International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Thangappah RBP et al. Int J Reprod Contracept Obstet Gynecol. 2022 Jun;11(6):1727-1733
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20221448

Original Research Article

Clinical significance of umbilical cord abnormalities: an observational study

Radha B. P. Thangappah*, C. Suhashini Karnal, Monika R. Ravichandran, Alagu Sakthi Sowparnika, Pavithra Sundaravadivelu

Department of Obstetrics and Gynaecology, Sri Muthu Kumaran Medical College Hospital and Research Institute, Chennai, Tamil Nadu, India

Received: 14April 2022
Revised: 05 May 2022
Accepted: 06 May 2022

***Correspondence:**
Dr. Radha B. P. Thangappah,
E-mail: radhaprabhu54@ymail.com

ABSTRACT

Background: The well being of a foetus depends on the uncompromised placental function and normal blood flow through the umbilical vessels. If there are umbilical cord abnormalities, it can lead to perinatal complications. The aim of the study was to analyse the prevalence of umbilical cord abnormalities and to study the relationship between the cord abnormalities and intrapartum complications.
Methods: This was a prospective observational study conducted at a tertiary care hospital, Chennai, from September 2020 to August 2021. Four hundred mothers who met the inclusion and exclusion criteria were included in the study. At the time of delivery, umbilical cord , intrapartum and neonatal details were noted. The association between the cord length and parameters such as nuchal coiling, FHR changes, mode of delivery, APGAR at birth and NICU admissions were analysed and the statistical significance was derived.
Results: The mean cord length was 57.44±20.11 cms. 65% had normal cord length, 15% had short cords and 20% of babies had long cords. Nuchal coiling was seen in 31.75%, cord prolapse in 0.75% and true knot in 1% of cases. Cases with long cords were associated with statistically significant increase in the incidence of nuchal cords, multiple cords, FHR abnormalities, operative interventions and birth asphyxia. The presence of short cord was not associated with significant adverse maternal and perinatal outcome.
Conclusions: This study showed that 35% of all deliveries were complicated by abnormal cord length and other cord complications. It is important to document these findings in the event of antenatal or intrapartum complications.

Keywords: Umbilical cord abnormalities, Cord length, nuchal cord, Intra partum complications

INTRODUCTION

The growth and wellbeing of a foetus depends up on the normal blood flow through the umbilical cord from the mother. When there are umbilical cord abnormalities, they disrupt the normal blood flow to the fetus, exchange of gases, and supply of nutrients from the mother to the fetus leading to adverse perinatal outcome. During the antenatal period, intermittent obstruction or vasospasm of the cord often leads to fetal growth restriction (FGR), intrauterine foetal hypoxia, foetal distress and intrauterine brain damage. In labour, complications such as failure to progress in the second stage of labour, foetal distress and birth asphyxia can occur and most of the times the reason for these complications are not apparent.[1] In these situations, careful examination of the umbilical cord may reveal significant findings which may be the causal reason for these intra partum events. At term, the normal cord is about 50-60 cms in length and 1-2 cm in diameter.

However, there is considerable variation in the length of the umbilical cord, ranging from no cord (achordia) to length up to 300 cms. A long cord is defined as a cord length of >100 cms and in a short cord, the cord length is <30 cms. There could also be true knots in the umbilical cord which can compromise the well-being of the baby. Variations in the umbilical cord length such as long and short cords may be associated with adverse perinatal outcome and maternal intrapartum complications.[2]

Aim of the study

The aim of this study was to analyse the prevalence of umbilical cord abnormalities and to study the relationship between the cord abnormalities in terms of cord length, nuchal position of the cord, cord prolapse and adverse perinatal outcome.

METHODS

This was a prospective observational study conducted at the Sri Muthu Kumaran Medical College Hospital and Research Institute, Chennai, Tamil Nadu from September 2020 to August 2021. Ethical committee approval was obtained for the study and informed consent was taken from each participant. Mothers who were willing to participate in the study and those who were > 37 weeks of gestation at delivery were included in the study. Mothers who presented with multiple gestations, major congenital anomalies of the fetus and those presented with preterm labour were excluded from the study. Convenience sampling technique was used and four hundred mothers who met the inclusion and exclusion criteria were taken for the study. In labour, the labour progress was assessed using a partograph. Based on the partographic findings, a diagnosis of prolonged labour was made. The fetal heart rate was monitored using conventional method and by intermittent /continuous cardiotocography (CTG). The CTG was carefully analysed for foetal heart rate abnormalities. The mode of delivery by the vaginal route/caesarean section or instrumental delivery and the indications for caesarean section was noted. At the time of delivery, the following findings were noted: the presence or absence of loop of cord around the neck, trunk, shoulder, and limbs, if present, the number of loops of cord, and whether the cord was loose or tight. After the delivery of the foetus, the cord was clamped at two places and cut in between and the baby was separated. After the delivery of the placenta, using a flexible inch tape the length of the cord was measured in two portions; from the placental attachment to the proximal cut end and from the foetal umbilicus to the distal cut end and were added. The Cord was examined for abnormalities such as false and true knots, cysts, and haematomas. The type of insertion of the cord on the placenta was also noted.

