

Umbilikal Kord Morfometrisi İle Fetal ve Maternal Parametreler Arasındaki İlişkinin Araştırılması

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ÖZET

Amaç: Kordon çapı ve boyu ile fetal ve maternal parametreler arasındaki ilişkiyi postpartum dönemde incelemek.

Materyal ve Metod: Zonguldak Karaelmas Üniversitesi Tıp Fakültesi Hastanesinde doğum yapmış 202 kadının maternal, plasental ve yenidoğana ait parametreleri, daha önceden hazırlanmış formlara doldurularak prospektif olarak incelendi.

Bulgular: Maternal BMI ile kordon boyu arasında negatif korelasyon bulundu ($p=0.045$, $r=-0.130$). Umbilikal kord çapı yenidoğan boy, kilo, BMI ve göğüs çevresi ile pozitif korelasyon gösteriyordu. Umbilikal kord uzunluğu ile 5. dakika Apgar skoru arasında pozitif korelasyon vardı. Umbilikal kord uzunluğu plasenta santral kalınlığıyla pozitif korelasyon gösteriyordu. Umbilikal kord çapı tüm plasenta boyutları ve 5. dakika Apgar skoru ile pozitif korelasyon gösteriyordu. Umbilikal kord çapı ile uzunluğu arasında negatif korelasyon vardı ($p=0.00$, $r=-0.227$). Tüm istatistik sonuçları istatistiksel olarak anlamlı fakat zayıf korelasyon değerlerine sahiptir. Umbilikal kord morfolojisinin değerlendirilmesi önemlidir çünkü özellikle umbilikal kord çapındaki değişiklikler yenidoğan boyutlarını etkileyebilmektedir.

Anahtar Kelimeler: Umbilikal kord, morfometri, maternal-fetal parametreler, ilişki.

ABSTRACT:

Investigation Of The Relationship Between Umbilical Cord Morphometry And Fetal And Maternal Parameters

Aim: To research the relationship between diameter and length of umbilical cord and fetal and maternal parameters, with respect to postpartum period.

Materials and Methods: Maternal, placental and neonatal parameters of 202 women who delivered singleton delivery was filled to forms prepared previously and researched prospectively.

Findings: Negative correlation was determined between maternal BMI and umbilical cord length ($p=0.045$, $r=-0.130$). Diameter of umbilical cord showed positive correlation with weight, length, BMI and chest circumference of newborn. Positive correlation between umbilical cord length and 5. minute Apgar score was found. Umbilical cord length showed positive correlation with placental central thickness. Umbilical cord diameter showed positive correlation with all dimensions of placenta and 5. minute Apgar score. There was a negative correlation between umbilical cord diameter and umbilical cord length ($p=0.00$, $r=-0.227$). All test scores showed statistically significant but weak correlations with umbilical cord length and diameter. Evaluating of the umbilical cord morphometry is important because of changes in umbilical cord diameter may especially affect outcome of newborn.

Key Words: Umbilical cord, morphometry, maternal-fetal parameters, relationship.

INTRODUCTION

Umbilical cord provide relationship between fetus and placenta and play important role in

structurally and functional developing fetus life (1). Umbilical cord is a mezoblastic

structure and it begins to development in third week of embryonic life and in term, length of umbilical cord is about 60 cm and thickness of umbilical cord is about 1.5-2 cm (2). Traditionally, prenatal evaluation of the umbilical cord consist of number of vessel and Doppler evaluation of arterial resistance. However, clinical experiences have shown that morphology of the umbilical cord and its component affect the gestation process and delivery state and outcome of delivery (3-5). Recently, relationship between umbilical cord length and fetal development have been demonstrated in literature. A lot of researcher group have revealed that changed umbilical cord morphology creates poor outcomes, hypertensive disorders, fetal distress, growth failure of fetus and intrapartum complications at second and third trimester (6-9). Additionally, existence of thin umbilical cord at second trimester causes of low birth weight in fetus according to gestational time and distress symptoms during delivery (10,11).

