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ORIGINAL ARTICLE

Study of Length of Umbilical Cord at Term and Its Correlation with Fetal Outcome: A Study of 500 Deliveries

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ABSTRACT

Introduction: Umbilical cord plays an important role in the life of the fetus. Though variations in shape and other features of umbilical cord are common, some variations can adversely affect the pregnancy outcomes.

Aims and objectives: The aim of our study was to study the correlation between the length of the umbilical cord in term gestation evaluated after birth and fetal outcome.

Materials and methods: This study was carried out on 500 patients admitted in our hospital. It was a prospective study. In this study, the length of umbilical cord was measured after delivery in subjects who fulfilled the inclusion criteria. Examination of umbilical cord was done regarding the presence of any loop around neck, trunk, number of loops of cord and positions, presence of true or false knots of cord, or any other cord abnormalities, such as cord varix and cord hematoma. Fetal parameters regarding sex, weight, and length of the newborn and Appearance, Pulse, Grimace, Activity, and Respiration (Apgar) score at 1 and 5 minutes were measured and its correlation with umbilical cord parameters was studied.

Results: In our study, the cord length varied from 16 to 144 cm. The mean cord length was 64.2 cm (±17.26 cm) and mean cord thickness was 1.21 cm (±0.39 cm). Maximum cases seen were in the group of cord length between 50 and 59 cm (27.8%). Lower sixth percentile was considered as short cord and upper sixth percentile was considered as long cord. A positive correlation existed between the cord length and birth weight and placental weight and body length of the newborn. There was no significant difference between sex of the fetuses and the cord length. Abnormal cord length cases (long and short group) have higher incidences of cord complications, and hence there was increased incidence of operative interference in such cases. The cases of long cord group had maximum number of lower segment cesarean section (46.43%). The significance was tested by using a chi-square test, and it was found to be statistically significant ($p < 0.05$). The incidence of birth asphyxia (21%) was significantly more in long and short cords as compared with normal length cords ($p < 0.01$).

Keywords: Fetal outcome, Length, Term delivery, Umbilical cord.

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INTRODUCTION

The umbilical cord is one of the most important parts of the fetoplacental unit. It is vulnerable to kinking, compression, traction, and torsion during delivery or cesarean section and is subjected to wide variations and untoward gestation events. The intrapartum complications have been ascribed to variations in cord length, such as failure of descent of presenting part, prolonged labor, uterine inertia, placental abruption, fetal distress, and fetal death. Often, no explanation for such intrapartum complications is apparent. Obstetricians often remain unaware of many fetal deaths and labor outcome, which eventually may be indisputably pinpointed to cord failure and its anomalies.

Umbilical cord has been found to be a marker of intrauterine complications. Morphological variations in umbilical cord due to its susceptibility to malformations, lesions, mechanical and iatrogenic events throughout pregnancy, labor, and delivery are collectively referred to as umbilical cord accidents, which are said to be the possible causes of fetal injury or death.

Cord length at term has appreciable variation, with extremes ranging from no cord (achordia) to lengths up to 300 cm. At birth, a mature cord measures about 50 to 60 cm in length and 1 to 2 cm in diameter. A cord of length less than 30 cm is a short cord and that longer than 100 cm is a long cord. Umbilical cord abnormalities are numerous, which includes false and true knots, hypo- or hypercoiling, cord stricture, cord varix, cord hematoma, and cyst. Although assessing cord length prenatally is not possible, many other abnormalities can be diagnosed *in utero* by prenatal scans.

Various studies in the literature have concluded that umbilical cord length correlates with maternal age, parity, and its impact on intrapartum complications, mode of delivery, and perinatal and maternal outcome.

Short cords have been associated with fetal growth restriction and congenital malformations. Intrapartum complications, such as delay in second stage of labor, irregular fetal heart rate patterns, placental abruption, rupture of umbilical cord, inversion of uterus, intrapartum distress, and an increased risk of fetal death have been reported with short umbilical cords. Long cords have been associated with cord prolapse, torsion, true knot entanglement around the neck, delivery complications, fetal distress, and fetal anomalies.