With regards to the new born parameters, sex of the baby, weight of the baby, Apgar score at 1 and 5 minutes and the need for admission into new born Intensive care Unit (NICU) were noted. The association between the cord length and the parameters such as nuchal coiling, FHR changes, mode of delivery, duration of labour, APGAR at birth and NICU admissions were analysed and the statistical significance was derived.

Statistical analysis

For statistical analysis IBM Statistical package for social sciences (SPSS) version 22 was used. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. The association between categorical explanatory variables and quantitative outcome was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Independent sample t-test/ ANOVA/Paired t- test was used to assess statistical significance. The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Odds ratio along with 95% CI is presented. Chi square test was used to test statistical significance. P<0.05 was considered statistically significant.

RESULTS

The age of the study population ranged between 22 to 36 years with a mean age of 25.66±2.9. Among the 400 cases studied, the length of the cord ranged between 21 to 111 cm and the mean cord length was 57.44±20.11.

Table 1: Descriptive analysis of umbilical cord variations.

	Frequency	Percentage
Cord length		
Short cord	60	15
Normal length	260	65
Long cord	80	20
Cord complications		
No complications	266	66.5
Nuchal coiling	130	32. 5
Cord prolapse	3	0.75
True knot	4	1
No. of loops of nuchal coiling		
No coiling	270	67.5
One loop	68	17
Two loops	54	13.5
Three loops	08	2

For this study, cord length <40 cms was taken as short cord >80 cms was taken as long cord. Based on this, 260 babies (65%) had normal cord length, 60 babies (15%) had short cords and 80 (20%) babies had long cords. The commonest type of cord attachment was one of eccentric type (55%), followed by central type (45%) both of which are normal cord attachments. Nuchal coiling was seen in 130 (31.75%) of cases, cord prolapse in 3 cases (0.75%) and there was true knot in four cases (1%). In this study, 17% of all deliveries were complicated by single loop of nuchal

cord, 13.75% had two loops of cord around the neck and 2% had cord three times around the neck (Table 1). Besides the nuchal positioning, the cord was also wrapped around the body in 6 cases, and around the arm in 4 cases. The umbilical cord was tightly around the neck in 22 of the 130 cases (16.9%) with nuchal coiling.

Table 2: Descriptive analysis of maternal and neonatal outcome.

	Frequency	Percentage
Mode of delivery		
Normal vaginal delivery	284	71
Caesarean section	100	25
Instrumental delivery	16	04
Labour duration		
Normal	356	89
Prolonged	44	11
FHR changes		
Normal	326	81.5
Abnormal	74	18.5
Sex of the baby		
Male	220	55
Female	180	45
APGAR at birth		
Good	356	89
Poor	44	11
NICU admission		
Admitted	48	12
Not admitted	352	88

On analysing the maternal and neonatal outcome, 71% of all cases had normal vaginal delivery, 25% were delivered by caesarean section and 4% were delivered by forceps. The indication for caesarean section was failure to progress in labour in 23 cases, breech presentation in 3 cases, prolonged labour and abnormal CTG in 21 cases and foetal distress in 53 cases. 18.5% of the babies showed foetal heart rate abnormalities with foetal bradycardia, tachycardia and decelerations. 55% of the babies were males and 45% were females and there were no cases of FGR in this study. 11% of the babies had birth asphyxia and were admitted to NICU for management. (Table 2). Another 4 babies were also admitted to NICU because of low birth weight.

