Health Sciences; 2012.
- Di Naro E, Ghezzi F, Raio L, et al. Umbilical cord morphology and pregnancy outcome. *Eur J Obstet Gynecol Reprod Biol* 2001;96(2):150–157. DOI: 10.1016/s0301-2115(00)00470-x.
- Predanic M. Sonographic assessment of the umbilical cord. *Ultrasound Rev Obstet Gynecol* 2005;5(2):105–110. DOI: 10.3109/14722240500190616.
- Diwakar RK, Naik MM, Jindal MM. Umbilical cord coiling: Case report and review of literature. *BJR Case Rep* 2017;39(1):20150152. DOI: 10.1259/bjrcr.20150152.
- Machin GA, Ackerman J, Gilbert-Barness E. Abnormal umbilical cord coiling is associated with adverse perinatal outcomes. *Pediatr Developmental Pathol* 2000;3(5):462–471. DOI: 10.1007/s100240010103.
- Chitra T, Sushanth YS, Raghavan S. Umbilical coiling index as a marker of perinatal outcome: An analytical study. *Obstet Gynecol Int* 2012;2012:213689. DOI: 10.1155/2012/213689.
- Fall CH, Sachdev HS, Osmond C, et al. Association between maternal age at childbirth and child and adult outcomes in the offspring: A prospective study in five low-income and middle-income countries (COHORTS collaboration). *Lancet Global Health* 2015;3(7):e366–e377. DOI: 10.1016/S2214-109X(15)00038-8.
- Pawde AA, Kulkarni MP, Unni J. Pregnancy in women aged 35 years and above: A prospective observational study. *J Obstet Gynecol India* 2015;65(2):93–96. DOI: 10.1007/s13224-014-0616-2.
- Salihu HM, Shumpert MN, Slay M, et al. Childbearing beyond maternal age 50 and fetal outcomes in the United States. *Obstet Gynecol* 2003;102(5 Pt 1):1006–1014. DOI: 10.1016/s0029-7844(03)00739-7.
- Rana J, Ebert GA, Kappy KA. Adverse perinatal outcome in patients with an abnormal umbilical coiling index. *Obstet Gynecol* 1995;85(4):573–577.
- Kattah AG, Garovic VD. The management of hypertension in pregnancy. *Adv Chronic Kidney Dis* 2013;20(3):229–239. DOI: 10.1053/j.ackd.2013.01.014.
- Kumar S, Chetty S. Umbilical coiling index as a marker of perinatal outcome: An analytical study at Navodaya Medical College, Raichur. *Indian J Child Health* 2017;4(1):18–21. DOI: 10.32677/IJCH.2017.v04.i01.006.

15. Tripathy S. Umbilical coil indexing and its relationship with perinatal outcomes. *Indian J Neonatal Med Res* 2014;2(2):1–4. DOI: IJNMR/2014/10881.2012.
16. Said AM, Mustafa SJ. Association of umbilical coiling index in normal and complicated pregnancies. *Diyala J Med* 2013;5(1):15–22.
17. Gupta S, Faridi MMA, Krishnan J. Umbilical coiling index. *J Obstet Gynecol India* 2006;56(4):315–319.
18. Goyal A, Gupta Y, Singla R, et al. American Diabetes Association “Standards of medical care—2020 for gestational diabetes mellitus”: A critical appraisal. *Diabetes Ther* 2020;11(8):1639–1644. DOI: 10.1007/s13300-020-00865-3.
19. Chholak D, Gupta P, Khajotia S. Study to evaluate association of umbilical coiling index and perinatal outcome. *Int J Reprod Contracept Obstet Gynecol* 2017;6(2):408–412. DOI: <https://doi.org/10.18203/2320-1770.ijrcog20170025>.