This study has been planned with the main aim of studying the correlation of pregnancy outcomes with abnormal length of umbilical cord and cord abnormalities.

MATERIALS AND METHODS

This was a prospective study, carried out in Umaid Hospital, affiliated to Dr. Sampurnanand Medical College, Jodhpur, Rajasthan, India. This study was conducted from March 2014 to November 2014. The study was to assess any association between umbilical cord parameters related to length of the cord and pregnancy outcome. 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 >37 weeks. Both primigravidas and multigravidas were included in the study.

Cases with preterm labor, multifetal gestation, intrauterine dead fetuses, and major congenital anomalies were excluded from the study. The progress of labor was monitored clinically by intermittent auscultation and fetal Doppler, and the progress was plotted on partograph. 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. From the cut end up to fetal umbilicus and placental attachment of umbilical cord, length in centimeters was measured using a flexible measuring tape and added. The umbilical cord diameter was measured with a pair of dividers using a standard tape measure, placed outer to outer so that Wharton's jelly was also included in the measurement. 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.

Placental weight was recorded in grams using an electronic weighing machine after removal of adherent blood clots from the maternal surface of the placenta.

Umbilical parameters were correlated with fetal parameters. History of intrauterine growth restriction (IUGR), intrauterine death (IUD), or fetal distress was noted. All the above observations were tabulated and the resultant findings were analyzed. Conclusions were drawn keeping in view the aims and objectives.

Statistical Analysis

Descriptive analysis consisted of mean with standard deviation (SD) and range for various parameters. Frequencies for categorical data were expressed in percentage. Correlation between continuous variables was analyzed using correlation coefficient. A p-value <0.05 was considered to be statistically significant.

The umbilical cord was categorized into three groups according to the size, viz., short cord ≤38 cm, normal between 39 and 95 cm, and long cord ≥96 cm. Classification of the cords was based on Rayburn et al[1] who took short cord as lower sixth percentile of total 536 cases. Lower sixth percentiles in this study were 38 cm (≤38 cm was considered as short cord) and upper sixth percentile of the series was 96 cm (≥96 cm considered as long cord).

RESULTS

This study has compared the outcome characteristics of the population under three categories of the umbilical cord length. In the present study, out of 500 umbilical cords, 6.2% were short, 88.2% were normal, and 5.65% were long (Table 1 and Graph 1). The cord length varied from 16 to 144 cm. The results of the present study were comparable with the study of Balkawade and Shinde[2] where the lower fifth percentile of their series was found to be 45 cm, which was short cords, and the upper fifth percentile of their series was 95 cm, which was considered as long cords.

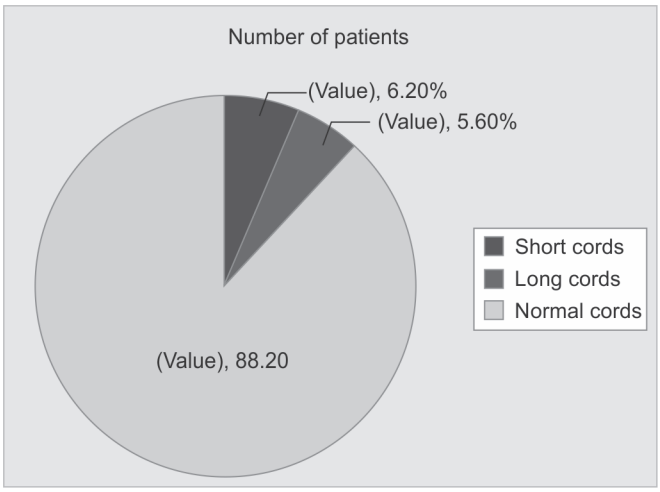
The mean cord length of the present study was 64.2 (SD ± 17.26 cm), which corresponds with that of the study of Balkawade and Shinde[2] where the mean cord length was 63.86 cm (±15.69 cm). The mean umbilical cord length in the present study is also comparable with the mean umbilical cord length of various other authors' studies. The average length of the cord is usually between 50 and 60 cm (Table 2 and Graph 2). This study is comparable with the findings of Mishra et al,[3] where the average cord length was 50–60 cm, of Malpas[4] where cord length varied between 46 and 79 cm, and Agboola[5] who reported the mean cord length to be 61 cm.

