Relationship between Umbilical Cord and Anthropometric Measurements of term Newborns : A Preliminary Study

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Abstract - Uteroplacental function and maternal environment are factors affecting fetal growth and development. They have influence on anthropometric measurements (AM) of newborns (NB). Aim of this study is to analyze relationship between umbilical cord (UC) parameters and AM of NB. Total of 52 pregnant women were selected from teaching hospital, Jaffna. Data like parity status, gender, birth weight, birth length, head circumference of NB, length and diameter of UC were taken. It was observed that mean birth weight of male was 3.0026 and female fetus was 2.8556 grams. Mean head circumference is 33.36. Length of NB ranges 39-56cm. Length of UC ranges 50-105cm. A positive correlation was found between length of UC and parity status of mother. UC diameter ranges 7.25-14.75mm. A positive correlation was observed between birth weight and UC diameter of NB. Mean value for UC diameter in male NB is 10.898mm and for female was 9.44mm, it was statistically significant.

Keywords - head circumference, newborn weight, umbilical cord diameter

I. Introduction

Healthy uteroplacental circulation is an important factor in producing a healthy fetus. Placenta is developing from both maternal and fetal component. After four weeks of gestation, the only link between the placenta and the fetus is the umbilical cord. It is a cylindrical structure with two arteries and one vein embedded in the gelatinous Wharton's jelly.

Umbilical cord is playing a role in determining the growth and wellbeing of the fetus [1].

To date several studies have been investigated the umbilical cord morphometry in utero. Nomograms for the diameter of the umbilical vessels have been reported by Weissman et al (1994) [2]. Raio et al (1999) have generated nomograms for sonographic diameter and cross sectional area of umbilical cord in uncomplicated pregnancies and reported a significant relationship between diameter and area of umbilical cord and fetal anthropometric parameters (Biparietal diameter, femur length, abdominal circumference)[3].

Pathological studies have demonstrated that fetuses with a thin umbilical cord on sonography during second and third trimester of gestation are at increased risk of adverse perinatal outcome [4]; [5]; [3]. A thin umbilical cord might be determined by a reduction of the amount of Wharton's jelly, by reduction of umbilical cord vessel's cross-sectional area or by both [5]. Changes or alterations of any of the components of Wharton's jelly have been described in some pathological conditions such as fetal growth restriction [4], fetal distress [6]. Moreover, the presence of a large umbilical cord diameter without alteration of the vessel's diameter has been reported in pregnancies complicated by gestational diabetes [7].

Fetal genetic structure, uteroplacental function and maternal environment are the main factors affecting fetal growth and development.

Indicators of the measurements which indicate that the normalcy 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.

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.

Although some studies indicated a correlation between umbilical cord and fetal development, studies done by Emine at el., (2011) suggest that umbilical cord length has no effect on fetal development[8].

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

II. Objectives

1. To determine normal anthropometric values of the term newborns.
2. To determine the correlation between the umbilical cord length and the parity of mother.
3. To determine the correlation between the umbilical cord diameter and the gender of the newborn.

III. Methodology

It was a descriptive cross sectional study. It was carried out during November 2011-January 2012. Since it was a preliminary study, it was conducted among 52 newborns at Professorial unit of Obstetrics and Gynecology; ward no 21, Teaching hospital Jaffna. Relevant history and data were recorded from mothers of 52 newborns (27 males and 25 females) with uncomplicated pregnancy, aged 20 – 40 years, who deliver by normal vaginal at 37 - 42 gestational weeks. Gestational age was determined based on last menstrual period and the anthropometric values were taken during the time of delivery and the laboratory analysis of umbilical cord parameters was done immediately by the lecturer of Anatomy. It was confirmed by an Anatomist. Pregnancies complicated by hypertension and diabetes were excluded. Also multiple pregnancies, maternal smokers were excluded.

The data like gender, birth weight, birth length, parity status of mother and head circumference of all 52 singleton newborn were taken. Also umbilical cord parameters like cord length and cord diameter were noted.

Birth weight was recorded within half an hour of delivery after the removal of umbilical cord. Length of newborn measured from the crown to heel length.

Head circumference is measured at the most prominence part of the head by taking measurement at the largest circumference of the head by using the measuring tape.

Length of the umbilical cord was measured start from the placenta attachment to the point of insertion of umbilicus in the fetus by using the measuring tape in cm. Nearly 5 cm of straight umbilical cord was dissected in the mid portion of the umbilical cord immediately after the delivery of the placenta and it was washed gently with fresh water to remove the blood clots.

Each 5 cm cord was tagged with a label and sectioned into 5 small pieces by a fine scalpel. Both horizontal and vertical diameter of each sectioned pieces of umbilical cord was measured by using the Vernier Caliper (Fig 1).

