Research Article

Umbilical Cord Length and Fetal Outcomes in Singleton Term Pregnancies

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Abstract

***Objective**: To study the relationship between umbilical cord length and fetal outcomes in singleton term pregnancies.*

***Methods**: A prospective observational study was done at the Department of Obstetrics and Gynecology at a tertiary hospital on 500 antenatal patients with a period of gestation >37 weeks of pregnancy and singleton pregnancy from October 2014 to March 2016. The length of the umbilical cord was measured for all fetuses immediately after birth and it was correlated with the fetal outcomes.*

Results: *The mean age of the patients was 27.27+3.81 years and the mean umbilical cord length was 54.25+11.58cm and the mean cord thickness was 1.78+0.19cm. Male fetuses had longer umbilical cords than female fetuses but it wasn't statistically significant (p=0.055). Fetuses with non-reassuring cardiotocography (CTG) had significantly longer umbilical cords than those with reassuring CTG (p<0.001). Interventions (operative vaginal deliveries/emergency LSCS) were required in 172 patients (34.4%). The babies born as a result of caesarean sections had longer umbilical cords than those born after vaginal deliveries but it wasn't statistically significant (p=0.26). Patients who had an emergency caesarean section for non-progress of labor and second stage arrest had a shorter average umbilical cord length (p=0.012). Longer umbilical cords had more number of loops (p<0.001) and cord abnormalities (p=0.002). Fetuses with longer umbilical cords had lower APGAR scores (p=0.014) and significantly more admissions to the nursery and neonatal ICU (p<0.001).*

Conclusion: *Longer umbilical cord length is associated with increased risk of fetal distress, operative vaginal deliveries and emergency LSCS, umbilical cord anomalies and poorer APGAR scores.*

Keywords: *Umbilical cord length; fetal distress; cord abnormalities; term pregnancy; India*

Introduction

The umbilical cord is an essentially important structure for the maintenance of intrauterine life because it is responsible for transporting nutrients and oxygen between the mother's circulatory system and that of the fetus. The relationship between placenta/umbilical cord, fetus and variations in its development have been documented in the cases of Gestational Hypertension and Gestational Diabetes Mellitus. The evaluation of macroscopic umbilical cord alterations can help in evaluating causes of perinatal hypoxia and hence, provide us with a clearer understanding of the pathophysiology of adverse fetal events **(**1**)**.

The umbilical cord length has quite a lot of variation and extremes of length have been reported, ranging from its absence to lengths up to 300cm. The average length of the mature umbilical cord at birth is about 50-60cm and about 37.7 + 7.73 mm in diameter. A long cord has been defined as a length longer

than 100cm and a short cord as a length less than 30cm **(**2–4**)**. The causes for abnormalities in umbilical cord length still need to be elucidated and it is thought that the umbilical cord length is a reflection of the space available for movement in the amniotic cavity and tensile strength applied to the umbilical cord during fetal movement.

There has been recent interest in correlating the length of umbilical cords with neonatal complications and excessive long cords be associated with cord entanglements, cord prolapse, torsion, true knots, emergency deliveries and fetal thrombotic vasculopathy in the placenta, fetal death and increased risk of neurological complications and low IQ values **(**5,6**)**. A short umbilical cord is associated with congenital fetal malformations (sirenomelia, schisis, anencephaly, acardia), oligohydramnios, uterine structural anomalies and maternal alcohol abuse. Short cords end up interfering with the mechanism of labor, increase the risk for placental abruption, the prolonged second stage of labor, fetal distress, increased incidence of instrumental delivery, caesarean sections, retained placenta, umbilical cord rupture, herniation, uterine inversion, and birth asphyxia **(**2,7,8**)**.

It is important to understand the relation between umbilical cord length and feto-maternal outcomes to increase awareness among obstetricians for better outcomes. The purpose of the present study is to evaluate the relationship between the length of the umbilical cord at birth with the maternal, fetal and neonatal outcomes in the Indian population.

Materials and Methods

Study population and sample size

This is a prospective observational study conducted in the Department of Obstetrics and Gynaecology of Batra Hospital and Medical Research Centre, New Delhi, from October 2014 to March 2016. The sample size was calculated based on data reported from previous studies, patient statistics at our hospital and considering the two-sided significance level to be 95% and power of the study to be 80%. The calculated sample size was 450 and we decided to include 500 patients in our study. Antenatal patients admitted to our hospital with a period of gestation >37 weeks with a singleton pregnancy who delivered either vaginally or by lower segment caesarean section (LSCS) and who were willing to participate in the study were included. Antenatal patients with preterm delivery (<37 weeks), multifetal gestation, babies with major congenital anomalies and who were unwilling to give consent, were excluded from the study. The study was approved by the Institute Ethics Committee.

