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The effect of Placental Morphometric Measurements on the Newborn's Body Mass Index

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Original Research Article

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Abstract: ***Introduction:*** Placenta is a functional unit between the mother and the foetus. Human placenta is discoid, deciduate, haemochorial, chorioallantoic, labyrinthine and endocrine gland which connects developing embryo by umbilical cord to the endometrium of mother's uterus. It develops from two sources. ***Material and Method:*** This is a prospective study conducted at Department of Anatomy and Physiology, at Tertiary Care Teaching Hospital over a period of 1 year. Inclusion Criteria: Totally, 70 healthy mothers who gave birth to uncomplicated singleton pregnancy, and their new-borns were included in the study. Exclusion Criteria: Subjects with diabetes mellitus, hypertension, anaemia, vascular diseases and multiple pregnancies were excluded in this study. ***Result:*** The New-born body mass index (Kg/m^2) was measured and the majorities (55.7%) of the new-born were within 11-13 followed by 25.7% of the new-born were more than 14 and the lesser proportion of 18.5% was <10 BMI (Kg/m^2). The mean placental weight (in gms) for the female babies <10 BMI (Kg/m^2) were 386.62±45.72. The Mean placental weight (in gms) for the male and female babies of BMI 11-13 (Kg/m^2) were 398.53±43.74 and 478.63±49.48 respectively. The mean placental diameter (in cms) for the female babies of <10 BMI (Kg/m^2) were 14.64±1.23. The mean placental diameter (in cms) for the male and female babies were 15.64±1.53 and 16.64±1.42 respectively of BMI of 11-13 (Kg/m^2). Moreover, mean placental diameter (in cms) for the male and female babies were 17.54±1.67 and 16.68±1.86 respectively of BMI of 11-13 (Kg/m^2). ***Conclusion:*** This study confirms that morphometric observation of placenta is associated with foetal weight. So, an early examination of not only the fetus, but also the placenta by non-invasive techniques like ultrasonography will be helpful to predict and to avoid low birth weight babies with better preventive measures. This study will also make the physicians and researcher to focus on the placenta.

Keywords: Placental Morphometric, Body Mass Index, New-born.

INTRODUCTION

Placenta is a functional unit between the mother and the foetus. Human placenta is discoid, deciduate, haemochorial, chorioallantoic, labyrinthine and endocrine gland which connects developing embryo by umbilical cord to the endometrium of mother's uterus. It develops from two sources. [1] The fetal component which is the principal component develops from chorion frondosum and the maternal component from decidua basalis. The fetal surface is smooth, covered by amnion and presents the attachment of the umbilical cord close to its centre. [2] The maternal surface is rough, irregular and spongy and is mapped out into 15-20 convex polygonal areas known as lobes or cotyledons which are limited by fissures [3].

The peripheral margin is continuous with the foetal membrane which consists from outside inwards of fused deciduas parietalis and capsularis, chorion laeve and amnion [4]. The placenta is usually attached to the upper part of the body of the uterus encroaching to the fundus adjacent to the anterior or posterior wall with equal frequency. Placenta separates after the birth of the baby and the line of separation is through the decidua spongiosum. [5] In the first trimester, growth of the placenta is more rapid than of the foetus, but by 17 weeks, placental and fetal weights are approximately equal. It occupies 30% of uterine wall. At term the placental weight is approximately 1/6th of the fetal weight. [6]

The placenta responds to cues in the pregnancy environment through morphological and functional

changes in an effort to maintain proper fetal growth and development [7]. For example, delayed maturation of the placenta has been observed in response to increasing maternal BMI [8]. This altered placental maturity may result in poor gas and nutrient exchange at the maternal-fetal interface and, subsequently, suboptimal infant outcomes [9]. For example, delayed placental maturation, including the persistent thickness of vasculosyncytial membranes, forfeits optimal gas exchange and has been associated with placental insufficiency and fetal macrosomia [10].

