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EVALUATION OF MATERNAL BODY MASS INDEX ON PLACENTAL MORPHOLOGY AND FOETAL BIRTH WEIGHT

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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. The placenta responds to cues in the pregnancy environment through morphological and functional changes in an effort to maintain proper fetal growth and development. For example, delayed maturation of the placenta has been observed in response to increasing maternal BMI. This altered placental maturity may result in poor gas and nutrient exchange at the maternal-fetal interface and, subsequently, suboptimal infant outcomes.

Material and Method: This is a prospective study conducted in the Department of Anatomy at Index Medical College over a period of 2 year. Totally, 217 healthy mothers who gave birth to uncomplicated singleton pregnancy, and their new-borns were included in the study. With the mothers' consent the freshly delivered placentas were examined consecutively until the sample size of 184 was achieved. The mothers was weighed prior to delivery (with 12 kg deducted to give pre-pregnancy weights) and their BMIs calculated. The Naked birth weight is measured immediately after birth using electronic weighing scale and plotted in WHO Growth curve and based on which babies are classified as AGA, SGA and LGA.

Results: Of the 217 new-borns were 55.76 % male babies and 44.23 % were female babies. The New-born body mass index (Kg/m^2) was measured and the majorities (45.16%) of the new-born were within 11-13 followed by 31.33% of the new-born were more than 14 and the lesser proportion of 23.50% was <10 BMI (Kg/m^2). The mean placental weight (in gms) for the female babies <10 BMI (Kg/m^2) were 374.74±39.50 . The Mean placental weight (in gms) for the male and female babies of BMI 11-13 (Kg/m^2) were 373.41±55.53 and 481.63±49.38 respectively. In addition, Mean placental weight (in gms) for the male and female babies of BMI >14 (Kg/m^2) were 549.52±64.63 and 546.53±52.39 respectively.

Conclusion: Placental provides an overview of placental function. Moreover, it encapsulates numerous factors, such as placental exchange surface area, transporter density and activity, and blood flow Placental measure rates, which all require more detailed individual stereological, molecular, and physiological research. In the present study, the BW/PW ratio was higher in term than preterm, reflecting the high demand of the fetus across the entire pregnancy.

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 in the Department of Anatomy at Index Medical College over a period of 2 year.

Inclusion Criteria: Totally, 217 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 217 was achieved. The mothers was weighed prior to delivery (with 12 kg deducted to give pre-pregnancy weights) and their BMIs calculated.

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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.

ANTHROPOMETRIC MEASUREMENTS

1. BIRTH WEIGHT: The Naked birth weight is measured immediately after birth using electronic weighing scale and plotted in WHO Growth curve and based on which babies are classified as AGA, SGA and LGA.

2. BMI Babies: BMI is calculated using formula weight (kg)/ length (meter)2 and based on BMI newborns are classified as malnourished with cut-off

Statistical Analysis

Data management and analysis was 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.

Results

Table 1: Distribution of Babies Gender

Gender	**Frequency**	**Percentage**
Male Babies	121	55.76
Female Babies	96	44.23
Total	217	100

In table 1, of the 217 new-borns were 55.76 % male babies and 44.23 % were female babies.

Table 2: Distribution of Parity

Parity	**Frequency**	**Percentage**
Primipara	84	38.70
Multipara	133	61.29
Total	217	100

Table 3: Distribution of body mass index of New-born

Body mass index of new-born (Kg/m^2)	**Frequency**	**Percentage**
<10	51	23.50
11-13	98	45.16
>14	68	31.33
Total	217	100

The New-born body mass index (Kg/m^2) was measured and the majorities (45.16%) of the new-born were within 11-13 followed by 31.33% of the new-born were more than 14 and the lesser proportion of 23.50% was <10 BMI (Kg/m^2) in Table 3.

Table 4: 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	364.65±47.71	374.74±39.50
11-13	373.41±55.53	481.63±49.38
>14	549.52±64.63	546.53±52.39

The mean placental weight (in gms) for the female babies <10 BMI (Kg/m^2) were 374.74±39.50 .