Fetal development is affected by a lot of factors as maternal factors, placental factors, blood flow into fetus and nutrients provided with this blood flow, enviromental and genetic factors (12). It is known that maternal body weight, height and consequently body mass index (BMI) relevant to fetal growth directly (13,14). It was reported that the umbilical cord length did not affect the fetal weight (15). Examination of placenta in the delivery room gives important information about maternal and fetal status for presently and subsequently. Dimensions, shape, consistence, integrity and other abnormal findings affect fetal development and perinatal morbidity (8). It was declared that the dimensions of plasenta was not been affected from the umbilical cord length (16). To evaluate mortality and morbidity of newborn some methods are used during delivery. Apgar scoring system presented to evaluate quickly the clinical status of newborns is a classical method. Apgar scoring is used for nearly 50 years, but, because of some reasons such as prematurity, congenital anomalies, gestational age, maternal medication or anesthesia type applied to mother, the person who made scoring, it is a subjective method (17). Apgar scoring system benefits the infant

after birth to evaluate whether a medical support is needed (18). When the literature about the umbilical cord dimensions was investigated, it was seen that there was no study that showed the relationship among the umbilical cord length, the umbilical cord diameter and Apgar score. In addition, there was no study that showed the relationship between the umbilical cord diameter and placental dimensions and the relationship among the umbilical cord diameter and maternal height and maternal weight. The umbilical cord diameter was studied only considering the prepartum period in some of the studies (19, 20). Therefore, this study was planned to compare all data related with the umbilical cord, maternal, fetal, placental dimensions and Apgar score.

MATERIALS AND METHODS

Our study was performed in the Karaelmas University Faculty of Medicine, Department of Obstetrics and Gynecology and Bolu Obstetrics and Gynecology Hospital. The research proposal was approved by the Ethics Committee of Karaelmas University hospital. 202 pregnant women who delivered singleton delivery and 110 male (54%), 92 female (46%) normal term newborn and placenta were examined early postpartum period. Pregnant women do not have any other identified health problems (such as hypertension, preeclampsia, eclampsia, diabetes and chronic disease) were in range between 19-45 (average 29.54 ± 6.61) years of age. They were evaluated regardless of their number of the previous birth, abortion and curettage. Healthy newborns who were delivered in 38-42 gestational weeks and with normal birth weight were included in this study. Newborns with 2500-4000 g birth weight were accepted as normal (21, 22). Antenatal weight, height and body mass index (BMI) were measured as maternal parameters. Weight, height, body mass index, head circumference, chest circumference, 1. and 5. minute Apgar score were evaluated as neonatal parameters. Anthropometric measures of infants were made within 1 h of birth, and the Apgar score was measured by an experienced nurse in the delivery room (23). A line crossing the inion (protuberentia occipitalis externa) and glabella was measured for head circumference. The body length was taken in supine and head

fixed position. The body weight was measured with electronic scale which is sensitive to 10 grams. Chest circumference was measured throughout transverse line at nipple level (24). Measurements taken for the placenta consist of placental weight, placental size (long and short diameters and thickness), placement, also measuring the length of the cord and the diameter of the cord. The maximum diameter (1. dimension) of placenta was measured with a metallic scale graduated in centimeters (cm). Then a second maximum diameter (2. dimension) was taken at right angles to the first one. Thickness was measured from the centre of the central zone with a long needle (25). The umbilical cord length from the insertion sites from the infant to the placenta and the umbilical diameter were measured (26). Umbilical cord diameter measured about 10 cm from placental insertion by planimetry of transverse sections. Measurements were made by one (same) person. Measurements for neonatal and umbilical cord length, a non-elastic cloth tape measure was used and measurements were made immediately after birth (7). Weights as gr, other measurements as cm, diameter of umbilical cord and placenta thickness as mm was measured (27,28). Umbilical cord diameters were measured with digital caliper which has the accuracy of 0.01mm/0.0005. These measurements were recorded pre-designed forms and were evaluated prospectively.

Data analyses

The data were evaluated by using SPSS 11.0 statistical program on computer. According to the relationship between the parameters, as the case may be Pearson correlation test and student-t test was used. P values <0.05 were considered significant.

FINDINGS

In the table below the mean of measurements are presented.

Table 1: Means and standard deviations of maternal measurements.

	N	Min.	Max.	Mean	Std. Dev.
MBMI	202	20.83	40.67	27.98	2.86
Mheight(cm)	202	149	176	162.21	4.85
Mweight(kg)	202	52.00	120.00	73.47	9.56

Table 2: Means and standard deviations of newborn measurements.