While the effects of maternal undernutrition on placental maturity are less studied, animal models of undernutrition have shown evidence of abnormal placental vascularization, which may have functional consequences. [11] Histomorphology of the placenta ultimately determines placental function, and histological markers of placental maturity and morphometry are thus clinically useful and may reveal mechanisms underlying poor offspring outcomes in the context of suboptimal maternal BMI. [12] Yet, the limited evidence on the effect of suboptimal maternal BMI on placental maturity and morphometry stems predominantly from complicated pregnancies, while the effects of suboptimal maternal BMI alone on placental histomorphology remain unclear.

MATERIAL AND METHOD

This is a prospective study conducted at Department of Anatomy and Physiology, at Tertiary Care Teaching Hospital over a period of 1 year.

Inclusion Criteria: Totally, 70 healthy mothers who gave birth to uncomplicated singleton pregnancy, and their new-borns were included in the study.
Exclusion Criteria: Subjects with diabetes mellitus, hypertension, anaemia, vascular diseases and multiple pregnancies were excluded in this study.

With the mothers' consent the freshly delivered placentas were examined consecutively until the sample size of 70 was achieved. The mothers were weighed prior to delivery (with 12 kg deducted to give pre-pregnancy weights) and their BMIs calculated. The nurse-midwife who delivered the placenta gave it to the researcher who cleaned off the blood using running tap water. The placenta was put in a plastic bag and weighed, using a scale which recorded to 0.01 kg, after the umbilical cord was cut 3 cm from the neonate (after the cord had been measured). Cord length was considered short when< 32 cm and long when>70 cm.

Statistical Analysis

Data management and analysis were performed using Statistical Package for Social Sciences (SPSS) version 20 and the results presented in frequency tables; bivariate analyses were conducted to determine the effects of maternal BMI on placental morphology and foetal birth weight.

RESULT

In our study, the majority of (54.2%) were in the age group between 18 – 24 years while the rest were (32.8%) in the age group between 25 – 31 years, (12.8%) in the age group between 32 – 38 years in table 1.

Table 1: Distribution of Age group

Age years	Frequency	Percentage
18-24	38	54.2
25-31	23	32.8
32-38	9	12.8
Total	70	100

Table 2: Distribution of Babies Gender

Gender	Frequency	Percentage
Male Babies	47	67.1
Female Babies	23	32.8
Total	70	100

In table 2, of the 70 new-borns were 67.1% male babies and 32.8 % were female babies in Table 2.

Table 3: Distribution of Parity

Parity	Frequency	Percentage
Primipara	33	47.1
Multipara	37	52.8
Total	70	100

Table 4: Distribution of body mass index of New-born

Body mass index of new-born (Kg/m^2)	Frequency	Percentage
<10	13	18.5
11-13	39	55.7
>14	18	25.7
Total	70	100

The New-born body mass index (Kg/m^2) was measured and the majorities (55.7%) of the new-born were within 11-13 followed by 25.7% of the new-born were more than 14 and the lesser proportion of 18.5% was <10 BMI (Kg/m^2) in Table 4.

Table 5: Comparison of body mass index of new born and mean placental weight

Body mass index of new-born (Kg/m^2)	Placental weight (in gms) Mean ±SE	
	Male	Female
<10	-	386.62±45.72
11-13	398.53±43.74	478.63±49.48
>14	537.64±44.82	532.52±53.63

The mean placental weight (in gms) for the female babies <10 BMI (Kg/m^2) were 386.62±45.72. The Mean placental weight (in gms) for the male and female babies of BMI 11-13 (Kg/m^2) were 398.53±43.74 and 478.63±49.48 respectively. In addition, Mean placental weight (in gms) for the male and female babies of BMI >14 (Kg/m^2) were 537.64±44.82 and 532.52±53.63 respectively in Table 5.

