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Original Research Article

Study of length of umbilical cord and fetal outcome: a study of 1000 deliveries

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ABSTRACT

Background: Human embryo develops inside the body of the mother. One of the important part of the fetoplacental unit is the umbilical cord. The umbilical cord is the lifeline of the fetus. Objective of present study was to investigate the correlation of umbilical cord length with fetal parameters like APGAR score, sex, weight, and length, and its effect on labor.

Methods: This prospective study conducted in the Department of OBG of VIMS, Bellary, from 1st February 2016 to 31st January 2017. The 1000 pregnant women of >37 weeks were studied following delivery for length of umbilical cord, any loop around neck, trunk, shoulder and number of loops of cord; knots of cord etc. Fetal parameters recorded were sex, weight, and length of the newborn and APGAR score at 1 and 5 min.

Results: Cord length varied from 22 to 126 cm. The mean cord length was 66 cm (± 10 cm). Maximum cases have cord length of 61 and 70 cm. Lower 5th percentile and upper 5th percentile considered as short and long cord. Short-cord group was associated with significantly higher ($p < 0.05$) incidence of LSCS cases. The incidence of all types of cord complications increases as the cord length increases ($p < 0.001$). Nuchal cords had higher mean cord length and as the number of loops in a nuchal cord increases to two or more loops, the operative interference and fetal heart abnormalities increases. Fetal heart rate abnormalities and birth asphyxia increase with extremes of cord length ($p < 0.001$).

Conclusions: Short and long cords are associated with increased incidence of cord complications, operative interference, intrapartum complications, increased fetal heart rate abnormalities, and birth asphyxia. But cord length did not vary according to the weight, length, and sex of the baby.

Keywords: Birth asphyxia, Fetal distress, Umbilical cord

INTRODUCTION

Human embryo develops inside the body of the mother. One of the important part of the fetoplacental unit is the umbilical cord. The umbilical cord is the lifeline of the fetus. The baby's life hangs by a cord as said by Ian Donald aptly tells the importance of the umbilical cord.¹ The umbilical cord plays an essential role in intrauterine life. It is the pathway between mother, placenta and fetus during pregnancy and delivery. Complete cord occlusion often leads to fetal demise, while intermittent occlusion

has been associated with intrauterine brain damage. Compression and vasospasm in utero are important factors in fetal distress.

Fetal distress or failure of descent of fetus during labor is common. Long or short umbilical cord complications may explain these enigmas. Delay in second stage of labor, irregular fetal heart rate, placental abruption, rupture of umbilical cord, inversion of uterus, birth asphyxia, and cord herniation have been associated with very short umbilical cords¹. Short umbilical cords may be

associated with adverse perinatal outcomes such as fetal growth restriction, congenital malformations, intra partum distress, and a two fold risk of foetal death.² Long umbilical cords are associated with cord prolapse, torsion, true knot entanglement around the fetus.¹ Nuchal Umbilical Cord can be diagnosed antepartum using ultrasound (USG), but the complications are unpredictable and unpreventable.

This study would provide information about the length of umbilical cord and its association with adverse fetal outcome.

METHODS

This is a prospective study conducted in the Department of OBG, VIMS, Bellary from 1st February 2016 to 31st January 2017 after obtaining approval from Institution’s Ethical Committee and proper counselling and consent of patients. The study included 1,000 cases at random. The present study includes pregnant women who are >37 weeks admitted to labor room.

Exclusion criteria

- Preterm deliveries;
- Multifetal gestation;
- Babies with major congenital anomalies.
- Fetal heart rate was monitored clinically during labor.
- Mode of delivery vaginal or cesarean was noted.

Examination of umbilical cord: done at the time of delivery and after delivery for the following:

- the presence of any loop around neck, trunk, shoulder, etc.
- cord loops tight or loose;
- number of loops of cord and positions;
- knots of cord (true or false); and
- any cord abnormalities (cyst, hematoma, velamentous insertion)

After the delivery of fetus, cord was clamped at two places and cut in between. From the cut end up to fetal umbilicus and placental attachment, umbilical cord length was measured with flexible tape in cms and added. Number of umbilical arteries was not studied. Type of insertion on the placenta was also noted. Placental weight was recorded in grams.

Following parameters were recorded after the delivery.

- Sex of the newborn.
- Weight of the newborn: newborn was weighed after cutting the cord within half an hour of delivery.
- Length of newborn
- Fetal outcome was studied by Apgar score at 1 and 5 min.