The Mean placental weight (in gms) for the male and female babies of BMI 11-13 (Kg/m^2) were 373.41±55.53 and 481.63±49.38 respectively. In addition, Mean placental weight (in gms) for the male and female babies of BMI >14 (Kg/m^2) were 549.52±64.63 and 546.53±52.39 respectively in Table 4.

Table 5: Comparison of mean placental diameter **of new born**

Body mass index of new-born (Kg/m^2)	**Mean placental diameter (in cms) Mean ±SE**	
	Male	**Female**
<10	-	13.53±2.25
11-13	14.52±2.34	15.52±2.62
>14	16.34±2.53	16.72±2.25

The mean placental diameter (in cms) for the female babies of <10 BMI (Kg/m^2) were 13.53±2.25. The mean placental diameter (in cms) for the male and female babies were 14.52±2.34 and 15.52±2.62 respectively of BMI of 11-13 (Kg/m^2). Moreover, mean placental diameter (in cms) for the male and female babies were 16.34±2.53 and 16.72±2.25 respectively of BMI of 11-13 (Kg/m^2) in Table 5.

Discussion

As expected, weight, largest diameter, smallest diameter, and thickness of the placenta were positively associated with BW. In addition, four PMs explained 50% of the birth weight (BW) variability, yet only placental weight (PW) and smallest diameter showed statistical significance. [13] In contrast, an American study with a similar methodology found that the adjustment for covariates diminished the power of association between PM and BW. [14] This finding suggests a wide variation in placental efficiency, which corroborates previous data. [15]

The caloric intake and dietary composition during pregnancy affect the size of the human placenta at term29. It is positively related to maternal BMI across the normal spectrum. The smallest diameter was more strongly correlated to BW than the largest diameter in the three models. Other studies have also found this difference. Previous research has concluded that the smallest diameter is more sensitive to the pregnancy nutritional status than the largest one. [16] Barker et al. identified that placental growth along the major axis is qualitatively different from growth along the minor axis. They postulated that the minor axis is more important for nutrient transfer to the fetus, partially explaining current results. [17] A previous study revealed that neonatal ponderal index, head, chest, abdomen, and thigh circumferences are all highly associated with placental breadth, while none of them are related to placental length30. Freedman et al. found that the surface area had more impact on BW than other PM. [18]

The surface area of the maternal-fetal interface increases in line with PW during pregnancy due to the growing length and branching of the fetal villi. Besides, the mean chorionic plate eccentricity could explain the round placental shape predominance (77%). In addition, this may have contributed to 74.5% of the newborns being classified as appropriate for gestational age (AGA). This is also consistent with the hypothesis that tissue along the smallest diameter plays a key role in nutrient transfer from mother to fetus. [19]

At present, data show that elliptical placentas tend to be less efficient than circular ones, yet more research is necessary to understand the underlying biological reasons. The degree to which a placenta deviates from being perfectly round has a predictive value for specific diseases. A suitable explanation is that placental shape is a proxy indicator of placentation processes related to its transport and other physiological functions. [20] Previous studies conclude that a placenta with a

low average thickness has decreased functional efficiency, leading to a smaller newborn for a given PW. [21]

However, this and another Latin American study have found a low explanatory power of BW by placental thickness. [22] The speculated reason is that this measurement incompletely captures the variability that characterizes the human placenta. Fetal growth restriction (FGR) has been associated not only to PW and length but also to other gross morphological changes such as type of placental cord insertion and presence of knots in the umbilical cord. [23]

Conclusion

Placental efficiency is a amount of fetal body mass accumulated per gram of placenta, is a key indicator of the resilience and susceptibility of the offspring to chronic diseases in later life. It also provides an overview of placental function. Moreover, it encapsulates numerous factors, such as placental exchange surface area, transporter density and activity, and blood flow Placental measure rates, which all require more detailed individual stereological, molecular, and physiological research. In the present study, the BW/PW ratio was higher in term than preterm, reflecting the high demand of the fetus across the entire pregnancy.

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