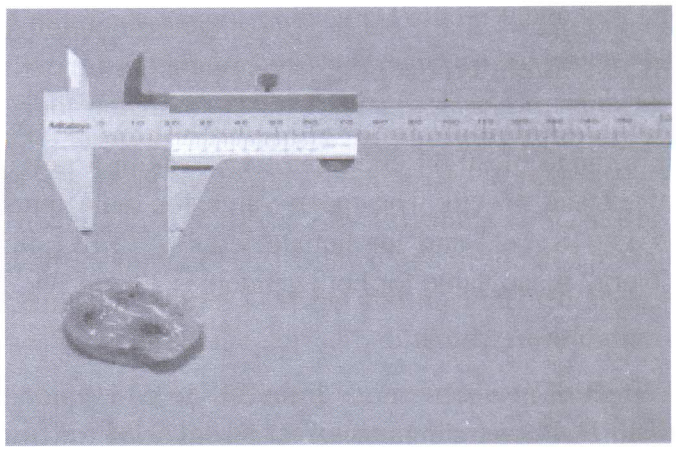

Fig -1 Diameter of the umbilical cord was measured by Vernier caliper

Average diameter of the umbilical cord was studied. Correlation coefficient, t test and one way ANOVA were used to assess the relationship between umbilical cord parameters and anthropometric measures.

IV. Results

Birth weight:

The weight of newborns was in a range of 1560-4100 grams (see Table 1). Percentage of 15.3%newborns (3male & 5 female) were between 1500 -2500grams. Maximum number of newborns 73% (19 males & 19 females) were between the range of 2500- 3500 grams and 11.5% (5 males & 1 female) were in range of 3500- 4500 grams.

Table -1 Weight of newborns with their gender

Weight in grams	Sex		Total
	Male	Female	
<1500			0
1500-1999	1		1
2000-2499	2	5	7
2500-2999	9	11	20
3000-3499	10	8	18
3500-3999	4	1	5
4000-4499	1		1
Total	27	25	52

The mean birth weight of male fetus was 3.0026± 0.535 grams and female fetus was 2.8556±0.391 grams and the difference was not statistically significant (t = 1.122 and p= 0.267) (Fig 2).

Head Circumference:

It was in a range of 30- 36 cm. A total of 78.8% was in a range of 30-34 cm and 21.1% was in a range of 35 and 36 cm. The mean value for male fetus is 33.518±1.22 and for female fetus is 33.2±1.48. Overall mean value for both genders is 33.3±1.34.

Length of newborn:

Length of newborn varies from 39 -56 cm. Among them 71.1% were in range of 50-56 cm, 23% were in range of 45-49 cm, 3.8% were in range of 40-44 cm and 1.9% was 39 cm.

Umbilical cord length:

It ranges from 30-105cm. A total of 11.5% were in range of 30-39cm, 32.6% from 40-49cm, 30.7% range from 50-59 cm, 17.3% from 60-69cm, 1.9% of cord range from 70-79cm and 3.8% have 80-89cm. it was noted a single case(1.9%) of long umbilical cord of length 105cm in a multipara mother.

It was noted that the longer umbilical cord was mostly observed in the multipara women than the primi.

Mean umbilical cord length for primi is 48.35±11.166 cm and the mean umbilical cord length for multipara is 55.034±14.727cm.

The correlation between the umbilical cord length and the parity of mother is significant with one way Anova test (t=0.427 and p= 0.002)

Umbilical cord diameter:

The diameter of the cord was in a range of 7.2 mm -14.7 mm. Out of it, 19.2% (3 male & 7 female) were in the range of 7.25 -< 9mm in diameter.

Maximum number 50% (12 male &14 female) were in the range of 9 -< 11mm, 23% (8 male & 4 female) were in range of 11-<13 mm, 7.69% (only male fetus were in the range of 13-≤14.7 mm. (see Table 2)

The mean diameter of the umbilical cord of the male fetus was 10.898mm (SD 1.92) and mean for female fetus was 9.44mm (SD 1.412), it was statistically significant, t=3.094 and p=0.003 (Fig 3).

Table -2 Diameter of umbilical cord with the gender of the newborns

Cord diameter in mm	Gender	
	Male	Female
< 7		
7- <9	3	7
9-<11	12	14
11-<13	8	4
13-<15	4	
>15		
Total	27	25

It is also noted a positive statistically significant correlation between the birth weight and the umbilical cord diameter of newborns. (r= 0.446 and p= 0.001) (See table 3).

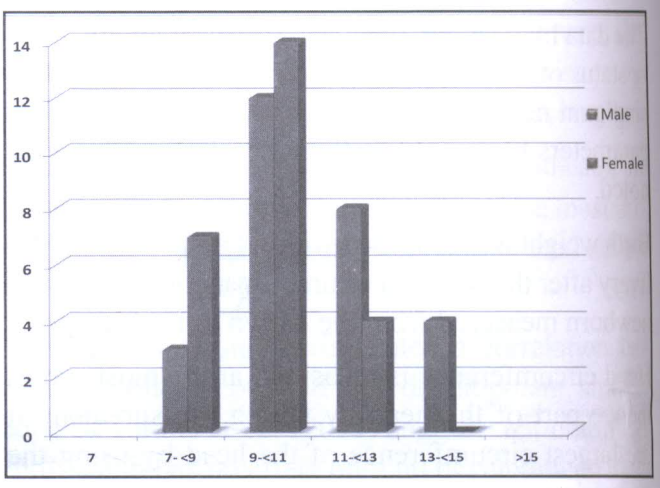

Fig -3.Distribution of umbilical cord diameter and number of male and female newborns.