RESULTS

The cord length varies between 22 to 126 cm (Table 1).

Table 1: Distribution of cases according to length of umbilical cord.

Cord length cms	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	110-120	121-130
No of cases	20	50	10	268	328	114	106	52	14	28	10

Table 2: Distribution of cases in groups according to length of umbilical cord.

Length of cord	No. of cases	%	Mean umbilical cord length in cm
Long	64	6.4	100±5
Normal	864	86.4	66±10
Short	72	7.2	50±5
Total	1000	100	

The group of cord length between 61 and 70 cm accounts for maximum (32.8%) cases. Upper 5th percentile of the present series, 95cm = long cord and lower 5th percentile is 45 cm =short cord. Remaining are considered as normal. The mean cord length was 66±10 cm (Table 1).

Eccentric type (72.2%), and central type (27%) were the commonest type of cord attachment both of which are

normal cord attachments. Marginal 0.5% and velamentous insertion 0.3% were the abnormal cord attachments.

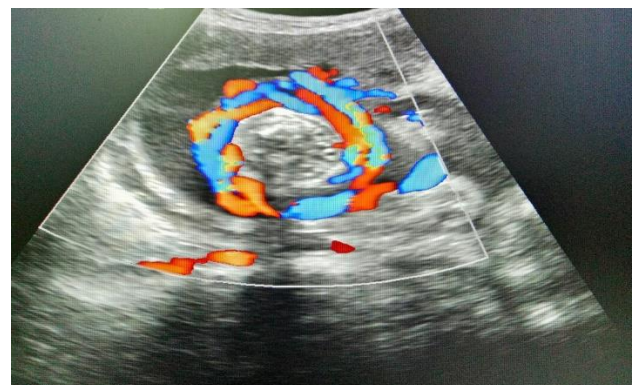


Figure 1: USG Showing 2 loops of cord around neck.

220 cases had cord around the neck (22%). In long cord the incidence of nuchal coiling was 70%, where as in

short cord group it was only 1% and 29% in cases with a normal cord length (Table 3).

Table 3: Umbilical cord length and incidence of cord complications.

Umbilical cord length	Cord complication					Total (n = 341)
	No. of cases	Nuchal cords (n = 220) (%)	True knot (n = 33) (%)	Cord prolapse (n = 10) (%)	Cord hematoma (n = 1)	
Long	64	45 (70%)	7 (10.9%)	4 (6.25%)	0	56 (87.5%)
Normal	864	251 (29%)	26 (3%)	6 (0.69%)	1 (0.11%)	284 (32.87%)
Short	72	1 (1.3%)	0	0	0	1 (1.38%)

Table 4: No. of nuchal cords and mode of delivery.

No. of coils	No. of Cases n=220 (%)	Mean cord length (in cm±SD)	Mode of delivery	
			Vaginal	LSCS
One loop	124	65±15	88	36
Two loops	78	84±15	42	36
Three loops	15	95±15	13	2
Four loops	2	100±15	1	1
Five loops	1	110	0	1

One case had five tight loops of cord around neck. The cord length was 105 cm in this case with central cord insertion, second stage of labor was prolonged, and LSCS had to be done for fetal distress. After delivery, APGAR score of the baby was low, APGAR 2 at 1 minute and 5 at 5 minute. NICU admission of the baby had to be done (Table 4).



Figure 2: Intra operative photo showing 6 tight loops of cord around neck.

Although excluded from current study, we have a case of gravida 4, with all three normal deliveries, was given trial of labor for 2 days in PHC and then referred to us as IUD with non progress of labor, decision for caesarian was taken, Baby has 6 tight loops of cord around neck and cord length was only 95cms. In this case tight loop of cord around neck was the cause for both IUD and arrest of descent (Figure 2).

True knots accounted for 10.9% in long cord group and 3% in normal cord group (Table 3). Ten cases had cord prolapse, four in long cord group and six in normal cord length (Table 3).

The incidence of operative interference increases with extremes of cord length, Short-cord group had maximum cases of LSCS (42.7%), than long (26%) or normal (22%) cord length. Normal-cord group cases had maximum no. of vaginal delivery (78%) more than for long-cord group 74% and for short-cord group 57.3%.

Short-cord group was associated with significantly higher ($p < 0.05$) incidence of LSCS.

The incidence of operative interference increases with cord complications. The percentage of total LSCS in the present study was 23.6% (236 cases). LSCS was done for all the cases of cord prolapse. Cord complications were associated with more incidences of LSCS [nuchal cord 34.54%, true knot 25%, and 100% for cord prolapse and cord hematoma.

