DOI - 10.21276/obgyn.2023.9.2.7 *ISSN Print – 2454-2334; ISSN Online – 2454-2342*

RESEARCH ARTICLE

Length of the umbilical cord and perinatal outcomes: a study of 500 deliveries

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ABSTRACT

Background: The umbilical cord is the lifeline of the fetus. Though variations in shape and other features of umbilical cord are common, some variations can adversely affect the pregnancy outcomes. **Objective:** The present study was undertaken to find out association between umbilical cord length and perinatal outcome. **Method:** A total of 500 cases were selected randomly from a group of patients who were admitted in the labor room with a period of gestation >34 weeks. The length of umbilical cord was measured after delivery and examination of umbilical cord was done. Fetal parameters recorded and correlated with umbilical cord parameters. **Results:** The mean cord length was 56.93±9.18cm. We found statistically significant association of cord complications with increase in the cord length (i.e., long cords) and cord complications were associated with more incidences of LSCS (nuchal cord 37.07%, true knot 33.33%, and 100% for cord prolapse). Fetal heart rate abnormalities were higher in both long (82.85%) and short cord group (45%) as compared to 15.73% in normal cord length. Perinatal outcome of the babies in terms of birth weight was statistically insignificant (> 0.05), but the APGAR score, NICU, TCU and nursery admissions rate, as well as umbilical cord coiling was directly proportional to the length of the cord. **Conclusion:** Cases with abnormal cord length (short and long cords) had higher incidence of cord complications, increased incidence of operative interference, intrapartum complications, increased fetal heart rate abnormalities, and more chances of birth asphyxia. Thus, this study shows the importance of the knowledge of cord length.

Keywords: Umbilical cord, perinatal outcome, cord length, nuchal cord, fetal heart rate, cord coiling.

Umbilical cord is the life line of placenta attached to the fetus. This consists of 3 blood vessels; two tiny blood-bearing arteries to the placenta and a bigger vein that gives blood back to the fetus [1]. Morphological changes in umbilical cord throughout pregnancy, labor, and delivery due to its vulnerability to malformation, lesion and mechanical and iatrogenic events are together referred to as an umbilical cord, which is thought to lead to fetal damage and death [2].

The human umbilical cord ranges in length from no cord (achordia) to 300 cm, with diameters up to 3 cm [3]. Umbilical cords range up to 380 helicals and are helical. Generally they are 55 cm long, 1-2 cm in diameter and 11 helices in diameter. When measured at different periods in the third trimester, the length of the umbilical cord was not substantially changed. Although the reasons are unknown, most of the cords bend left. About 5% of the cords are shorter than 35 cm and 5% more than 80 cm [4]. The umbilical cords, on the other hand, has an average length of 50–60 cm at term [5].The length of the cord ranges from 30 cm to 100 cm, with less than 30 cm considered short. Long cords have been linked to prolapse, cord looping around the foetal neck, entanglement, distress, knots, and foetal death. Short cords, on the other hand, have been linked to delayed foetal descent, early placental separation, growth limitation, congenital anomalies, foetal distress, and death [6].

The causes of variations in cord length are unclear;

Received: 11th June 2021, **Peer review completed: 30th July 2021**, **Accepted: 10th October 2021**.
Dias Z, Kore S. Length of the umbilical cord and perinatal outcomes: a study of 500 deliveries. The New Indian Journal of OBGYN. 2023; 9(2): 228 - 32.

nevertheless, the length of the cord is considered to represent fetal movement in utero. Variations in protein expression patterns of many genes linked to cell proliferation may also have a role in cord length abnormalities. Because abnormal cord length affects long-term fetal health, it is critical to consider measuring and documenting cord length after birth in situations of placental abruption, oligohydramnios, or breech presentation [6]. Even though pathophysiology of umbilical cord length variations is unknown, the current study was conducted to offer information on umbilical cord length and its association with adverse fetal outcome.