Table 1: Distribution of cases according to cord length

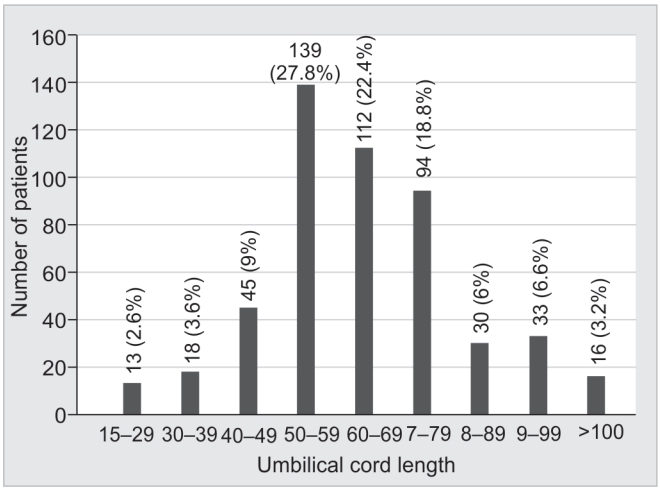
Sl. no.	*Groups*	*No.*	*Percent*	*Cord length (cm)*	*Mean cord length ± SD (cm)*
1	Short cords	31	6.20	Less than 39 cm	29.90 ± 5.19
2	Long cords	28	5.60	More than 95 cm	101.96 ± 9.18
3	Normal cords	441	88.20	39–95 cm	64.21 ± 12.53
4	Total	500	100	–	64.2 ± 17.26

Table 2: Distribution of cases according to frequency of cord length

Sl. no.	*Umbilical cord length*	*n (%)*
1	15–29	13 (2.6)
2	30–39	18 (3.6)
3	40–49	45 (9)
4	50–59	139 (27.8)
5	60–69	112 (22.4)
6	70–79	94 (18.8)
7	80–89	30 (6)
8	90–99	33 (6.6)
9	>100	16 (3.2)



Graph 1: Distribution of cases according to cord length



Graph 2: Distribution of cases according to frequency of cord length

Table 3: Distribution of cases according to maternal age

				Study group		
Age in years	*No. of cases*	*Percent*	*Mean cord length (cm) ± SD*	*Short cord (31), n (%)*	*Long cord (28), n (%)*	*Normal cord (441), n (%)*
<19	26	5.20	59.88 ± 7.86	3 (9.68)	0	23 (5.22)
20–24	298	59.60	64.31 ± 17.22	14 (45.16)	14 (50)	264 (59.86)
25–29	131	26.20	65.52 ± 17.25	2 (22.580)	7 (22.58)	119 (26.98)
30–34	38	7.60	63.15 ± 17.91	4 (12.90)	4 (12.90)	31 (7.030)
>35	7	1.40	56.57 ± 11.73	0	0	7 (1.59)

In the present study, the relationship between umbilical cord and mother's age was not found to be statistically significant ($r = 0.0061$, $p > 0.05$) (Table 3). Walker and Pye,[6] Agboola,[5] Adnima[7] Wu et al,[8] and Yadav et al[9] also did not find any correlation between maternal age and umbilical cord length. Hence, the findings of the present study coincided with other authors' results.

Evaluation of correlation between cord length and parity revealed no statistically significant difference in the groups. This study corresponds with various studies by previous authors, and all of them accomplished the same fact of no relationship of cord length with parity.