Clinical Protocol

Socio-demographic characteristics of the eligible antenatal patients were documented, proper history taking was done and obstetric examination was done to ascertain the fetal presentation, lie and position just before delivery. Fetal heart rate was monitored clinically during labor and mode of delivery – vaginal or caesarean section was duly noted. The following features of the umbilical cord were examined and documented during delivery: the presence of any loop around the neck, trunk, shoulder, number of loops, cord knots (true or false) and any abnormalities like a cyst, hematoma, or anomalous insertion.

The cord was clamped at two places after the delivery of the fetus and cut in between the two clamps. The umbilical cord length was measured from the cut end to the placental attachment and from the other cut end to the fetal attachment and the two measurements were added to obtain the final umbilical cord length. The measurement was done with flexible tape in centimeters. The cord thickness was diameter (in centimeters) across the cut end of the cord and the number of vessels was observed.

The placenta was examined under running water to remove blood clots and placental weight was recorded in grams and the type of insertion of the placenta was also noted. The following parameters were recorded for the newborn: sex, weight (weighed after cutting the cord within 30 minutes of delivery), APGAR score at 1 and 5 minutes and need for neonatal intensive care (if admitted to Neonatal ICU).

Statistical Analysis

Data of continuous variables were presented as mean ± standard deviation and data of categorical variables were presented as a frequency or percentage analysis. Student's t-test or Mann Whitney U test (if data was not normally distributed) was used to compare continuous data. The Chi-Square test or Fisher's Exact test was used to compare categorical data. Adjusted Odds Ratio (OR) and 95% confidence intervals (95% CI) have been reported. A p-value <0.05 was considered statistically significant. All statistical calculations have been performed on Statistical Package for the Social Sciences (SPSS) Version 20.0 (IBM, Chicago, IL, USA).

Results

A total of 520 patients were enrolled in the study and out of which 20 were excluded – 7 were preterm deliveries and 13 patients had babies with congenital malformations. The mean age of the patients in our study was 27.27+3.81 years and the majority of them were between 21 and 30 years of age (380/500, 76%). All the patients were between 37 and 41 weeks period of gestation and the mean gestational age

was 38.32+0.92 weeks. The mean umbilical cord length was 54.25+11.58cm (24.5cm-100cm) and the mean thickness was 1.78+0.19cm (1.2cm-2.3cm). The mean weight of the babies was 2.86+0.38kg (1.84kg-4.25kg) and the mean placental weight was 524.76+90.31 grams.

Table 1: Baseline characteristics and umbilical cord length

Parameter	**n (%)**	**Cord Length (cm) Mean ± SD**	**p-value**	**Chi-square**
Mode of Delivery			0.26	-
Normal Vaginal Delivery	284 (56.8)	53.56±9.91		
Operative Vaginal Delivery	55 (11)	53.45±9.06		
Elective Caesarean Section	44 (8.8)	59.16±15.47		
Emergency Caesarean Section	117 (23.4)	54.44±14.17		
Sex of the Baby			0.055	-
Male	263 (52.6)	55.19±12.22		
Female	237 (47.4)	53.21±10.76		
CTG (during labor)			<0.001	-
Reassuring	446 (89.2)	53.63±10.62		
Non-reassuring	54 (10.8)	59.36±16.94		
No. of Loops of Umbilical Cord			<0.001	54.36
0	385 (77)	51.93±9.16		
1	92 (18.4)	60.67±14.67		
2	22 (4.4)	66.58±15.46		
3	1 (0.2)	85.00		
Cord Abnormalities			0.002	19.13
No abnormality	485 (97)	53.83±10.95		
1 true knot	5 (1.0)	92.00±13.09		
1 false knot	6 (1.2)	58.66±10.67		
2 false knots	2 (0.4)	45.00±9.89		
3 false knots	1 (0.2)	63.00		
Single Umbilical Artery	1 (0.2)	50.50		
APGAR Score at Birth (1 min)			0.014	-
5	5 (1.0)	59.52±8.09		
6	35 (7.0)	59.76±17.53		
7	274 (54.8)	53.05±9.84		
8	180 (36.0)	54.85±12.38		
9	6 (1.2)	54.33±12.09		
Baby Status			<0.001	-
Mother-side	453 (90.6)	53.51±10.77		
Nursery	40 (8.0)	60.81±15.98		
Neonatal ICU	7 (1.4)	64.81±17.35		

Table 1 summarizes the parameters with umbilical cord length. Male fetuses had longer umbilical cords than female fetuses but it wasn't statistically significant (p=0.055). Fetuses with non-reassuring CTG

had significantly longer umbilical cords than those with reassuring CTG ($p<0.001$). Interventions (operative vaginal deliveries/emergency LSCS) were required in 172 patients (34.4%). The most common causes for intervention were – 52 patients (10.4%) had cephalo-pelvic disproportion/outlet contraction, 48 patients (9.6%) had acute fetal distress and 29 patients (5.8%) required interventions due to exhaustion/poor bearing down efforts. Although, the babies born as a result of caesarean sections had longer umbilical cords than those born after vaginal deliveries it wasn't statistically significant ($p=0.26$). Patients who had an emergency caesarean section for non-progress of labor and second stage arrest had a shorter average umbilical cord length ($p=0.012$).