The association between the cord length and the maternal and neonatal parameters such as nuchal coiling, FHR changes, mode of delivery, duration of labour, APGAR at birth and NICU admissions were analysed and the statistical significance was derived. (Table 3)

Among the cases with a long cord, the nuchal coiling was seen in 85% (68/80) of cases and in short cord the incidence of nuchal coiling was 13.3% (8/60) while in cases with a normal cord length, the incidence was 20.7 (54 /260) and there was a significantly a high incidence of nuchal coiling in the long cord group ($p<0.001$). On analysing the length of the umbilical cord and the number of loops of coiling, in those with short cords, only single loop of coiling was present and with normal cord length, single, as well as double loops of coiling was present. However, in the long cord length group, besides the single and double loops, the cord had gone around the neck three times in eight cases. On statistical analysis, the incidence of nuchal coiling as well as the number of loops of cord increased linearly with the cord length and was found to be highly significant ($p<0.001$) (Table 3). In eight cases where the cord length was 90-110 cms, there were three loops of cord tightly around the fetal neck. In these cases the duration of second stage of labour was increased, and caesarean section was done for foetal distress and prolonged labour. After delivery, 7 of the 8 babies had birth asphyxia and were admitted to the NICU. Besides the nuchal positioning, the cord was also wrapped around the body in 6 cases, and around the arm in 4 cases. All these 10 cases belonged to the long cord length group.

Table 3: Association between umbilical cord length and various maternal and neonatal parameters.

	Cord Length			Chi square	P value
	Short cord (N=60)	Normal length (N=260)	Long cord (N=80)		
Nuchal coiling					
Absent	52 (86.7%)	206 (79.2%)	12 (15%)		
Present	08 (13.3%)	54 (20.7%)	68 (85%)	29.73	<0.001
No. of loops of nuchal coiling					
No coiling	52 (86.7%)	206 (79.2%)	12 (15%)		
single loop	08 (13.3%)	30 (11.5%)	26 (32.5%)		
Double loops	0 (0%)	24 (9.2%)	34 (42.5%)	35.56	<0.001
Three loops	0 (0%)	0 (0%)	08 (10.%)		
Fetal heart rate					
Normal	58 (96.6%)	234 (90%)	34 (42.5%)	23.18	<0.001
Abnormal	2 (3.3%)	26(10%)	46 (57.5%)		
Mode of delivery					
NVD	54 (90%)	206 (79.2%)	24 (30%)	18.39	0.001

Continued.

	Cord Length			Chi square	P value
	Short cord (N=60)	Normal length (N=260)	Long cord (N=80)		
CS	06 (10%)	42 (16.15%)	52 (65%)		
Instrumental	0 (0%)	12 (4.6%)	04 (5%)		
Duration of labour					
Normal	53 (88.3%)	235 (90.4%)	68 (85%)	1.395	0.498
Prolonged	07 (11.6)	25 (9.61%)	12 (15%)		
Sex of the baby					
Boy	28 (46.7%)	150 (57.7%)	42 (52.5%)	0.641	0.726
Girl	32 (53.3%)	110 (42.3%)	38 (47.5%)		
APGAR at birth					
Good	60 (100%)	244 (93.8%)	52 (65%)	10.86	0.004
Poor	0 (0%)	16 (6.2%)	28 (35%)		
NICU admission					
Admitted	0 (0%)	20 (7.6%)	28 (35%)	10.86	0.004
Not admitted	60 (100%)	240 (92.4%)	52 (65%)		

18.5% of the babies showed foetal heart rate abnormalities with foetal bradycardia, tachycardia and decelerations. The incidence of fetal heart rate abnormalities was 3.3% with short cord group and 57.5% in the long cord group and 10. % in the normal cord group. The incidence of fetal heart rate abnormalities was more in long cord group than in normal and short cord group which is statistically significant ($p<0.001$). On analysing the mode of delivery, 71% cases had normal vaginal delivery, 25% were delivered by caesarean section and 4% were delivered by instrumental delivery. The incidence of caesarean section was 65% in the long cord length group compared to 10% in the short cord length group 16.2% in the normal cord length group and the difference was statistically significant ($p<0.001$). The duration of labour was prolonged in 11% of cases. The labour was prolonged in 7 cases with short cord length, in 25 cases with normal cord length and in 12 cases with long cord length and the difference among the various cord length group was not statistically significant. ($P>0.498$), also there was no statistically significant relation between the cord length and sex of the baby.

On analysing the condition of the newborn at birth, 11% of the babies had poor APGAR score and they needed admission to NICU. The incidence of birth asphyxia was significantly high with 35% in cases with long cords, compared to 6.2% in those with normal cord length and difference measured by using Chi square test was statistically significant ($p<0.004$). None had birth asphyxia from the short cord length group.

There were 3 cases of cord prolapse, one case occurred in the normal cord length group and two cases occurred in the long cord group and there were four cases of true knots, all occurred in the long cord group. All the three patients who presented with cord prolapse were delivered by caesarean section.