Materials and methods

This is a prospective study conducted in the Department of Obstetrics & Gynaecology, at Tertiary Care Hospital during a period of two years from Nov 2017 to Nov 2019. For the initiation of study Institutional Ethical Committee approval was obtained and written informed consent was taken from all the patients. A total of 500 cases were selected randomly from a group of patients who were admitted in the labor room with a period of gestation >34 weeks. Low risk women delivered either vaginally or abdominally after 34 completed weeks of gestation, primigravidas and multigravidas women and those willing to participate in the study were included. Women delivered before 34 completed weeks of gestation, women with obstetric high risk factor which is likely to alter perinatal outcome, cases with preterm labor, pregnancies complicated by intrauterine fetal death (MSB), malpresentations & multiple gestations, gross congenital malformations of fetus and women undergoing elective CS for other obstetric indications were excluded from the study. Fetal heart rate (FHR) monitoring was done with intermittent auscultation with stethoscope every 30 minutes in first stage of labour and every 10 minutes in second stage of labour during propulsive phase of labour and after every contraction in expulsive phase of second stage of labour. Details of the delivery were noted whether vaginal, instrumental, or cesarean section.

After delivery, the cord was clamped at two places and cut in between. Total cord length was calculated by adding fetal portion length and placental portion length and length measured in centimeters. Umbilical coiling pattern and number of complete coils noted. A special note of the various parameters about the umbilical cord was done regarding the presence of any loop of cord around the neck, trunk, or shoulder, or if the loops were tight or loose, the number of loops, the presence of false or true knots, cord insertion, or any other associated cord abnormalities. The outcomes of abnormally long or short cord were compared with that of normal length of the cord. A data check sheet for each case was maintained till the completion of delivery. Neonatal details after birth included sex of the newborn, weight of the newborn, length of the newborn, and appearance, pulse, grimace, activity, and respiration (Apgar) score at 1 and 5 minutes were noted. Umbilical parameters were correlated with fetal parameters.

Statistical analysis was done using SPSS Version 22. Descriptive analysis consisted of mean with standard deviation (SD) and range for various parameters. Frequencies for categorical data were expressed in percentage. Chi square test was applied between short and long cord groups to find out p-value for significance. A p-value < 0.05 was considered to be statistically significant.

Observations and results

Table 1 shows the clinical characteristics of the pregnancies delivered at greater than 34 weeks' gestation with normal, short and long umbilical cords. There were nomeasurable differences in maternal age, parity or maternal complications such as hypertensive disorders or gestational diabetes among the 3 groups.

Table 1: Clinical characteristics of pregnancies at >34 weeks' gestation

Characteristics	Mean ± SD
Maternal age (years)	25.40±4.93
Body Mass Index (BMI)	21.82±2.42
Gestational age at delivery (weeks)	38.59±1.52
Umbilical cord length (cm)	56.93 ± 9.18
Placental weight (g)	591 ± 113

The cord length varied from 38 to 74 cm. The mean cord length was 56.93 ± 9.18cm. Maximum cases seen were in the group of cord length between 51 and 60 cm (33.2 %) followed by 61 to 70 cm (30.4%) as depicted in figure 1. Normal cord length included all the three groups from 41-70 cm, which counted for 445 (89%) cases as shown in table 2.

Table 2: No. of cases in three main groups of umbilical cord length

Cord length (cm)	Frequency	Percentage
Short cord<40 cm	20	4%
Normal length41-70 cm	445	89%
Long cord>70 cm	35	7%
Total	500	100%

Cases of short umbilical cord had maximum cases of LSCS (80%) than cases with long (22.85%) or normal cord length (16.62%). Normal cord group cases had maximum number of vaginal delivery cases (68.31%) and for long 34.28% and for short cord 20%. Thus the short cord group was associated with significantly higher (p<0.05) incidence of LSCS cases.

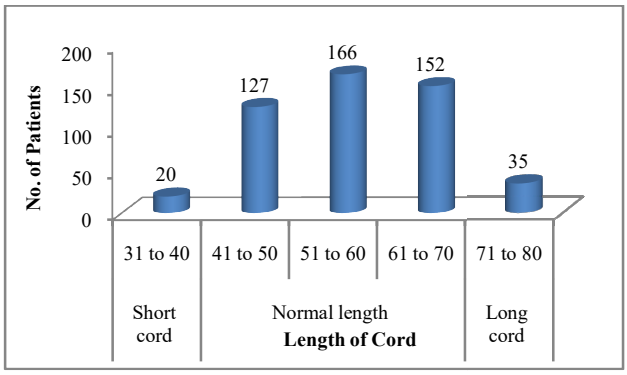

Figure 1: Umbilical cord length in different groups

The incidence of all types of cord complications increases as the cord length increases. Of the total, nuchal coiling was seen in 35.6% (178 cases). In cases with a long cord the incidence of nuchal coiling was 65.71%, while in cases with a short cord it was 5% as shown in table 3.