	N	Min.	Max.	Mean	Std. Dev.
Placental weight(gr)	202	410	1140	588.05	134.62
Placental 1 dimension (cm)	202	15	37	19.37	3.86
Placental 2 dimension (cm)	202	14	29	18.18	2.73
Placental central thickness(mm)	202	15	35	20.71	4.68
Umbilical cord length(cm)	202	37	84	55.24	10.82
Umbilical cord diameter(mm)	202	15.32	25.28	17.96	2.13

Table 3: Means and standard deviations of placental measurements.

	N	Min.	Max.	Mean	Std. Dev.
Nweight(gr)	202	2510	4000	3098.75	428.01
Nlength(cm)	202	41	56	49.98	2.41
N head circum.(cm)	202	30	40	34.78	1.77
N chest circum.(cm)	202	28	40	33.73	2.04
Apgar 1.min.	202	5	10	8.64	1.8
Apgar 5.min.	202	6	10	9.58	0.77
NBMI	202	9.80	20.23	12.38	1.33

A) Umbilical cord and maternal measurements: Between cord length and maternal BMI, a negative correlation was also found ($p = 0.045$, $r = -0.130$).

Table 4: Correlations between maternal parameters and umbilical cord measurements.

		Umbilical cord length(cm)	Umbilical cord diameter(mm)	Mweight(kg)	Mheight(cm)	MBMI
Umbilical cord length(cm)	Pearson	1	-.227**	.036	.093	-.130*
	Correlation					
Umbilical cord diameter(mm)	Pearson	.000	1	.616	.188	.045
	Correlation					
Mweight(kg)	Pearson	.036	-.083	1	.162	.901
	Correlation					
Mheight(cm)	Pearson	.093	-.099	.585**	1	.000
	Correlation					
MBMI	Pearson	-.130**	.000	.052	.463	1
	Correlation					
	Sig. (2-tailed)	.045	.901	.000	.463	.202
	N	202	202	202	202	202

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

B) Umbilical cord and newborn measurements: Umbilical cord diameter is positively correlated with newborn length and weight, BMI and chest circumference. No relationship between the length of the umbilical cord and newborn weight, length, BMI, head and chest circumference was found.

Table 5: Correlations between umbilical cord and newborn measurements.

		Umbilical cord length(cm)	Umbilical cord diameter(mm)	Nweight(gr)	Nlength(cm)	NBMI	N head circum.(cm)	N chest circum.(cm)
Umbilical cord length(cm)	Pearson	1	-.227**	.003	-.042	.016	.045	.004
	Correlation							
Umbilical cord diameter(mm)	Pearson	.000	1	.317**	.236**	.194**	.006	.155*
	Correlation							
Nweight(gr)	Pearson	.003	.317**	1	.718**	.751**	.576**	.690**
	Correlation							
Nlength(cm)	Pearson	.000	.000	.000	1	.000	.000	.000
	Correlation							
N head circum.(cm)	Pearson	-.042	.236**	.718**	1	.100	.501**	.571**
	Correlation							
N chest circum.(cm)	Pearson	.549	.001	.000	.158	.000	1	.582**
	Correlation							
NBMI	Pearson	.045	.006	.576**	.501**	.365**	.365**	1
	Correlation							
N head circum.(cm)	Pearson	.528	.929	.000	.000	.000	1	.000
	Correlation							
N chest circum.(cm)	Pearson	.004	.155*	.690**	.571**	.461**	.582**	1
	Correlation							
NBMI	Pearson	.955	.028	.000	.000	.000	.000	.000
	Correlation							
	Sig. (2-tailed)	.016	.194**	.751**	.100	1	.365**	.461**
	N	.820	.006	.000	.158	.000	.000	.000
	N	202	202	202	202	202	202	202

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Any other, concerning the umbilical cord length and diameter, a significant difference could not be found between male and female newborns ($p>0.05$). Umbilical cord length and diameter for male newborn is 55.06 ± 10.55 cm and 17.71 ± 2.15 mm respectively. Umbilical cord length and diameter for female newborn is 55.39 ± 11.15 cm and 18.30 ± 2.08 mm respectively.

