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Study of length of umbilical cord and fetal outcome

Dr. Varsha Dharmendra Kose[1], Dr. Nikita Rajendra Dode[2]

[1]Unit Incharge (Professor), NKP SIMS ,Nagpur, Dept-OBGYN

[2]Junior Resident (obgy), NKP SIMS,Nagpur, Dept-OBGYN

Corresponding author

Dr. Varsha Dharmendra Kose

Unit Incharge (Professor) NKP SIMS ,Nagpur Dept-OBGYN

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ABSTRACT

Background: Umbilical cord (UC) length is widely regarded as a critical determinant of fetoplacental well-being and has been strongly associated with adverse perinatal outcomes. Hence; the present study was conducted for assessing correlation of length of umbilical cord and fetal outcome.

Materials & methods: This prospective observational study included 200 term pregnancies (>37 weeks), with systematic intrapartum monitoring and detailed post-delivery assessment of umbilical cord characteristics, placental features, and neonatal outcomes. Data on cord length, cord complications, fetal parameters, and delivery mode were recorded and statistically analyzed using SPSS software.

Results: Umbilical cord length ranged from 25–118 cm, with most cases showing normal length; short and long cords were less common but were associated with a significantly higher incidence of cord-related complications. Increasing cord length correlated with multiple nuchal loops and greater fetal heart rate abnormalities, whereas normal-length cords were predominantly associated with normal intrapartum fetal heart rate patterns.

Conclusion: Normal umbilical cord length was most common and was associated with fewer cord-related complications and more stable fetal heart rate patterns. Deviations in cord length, particularly short and long cords, showed a higher association with nuchal loops, cord complications, and abnormal fetal heart rate changes, potentially influencing perinatal outcomes..

Keywords: *Umbilical cord, Fetal, Outcome*

1. INTRODUCTION

Umbilical cord (UC) length is widely regarded as a critical determinant of fetoplacental well-being and has been strongly associated with adverse perinatal outcomes. Both excessively short and excessively long cords have been linked to an increased risk of stillbirth, spontaneous abortion, neonatal mortality, and long-term neurological sequelae. Neurological injury in this context is largely attributed to chronic or acute hypoxic events and thrombotic phenomena within the fetoplacental circulation, which can culminate in characteristic patterns of brain damage and subsequent neurodevelopmental impairment.1, 2

From a physiological perspective, the fetal cardiovascular system operates at a higher baseline workload than the adult heart, as it is responsible not only for perfusing the fetal organs but also for maintaining continuous circulation through the umbilical cord and placenta to the terminal capillary networks of the chorionic villi. Consequently, any abnormality in umbilical cord length can significantly influence fetoplacental hemodynamics. This concept also provides a plausible explanation for the high intrauterine mortality observed in severe congenital cardiac anomalies, where compromised cardiac output fails to meet the combined circulatory demands of the fetus and placenta.3, 4 To further elucidate this relationship, theoretical models based on physical principles have been developed to describe the effect of umbilical cord length on fetal cardiac output. Using fundamental laws of fluid dynamics, particularly the concept of viscous laminar flow through a cylindrical conduit, these models demonstrate that vascular resistance is directly proportional to the length of the conduit and inversely proportional to its radius, while also being influenced by blood viscosity. Accordingly, an increase in umbilical cord length results in higher resistance to blood flow, thereby imposing an additional load on the fetal heart. These biomechanical insights provide a scientific framework for understanding how deviations in umbilical cord length can disrupt normal fetoplacental circulation and contribute to adverse fetal and neonatal outcomes..

5, 6 Hence; the present study was conducted for assessing correlation of length of umbilical cord and fetal outcome

2. MATERIALS & METHODS

This prospective observational study included a total of 200 randomly selected term pregnancies. Women admitted in active labor with a gestational age of more than 37 weeks were enrolled. Pregnancies complicated by preterm delivery, multifetal gestation, or major congenital anomalies were excluded. Fetal heart rate was monitored clinically throughout labor, and the mode of delivery was documented as vaginal or cesarean. Detailed examination of the umbilical cord was performed during and after delivery to assess the presence and location of cord loops around the neck, trunk, or extremities, the tightness of loops in cesarean deliveries, the number and position of loops, the presence of true or false knots, and any cord abnormalities such as cysts, hematoma, or velamentous insertion. After birth, the cord was clamped, cut, and its total length was measured using a flexible measuring tape by adding the fetal and placental segments. The placental insertion type was noted, adherent clots were removed, and placental weight was recorded. Neonatal parameters including sex, birth weight (measured within 30 minutes of delivery), crown–heel length, and Apgar scores at 1 and 5 minutes were documented to evaluate fetal outcome. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

3. RESULTS

In our study, the cord length varied from 25 to 118 cm. The majority of cases were classified as having a normal umbilical cord length, accounting for 181 out of 200 deliveries, with a mean cord length of 65.7 cm. Short umbilical cords were observed in 9 cases with a mean length of 39.1 cm, while long cords were noted in 10 cases with a mean length of 101.8 cm. The overall mean umbilical cord length in the study population was 52.1 cm, indicating a predominance of normal cord length patterns. Cord complications were proportionally higher in cases with short and long umbilical cords compared to those with normal cord length. Among short cords, more than half of the cases exhibited complications, with cord hematoma being the most frequent, followed by nuchal cords and cord prolapse. In the long cord group, complications were also frequent, with nuchal cords being the most common, followed by true knots and cord prolapse. In contrast, the normal cord group showed a relatively low incidence of complications, with nuchal cords constituting the majority of events. Overall, abnormal umbilical cord lengths—both short and long—were associated with a higher burden of cord-related complications compared to normal cord length. Cases with a single loop had the shortest mean cord length (65.38 cm), while those with two and three loops showed progressively longer cords measuring 90.15 cm and 98.09 cm, respectively. Markedly longer cords were observed in cases with four and five loops, with mean lengths of 101.18 cm and 112.62 cm, indicating a clear association between excessive cord length and the occurrence of multiple nuchal cord loops. Normal fetal heart rate was most frequently observed in cases with a normal-length cord (181 cases), whereas bradycardia and tachycardia were comparatively fewer in this group. Short and long cords demonstrated a relatively higher occurrence of abnormal fetal heart rate patterns, indicating that deviations in cord length may be associated with increased fetal heart rate variability during labor.