Table -3 Umbilical cord diameter with the weight of the newborns

Cord diameter in mm	Weight of newborns in grams					
	<1500	1500-1999	2000-2499	2500-2999	3000-3499	3500-4000
<7						
7-<9	1	3	4	2		
9-<11		3	11	10	2	
11-<13			4	5	2	1
13-<15			2	1	1	
>15						
Total= 52	1	6	21	18	5	1

V. Discussion

Placental and umbilical cord measurements have been reported in many countries over the years, but these documented data are lacking in the Jaffna population, Sri Lanka.

A study done by Emine et al.,(2011)at turkey with sample of 303 newborns stated that a positive correlation was found between umbilical cord length and with the following parameters like birth weight ($p<0.001$), newborn length ($P<0.05$) and newborn head circumference ($P<0.001$) [8].

Emine et al.,(2011) suggest that there is a significant relationship between the parity and umbilical cord length ($P<0.05$), which is similar to this study.

Emine et al., (2011) also suggested that there was a significant positive correlation between the maternal age and cord length [8].

Balkawade et al., (2012) stated that the perinatal mortality was more with the short and long cord than with the normal cord[9].

The mature cord must be about 50-60 cm in length and its diameter is 12 mm. Umbilical cord >100 cm is considered as long and < 30 cm as short cords[9].

Study done by Barbieri et al.,(2012) shows that there is a significant, consistent and practically linear increase in the measurements of the diameters of the umbilical artery and vein, the umbilical cord and the cross sectional area of the cord until around 32 weeks of gestational age, after which these measurements remain practically constant until the end of pregnancy [10].

Umbilical cord diameter is easy to measure during pregnancy and has an accurate estimation of the gestational age[11].

Elsafi et al., (2014) stated that umbilical cord diameter is the modality of choice for the assessment of gestational age in the first, second and third trimester of pregnancy[11].

Eze et al., (2014) in Nigeria Teaching Hospital found that the mean umbilical cord diameter is 14.5 mm, which is slightly deviated from the studies done in other countries like Caucasian subjects (mean 15 mm) and Turkish population (mean 20mm)[12].

Although previous large scale studies was done on the anthropometric measurementsof Singalese and Moor newborns in Sri Lanka by Deepthi Nanayakkara et al., (1998) with a sample size of 1325 newborns at the Maternity Unit of the Kegalle, Base Hospital [13] and study by Priyantha et al., (2013) with a sample of 2215 newborns in the hospital of Gampaha district [14] but the documented studies were lacking in the northern districts of Sri Lanka.

Comparison of different studies done in Sri Lanka for birth weight and head circumference was illustrated in Table 4 and 5.

Mean birth weight for the Moor newborns was 3061.11 grams is higher than the Sinhalese newborn whose mean weight is 2852.45 grams in Sri Lanka [13].

Study was done by Fernando et al., (2011) from 108 newborns at the post natal ward and special care baby unit of teaching hospital of Peradeniya and they calculated the average weight of both male and female newborns as 1532 grams [15].

Table -4 Studies done in Sri Lanka for mean and average birth weight of newborns.

Mean weight in grams					
Deepthi in 1998				Periyantha in 2013	
Sinhalese		Moor		Male	female
male	female	male	female		
2869 ± 467	2831 ± 435	3116 ± 3.50	2980 ± 3.65	2.97	2.89

The mean value for head circumference of Sri Lankan newborns reported in previous studies is comparable with this study. In this study, mean value for head circumference is 33.365±1.34which is more or less similar with the study done by Priyantha et al., (2013) [14].

Table -5 Studies done in Sri Lanka for mean value of head circumference of newborns.

Deepthi in 1998				Periyantha in 2013
Sing		Moor		
M	F	M	F	
33.02 ± 1.8	32.72 ±1.84	34.13±1.5	33.14±1.42	33.6 cm

The limitation of this study is the small sample size and it is a preliminary study done at teaching hospital, Jaffna, Sri Lanka for the comparison of relationship between the umbilical cord parameters and the anthropometric values of newborn.

VI. Conclusion

From this study, it was observed that the mean birth weight of male fetus was 3.0026 ± 0. 53 grams and female fetus was 2.8556 ± 0.39 grams.

Mean value of head circumference is 33.365±1.343. These results are similar with other previous studies done in Sri Lanka.

Length of newborn varies from 39 cm -56 cm.The length of umbilical cord varies from 50-105 cm. A significant positive correlation was found between the length of umbilical cord and the parity status of mother.

Umbilical cord diameter was in a range of 7.25 mm -14.75 mm. A total of 50%of newborns have 9 -11mm of diameter.

A positive correlation was observed between the birth weight and the umbilical cord diameter of newborns. It was statistically significant.

Also umbilical cord diameter in male newborns was larger when compared with female newborns. It was statistically significant.

Further large scale studies in Jaffna Peninsula are needed to revalidate these findings.

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