

Association of Umbilical Cord Coiling and Medical Disorders of Pregnancy: a Cross-Sectional Study

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ABSTRACT

Introduction: The coiling of the umbilical vessels develops by about 28 days post-conception and is present in about 95% of fetuses by around nine weeks of conception. Umbilical coiling (UC) is associated with many maternal and fetal outcomes. The present study attempts to assess any associations between medical disorders of pregnancy with umbilical cord coiling.

Methodology: This cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Gandhi Medical College & Sultania Zanana Hospital, Bhopal, India, from January to December 2020. A total of 300 obstetric mothers were included in the study. Coiling of the umbilical cord numbers and pattern and umbilical coiling index was assessed at the time of delivery. Medical disorders such as diabetes mellitus, hypertension and thyroid disorders during pregnancy were evaluated at the time of delivery. Data was entered and analysed with Epi info software.

Results: Gestational diabetes mellitus was seen in hyper-coiled and normocoiled, but not also in hypocoiled UC. Hypothyroidism with GDM was seen only in hypocoiled UC. A significant association was seen with selected endocrinal medical problems with umbilical cord coiling (P value <0.05). The most common blood pressure-related disorder identified in the present study is eclampsia (66.66%). Gestational hypertension was seen only in hypocoiled UC coiling.

Conclusion: The most common endocrine disorder associated with umbilical cord coiling was gestational diabetes in hyper coiled and normocoiled UC. Hypocoiling and normocoiling have been found in medical disorders of pregnancy. Multicentric studies are required to identify the relationship between endocrine and blood pressure-related disorders and umbilical coiling.

Keywords: umbilical coiling, gestational diabetes, eclampsia, hypothyroidism.

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INTRODUCTION

The umbilical cord is vital for foetal development, well-being, and survival, but is vulnerable to kinking, compressions, traction and torsions which may affect the perinatal outcome (1). The normal umbilical cord extends from the placenta to the fetal umbilicus, twisting (coiling) as it traverses the distance between these two points (2). The most distinctive feature of the umbilical cord is the helical pattern of its vessels. Speaking in technical terms, the vessels of the cord are wound as cylindrical helices, rather than spirals, but both terms can be used interchangeably to avoid confusion (3). The coiling is caused by muscular fibres in the walls of arteries (4). The coiling of the umbilical vessels develops by about 28 days post conception and is present in about 95% of foetuses by around nine weeks of conception. The helices of the umbilical cord are visible on ultrasonography as early as during the first trimester of pregnancy (5). Umbilical coiling index (UCI) by definition is the total number of coils of the cord divided by the total length of the cord centimetres (6). Further, UCI has been grouped as follows: <10th percentile – hypo-coiled; 10th–90th percentile – normocoiled and >90th percentile – hypercoiled (6). Studies have found a relationship between certain medical disorders of pregnancy and UCI. A previous study has identified that neonates of mothers with gestational diabetes are therefore more likely to have hypercoiled or non-coiled umbilical blood vessels (7). The present study attempts to assess any association between medical disorders of pregnancy with umbilical cord coiling. □

METHODOLOGY

Study design

The present study was a cross-sectional study.

Study site

The present study was conducted in the Department of Obstetrics and Gynaecology, Gandhi Medical College & Sultania Zanana Hospital, Bhopal, India.

Study population

The study population comprised pregnant women who delivered in our hospital at their term. Those who had their umbilical cord milking

done were excluded from the study. The following inclusion criteria were used: pregnant women with a term singleton gestation, irrespective of the mode of delivery (vaginal and lower segment caesarean section) and parity. The exclusion criteria comprised multiple pregnancies, congenital anomalies, placental anomalies and cord prolapse.

Study duration

The present study was conducted over one year from January to December 2020.

Sample size calculation

Using OpenEpi open source software and assuming the prevalence of umbilical cord coiling as 12.55% (7.5%-16%) for hypo coiling and (6.7%-20%) for hyper coiling, based on a previous study by Steinl GK et al (8), the sample size was calculated as 292, which was rounded off to 300.

