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The Length of Umbilical Cord and Perinatal Outcome

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Abstract

The umbilical cord is the lifeline of the fetus: It's one of the most important parts of the fetoplacental unit. Careful umbilical cord examination often reveals significant lesions which may be associated with these processes. This study aimed to study the correlation of umbilical cord length with fetal parameters among 100 pregnant Iraqi women with singleton pregnancy with gestational age between 37 completed weeks to 41 completed weeks in the department of Gynecology and Obstetrics at Baghdad Teaching Hospital for during 2013-2014. The umbilical cords and placentae had been examined after delivery for any abnormalities of shape of placenta, the site of umbilical cord insertion in it, abnormalities and the relation of these parameters to perinatal outcome. Long umbilical cord was significantly associated with Non-reassuring fetal heart (P=0.03), low apgar scores. Short umbilical cords had a significant association with low apgar score (P<0.05) while other clinical and perinatal outcome parameters showed no significant correlation with umbilical cord length (p>0.05).

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Introduction

The umbilical cord is a narrow tube-like structure that connects the developing fetus to the placenta. It delivers nutrients and oxygen to the fetus and removes the fetus waste products [(1)]. Umbilical cord development begins around the 5th week of pregnancy from the yolk sac and allantois and replaces the yolk sac as the fetus' source of nutrients [(2)].

It becomes progressively longer until 28 weeks of pregnancy, reaching an average length of 35to 70 cm [(3)]. As the cord gets longer, it generally coils around itself. In most cases, the umbilical vessels spiral through the cord and a predictable number of coils per unit length can be determined [(3)].This umbilical coiling index (UCI) is defined as the number of complete coils divided by the length of the cord in centimeters.[(5)] Antenatally, coiling can be determined sonographically, although with lower sensitivity than measurement postpartum [(6)]. Clinically, hypocoiling has been linked with fetal demise, whereas hypercoiling is related to fetal-growth restriction and intrapartum fetal acidosis and asphyxia [(7)]. Both have been linked to trisomies and single umbilical artery [(8)].

Umbilical cord abnormalities

Single umbilical artery

About 1 percent of singleton and about 5 percent of multiple pregnancies have an umbilical cord that contains only two blood vessels, instead of the normal three[(9)]. In these cases, one artery is missing. The cause of this abnormality, called single umbilical artery, is

unknown [10]. Single umbilical artery has been linked with birth defects.

Abnormal Length of cord

Length: The human umbilical cord can be totally absent or reach a length of 300cm [2], Absent or Short (< 35cm) umbilical cords (3% of cords) [2]. Absolutely short cords can interfere with the mechanism of labor and delivery while exhibiting changes in fetal heart rate patterns [20]. This restriction of decent leads to an increase in the incidence of cesarean section, forceps and vacuum extractions [19].

Short cords have been associated with adverse perinatal outcomes such as fetal-growth restriction, congenital malformations, Intrapartum distress and a twofold risk of death [21].

Long umbilical cords (>70cm, 4% of cords) are documented to be associated with poor fetal outcome and associated with UCA especially; cord entanglement, true knots, and torsion. [22, 23]. Multigravida cord length may be longer than primagravida cord length [24]. Twin gestations may have fetuses with discordant lengths and shorter lengths than singletons [25].

Velamentous insertion

With velamentous insertion, the umbilical cord inserts into the chorion laeve at a point away from the placental edge, and the vessels pass to the placenta across the surface of the membranes between the amnion and the chorion. 1% percent of singletons have velamentous insertion [26]; however, this condition occurs in almost 15% of monochorionic twins and is common in triplets [27].

Velamentous insertion can cause hemorrhage if the vessels are torn when the membranes are ruptured [28]; most often with a vasa Previa[27]. Velamentous insertion of the cord is associated with low birth weight, prematurity, and abnormal fetal heart patterns in labor [29] .

Marginal Insertion

The cord usually is inserted at or near the center of the fetal surface of the placenta. Cord insertion at the placental margin is sometimes referred to as a Battledore placenta (31) found in about 7 percent of term placentas.With the exception of the cord being pulled off during (32) delivery of the placenta, it is of little clinical significance.