C) Placental and umbilical cord measurements: Between the cord diameter and placenta weight, size, central thickness, a positive correlation was found. Between the umbilical cord length and placenta central thickness, a positive correlation, between the umbilical cord length and diameter, a negative correlation was found. Between placental weight and umbilical cord diameter $p = 0.02$, $r = 0.295$ between the placenta 1. dimension and umbilical cord diameter $p = 0.00$, $r = 0.405$, between the placenta 2. dimension and umbilical cord diameter $p = 0.00$, $r = 0.354$, between the placenta central thickness and cord diameter $p = 0.01$, $r = 0.268$, between the placenta central thickness and umbilical cord length $p = 0.04$, $r = 0.143$ were determined. Umbilical cord length is positively correlated with the central thickness of the placenta ($p = 0.08$, $r = 0.186$). Umbilical cord diameter is positively correlated with placental weight and all dimensions.

Table 6: Correlations between placental and umbilical cord measurements.

		Placental weight(g)	Placental 1 diameter (cm)	Placental 2 diameter (cm)	Placental central thickness(mm)	Umbilical cord length(cm)	Umbilical cord diameter(mm)
Placental weight(g)	Pearson Correlation	1	.479**	.480**	.267**	-.018	.295**
	Sig (2-tailed)		.000	.000	.000	.801	.000
Placental 1 diameter (cm)	Pearson Correlation	.479**	1	.645**	.288**	-.081	.405**
	Sig (2-tailed)	.000		.000	.000	.254	.000
Placental 2 diameter (cm)	Pearson Correlation	.480**	.645**	1	.301**	.017	.354**
	Sig (2-tailed)	.000	.000		.000	.806	.000
Placental central thickness(mm)	Pearson Correlation	.267**	.288**	.301**	1	.143*	.268**
	Sig (2-tailed)	.000	.000	.000		.042	.001
Umbilical cord length(cm)	Pearson Correlation	-.018	-.081	.017	.143**	1	-.227**
	Sig (2-tailed)	.801	.254	.806	.042**		.000
Umbilical cord diameter(mm)	Pearson Correlation	.295**	.405**	.354**	.268**	-.227**	1
	Sig (2-tailed)	.000	.000	.000	.001	.000	
	N	202	202	202	202	202	202

** Correlation is significant at the 0.01 level (2-tailed).

D) Umbilical cord and APGAR score: Umbilical cord length is positively correlated with 5. minute Apgar score ($p = 0.03$, $r = 0.151$). Umbilical cord diameter is positively correlated with 5. minute Apgar score ($p = 0.03$, $r = 0.149$).

Table 7: Correlations between umbilical cord measurements and APGAR score.

		N Apgar 1.min.	N Apgar 5.min.	Umbilical cord length(cm)	Umbilical cord diameter(mm)
N Apgar 1.min.	Pearson Correlation	1	.789**	.055	-.010
	Sig (2-tailed)		.000	.439	.892
N Apgar 5.min.	Pearson Correlation	.789**	1	.167*	.149*
	Sig (2-tailed)	.000		.018	.035
Umbilical cord length(cm)	Pearson Correlation	.055	.151*	1	-.227**
	Sig (2-tailed)	.439	.032		.000
Umbilical cord diameter(mm)	Pearson Correlation	-.010	.149*	-.227**	1
	Sig (2-tailed)	.892	.035	.000	
	N	202	202	202	202

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

E) The relationship between umbilical cord length and umbilical cord diameter was determined as $p = 0.00$, $r = -0.227$. When cord diameter was increased, the length of cord was reduced.

DISCUSSION

Umbilical cord morphology and its components affect the process of pregnancy type and outcomes of delivery (6,7). The length of umbilical cord is determined by both genetically and movement of fetus. More movement provides the development of a longer cord, less fetal movement leads to the formation of a short cord. This theory has been shown in the experiments on animals. It was observed that when experimental muscle paralysis was applied in animal tissue, the decrease in the umbilical cord was observed. A short umbilical cord may be associated with less active fetus, fetal malformations, myopathic and neuropathic diseases, Down syndrome and oligo-hydroamnios (29,30). Furthermore, umbilical cord morphology can also be used to identify the fetuses at risk in terms of fetal death (16).