In the present study, there was no significant difference between the sex of fetuses and cord length. This result was also comparable with other previous studies in the fact that umbilical cord length was not influenced by weight, length, and sex of the baby, although a few studies have concluded that there was a positive correlation of longer cord lengths with male sex of the fetus.

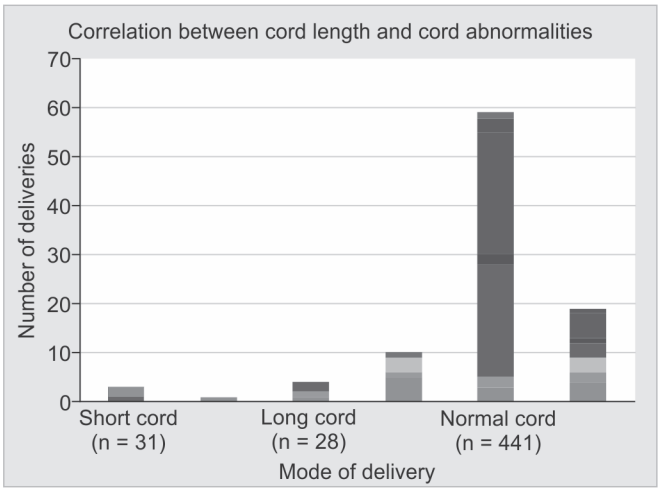
Our study reveals that the mean cord length of babies with fetal distress was more than that in normal deliveries without any fetal distress, which was statistically significant ($p < 0.01$) (Table 4), whereas the mean cord

Table 4: Correlation of cord thickness with cord length for comparison with fetal outcome

Fetal outcome	*n*	*Mean cord thickness ± SD*	*Mean cord length ± SD*
Normal	427	1.21 ± 0.39	63.22 ± 16.34
IUGR	11	1.14 ± 0.46	62.64 ± 18.29
Fetal distress (two stillborn and three IUGR included)	59 + 5	1.25 ± 0.44	70.83 ± 21.49
Stillborn	3	1.03 ± 0.38	69 ± 14.53

Table 5: Umbilical cord length and cord complications (abnormalities) and mode of delivery

		Short cord (n = 31)		*Long cord (n = 28)*		*Normal cord (n = 441)*	
Cord complications	*(n) (%)*	*Vaginal (n) (%)*	*LSCS (n) (%)*	*Vaginal (n) (%)*	*LSCS (n) (%)*	*Vaginal (n) (%)*	*LSCS (n) (%)*
Cord entanglement	3	0	1 (3.23)	1 (3.57)	5 (17.86)	3 (0.68)	4 (0.91)
True knot	6 (1.2)	0	0	1 (3.57)	1 (3.57)	2 (0.45)	2 (0.45)
Cord prolapsed	6 (1.2)	0	0	0	3 (10.71)	0	3 (0.68)
False knot	29 (5.8)	1 (3.23)	0	2 (7.14)	0	23 (5.22)	3 (0.68)
True cyst	2 (0.4)	2 (2.65)	0	0	0	0	0
False cyst	3 (0.6)	0	0	0	0	2 (0.45)	1 (0.23)
Cord varix	31 (6.20)	0	0	0	1 (3.57)	25 (5.67)	5 (1.13)
Cord hematomas	4 (0.8)	0	0	0	0	3 (0.68)	1 (0.23)
Cord stricture	1 (2)	0	0	0	0	1 (0.23)	0



Graph 3: Umbilical cord length and cord complications (abnormalities) and mode of delivery

length of stillborn with that of normal cord (p-value > 0.5) and that of IUGR was not significant (p > 0.9).

About 14 (2.8%) cases of cord entanglement (non-nuchal) have been found in our study, among which one case of short cord, five cases of long cord, and four cases of normal cord have undergone lower segment cesarean section (LSCS) (Table 5 and Graph 3). This study corresponds with the study of Sarwono et al,[10] in which they observed that the risk of cord entanglement increases linearly (parallel) with cord length.