As the number of loops in a nuchal cord increases to two or more 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).

Mean cord length in cases with nuchal cords was 77 ± 15 cm and that in cases without nuchal cords was 60 ± 15 cm. Umbilical cords with nuchal cords had higher mean cord length than in cases without nuchal cords.

Significance was tested by using Z test and was found to be statistically significant ($p < 0.001$) (Table 4).

True knots were associated with a higher mean cord length of 77cm. The difference is statistically significant ($p < 0.001$) (Table 3).

There is no significant difference ($p > 0.05$) in the mean cord length with respect to the sex, weight and length of the baby.

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

Length of cord	Normal	Bradycardia	Tachycardia
Short	42 (58.33%)	23 (32%)	7 (9.72%)
Normal	717 (82.98%)	130 (15.06%)	17 (1.96%)
Long	32 (50%)	26 (40.63%)	6 (9.37%)
Total	791	179	30

Fetal heart rate was monitored by intermittent auscultation as continuous fetal monitoring was not possible. Bradycardia was seen in 32% of short cord group and 40% in long cord group. There is higher incidence of variability in fetal heart rate with extremes of cord length: bradycardia and tachycardia are seen more with short and long cords than with normal cords. It was statistically significant ($p < 0.001$) using the Chi-square test (Table 5).

Table 6: Distribution of cases according to birth asphyxia.

Length of cord	Birth asphyxia (Number)	%
Short	24	33.3
Normal	172	19.9
Long	38	59.3
Total	234	23.4

Total of 234 babies have birth asphyxia defined by APGAR less than or equal to 6 at 1 minute. The birth asphyxia was significantly more in long (59.3%) and short (33.3%) cords as compared to cords with normal (19.9%) cord length. In comparison to cords with normal length, short cords and long cords were associated more commonly with birth asphyxia. Birth asphyxia was seen maximum (59.3%) in cases with long cord length. The difference was measured by using Chi-square test. It was statistically significant ($p < 0.001$) (Table 6).

The total no of perinatal death were 40, 22 Still birth and 18 early neonatal death. Maximum still births 9.37% in long-cord group and maximum early neonatal deaths 6.9% in short-cord group. Still births and early neonatal deaths are more with short- and long-cord groups than those in normal cord groups. It was found that perinatal mortality was more with short and long cords than that in normal ones, and the difference was statistically significant ($p < 0.001$) (Table 7).

Table 7: Distribution of cases according to birth asphyxia.

Length of cord	Still birth	Early neonatal death
Short (72)	4 (5.55%)	5 (6.94%)
Normal (864)	12 (1.38%)	10 (2.74%)
Long (64)	6 (9.37%)	3 (4.68%)
Total (1000)	22 (2.2%)	18 (1.8%)

DISCUSSION

The length of the umbilical cord varies widely. At birth, mature cord is about 50–60 cm in length and 12 mm in diameter. Long cord is defined as > 100 cm and a short cord as < 30 cm. Cord length can vary from no cord upto 300 cms.^{2,3}

In a study by Suzuki S et al the average cord length was 60–70 cm and in Birla et al it was between 45 and 79 cm. In our study average length of cord was between 61 and 70 cms (Table 1).^{4,6}

Eccentric insertion of the cord is the commonest finding. In Balkawade’s series it was seen in 62% and in present study it was seen in 72.2%.⁷

In a study by Balkawade’s et al, Pregnants with term from 38 to 40 weeks of gestation were studied after excluding preterm deliveries, multifetal gestation and babies with major congenital anomalies.⁷ In this study normal cord group includes 45-95 cms and percentage of LSCS in short cord group was (40.7%), long cord group (24.5%) and in normal cord group (23.6%). In present study, also normal-cord group was 45-95 cm and percentage of LSCS in both studies are comparable, and there was increased incidence of LSCS in short (42.7%) and long-cord (26%) groups.

There was no difference in the overall mode of delivery for the cord entangled, or non-entangled, although cord entanglement was more prevalent in spontaneous vertex vaginal deliveries.⁸

In long-cord group, the increased incidence of operative interference may be due to cord abnormalities (cord around neck, cord prolapse and true knot).

The percentage of total LSCS in the present study was 23.6% (236 cases). The cord complications were associated with more incidences of LSCS (true knot 25%, nuchal cord 34.54% and 100% for cord prolapse and cord hematoma).