Table 3: Umbilical cord length and incidence of cord complications

Cord length	No. of cases	Cord complications			Total
		Nuchal cords	True knot	Cord prolapse	
Short cord	20	01 (5%)	0 (0.0%)	0 (0.0%)	01
Normal length	445	154 (34.60%)	2 (0.44%)	1 (0.22%)	157
Long cord	35	23 (65.71%)	1 (2.85%)	1 (2.85%)	25

The incidence of operative interference increases in cases with cord complications. The percentage of total LSCS cases in the present study was 19.6% (98/500 cases). Thus, cord complications were associated with more incidences of LSCS (nuchal cord 37.07%, true knot 33.33%, and 100% for cord prolapse). However, as the number of loops in a nuchal cord increases to more than two loops, the operative interference increases. The significance was tested by using a Chi-square test, and it was found to be statistically significant ($p<0.05$) (table 4).

Table 4: Nuchal cords and mode of delivery

Type of nuchal cord	No. of cases (%)	Mean cord Length (cm)	Mode of delivery	
			Vaginal (%)	LSCS (%)
Single loops	118(23.6%)	67.46 ± 14.55	86 (72.88%)	32 (27.11%)
Double loops	40(8%)	84.52 ± 16.68	19 (47.5%)	21(52.5%)
Triple loops	16 (3.2%)	96.23 ± 15.76	04 (25%)	11 (75%)
Quadriple loops	4(0.8%)	100 ±14.04	02 (50%)	02 (50%)

There was higher incidence of variability in fetal heart rate with extremes of cord length: bradycardia and tachycardia were seen more with short and long cords than with normal cords. It was statistically highly significant ($p<0.001$) using the Chi-square test (table 5).

Table 5: Distribution of cases according to changes in fetal heart rate (FHR)

Length of cord	Normal	Bradycardia	Tachycardia
Short cord	11 (55%)	06 (30%)	3 (15%)
Normal length	375 (84.26%)	36 (8.08%)	34 (7.64%)
Long cord	06 (17.14%)	16 (45.71%)	13 (37.14%)
Total	392	58	50

Perinatal outcome of the babies in terms of birth weight was not statistically significant, (>0.05) but the APGAR score, NICU, TCU and nursery admissions rate, as well as umbilical cord coiling was directly proportional to the length of the cord as shown in table 6. Birth asphyxia was seen maximum (57.14 %) in cases with long cord length while NICU admission was more in short length group (50%) whereas TCU admission was significantly more in long and short cords as compared to normal cord length. The less cord coiling(5 to 10) were seen maximum (90%) in cases with short length while more coiling (16 to 20) was seen maximum (100%) in cases with long cord length and it was statistically highly significant ($p<0.001$).

Table 6: Comparison of cord length with perinatal outcome

Neonatal outcome		Short length	Normal length	Long length	P value
Weight of baby (Kg)		2.56±1.10	3.03±1.24	2.99±1.13	0.281
Apgar score ≤7 at 1 min		07 (35%)	88 (19.77%)	20 (57.14%)	<0.001
Perinatal outcome	NICU	10 (50%)	28 (6.29%)	02 (5.71%)	<0.001
	TCU	06 (30%)	86 (19.32%)	14 (40%)	
	Nursery	04 (20%)	331 (74.38%)	19 (54.28%)	
Number of coils	5 to 10	18 (90%)	80 (17.97%)	00 (0.0%)	<0.001
	11 to 15	02 (10%)	268 (60.22%)	00 (0.0%)	
	16 to 20	00 (0.0%)	97 (21.79%)	35 (100%)	