Vasa Previa

Vasa Previa occurs when one or more blood vessels from the umbilical cord or placenta cross the cervix underneath the baby Vasa Previa occurs in 1 in 5200births (33).

These blood vessels sometimes tear when the cervix dilates or the membranes rupture which can lead to life-threatening bleeding in the baby. [33]. When vasa Previa is diagnosed unexpectedly at delivery, more than half of affected babies are stillborn [34]. However, when vas Previa is diagnosed by ultrasound earlier in pregnancy, fetal deaths generally can be prevented by delivering the baby by cesarean section [35]. Pregnant women with vasa Previa sometimes have painless vaginal bleeding in the second or third trimester.

Umbilical cord knots

About 1 percent of babies are born with one or more knots in the umbilical cord called true knot [1, 37]. Some knots form during delivery when a baby with a nuchal cord is pulled through the loop. Others form during pregnancy when the baby moves around. Knots occur most often when the umbilical cord is too long and in identical-twin pregnancies. Identical twins share a single amniotic sac, and the babies' cords can become entangled [38], Cord knots result in miscarriage or stillbirth in 5 percent of cases [1]. Fetuses with true umbilical knots are 5to10-fold increased risk of intrauterine death [37, 39]. False knots appear as knobs protruding from the cord surface and are focal redundancies of a vessel or Wharton jelly, with no Clinical significance (40).

Umbilical cord cyst

Umbilical cord cysts are out pockets in the cord. They are found in about 3 percent of pregnancies [41]. There are true and false cysts: True cysts are lined with cells and generally contain remnants of early embryonic structures. False cysts are fluid-filled sacs that can be related to a swelling of the Wharton's jelly) [42] Single umbilical cord cysts found in the first trimester tend to resolve completely, whereas multiple cysts may portend miscarriage or aneuploidy [43], moreover, pseudo cysts persisting. Beyond this can be associated with structural (kidney, abdominal defect) and chromosomal Anomalies, especially trisomy 18 and 13 [44]. When a cord cyst is

found during an ultrasound, the provider may recommend additional tests, such as amniocentesis and a detailed ultrasound, to diagnose or rule out birth defects [45].

Nuchal cord

About 25-34 percent of babies are born with a nuchal cord (the umbilical cord wrapped around the baby's neck). A nuchal cord, also called nuchal loops, [1]. Babies with a nuchal cord are generally healthy. Sometimes fetal monitoring in labor, showing about 20 percent of foetuses with a nuchal cord have moderate, severe, variable Heart rate decelerations and they are also more likely to have a lower umbilical artery pH [46]. This may reflect pressure on the cord. However, the pressure is rarely serious enough to cause death or any lasting problems, although occasionally a cesarean delivery may be needed [47].Less frequently, the umbilical cord becomes wrapped around other parts of the baby's body, such as a foot or hand. Generally, this doesn't harm the baby.[48]

Umbilical cord accident

Umbilical cord prolapse is the presence of umbilical cord below the presenting part after the membranes have been ruptured, while cord presentation is the presence of umbilical cord below the presenting part when the membrane intact[1] . This complication affects about 1 in 500 births [1].the presenting part press on the cord reduces or cuts off blood flow from the placenta to the fetus decreasing the fetus oxygen supply[49]. Leading to deep variable deceleration in fetal heart then bradycardia which can result in stillbirth unless the baby is delivered promptly usually by cesarean section [20].

Hematoma

Trauma these accumulations of blood are associated with short cords, and entanglement [51]. They may result from a varix rupture, usually of the umbilical vein, with effusion of blood into the cord. Hematomas also may be caused by umbilical vessel venipuncture [52].

Thrombosis

Intrauterine thrombosis of umbilical cord vessels is a rare event approximately 70 percent is venous, 20 percent are venous and arterial, and 10 percent are arterial thrombosis [53]. Venous thrombosis have lower perinatal morbidity and mortality rates than those in the artery. The latter is Associated with fetal-growth restriction and fetal demise [54].