It was reported that, the average length and the average diameter of the umbilical cord are 55-60 cm and 1.5-2 cm, respectively (8). In the present study the average length and the diameter of the umbilical cord were 55.24 ± 10.82 cm and 17.96 ± 2.3 mm, consequently (Table 3). In the literature, a positive correlation between umbilical cord length and maternal height has been reported (31). It has been reported that maternal height and weight are not correlated with length of umbilical cord (32). A study researching the correlation of umbilical cord diameter with maternal data was not encountered

in the literature. In this study, a negative correlation between the length of umbilical cord and maternal BMI was found ($p= 0.045$, $r= -0,130$). The relationship between maternal data and umbilical cord diameter was not detected (Table 4). The relationship between the umbilical cord length and newborn weight is explained in the literature. The linear relationship between the increase in the diameter of umbilical cord and increase in fetal dimensions has found in prenatal period (1). No relationship between the length of the umbilical cord and newborn weight was found another study (15). In Stefos' study, a positive correlation between the umbilical cord length and newborn weight was determined in peripartum period (31). In our study, however, no significant relationship was determined between the umbilical cord length and dimensions of newborn in postpartum period. (Table 5).

We have not seen a study involved umbilical cord diameter in portpartum period in the literature. Studies related to umbilical cord diameter were focused on prepartum period (1, 19, 20). In a study conducted by Uysal (2006), the relationship between isolated thin umbilical cord and low birth weight was explained (1), and it was revealed that a linear relationship was found between the fetal development and umbilical cord diameter (20). However, cord diameter is positively correlated with newborn height ($p= 0.001$, $r= 0.236$), weight ($p= 0.00$, $r= 0.317$), BMI ($p= 0.00$, $r= 0.194$) and chest circumference ($p= 0.02$, $r= 0.155$) in our study (Table 5). Normal dimensions of the placenta has been reported as the weight around 470 gr, thickness 2-2.5 cm, diameter 22 cm (6). Long and short diameter of the placenta was reported as 19 cm and 16.4 cm respectively (30). The averages of our measurements are in the Table 3. In a study, a correlation between placental weight, diameter, placement and length of umbilical cord has not been found (31). It was reported that, a positive correlation between umbilical cord length and placental weight was identified another study (7). In our study, the direct proportions between the umbilical cord length and the placenta central thickness was determined ($p= 0.04$, $r= 0.143$). The direct

proportions between umbilical cord diameter and placental weight and its all dimensions have been identified. Between the placental weight and cord diameter $p= 0.00$, $r= 0.295$, between the placenta 1. dimension and cord diameter $p= 0.00$, $r= 0.405$, between the placenta 2. dimension and cord diameter $p= 0.00$, $r= 0.354$, between the central thickness of the placenta and cord diameter $p= 0.00$, $r= 0.268$ were identified (Tablo 6). It was reported the newborn group which had Apgar score below 7 was under the average for the length of the umbilical cord (32). In another study it was concluded that short umbilical cord length causes lower Apgar score (33). When Apgar scores are considered, in our study, 1. min Apgar score was unbound with umbilical cord length and diameter. However, 5. min Apgar score was correlated with the umbilical cord length ($p= 0.03$, $r= 0.151$). In addition, 5. min Apgar score was also correlated with the umbilical cord diameter ($p= 0.03$, $r= 0.149$) (Table 7). In terms of umbilical cord measurements (length and diameter), a significant difference could not be found between male and female newborns. The same conclusion was also reported by Jaya's study between male and female newborns (7). Umbilical cord diameter shows a negative correlation (statistically significant but a weak negative correlation) with umbilical cord length ($p=0.00$, $r=-0.227$). When the umbilical cord diameter increases, the length of umbilical cord decreases.

In summary, a negative correlation between the maternal BMI and umbilical cord length was detected. Newborn weight, length, BMI and chest circumference is directly proportional to the umbilical cord diameter. 5. minute Apgar score is directly proportional to the length of the umbilical cord. Umbilical cord length is inversely proportional to umbilical cord diameter. Umbilical cord diameter is directly proportional to placental weight and its all dimensions. Umbilical cord length and diameter is directly proportional to 5.minute Apgar score and placental thickness. Diameter of the umbilical cord affects placental weight and all dimensions directly. However there was a statistically significant but a weak correlation between all datas. Our study revealed that

umbilical cord diameter significantly increases the height, weight, BMI and chest circumference of newborns. Umbilical cord diameter has a positive correlation with plasental size and increases the Apgar score of 5. min. The morphology of umbilical cord affects pregnancy period, mode of delivery and outcomes of the delivery (32). Moreover it may affect the IQ development and neurological conditions in the future (33). Therefore, we believe that cross-sectional and large case series prospective studies should be conducted to explore the importance of umbilical cord length and diameter on fetal and plasental size.

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