NICU: Neonatal intensive care unit; TCU: Transitional care unit

Discussion

The length of the umbilical cord varies greatly, ranging from 38 to 74 cm in the current research. The average cord length was 56.93±9.18 cm, which was consistent with earlier research [1,7,8]. The majority of instances (33.2%) were seen in the cord length 51 to 60 cm group, while the majority of patients (89%) had normal cord length, which is comparable to the study done by Sharma et al [2]. There was a significant rise in the incidence of LSCS in the short-cord group (80%) and an increase in the incidence of normal delivery (68.31%) in the normal-cord group, which is equivalent to the research done by Balkawade and Shinde [6]. Whereas short umbilical cords appeared to lead to a rise in cesarean delivery, they may not even be related with poor perinatal outcomes. If the child is to be delivered without problems, the unentangled cord length must stretch from the placental insertion to the vaginal outlet [9, 10]. Circumstances wherein less cord stays in the uterine cavity may have the ability to limit fetal descent

during labor, which may also lead to a rise in the rate of cesarean delivery without fetal asphyxia. These findings appear to support a recent report by Berg and Rayburn [11] that an exceptionally small umbilical cord at birth beyond 34 weeks is not linked with an increased incidence of acid-base imbalance at delivery; even so, they may contradict some previous work concerning the higher risk of short umbilical cord mothers and fetuses [9, 10]. One reason for the disparities might be the study's limited sample size. There were only 20 pregnancies in the current research that were complicated by a short umbilical cord. Another factor might be the research of singleton pregnant women who delivered at 34 weeks of gestation.

Similarly, to earlier [12, 13] research, we found a statistically significant (p - 0.05) relationship between cord problems and cord length growth (i.e., long cords). The prevalence of cord prolapses ranged from 0.2 to 0.6% of all deliveries. Cord prolapses occurred in 0.4% (2 cases/500) in the current study, and it occurred in the long cord length group of >70 cm, which is consistent with the study done by Shafqat et al [1]. The frequency of nuchal cord in the long cord group was 65.71%, which was greater than in previous research [14, 15]. A greater number of nuchal cords were found with cord lengths ranging from 72 to 74 cm. A single loop of nuchal cord was identified in 23.6 percent of instances of the long cord group, which is consistent with previous research [1, 16]. True knots in cord were found in 3 (0.6%) of the instances, which is close to the findings of Shafqat et al [1].

Fetal heart rate abnormalities were higher in both the long and short cord groups; 82.85% and 45%, respectively, compared to 15.73% in the normal cord length group. When comparing the short and long cord groups, the fetal heart rate abnormalities were higher in the long cord group, which is consistent with previous studies [1, 12, 17]. Long cords, on the other hand, were related with more loops around the neck as well as greater fetal heart rate fluctuations. The precise etiology of a slower newborn heart is unknown; it is most likely caused by vagotonia rather than genuine hypoxia [18].

A total of 117 infants were born with birth asphyxia, defined as an APGAR score of less than or equal to 7 at 1 minute. Birth asphyxia was significantly higher in long (57.14%) and short (35%) cords than in normal (19.77%) cord length cords, which is consistent with an Indian research by Balkwade and Shinde [6]. A higher percentage of birth asphyxia in the long-cord group may be attributed to an increased prevalence of cord anomalies (nuchal cord, true knot, and cord prolapse). Excessive traction will produce spasm of the umbilical vessels in the case of a short cord; early separation of the placenta will result in an increase in birth hypoxia. Furthermore, as compared to normal length, cord length extremes are related to poor perinatal outcome. Khadim et al [19] and Yamamoto et al [20] observed the same findings. According to Balkawade and Shinde [6], cord length does not alter depending on the baby's weight, length, or gender. In the current study, cord length had no relationship with the baby's length, weight, or gender.

Conclusion

The results of this study revealed that the length of the umbilical cord varies; nevertheless, the majority of instances had normal cord length. Cases with abnormal cord length (short and long cords) had a greater incidence of cord complications, a higher incidence of surgical interference, intrapartum difficulties, fetal heart rate abnormalities, and a higher risk of delivery hypoxia. As a result, this study demonstrates the significance of knowing the length of a cord. Furthermore, there is a vast area for research in this sector because what we are witnessing is only the tip of the iceberg. The challenge should be taken up, and newer equipment and strategies should be developed to analyze and avoid cord complications. This would decrease the incidences of the perinatal morbidity and mortality due to cord complications in the future and help in realizing the expectations for the delivery of a healthy baby.

Conflict of interest: None. **Disclaimer:** Nil.

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