Vessel Dilatation

An umbilical vein varix is a marked focal dilatation that may develop within the intra-amniotic part of the umbilical vein or within its fetal intra-abdominal portion. Those found intra-abdominally have increased rates of fetal demise, structural anomalies, and aneuploidy [55]. The most common complications are varix rupture, varix thrombosis, compression of the umbilical artery, and fetal cardiac failure due to increased preload [56].

Placental abnormalities

Multiple Placentae with a Single Fetus, Succenturiate LobePlacenta Membranacea, Ring-Shaped Placenta, Circumvallation

Assessment of fetal wellbeing during labour

This can be achieved by the following:[70]

Intermittent auscultation of fetal heart using A Pinard stethoscope or a hand- held Doppler ultrasound.

Continuous external fetal monitoring using CTG.

Observation of the color of liqure (blood stained or meconium stained)which give an indication of fetal compromise.
Fetal scalp blood sampling.

Cardiotocograph

It’s a continuose tracing of fetal heart used to assess fetal wellbeing[71], features which are reported from CTG to define normality and identify abnormalities and potential concern for fetal wellbeing include : Baseline rate, Baseline variability, Acceleration and deceleration

Normal baseline fetal heart rate

110-160 bpm. If less than 110 bpm defined as bradycardia while that above 160 bpm defined as tachycardia.

Normal baseline variability

Reflect a normal fetal autonomic nervous system and it's considered abnormal if it's less than 10 bpm.

Fetal heart acceleration

Mean increase in baseline heart rate of at least 15 second, the presence of 2 or more acceleration on 20-30 minute defines reactive CTG.

Fetal heart decleration

Are transient reduction of FHR of 15bpm or more, lasting for more than 15 second and its indicative of fetal hypoxia[72].

Interpretation of CTG

Reassuring CTG: defined as baseline FHR 110-160bpm, with baseline variability exceeding 10bpm, and with more than one acceleration with no deceleration being seen in 20-30 minute tracing.

Non reassuring CTG: when baseline FHR between 100-110 or161-180, or if baseline variability less than 5 bpm between 4022-90 minute, or presence of early or variable deceleration[73].

Abnormal CTG: when baseline FHR less than 100 or more than 180 bpm,and when variability less than 5 bpm for more than 90 minute, and when there is atypical or late deceleration or single prolonged deceleration lasts longer than 3 minutes.

Apathological CTG: is one where the CTG features two or more of the non-reassuring categories or one or more of abnormal categories(74).

Assessment of the neonate after delivery

Apgar score

It's a tool which assists in the recognition of infant who is falling to make a successful transition to extra uterine life it's recorded at 1 and at 5 minute, if it's still low at 5 minute further observations to be made at intervals[75].

Patients and Methods

This was a prospective observational study conducted in the Department of Obstetrics and Gynecology of Baghdad teaching hospital during the period from 1, December 2013 to, 1st June 2014. Included 100 pregnant women with singleton pregnancy at gestational age of >37 weeks who were admitted to labor room. Preterm deliveries<37 weeks of gestation, multiple pregnancy and delivered by elective caesarean section were excluded from the study. Data were collected using a pre-constructed data collecting sheet which filled by the researcher through direct interview and full history and clinical examination were performed. Verbal consent obtained from all women, Examination for the pregnant women including, general, medical, and obstetrical examination. Monitoring of the progress of labor including cervical dilatation, effacement, descend of the presenting part, fetal heart monitoring using cardiotocograph machine (CTG) and its changing with uterine contraction also monitored, Active management of third stage of labor was done, examination of the delivered placenta for missing lobule and abnormal shape. Examination of umbilical cord done after delivery of the placenta for the following: The presence of any loop around neck, trunk, shoulder. Knots of cord (true or false). Any cord abnormalities (cyst, hematoma, velamentous insertion,etc.). 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 and added. It was measured with flexible tape measure in cm. Number of umbilical cord vessels was also studied in present series.by taking a small piece of the cord and examined under light microscope. Weight of the newborns, fetal outcome were reported and Apgar score at 1 and 5 min. The neonates who was admitted to the neonatal care ward had being followed up until they have been discharged to home for early neonatal death. Statistical analysis was performed using the statistical package for social sciences (SPSS) version 20, and appropriate statistical management