Study methodology

After the delivery of the baby, the umbilical cord was secured at the foetal end and cut with scissors right after delivery. The placenta was permitted to separate on its own. The chord was severed 5 cm from the point of foetal implantation at the foetal end. The entire umbilical cord, including the placental end and the baby's umbilical stump, was measured at 5 cm. The total length of the cord was measured by adding the length of the placental end of the cord plus the length of the umbilical stump on the baby. The number of complete coils or spirals was counted from the neonatal end to the placental end of the cord. The coils were referred to as sinistral (left) and dextral (right) based on the direction of the coils. The UCI was calculated by dividing the number of vascular coils in a cord divided by the length of the cord in centimetres.

Data analysis

The outcome was appropriately coded, then data was collected and compiled using Epi info software and further tabulated and presented in the form of percentages and proportions. The UCI and other parameters such as the length of the cord and direction of coiling were assessed. The data was analysed. Appropriate statistical tests (Chi-square test and Fischer exact test) were applied. A p-value of < 0.05 was considered to be significant. □

RESULTS

Study participants had a mean (SD) age of 25 (± 4.1) years. The minimum and maximum age group was 18 to 37 years. The mean (SD) gestational age of study participants was 38 (± 2) (range 36 to 40 weeks). Among all study participants, 182 (60.7%) were primigravida and 118 (39.3%) multigravida women. Among the deliveries, the majority had normal vaginal delivery 186 (62%) and 114 (38%) underwent lower segment caesarean section.

S. No.	Age group (years)	N (%)
1	18-22	102 (34%)
2	23-27	135 (45.0%)
3	28-32	56 (18.7%)
4	33-37	7 (2.3%)
5	Total	300 (100%)

TABLE 1. Age-wise distribution of study participants (n=300)

TABLE 2. Age wise distribution of study participants and umbilical coiling (n=300)

S. No.	Age group (years)	Umbilical cord coiling			P value
		Hypocoiled	Normocoiled	Hypercoiled	
1	18-22	35 (34.0%)	41 (32.0%)	26 (37.7%)	0.850
2	23-27	45 (43.7%)	58 (45.3%)	32 (46.4%)	
3	28-32	20 (19.4%)	27 (21.1%)	9 (13.0%)	
4	33-37	3 (2.9%)	2 (1.6%)	2 (2.9%)	
5	Total	103 (100%)	128 (100%)	69 (100%)	

A chi-square test was applied, p-value < 0.05 is significant.

The maximum number of study subjects were comprised in the age group 23-27 years (45%) (Table 1). The mean (SD) umbilical cord length was 53.3 (± 6.1) cm, with a maximum length of 67 and a minimum of 51 cm. The number of coils ranged from a minimum of four to a maximum of 34. The mean (SD) number of coils length was 31 (± 11). Among the direction of the twist, the sinistral direction of the twist was more common than the dextral one. The mean (SD) UCI was 0.23 (± 0.07) with a maximum of 0.65 and minimum of 0.05. Out of the 300 participants, 128 (42.7%) were normocoiled, 103 (34.3%) hypocoiled and 69 (23%) hypercoiled.

A total of 15 patients out of all 300 study subjects had blood pressure-related disorders, including gestational hypertension, severe pre-eclampsia and eclampsia; out of these three, eclampsia was the most common blood pressure-related disorder identified by us (66.66% of cases). Gestational hypertension was seen only in hypocoiled UC coiling. The only blood pressure-related disorder seen in hypercoiled UC was eclampsia. A total of 15 patients out of the 300 study subjects had medical problems, including gestational diabetes mellitus (GDM), hypothyroidism and hypothyroidism with GDM; out of these three, GDM was the most common endocrinal medical problem identified by us (46.66%). Gestational diabetes mellitus was not seen in hypocoiled UC coiling. Hypothyroidism with GDM was seen only in hypocoiled UC. There was a significant statistical association of medical problems with umbilical cord coiling as explained by Fisher's exact test. $\square$

DISCUSSION

In the present study, the maximum study subjects were comprised in the age group of

TABLE 3. Association of medical disorders of pregnancy with umbilical coiling (N=15)