DISCUSSION

Umbilical cord can be affected by a number of abnormalities such as nuchal cord, varying length of the umbilical cord, cord prolapse, true and false knots of the cord, single umbilical artery, vasa previa, velamentous insertion of the cord and haematomas, haemangiomas and cysts of the umbilical cord.[1] When there are umbilical cord abnormalities, they disrupt the normal blood flow to the fetus, exchange of gases, and supply of nutrients from the mother to the fetus leading to adverse perinatal outcome. They can also lead to maternal complications such as placental abruption, prolonged labour and increased operative interventions. In the present study, due to the small sample size, complications such as single umbilical artery, vasa previa and velamentous insertion of the cord were not noted. The major complications observed were abnormal lengths of the umbilical cord, nuchal cord, true knot and cord prolapse. The association between these complications and the obstetric outcome was statistically analyzed. The mean umbilical cord length in the present series was 58.45±20.13 cms which is comparable to other authors.[2,3] The mean umbilical cord length reported by Rashid et al was 63.86±15.69 cm. The longest cord length reported by them was 125 cm.[4] The length of the umbilical cord varies from no cord (achordia) to 300 cm, with diameters up to 3 cm. An average umbilical cord is 55 cm long, with a diameter of 1-2 cm and 11 helices.

In the present study, the shortest length of cord seen was 20 cms and the longest was 110 cms. Various authors have kept different criteria to define short and long cords. In the study of Mishra et al. the criteria for short cord was <20 cm, long cord >100 cm.[5] For our study cord length <40 cms was taken as short cord >80 cms was as long cord. In the study by Stefos et al 5% of cords were shorter than 35 cm, and another 5% were longer than 80 cm.[6] In our series, 15% of the cords were short, 20% had long cords and 65% of cords were within normal range. Compared to other studies, the incidence of long cord was higher in our study.

The cause for differences in cord length is unknown; however, the length of the cord is thought to reflect the movement of the fetus in utero.[7]

Short cords are associated with fetal movement disorders and intrauterine constraint, placental abruption, cord rupture, and emergency caesarean deliveries for non reassuring fetal heart rate.[8] Although short cords have been associated with inability of some the fetuses to deliver vaginally, there are reports on vaginal delivery with cords as short as 13 cm, which is much shorter than the normal range.[9] In our series the shortest cord length was 20 cms and the woman had a normal vaginal delivery delivering a 3.25 kg baby. Among the 60 cases with short cords, nuchal coiling was seen in 8 cases (13.3%) with a single loop of umbilical cord. The FHR abnormalities was seen in 2 cases (3.3%) which was not more than those with normal cord length (10%). Similarly, prolonged labour and caesarean section rates were not higher as compared to those with normal cord length. There were no cases of abruption, fetal growth restriction or birth asphyxia noted in the short cord length group. On the contrary, in Balkawade's study, cases of short-cord group had maximum cases of LSCS (40.7%), than cases with long (24.5%) or normal (23.6%) cord length. Short-cord group was associated with significantly higher ($p<0.05$) incidence of LSCS cases.[3] Masarat Rashid et al study also showed higher frequency of LSCS (30%) with short umbilical cord compared to 23.2% with long cords and 4.4% normal cord length.[4]

The cord may become coiled around various parts of the body of the fetus, usually around the neck. Nuchal cord is defined as an umbilical cord that passes 360° around the fetal neck and is caused by movement of the fetus through a loop of cord. Incidence of nuchal coiling in our study was 32.5%, with single loop in 17% of cases and multiple loops in another 16% of cases. Other authors have reported lower incidence of nuchal coiling at 20.7% (3). One loop around the neck occurs in approximately 20% of cases and multiple loops occur in up to 5% of pregnancies.[10,11] The incidence of multiple loops is much higher in our study.