Results and Discussion

A total of 100 women with singleton pregnancies were enrolled in this study, the mean age of the studied group was 27.1 ± 6.8 years with a range of 15 – 42 years, The mean gestational age was 38 ± 1.9 weeks with a range of 37 – 41 weeks. The Birth weight of the newborn ranged between 1.9 and 4.75 kg with a mean of 3.2 ± 0.6 kg. The mean Apgar score at first minute was 6.4 ranged 2 – 8 and after 5 minutes was 7.2 ± 2 ranged between 2 – 10. Regarding the parity, nulliparous represented 33% of the studied group while multiparous were 67 (67%). The mode of delivery was by cesarean section (CS) in 18 women (18%) compared to 82 (82%) delivered with normal vaginal delivery. The mean Umbilical cord length was 69.8 ± 22.6 cm ranged 25 – 100 cm.. all these clinical descriptive characteristics of the studied group are shown in (Table 2).

By categorization of the umbilical cord length into 3 categories, it had been found that 57 women (57%) had normal umbilical cord length, 30 women (30%) with long umbilical cord and 13 women (13%) with short umbilical cord As it shown in (Table 3 and Fig. 9),.

As its shown in (table.4), (Fig10). Cord abnormalities had been reported in 17 cases distributed as Pseudoknot in 8 cases (8%), nuchal cord 6 (6%), True knot in 2 cases (2%), and Cord prolapse in one case (1%) The distribution of these abnormalities according to the length of umbilical cord revealed no significant correlation between the type of abnormalities and the length of the umbilical cord (P>0.05).

The placental abnormalities was Marginal placental cord insertion in 9 cases (9%), circumvallate placenta in 4 (4%) Placental abruption in 4 (4%) and Succenturiate lobe in one case (1%). However, by distribution of these abnormalities according to the umbilical cord abnormalities, no significant correlation had been found between the type of placental abnormalities and the umbilical cord length (P>0.05), these findings are shown in (Table 5)

The correlation matrix of umbilical cord length categories with the clinical characteristics and Perinatal outcomes of the studied group is demonstrated in (Table 6). there was a significant correlation between Non-reassuring fetal heart and long umbilical cord (P=0.03), other significant correlation was found between low apgar score (at 1st minute and 5 minutes) and short umbilical cord (P=0.027 and 0.015, respectively) from one side and long umbilical cord from the other side (P= 0.019 and 0.041) as compared to normal length umbilical cord. Other clinical and perinatal outcome parameters showed no significant correlation with umbilical cord length in all comparisons (p>0.05).

The umbilical cord is the lifeline of the fetus, the position of the placental cord insertion, its shape and cord coiling are thought to be associated with perinatal outcome.

It has been known for many years that the placental cord insertion, shape, size and pattern of cord coiling varies widely between pregnancies. In current obstetric and perinatal pathology practice, qualitative terms are generally used to describe the placenta There has been little attempt at quantifying or describing the relationship between measurements, including the distance of the umbilical cord insertion from the centre of the placenta. The length of the umbilical cord has been proposed as a clinically useful marker of placental insufficiency. [76, 77] In the current study the mean umbilical cord length was 69.8± 22.6 cm, the shorter cord was 25 cm in length and the longest one was 100 cm.

These values reported in our study were consistent with most of the reported averages in the literatures; a mean length of 44.3 ± 9.2 and 47.04cm ± 12.8 obtained by Gupta *et al.*, (78) in 2006 and Abaidoo *et al.*,.(79) in 2008, respectively. A study in Nigeria was conducted by Mutihir and Pam (80) in 2006 indicated an average cord length of 52.9±7.3cm.

Although it is not fully understood what controls cord length, various authors correlate cord length with foetal activity and movement.