The incidence of true knots in our study was found to be 1.2%: There was no true knot present in the short cord group, 2 cases out of 28 in the long cord group (7.14%), and 4 out of 441 in the normal cord group (0.9%) (Table 6). True knots were associated with higher mean cord length

Table 6: Correlation of cord knots with cord length group

	No. of cases, n (%)	*True knot, n (%)*	*False knot, n (%)*
Short cord	31 (6.2)	0	1 (3.22)
Long cord	28 (5.60)	2 (7.14)	2 (7.14)
Normal cord	441 (88.2)	4 (0.90)	26 (5.98)
Mean cord length	–	95.83 ± 24.99 cm	64.06 ± 16.58 cm
Total cases	500	6 (1.2)	29 (5.8)

of 95.83 ± 24.99 cm than with nontrue knots' mean cord length, that is, 63.81 ± 20.90 cm. The difference was highly significant (p < 0.001). Out of six cases of true knots, three cases underwent cesarean section on account of fetal distress. One neonate was shifted to the neonatal intensive care unit with low Apgar scores and was associated with the largest cord length in this present study, that is, 144 cm. Another was associated with cord prolapse but with good fetal outcome.

This present study was comparable with that of Balkawade and Shinde[2] in which 7.5% of long cord cases had true knots, while only 1.3% in the normal group had true knots.

DISCUSSION

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 outcome of pregnancy. Umbilical cord abnormalities can be numerous, ranging from false knots, which have no clinical significance, to vasa previa, which often leads to fetal deaths.

Abnormal cord lengths, thickness, hypercoiling or hypocoiling, marginal or velamentous insertion of the cord may be associated with IUGR, IUD, or fetal distress. The incidence of birth asphyxia was significantly higher in long and short cord cases compared with those with normal cord length.

The length of umbilical cord is variable, and in the present study it varied from 16 to 144 cm. The mean cord thickness was 64.2 cm (±17.26 cm), and the mean cord thickness was 1.21 ± 0.39 cm. There was no significant correlation between the mean cord length with respect to age (p > 0.05) and parity. There was a positive correlation between cord length and birth weight, placental weight, and body length of the baby. There was no significant difference between the sex of the fetus and the cord length. Maximum cases were seen in the group of cord length 50 to 59 cm (27.8%). Maximum number of the patients had normal cord length. Lower sixth percentile was considered as short cord (38 cm) and upper sixth percentile was

considered as long cord (96 cm). 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.

Cases with long cords had more chances of cesarean section (46.43%) than cases with short (12.90%) or normal (11.33%) cords. Normal cord length had maximum number of vaginal deliveries (88.66%) as compared with long cord group (53.57%) and short cord group (87.10%). The incidence of all types of cord complications increased and the cord length increased, and hence the incidence of operative interference increased. For all the cases of cord prolapse, LSCS was done. About 13.40% of the cases underwent LSCS in the present study.

CONCLUSION

Umbilical cord abnormalities are numerous, ranging from false knots, which have no clinical significance, to vasa previa, which often leads to fetal death. The present study showed that the length of umbilical cord is variable; however, maximum number of cases had normal cord length. Cases which had short and long cords constituted abnormal cord length. These cases had higher incidence of cord complications, increased incidence of operative interference, intrapartum complications, increased fetal heart rate abnormalities, and more chances of birth asphyxia. The cord length may vary according to the weight, length, but had no relationship with the sex of the baby.

CLINICAL SIGNIFICANCE

This study thus throws light on the importance of knowledge of cord and its impact on the life of the newborn. Therefore, there is a huge scope of research regarding this subject. The challenges should be taken up, and newer equipment and strategies should be developed to analyze and avoid cord complications. This would decrease the incidence of perinatal morbidity and mortality due to cord complications in the future and help in realizing the expectations for the delivery of a healthy baby.

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