The higher incidence of nuchal coiling in our study may be due to more number of cases with long cord length. Excessively long cords are associated with fetal entanglement and true knots.[2,3] In our series 20% of cases were associated with long cords. Among the cases with a long cord, the nuchal coiling was seen in 85 % (68/80) of cases and long cord was associated with significantly higher ($p<0.001$) incidence of nuchal coiling. Among those with long cords, in 30%, there was a single loop of cord, in 42.5% of cases there were double loops and three loops were present in 10% of cases. Compared to those with short and normal cord length there was a statistically significant increase in the number of loops among the long cord group ($p<0.001$). Similar to our study Balkawade et al study also showed 67.9% of nuchal coiling in cases with long cords.[4]

The incidence of fetal heart rate abnormalities was 3.3% with short cord group and 57.5 % in the long cord group and 10% in the normal cord group and the fetal heart abnormalities were significantly higher in those cases with long cord ($p<0.001$). These non-reassuring heart rate changes may be directly related to the increased incidence of nuchal coiling, increased number of loops causing compression of the umbilical cord. Similar to our findings, other authors' have also shown that as cord length increases, the incidence of fetal heart rate abnormalities also increase.[3,4] On analysing the mode of delivery, the incidence of caesarean section was 65 % in the long cord length group higher than those with short and normal length of cord, 10% and 16.2% respectively and the difference was statistically significant ($p<0.001$). This study has shown that the incidence of all types of cord complications increase as the cord length increases. The present study is comparable with the study by Mazarat et al and Rayburn et al and both the studies have shown statistically significant ($p<0.001$) association of cord complications with increase in the cord length.[4,12]

At time of delivery, presence of a cord around the neck or the body/leg/arms is a common finding seen in 25-30% of cases. Though most of the babies are born healthy, perinatal complications can develop if the cord is tight around the neck, or the cord is wrapped around the neck more than once or there is less amniotic fluid causing cord compression. The potential antenatal complications associated with nuchal cord may be chronic intrauterine hypoxia leading to FGR, intrauterine death due to complete cord occlusion. In labor, it can lead to FHR abnormalities, birth asphyxia, prolonged second stage of labor, increased operative interventions and long term sequelae could be neurodevelopmental delay. Though, nuchal cords were seen predominantly in the long cord length group, single nuchal cord also occurred in the short cord length group. Rogers et al have shown that nuchal cord can occur with short cords, in which case they tend to wrap around the infant's neck more tightly.[13] Bashir et al have not shown significant difference between the baby outcomes having nuchal cord or without nuchal cord.[14] There have also been similar reports from other authors.[15]

Nuchal cords are often identified during an obstetrical ultrasound. Nuchal cords are identified by taking multiple views of the fetal neck. A nuchal cord is diagnosed when the umbilical cord is seen encircling at least three-quarters of the fetal neck. If the cord encircles at least half of the neck, it may be classified as suspicious for the presence of a nuchal cord. Using Gray-scale and color Doppler imaging , the sensitivity of ultrasound in diagnosing a nuchal cord when there was more than one loop present was 60% compared to 37% when only one loop was present.[16]

True and false knots can occur in the umbilical cord. False knots have not been reported to cause any adverse perinatal outcome. However, true knots have been reported to lead to a 4-fold increase in fetal loss, presumably because of

compression of the cord vessels when the knot tightens.[8] In our study true knot was noted in four cases, where the umbilical cord length was >80 cms and the fetus presented with non-reassuring fetal heart rate for which caesarean section was done. The reported incidence of prolapse of the umbilical cord varies between 0.2 and 0.8% of births.[17] In our study, there were three cases of cord prolapse (0.75%), one case presented in the normal cord length group, and two cases in the long cord length group with cord length measuring 92 and 98 cm. There was a statistically significant increase in the incidence of birth asphyxia in the long cord group ($p<0.004$). This higher percentage of birth asphyxia in long-cord group may be due to more incidences of cord abnormalities (nuchal cord, true knot, and cord prolapse). All babies born with neonatal asphyxia were admitted to NICU and there were no perinatal deaths. A case-control study of stillbirth and live births conducted by the Stillbirth Collaborative Research Network from 2006-2008 showed that 19% of still births were due to umbilical cord abnormalities.[17] In our study, there was no statistically significant relation between the cord length and sex of the baby. However, in a Finnish population based study, girls had shorter cord length throughout gestation.[18]

The limitation of this study is that due to the small sample size, other cord abnormalities such as single umbilical artery and velamentous insertion were not noted.

CONCLUSION

In this study 34% of all babies had abnormal cord length and 35% had various cord complications such as nuchal cord, cord prolapse and true knots. The presence of short cord was not associated with significant adverse maternal and perinatal outcome. However, long cords were associated with statistically significant increase in nuchal coiling, FHR abnormalities, cord prolapse and caesarean section rates and birth asphyxia. Though nuchal cord is a common finding and frequently reported on USG, in majority of cases no adverse maternal and fetal outcome is noted. However, reducing fetal movements, unexplained FGR or FHR abnormalities in labour should alert the clinician as to the possibility of cord compression and action should be expedited. Also, in those cases presenting with unexplained FGR, oligohydramnios, placental abruption, unexplained non-reassuring FHR changes, birth asphyxia, failure to progress in second stage of labour, it is useful to measure and document the cord abnormalities which may help in cases of medico-legal issues. There is also potential for research, where the children born with cord abnormalities may be followed up for long term neuro developmental sequalae.