In a study on minimum cord length to allow spontaneous vaginal delivery by Lamonica et al. it was concluded that the uterine axis and birth canal are not so long as to impede spontaneous vaginal delivery in the presence of a short umbilical cord. Placental location makes no difference unless cord is excessively short.⁹

Incidence of LSCS in short-cord group was significantly increased in our study. Incidence of normal delivery (78%) were maximum in normal-cord group compared with short- and long-cord group in our Study.

As the cord length increases, all types of cord complications increase. Shrestha et al and Balkawade et al have shown statistically significant ($p < 0.001$) association of cord complications with long cords.^{10,7} In present study, in long cord group incidence of nuchal cord and fetal heart rate abnormalities were more (Table 3).

In present study, 210 cases had nuchal cords (i.e., 21 %). The incidence of multiple nuchal cords was slightly more than those given in other study groups.^{11,12} In present study, as the number of loops of cord around neck increased, the mean cord length was found to be more: 65 cm for one loop, 84 cm for two loops and 95 cm for three loops. Longer cords tend to become looped around neck. Nuchal coiling can occur in shorter cords, in which the cord tends to be more tightly wrapped around the infant's neck. This was also shown by Rogers et al, Fahad Algreisi et al and Sultana et al (Table 4).¹¹⁻¹³

The incidence of prolapse of the umbilical cord varies between 0.2 and 0.6% of births. Ibrahim et al.¹⁴ showed that the risk of complications increased linearly with the cord length.¹⁴ In present study, there were ten cases of cord prolapse (1%). The mean cord length in cases with cord prolapsed was 77cm (± 15) which was more than cases without cord prolapse. However, it was statistically insignificant ($p < 0.05$) as the number of cases of cord prolapse were less (Table 3).

In this study babies having birth asphyxia (APGAR <6) were 234 (23.4%). The incidences of birth asphyxia were maximum in long-cord groups (59.3%). In short-cord group, it was 33.3% compared to normal-cord group (19.9%). Higher percentage of birth asphyxia in long-cord group may be additionally due to more incidences of cord abnormalities (nuchal cord, true knot, and cord prolapse) (Table 6).

Atalla et al found no relation between umbilical cord indices and intrapartum FHR decelerations, meconium staining of the amniotic fluid, or mode of delivery.¹⁵ There were more cases of birth asphyxia in short and long cord groups as compared to cords with normal length. Yadav BB et al, Nandini B et al showed that all cord complications showed significantly low Apgar scores at 1min.^{5,6} In present study also, the incidence of fetal heart rate abnormalities was more in short and long cord groups.

Shrestha studied Nuchal cord and perinatal outcome.¹⁰ Neonatal outcome was analyzed by Apgar score at 1 and 5 min and the need for NICU admission. Apgar score <6 at 1 min was present in 24.78 % ($n = 29$) of newborns in study group and 14.68 % ($n = 58$) in control group, which

was statistically significant ($p = 0.01$).¹⁰ This Study also shows increased incidence of birth asphyxia in patients of cord around neck.

Balkawade et al showed that Cord length did not vary according to the weight, length, and sex of the baby.⁷ Present study also cord length has no relation with length, weight and sex of the baby.

This study was done to provide information about the length of umbilical cord and its association with adverse fetal outcome. Short and Long cord accounts for less number of cases. 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. But cord length did not vary according to the weight, length, and sex of the baby.

CONCLUSION

Length of umbilical cord is variable; but, maximum of cases had normal cord length. Cases which had short (<45 cms) and long cords (>95 cms) constituted abnormal cord length. This study shows the importance of the knowledge of cord length.

The abnormal fetal heart rate tracing, or failure of fetal descent during labor is quite common. Obstetrician would be interested in the proper management of such complications. Intense research in this field is necessary, as what we are seeing is just the tip of an iceberg. In the available gadgets, assessing cord length prenatally by USG with Doppler is not possible. Detection of umbilical knots has been reported with USG only in monoamniotic twinst. In the case of a nuchal cord, USG images will demonstrate an umbilical cord loop larger than 360° around the fetal neck. Controversial recommendations exist for follow-up and management of cases of nuchal cord diagnosed at USG. Increased fetal surveillance could be considered after a nuchal cord is detected. Hence the challenge should be taken seriously and newer equipment and strategies should be developed to analyze and avoid cord complications prenatally. This would avoid 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.

Recommendations

Extremes of cord length are associated with poor perinatal outcome. If new gadgets are developed to know cord length and other cord abnormalities prenatally, we can improve the perinatal outcome.

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