Table.1 Apgar scores

score	0	1	2
Appearance: central trunk color	**White or blue all over**	**Pink with blue extremities**	**Pink all over**
Pulse rate	**absent**	**<100 bpm**	**>100 bpm**
Grimace(response to stimulation)	**nil**	**Grimace**	**Cry or cough**
Activity (muscle tone)	**limp**	**Some flexion**	**Well flexed,active movement**
Respiratory effort	**absent**	**Gasping,irregular**	**Regular or strong cry**

Table.2 Maternal and neonatal descriptive characteristics (N=100)

Parameters		Values
Maternal age (years)	*Mean± SD*	27.1 ± 6.8
	Range	15 - 42
Gestational age (weeks)	*Mean± SD*	38.4 ± 1.9
	Range	37 - 41
Birth weight (kg)	*Mean± SD*	3.2 ± 0.6
	Range	1.90 – 4.75
Parity	*Nulliparous*	33
	Multiparous	67
Mode of delivery N (%)	*Caesarean*	18
	Normal vaginal	82
Umbilical cord length	*Mean± SD (cm)*	69.8 ± 22.6
	Range (cm)	25 - 100

Table.3 Distribution of umbilical cord length among studied group

Cord length	No.	%
Normal	57	57.0
Long	30	30.0
Short	13	13.0
Total	100	100.0

Table.4 Correlation between cord length and Cord abnormalities

Cord abnormality	Normal cord (No.=57)		Short cord (No.=13)		Long cord (No.=30)		*P*
	No.	%	No.	%	No.	%	
Cord prolapse	0	0.0	0	0.0	1	3.3	0.38 *NS*
Nuchal Cord	0	0.0	0	0.0	6	20.0	
Pseudo knot	2	3.5	2	15.4	4	13.3	
True knot	1	1.8	0	0.0	1	3.3	

Table.5 Correlation between cord length and placental abnormalities

Placental abnormality	**Normal cord (No.=57)**		**Short cord (No.=13)**		**Long cord (No.=30)**		*P*
	No.	%	No.	%	No.	%	
Circumvallate placenta	2	3.5	1	7.7	1	3.3	0.71 NS
Marginal placental cord insertion	6	10.5	1	7.7	2	6.7	
Succenturiate lobe	0	0.0	1	7.7	0	0.0	
Total	11	19.3	4	30.8	3	10.0	

Table.6 Clinical characteristics and Perinatal outcomes of singleton pregnancies of studied group with normal, short and long umbilical cords

	Normal cord		Short cord (No.=13)		*P Normal vs.*	Long cord (No.=30)		*P Normal vs.*
	No.	%	No.	%		No.	%	
Number of patients	**57**		**13**			**30**		
Maternal age								
≤ 20	11	19.3	3	23.1	0.92	6	20.0	0.83
21 - 34	39	68.4	7	53.8	0.49	19	63.3	0.81
≥ 35	7	12.3	3	23.1	0.57	5	16.7	0.81
Nulliparity	23	40.4	3	23.1	0.32	7	23.3	0.13
Perinatal complication								
Non-reassuring fetal heart	3	5.3	3	23.1	0.061	7	23.3	**0.03**
Intra uterine fetal death	3	5.3	0	0.0	0.93	0	0.0	0.51
Mode of delivery								
Caesarean section	8	14.0	5	38.5	0.82	5	16.7	0.99
Vaginal	49	86.0	8	61.5	0.43	25	83.3	0.92
Neonatal outcome								
Birth weight (kg)	3.2 ± 0.58		3.01 ± 0.47		0.48	3.33 ± 0.46		0.52
Apgar score < 7 at 1 minute	38	66.7	12	92.3	**0.027**	28	93.3	**0.019**
Apgar score < 7 at 5 minute	21	36.8	9	69.2	**0.015**	20	66.7	**0.041**
Early neonatal death	3	5.3	0	0.0	0.18	0	0.0	0.18
NICU Admission	11	19.3	0	0.0	0.19	5	16.7	0.99