S. No.	Medical disorders of pregnancy	Umbilical cord coiling			P value
		Hypocoiled	Normocoiled	Hypercoiled	
1	Gestational hypertension	1 (20%)	0 (0%)	0 (0%)	0.130
2	Severe pre-eclampsia	1 (20%)	3 (60%)	0 (0%)	
3	Eclampsia	3 (60%)	2 (40%)	5 (100%)	
4	Gestational diabetes mellitus (GDM)	0 (0%)	5 (71.42%)	2 (40%)	0.004
5	Hypothyroidism	1 (33.33%)	2 (28.57%)	3 (60%)	0.012
6	Hypothyroidism with GDM	2 (66.66%)	0 (0%)	0 (0%)	0.233

Fischer exact t-test applied, p-value < 0.05 is significant.

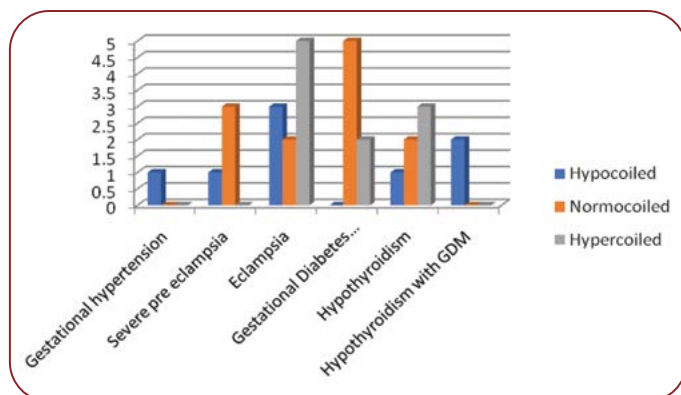


FIGURE 1. Association of selected medical disorders of pregnancy with umbilical coiling (N=15)

23-27 years (45%) and 2.3% in the age group of 33-37 years. The minimum age of all 300 study subjects was 18 years and the maximum age 37 years. Sujata Singh *et al* (9) found that maternal age ranged from 18 to 38 years, with a mean of 25.38 ± 3.90 years. A total of 15 patients out of the 300 participants had high blood pressure, including gestational hypertension, severe pre-eclampsia and eclampsia, out of which eclampsia was the most common blood pressure-related disorder identified in the present study (66.66%). Gestational hypertension was seen only in hypocoiled UC coiling, while eclampsia was the only blood pressure-related disorder seen in hypercoiled UC. Olaya *et al* (10) had concluded that umbilical cord abnormalities were associated with maternal gestational hypertension, with these umbilical cord abnormalities being ultimately associated with fetal and neonatal consequences (10). Pre-eclampsia has been connected to malformed VEGF family placental proteins, which have also been mentioned as crucial for embryo growth and implantation (11).

Although the precise mechanism of coiling is unknown, certain theories have been put forth

concerning umbilical cord coiling. Umbilical cord coiling can be caused by a variety of factors, including foetal movements, embryo torsion, umbilicus vascular growth rates, and the arrangement of muscle fibres on the walls of the umbilical artery (12-14).

As far as endocrinal diseases among the medical disorders of pregnancy are concerned, a total of 15 patients out of all 300 study subjects had medical problems, including GDM, hypothyroidism and hypothyroidism with GDM, out of which GDM was the most common endocrinal disorder identified by us (46.66%). Gestational diabetes mellitus was seen in hypercoiled and normocoiled but not also in hypocoiled UC coiling. Hypothyroidism with GDM was seen only in hypocoiled UC. Najafi *et al* (15) identified a statistically significant association between hypercoiling and GDM. This umbilical cord coiling could be identified in the first trimester during the antenatal period. Continuous monitoring could identify these diseases early, leading to timely intervention. Further studies done prospectively could validate these findings. □

CONCLUSION

Gestational diabetes mellitus and eclampsia were the most commonly seen endocrine disorder associated with umbilical cord coiling. Abnormal umbilical coiling parameters that can be measured have been found to have a strong association with certain medical disorders of Pregnancy. Assessment of these parameters during early pregnancy could be a predictor of these medical disorders of pregnancy. □

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