Longer umbilical cords significantly had more number of loops ($p<0.001$) and cord abnormalities ($p=0.002$). Fetuses with longer umbilical cords had lower APGAR scores (1 minute) at birth ($p=0.014$) and significantly more admissions to the nursery and neonatal ICU ($p<0.001$).

Discussion

The umbilical cord delivers oxygen-rich blood through the umbilical vein to the fetus, provides nutrients to the fetus and transfers waste metabolic products and deoxygenated blood from the fetal to the maternal circulation. The pathogenesis of variations in umbilical cord length and poor feto-maternal outcomes due to cord complications still haven't been studied adequately. Our study tried to evaluate the same and we found that longer umbilical cords were related to poor APGAR scores at birth and increased incidence of admissions to neonatal ICU.

The mean umbilical cord length in our study was 54.25cm and ranged from 24.5cm to 100cm and this is slightly lower as compared to the data reported in some of the published studies. Njoku et al. reported a mean umbilical cord length of 61.07cm in fetuses from Nigeria, Bose et al. reported a mean cord length of 62.54cm in fetuses born between 37 and 40 weeks of gestation in Bangladesh and Balkawade and Shinde et al. found mean cord length of 63.86cm in India **(**9–11**)**. The variations in umbilical cord length can be due to genetic, environmental and various socio-demographic factors. It has been hypothesized that the umbilical cord gets elongated due to the stretching encountered during fetal movements which in-turn depends on the space available to the fetus and liquor around the fetus **(**12,13**)**.

The mean umbilical cord thickness in our study was 17.8mm and it was by the values reported by Adesina et al. from Western Nigeria **(**13**)**. Njoku et al. and Krakowiak et al. had reported that male fetuses have longer umbilical cords as compared to female fetuses but in our study, the difference in the cord lengths between male and female fetuses wasn't statistically significant **(**2,9**)**.

The length of the umbilical cord in our study did not have any effect on the mode of delivery and the incidence of LSCS in our study was 32.2% and it was higher than that reported by Balkawade and Shinde et al. **(**11**)**. Longer umbilical cords were found to have more loops of cord in our study and similar findings have been recorded by Linde et al. in the population-based study from Norway **(**14**)**. The incidence of a knot in our study was 2.8% - true knot (1%) and the incidence of false knots was 1.8% and longer cords were associated with more cord abnormalities. Linde et al. had reported an incidence of 1.32% of a knot in their study population and the strongest risk factor for knot was a long umbilical cord knot **(**14**)**. Adesina et al. had reported a 14.5% incidence of knots in their study and a positive correlation with cord length. The incidence of knots is higher in their study than in other studies due to different study populations and ethnic variations **(**13**)**.

Our study showed that fetuses with longer umbilical cords had increased incidence of non-reassuring CTG, had poorer 1 minute APGAR scores at birth and increased incidence of nursery admissions and more frequently needed intensive care management. There have been conflicting reports on the correlation between umbilical cord lengths and adverse neonatal outcomes. Studies done by Wu et al. in the Taiwanese population and Njoku et al. have reported no significant association between umbilical cord length and antepartum and intrapartum fetal well-being **(**9,15**)**. On the contrary, Agwu et al., Dolgun et al. and Yadav et al. have reported increased chances of fetal distress with longer length of umbilical cords and Balkawade et al. reported poorer neonatal outcomes with extremes of cord length **(**11,16–18**)**.

The main strength of our study, apart from reflecting upon a very clinical and practical topic, is the sample size and the prospective nature of the study. The limitations of our study can be attributed to the inclusion of the only term, singleton low-risk pregnancies and lack of use of Doppler ultrasound in the diagnosis of umbilical cord abnormalities in the intrapartum period. Further studies are needed to analyze the causes of umbilical cord length and morphological variations, to prevent them and prevent adverse fetal outcomes in the future.

Conclusion

Our study concludes that longer umbilical cord length is associated with increased risk of fetal distress, increased risk of operative vaginal delivery and emergency LSCS, increases chances of umbilical cord anomalies and poorer APGAR scores at birth leading to increased nursery admissions and need for intensive care. Therefore, we recommend that appropriate methods need to be developed for the accurate antenatal assessment of umbilical cord length and umbilical cord abnormalities and proper

documentation is required to triage the high-risk antenatal patients and provided them with better obstetric care and improve the fetal outcomes.

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Ethical statement

Written informed consent was taken from all the participants before the study and prior approval was taken from the Institute Ethics Committee.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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