ACKNOWLEDGEMENTS

We wish to acknowledge and thank the Dean of the Institution for giving us permission conduct the study and to use the hospital data.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Elsayed W, Sinha A. Umbilical Cord Abnormalities and Pregnancy Outcome. J. Fetal Med. 2019;6:183-9.
2. Heifetz SA. The umbilical cord: obstetrically important lesions. Clin Obstet Gynecol. 1996;39(3):571-87.
3. Balkawade NU, Shinde MA. Study of Length of Umbilical Cord and Fetal Outcome: A Study of 1,000 Deliveries. J Obstet Gynaecol India. 2012;62(5):520-5.
4. Rashid M, Gul S, Khurshid R, Ahmad A. Prospective study for evaluation of the impact of umbilical cord length with fetal outcome. International Journal of Current Advanced Research. 2017;6(6):4458-62.
5. Mishra R, Vijaylaxmi P, Kumari NJ. Correlation of the length of umbilical cord of the fetus with outcomes of labour. J. Obstet. Gynaecol. India. 1987;37:781.
6. Stefos T, Sotiriadis A, Vasilios D, Tsirkas P, Korkontzelos I, Avgoustatos F et al. Umbilical cord length and parity—the Greek experience. Eur J Obstet Gynecol Reprod Biol. 2003;107(1):41-4.
7. Olaya-C M, Fritsch M, Bernal JE. Immunohistochemical protein expression profiling of growth- and apoptotic-related factors in relation to umbilical cord length. Early Hum Dev. 2015;91(5):291-7.
8. Weiner E, Fainstein N, Schreiber L, Sagiv R, Bar J, Kovo M. The association between umbilical cord abnormalities and the development of non-reassuring fetal heart rate leading to emergent cesarean deliveries. J Perinatol. 2015;35(11):919-23.
9. LaMonica GE, Wilson ML, Fullilove AM, Rayburn WE. Minimum cord length that allows spontaneous vaginal delivery. J Reprod Med. 2008;53(3):217-9.
10. Ogueh O, Al-Tarkait A, Vallerand D, Rouah F, Morin L, Benjamin A et al. Obstetrical factors related to nuchal cord. Acta Obstet Gynecol Scand. 2006;85(7):810-4.
11. Schäffer L, Burkhardt T, Zimmermann R, Kurmanavicius J. Nuchal cords in term and postterm deliveries--do we need to know? Obstet Gynecol. 2005 ;106(1):23-8.
12. Rayburn WF, Beynen A, Brinkman DL. Umbilical cord length and intraparturn complications. Obstet Gynaecol. 1981;57:450-2.
13. Rogers MS, Ip YW, Qin Y, Rogers SM, Dalijit S. Relationship between umbilical cord morphology and nuchal cord entanglement. Acta Obstet Gynecol Scand. 2003;82:32-7.
14. Bashir F, Zill-E-Huma, Aslam P, Naz R. Cord Around Neck and its Fetal Implication. P J M H S. 2013;7:264-7.
15. Akkaya H, Buke B, Pekcan MK, Sahin K, Uysal G, Yegin GF et al. Nuchal cord: is it really the silent risk

of pregnancy?. J Matern Fetal Neonatal Med. 2017;30(14):1730-3.
16. E. Peregrine , P. O'Brien , E. Jauniaux. Ultrasound detection of nuchal cord prior to labor induction and the risk of caesarean section. Ultrasound Obstet Gynecol. 2005;25:160-4.
17. Hammad IA, Blue NR, Allshouse AA, Silver RM, Gibbins KJ, Page JM et al. Umbilical Cord Abnormalities and Stillbirth. Obstet Gynecol. 2020;135(3):644-52.
18. Georgiadis L, Keski-Nisula L, Harju M, Räisänen S, Georgiadis S, Hannila ML, Heinonen S. Umbilical cord length in singleton gestations: A Finnish population-based retrospective register study. Placenta. 2014;35;4:275-80.

Cite this article as: Thangappah RBP, Karnal CS, Ravichandran MR, Sowparnika AS, Sundaravadivelu P. Clinical significance of umbilical cord abnormalities: an observational study. Int J Reprod Contracept Obstet Gynecol 2022;11:1727-33.