Original Article

Analysis of the relationship between umbilical cord placental morphology and anthropometric measurements of the newborn

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ABSTRACT

Objectives: Uteroplacental and maternal environment are the main factors affecting fetal growth and development. We aimed to investigate the relationship between umbilical cord and morphologic characteristics of the placenta and anthropometric measurements of the newborn.

Methodology: The parameters of newborn were recorded. Placenta weight and umbilical chord length were recorded. The umbilical cord vessels diameters were measured.

Results: Of the 303 newborns, 151 (49.8%) were female babies and 152 (50.2%) were male babies. The mean value of birth length was 49.58 ±2.12cm, birth weight 3395 ±459.31g, head circumference 34.26±1.44cm. The mean cord length was 57.54±12.21cm. The mean placental weight was 445.14±88g. The umbilical arteries diameters were 3.86±0.55mm and umbilical vein diameter 2.68±0.55mm. There was a significant positive correlation between cord length and birth weight, head circumference, birth length, placental weight and parity.

Conclusion: There was a significant positive correlation between the mothers age and cord length. There was no significant correlation between newborn sex and placental weight.

KEY WORDS: Birth weight, Head circumference, Umbilical cord, Placenta weight.

Pak J Med Sci April - June 2011 (Part-II) Vol. 27 No. 3 569-573

How to cite this article:

Petekkaya E, Deniz M, Yildiz E. Analysis of the relationship between umbilical cord, placental morphology and anthropometric measurements of the newborn. Pak J Med Sci 2011;27(3):569-573

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* Received for Publication: November 8, 2010

* Revision Received: May 17, 2011

* Revision Accepted: May 20, 2011

INTRODUCTION

Fetal genetic structure, uteroplacental function and maternal environment are the main factors affecting fetal growth and development. Under suitable conditions, a healthy fetus intrauterine completes its somatic growth. Abnormal maternal, fetal or placental factors may have negative effects on fetal growth and development, severally or jointly.[1,2]

Indicators of the measurements which indicate the sufficiency of fetal development include physical characteristics of the newborn, such as birth weight, birth length, head circumference, thoracic circumference and abdominal circumference. However, the most common of these physical characteristics are birth weight, head circumference and birth length.[3] Birth weight is a particularly reliable indicator of intrauterine development and is one of the most

important factors affecting physical and mental development of the baby.[4,5]

The relationship of the placenta with the anthropometric measurements of the newborn has been studied.[6-14] Placental weights are one of several standard placental measures by which placental growth can be characterized.[7] Sanin et al.[8] reported that for each gram increase in placenta weight, birth weight is increased by 1.98 g. Lo et al.[9] reported that there was a positive correlation between placenta weight and newborn weight, newborn height and umbilical cord length.

Although some studies indicated a correlation between umbilical cord and fetal development,[10] other studies suggest that umbilical cord length has no effect on fetal development.[11] Some researchers suggested that umbilical cord length emerged as a response to forces applied on the umbilical cord through fetal movements.[12,13] Naeye[14] reported a significant increase in the frequency of mental and motor dysfunction in children with a short umbilical cord.

The relationships between insertion of umbilical cord to placenta and with fetal measurements were analyzed. No relation was found between birth weight and umbilical cord insertion site.[15] Rath et al[16] analyzed insertion site in hypertensive pregnancies and noticed that only in severe hypertensive cases, the marginal attachment of umbilical cord with 27 % insertion, scored the highest in the series with 42 percent.

Kaplan et al[17] analyzed the relationship between umbilical cord vein diameter and birth weight and found no relationship between umbilical cord vein diameter and birth weight

The purpose of the present study was to analyze the relationship between umbilical cord and morphologic characteristics of the placenta and anthropometric measurements of the newborn.

METHODOLOGY

This study was carried out in 2005–2006 at the Sanliurfa Gynecology and Birth Hospital, Turkey. We have recorded data from 480 pregnant women. Gestational age was determined based on last menstrual period and confirmed by ultrasound within 20 weeks of gestation. Pregnancies complicated by hypertension and diabetes were excluded. Also multiple pregnancies, maternal smokers, delivered by a cesarean section and newborn weight below the 2500g were excluded. Total 303 pregnant women with uncomplicated pregnancy and normal vaginal delivery in term (between 37-40th week of the pregnancy) were included. Only singleton births were included. There was no prenatal death and all infants were chromosomally and anatomically normal.

The gender, birth weight, birth length and head circumference of all 303 singleton newborn were analyzed. Placenta weight was measured after separation of membranes and after the umbilical cord was removed. A scale with 1 gram sensitivity was used for measurement of placenta. Placental disc thickness at the center of the chorionic disc was measured by piercing the disc with a knitting needle and analyzed in units of 0.1cm and placental circumference were measured by a tape measure. The insertion site of the umbilical cord was considered as a circle. Long and short diameters from edges to cord insertion site were measured. The distance from the edge of the placenta to insertion site, attachments up to 2cm were considered to be marginal; while 2-8cm attachments were considered to be lateral and 8cm placenta center attachments were considered to be central.