It is suggested that sufficient space in the amniotic cavity for movement and the tensile force applied to the umbilical cord during foetal movements are two main factors that determine cord length. [81,82]

Cords of foetuses that have severely diminished motions are remarkably short, and twins have slightly shorter cords probably due to a reduced space for movement. [81]

The prevalence of short cords found in the present study was 13% and the long umbilical cord was found in 30% of the cases, while other women had normal length cords. Although reference standards for cord length have been reported, variation exists in the definition of short cords, studies referred that short cord is less common[83]

In studying correlation of umbilical cord length against cord abnormalities which had been reported in 17 cases (8 cases with Pseudoknote, 6 with nuchal cord, 2 with true knote and one case with cord prolapse) or as a correlate with placenta abnormalities which had been reported as Marginal placental cord insertion in 9 cases, Circumvallate placenta in 4 cases, Placental abruption in 4 cases and Succenturiate lobe in one case), both cord abnormalities or placental abnormalities didn't show the statistically significant correlation with the cord length,

i.e. no statistically significant differences in the incidence of these abnormalities when compared between the three categories of cord length (short, long and normal). In the pregnancies with long umbilical cords, the incidence of pregnancies with succenturiate lobes of placenta, multiple nuchal cords and true umbilical knots were significantly higher than those with normal umbilical cords. These findings agreed that reported, in Japan in 2012, by Suzukia S and Fusea Y [(84)], who could not found these abnormalities in relation with short or long umbilical cords, however, they reported the short umbilical cords seemed to contribute to the increased rate of emergent Cesarean delivery, while the long umbilical cords seemed to contribute to the increased rate of multiple nuchal cords and true knots.

Correlation of umbilical cord length and maternal and perinatal parameters:

Many studies and literatures suggested that long or short umbilical cords, are associated with a number of circumstances which can impact foetal life and have been associated with antepartum abnormalities and risk factors for complications of labour and delivery.[(85,86)]

Our data showed that long cord associated with perinatal complication, Non-reassuring fetal heart was found in 23.1% of the cases with short cord and 23.3% of those with long cords compared to 5.3% of those with normal cords length, this indicated association between the abnormal cord length and these complications, however, the difference was statistically significant in cases with long cord and didn't reach the statistical significance in those with short cords. Our findings are in agreement with that reported in 2004 by Krakowiak *et al.,* [(86)] who found out that infants with short umbilical cords were more likely to have low apgar score, and be small for their gestational age and have more perinatal complication.

Our study was also concluded that short and long cords were associated with low Apgar scores, vast majority of neonates with short cords (92.3%) and also of those with long cords (93.3%) had low Apgar score at 1 minute as compared to those with normal cords (66.7%). At 5 minute low Apgar score was still significantly more frequent in those with short cords (69.2%), and long cord (66.7%) cords as compared to those with normal cords (36.8%). Our findings were in agreement with other studies that reported short and long cords associated with increased risk for maternal labor and delivery complications and adverse fetal and infant outcomes in cases included fetal distress among term infants.[(86)] , in Suzukia S and Fusea Y[(84)] they concluded that the short or long umbilical cords may not be associated with the adverse perinatal outcomes in Japanese singleton pregnancies delivered at ≥ 34 weeks' gestation. Our data, however, showed no significant correlation between cord length and each of maternal age, Parity, maternal complication, and mode of delivery, which consistent with the conclusion of Japanese study of Suzukia S and Fusea Y[(84)] and an earlier study in Taiwan was conducted by Wu JF in 1996 [(87)] they used multivariate analyses, and concluded conclude that the umbilical cord length does not significantly correlate with either maternal age, gestational age, parity fetal outcome or intrauterine fetal well-being. The limitations of this study included the restriction in time and resources that lead to restriction in sample size.

Abnormal cord length either short or long cord associated with low Apgar score at 1and 5 minute as compared to the normal length of cord and the long cord associated with non-reassuring fetal heart more than short or normal cord. Further detailed studies are needed to study this subject on larger population in more than one hospital.

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