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

Length of cord	Number of cases	Mean umbilical cord length (cm)
Short	9	39.1
Normal	181	65.7
Long	10	101.8
Total	200	52.1

Table 2: Umbilical cord length and incidence of cord complications

Umbilical cord length	Number of cases	Nuchal cords	True knots	Cord prolapse	Cord hematoma	Total complications
Short cord	9	1	0	1	3	5 (55.56%)
Normal cord	181	10	3	1	0	14 (7.73%)
Long cord	10	3	1	1	0	5 (50%)

Table 3: Number of Nuchal Cord Loops and Mode of Delivery (Numbers Only)

Number of nuchal cord loops	Mean cord length (cm)
One loop	65.38
Two loops	90.15
Three loops	98.09
Four loops	101.18
Five loops	112.62

Table 4: Distribution of Cases According to Changes in Fetal Heart Rate (FHR)

Length of cord	Normal	Bradycardia	Tachycardia
Short	9	6	3
Normal	181	170	11
Long	10	8	2
Total	200	184	165

4. DISCUSSION

The umbilical cord is a vital component of the fetoplacental unit, serving as the sole conduit for fetal oxygenation and nutrition; complete occlusion can result in fetal death, while intermittent compromise may cause intrauterine hypoxic brain injury and fetal distress. Abnormalities in cord length and structure often underlie otherwise unexplained intrapartum complications, including non-reassuring fetal heart rate patterns and failure of descent during labor. Excessively short cords are associated with placental abruption, intrapartum distress, birth asphyxia, and increased perinatal mortality, whereas excessively long cords predispose to prolapse, torsion, true knots, and entanglement. Although the normal umbilical cord measures approximately 50–60 cm at term, marked deviations in length are clinically significant and correlate with adverse perinatal and neonatal outcomes.[7- 10] Hence; the present study was conducted for assessing correlation of length of umbilical cord and fetal outcome.

Balkawade NU et al conducted a prospective study on 1,000 deliveries to evaluate the relationship between umbilical cord length and fetal parameters, including Apgar scores, neonatal sex, birth weight, crown–heel length, and labor outcomes. Umbilical cords were examined for loops, knots, and structural abnormalities, and fetal outcomes were assessed at 1 and 5 minutes using Apgar scoring. Cord length ranged from 24 to 124 cm, with a mean of 63.86 ± 15.69 cm, and most cases clustered between 51 and 60 cm. Short cords were significantly associated with a higher rate of cesarean delivery, while cord length showed no correlation with neonatal weight, length, or sex. Increasing cord length was linked to a higher frequency of cord-related complications, nuchal cords, fetal heart rate abnormalities, operative intervention, and birth asphyxia, particularly at the extremes of cord length. The authors concluded that although most umbilical cords fall within the normal range, both short and excessively long cords represent abnormal variants associated with adverse intrapartum and perinatal outcomes.[10] Eleje GU et al. reviewed contemporary literature on the sonographic identification of umbilical cord abnormalities, emphasizing recent diagnostic advances. They also reported a case involving a multiparous woman with an uncomplicated antenatal course who underwent an elective cesarean delivery, during which a loose nuchal cord and two true knots were identified in a 65 cm umbilical cord. The neonate had satisfactory Apgar scores and normal birth weight, with an uneventful maternal and neonatal recovery. Although true umbilical knots are uncommon and their coexistence with a nuchal cord is exceedingly rare, recognized risk factors include multiparity and male fetal sex. True knots are clinically important as they are associated with adverse fetal outcomes due to potential compromise of umbilical blood flow.[11] In another previous study conducted by Rayburn WF et al, authors studied umblical cord length 536 term deliveries to test the hypothesis that a short or long umbilical cord is more frequently associated with certain intrapartum complications. The mean umbilical cord length was 55 cm (range, 14 to 129 cm). A short cord was defined as 35 cm or less (lower sixth percentile). Umbilical cord accidents were most frequent in the presence of a long cord (20 of 32 cases, 62%). Inadequate fetal descent was significantly

more common when a long cord or an excessively short cord (25 cm or less, lower first percentile) was found. Fetal heart rate (FHR) abnormalities that primarily reflected cord compression patterns were significantly more frequent in the presence of a short (17 of 27 cases, 63%) or a long cord (28 of 32 cases, 87%), as compared with a normal length cord (145 of 393 cases, 37%). The measurement of umbilical cord length requires minimal effort, no expense, and may explain certain intrapartum FHR abnormalities or an arrest of fetal descent.[12]

5. CONCLUSION

Normal umbilical cord length was most common and was associated with fewer cord-related complications and more stable fetal heart rate patterns. Deviations in cord length, particularly short and long cords, showed a higher association with nuchal loops, cord complications, and abnormal fetal heart rate changes, potentially influencing perinatal outcomes..

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