In measurement of the umbilical cord, the sections in baby and the placenta were measured separately. The length of the umbilical cord was the sum of these two values. For histological analysis, a 2.5cm cross section was taken from the placental insertion section of the umbilical cord. After routine histological analysis, the cross section was stained with hematoxylin and eosin.

The diameters of the umbilical vein and arteries were measured by Zeiss Axioplan 2 microscope using computer imaging. Diameter measurement was achieved using AxioVision software and vein and arteries were imaged by 5 ocular magnification. First, the perimeter of the vein and arteries were measured. Using the formula periphery=2pr, radius was found using the formula r=periphery/2p, and then by multiplying the radius by 2, the diameter was found. General structure of the umbilical cord was analyzed and artery-vein anomaly detection was also carried out.

Statistical analysis was performed using the SPSS 11 statistical program. Pearson correlation analysis was used to assess the correlations between umbilical cord measurements and placental measurements and anthropometric parameters. One-way ANOVA was used to determine relationships between the insertion site of the umbilical cords and anthropometric measurements of the newborns.

RESULTS

Four hundred and eighty pregnant women were studied. Thirty one of them (6.45%) were suffering from hypertension, 29 (6.04%) were maternal

Table-I: Anthropometric characteristics of the newborns.

	Male		*Female*		*Total*
	Range	*Mean ± SD*	*Range*	*Mean ± SD*	*Mean ± SD*
Birth length(cm)	42.00-55.00	49.58 ± 2.12	41.00-55.00	50.02 ± 2.25	49.80 ± 2.19
Birth weight (g)	2000-5300	3395.96 ± 459.31	1900-5300	3510.98 ± 492.95	3453.66 ± 479.17
Head circumference (cm)	30.80-39.00	34.26 ± 1.44	30.30-49.50	34.99 ± 1.99	34.62 ± 6.71

smokers and 25 (5.2%) were diabetics. Three hundred and eighty seven of them (80.6%) were normal vaginal delivery, 93 (19.4%) were delivered by a cesarean section. Of the 480 deliveries, 473 (98.5%) were singleton births, 7 (1.5%) were twins births. In 62 (12.9%) of newborn were low birth weight (LBW).

Total 303 pregnant women were uncomplicated pregnancy and normal vaginal delivery in term. The average age of the 303 women who were included in the study was 26.89±6.22 years (17-44). The average of parity was 3.29±2.51 (1-13). Of the 303 newborns, 151 (49.8%) were female babies and 152 (50.2%) were male babies. Anthropometric characteristics of the newborns are given in Table-I.

A statistically significant relationship was found between umbilical cord and anthropometric characteristics of the newborn. A positive correlation was found between umbilical cord length and birth weight (r=0.233, p<0.001), birth length (r=0.174, P<0.05) and newborn head circumference (r=0.217, P<0.001). In addition, a statistically significant relationship was found between umbilical cord length and placenta weight (r=0.201, P<0.05) and number of births (r=0.158, P<0.05). As umbilical cord length increased, so did placenta weight. The placental measurements presented in Table-II.

The umbilical cord was found to be longer for babies whose mothers who had high number of births. The relationship between umbilical cord length and mother's age was found to be statistically significant (r=0.196, P<0.001). It was observed that the babies of younger mothers had shorter umbilical cord. The umbilical cords measurements are presented in Table-III.

Pearson correlation analysis was used to determine the relationship between placental variables and number of births, age of the mother, gender, newborn weight and birth length. Only the relationship between placenta weight and newborn weight was found to be statistically significant (r=0.543, P<0.001). As newborn weight increased, so did placenta weight. No statistically significant relationship was found between placenta weight and the age of the mother, number of births, newborn gender and height.

The insertion site of the umbilical cords to placenta was found to be central, lateral and marginal, 53.8%, 36%, 10.2%, respectively. The distribution of placental umbilical cord insertion sites is presented in Table-IV. Insertion of the umbilical cord in relation to the newborn parameter was analyzed. No relation was found between anthropometric measurements of the newborn and umbilical cord insertion site.

A significant relationship was found between umbilical vein diameter and birth weight (r=0.318, P<0.001) and placenta weight (r=0.234, P<0.05).

Pearson correlation analysis was used to determine the statistical significance of variables related to umbilical artery diameter. A significant relationship was found only between umbilical artery diameter and placenta weight (r=0.267, P<0.05). Relationship between umbilical artery diameter and other variables wasn't found.

DISCUSSION

It was observed by Ozkan et al[18] that hypertension causes low birth weight. Several studies have reported that smoking during pregnancy causes fetal growth retardation.[19-21] In our study, pregnant women with pregnancy complications, possibly affecting fetal growth were not included. It has been shown that placental weights from caesarean sections were higher than those from vaginal deliveries.[22,23]

Table-II: Placental measurements.