Table 6: Comparison of body mass index of new born and mean placental weight

Body mass index of new-born (Kg/m^2)	Placental weight (in cms) Mean ±SE	
	Male	Female
<10	-	14.64±1.23
11-13	15.64±1.53	16.64±1.42
>14	17.54±1.67	16.68±1.86

The mean placental diameter (in cms) for the female babies of <10 BMI (Kg/m^2) were 14.64±1.23. The mean placental diameter (in cms) for the male and female babies were 15.64±1.53 and 16.64±1.42 respectively of BMI of 11-13 (Kg/m^2). Moreover, mean placental diameter (in cms) for the male and female babies were 17.54±1.67 and 16.68±1.86 respectively of BMI of 11-13 (Kg/m^2) in Table 6.

DISCUSSION

Placenta plays a key role in the development of fetus in the utero but still it receives less attention throughout the pregnancy in contrast to the foetal weight. Though many factors like race, genetic and health problems of the pregnant women determines the placental and fetal growth but still the morphometry examination of placenta will give a valuable information about the status of the foetal well being and also helpful in the management of complications in mother and the new-born. [13] Hence in the present study morphometry examination of placenta which includes weight, number of cotyledons, maternal and foetal surface area, site of umbilical cord insertion of normal and low birth weight babies were carried out in the Union territory of Puducherry, India.

The placenta supplies nutrients to the fetus depend on its size, morphology, blood supply and transporter abundance. During normal pregnancy, the placenta undergoes a variety of physiological changes, regulated by angiogenic factors, hormones and nutrient-related genes, to maximize efficiency for an ever-increasing demand for nutrients. [14] Variation in the size of the placenta may affects its function, in particular the ability to transfer nutrients to the fetus via changes in the exchange surface area, in general, small placentas are associated with small fetuses. [15] The size of the placental is affected by maternal factors, such as Body Mass Index, gestational weight gain, smoking, as well as various other medical and socio-demographic factors. [16]

The etiology of low birth weight is multi-factorial; with genetic, placental, fetal and maternal factors interplaying with each other. Despite the observed link between maternal health, placenta and newborn health, any kind of placental study is not routinely performed in hospitals. However, a study focused at least on the placenta of low birth weight babies will shed light on the causative factors and will help in the better understanding of the etiology. [17] Hence the present study is undertaken to analyze the spectrum of morphometric changes in placenta and its relation with birth weight of full term new-borns. In the present study, the mean placental weight (in gms) for the female babies <10 BMI (Kg/m^2) were 386.62±45.72. The Mean placental weight (in gms) for the male and female babies of BMI 11-13 (Kg/m^2) were 398.53±43.74 and 478.63±49.48 respectively. In

addition, Mean placental weight (in gms) for the male and female babies of BMI >14 (Kg/m^2) were 537.64±44.82 and 532.52±53.63 respectively.

The mean placental diameter (in cms) for the female babies of <10 BMI (Kg/m^2) were 14.64±1.23. The mean placental diameter (in cms) for the male and female babies were 15.64±1.53 and 16.64±1.42 respectively of BMI of 11-13 (Kg/m^2). Moreover, mean placental diameter (in cms) for the male and female babies were 17.54±1.67 and 16.68±1.86 respectively of BMI of 11-13 (Kg/m^2). Surya Babu et al studied 50 placentae of low birth weight babies and found that the placental parameters like weight and size of the placenta were significantly less than normal in low birth weight deliveries [18].

In the present study placental weight, maternal and fetal surface area and insertion of umbilical cord at centre were significantly reduced in the low birth weight babies. Reduction in the morphometry of placenta observed in the present study may associate with altered fetal nutrient and hormone supply, which in turn may reduce the foetal weight. [19] Early evaluation of placenta by sonography, in addition to the routine use of uterine artery doppler may be a valuable tool to help in predicting low birth weight infants in the uterus itself and it might helpful to avoid low birth weight. [20]

CONCLUSION

This study confirms that morphometric observation of placenta is associated with foetal weight. So, an early examination of not only the fetus, but also the placenta by non-invasive techniques like ultrasonography will be helpful to predict and to avoid low birth weight babies with better preventive measures. This study will also make the physicians and researcher to focus on the placenta.

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