	Male		*Female*		*Total*
	Range	*Mean ± SD*	*Range*	*Mean ± SD*	*Mean ± SD*
Placental weight (g)	159-655	436.56 ± 78.06	274-836	453.66 ± 96.37	445.14 ± 88
Placental circumference (cm)	44-85.5	54.47 ± 5.80	42-86	55.34 ± 5.90	54.90 ± 5.85
Placental thickness (cm)	0.80-2.50	1.58 ± 0.44	0.70-2.60	1.63 ± 0.43	1.61 ± 0.43

Table-III: Umbilical cords measurements.

	Female		*Male*		*Total*
	Range	*Mean ± SD*	*Range*	*Mean ± SD*	*Mean ± SD*
Umbilical cord length (cm)	34-144	57.79 ± 12.23	30.50-101.50	57.29 ± 12.22	57.54 ± 12.21
Artery Diameter (mm)	2.37-4.72	3.82 ± 0.50	2.02-4.96	3.90 ± 0.59	3.86 ± 0.55
Vein Diameter (mm)	2.03-3.84	2.59 ± 0.46	2.23-3.59	2.75 ± 0.33	2.68 ± 0.40

Burkhardt et al[23] reported that birth weights of newborns delivered by caesarean section were lower than those from vaginal deliveries. In our study normal vaginal delivery in term were included.

The effect of umbilical cord length on fetal development has been analyzed by many researchers. It was reported that there was a positive correlation between umbilical cord length and fetal weight.[10,24] However, Walker and Pye[11] suggested that umbilical cord length had no effect on fetal development. Some researchers suggested that umbilical cord length emerged as a response to forces applied on the umbilical cord via fetal movements.[13,24] Naeye[14] reported a significant increase in the frequency of mental and motor dysfunction in children with short umbilical cords. In our study, a positive correlation was found between umbilical cord length and birth weight ($p<0.001$), newborn length ($P<0.05$) and newborn head circumference ($P<0.001$).

Some researchers have reported that umbilical cord lengths of male babies were longer than those of female babies.[2,14,24-26] Jaya et al[27] reported that there was no significant relationship between newborn gender and umbilical cord length. In our study, no statistically significant relationship was found between newborn gender and umbilical cord length.

A positive correlation was reported between parity and umbilical cord length.[15,28] Our results support this finding. We suggest that there is a significant relationship between the parity and umbilical cord length ($P<0.05$).

Morphologic aspects of the umbilical cord have usually been studied and retrospectively correlated with the prenatal outcome. The normative parameters of the umbilical cord may facilitate the identification of large or short umbilical cords associated with fetal growth.

Benishke and Kaufman[29] calculated average placenta weight in 38 W gestations as 470g without the cord and membrane. Little et al[30] calculated placenta weight in term as 476 g. In our study, average placenta weight was found to be 445.14±88g.

In previous studies, a positive correlation was reported between placenta weight and newborn weight, newborn height and umbilical cord length.[9-11,15,27,30] Sanin et al [8] reported that for each gram increase in placenta weight, birth weight is increased by 1.98gr.

In our study a significant relationship was found between placenta weight and umbilical cord length ($P<0, 05$), newborn weight ($P<0.001$). As umbilical cord length increases, so does placenta weight.

Prevalence rates of marginal cord insertions are 9% in singletons.[29] In hypertensive pregnancies Rath et al[16] found the proportion of marginal insertion area as 27% and in classification of hypertension, in pregnant women with acute hypertension, the prevalence of marginal insertion areas was found to be 42% higher. In their studies Woods and Malan [15] found no relationship between birth weight and umbilical cord insertion area. Similarly, in our study no relationship was found between anthropometric measurements of the newborn and umbilical insertion area.

In a study which analyzed the effect of umbilical cord vessels diameter on birth weight, no relationship was found between umbilical cord vessels diameters and birth weight. [17] In our study, a significant relationship was found between umbilical vein diameter, birth weight and placenta weight. When the relationship between umbilical artery diameter and anthropometric measurements of the newborn was analyzed, it was found that there was a significant relationship only between umbilical artery diameter and placenta weight.

Placental measurements have been reported from many countries over the years, but we are not aware of data in Turkey. Placental availability, consistency of placental measurements, and placental ratio's reflection of an independent facet of fetal growth make the placenta a useful research tool. The volume of

Table-IV: Distribution of placental umbilical cord insertion site.

Insertion Site	*n*	*%*
Central	163	53.8
Lateral	109	36
Marginal	31	10.2
Total	303	100

the placenta is directly proportional to the birth weight of the baby. Measurement of the placental volume can be done by the noninvasive technique like ultrasonography and this will be helpful in assessing the development of the baby.

CONCLUSIONS

There was a positive correlation between umbilical cord length and anthropometric measurements of the newborn, placental weight and parity. There was a significant positive correlation between the mothers age and cord length. There was no significant correlation between newborn sex and placental weight. As newborn weight increases, so does placenta weight. Finally, we conclude that the placenta is an indicator of fetal growth for research purposes. The presented reference ranges for umbilical cord, placentas and anthropometric parameters of newborn may be serving as a normative data of Turkish fetuses.

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