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Influence of maternal parameters on the morphometry of hypertensive and normotensive placenta

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ABSTRACT

The placenta is an essential component for maintaining pregnancy and the proper development of the fetus. Among the complications of pregnancy hypertensive disorders ranks first worldwide for maternal mortality and morbidity. Throughout gestation, placenta undergoes a lot of changes in its morphology and morphometric parameters. The aim of the present study to examine the effect of maternal parameters such as age, parity, height, pre-gestational weight, BMI and a gestational week on placental morphology and morphometric parameters. 80 pregnant women aged between18-40, parity1 - 4, gestational age between 37weeks-40weeks, who attended the antenatal clinic of the hospital and delivered by either vaginal route or caesarean section were included. Placental and maternal parameters were assessed using standard methods. In the present study pre-gestational weight shows a significant positive correlation with the thickness in both groups and significant negative correlation with the placental diameter in the normal placenta Height of the mother also shows a statistically significant negative correlation with the number of maternal cotyledons. Positive as well as negative correlation exists among variables. Longitudinal studies in more samples are required, and results cannot be generalized. Examination placental parameters and its correlation with the maternal parameters will help to manage future pregnancies, fetal outcome and maternal health.

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INTRODUCTION

The placenta is an essential component for maintaining pregnancy and the proper development of the fetus (F. K. Addai 1997). Its integrity reflects how the fetus survived in the intrauterine environment and gives a proper record of the antenatal period. The proper examination of the placenta will also give an idea about future health risks for mother and baby. The placenta contains components from both the mother and the fetus. It is the main channel of nutrient transfer to the growing fetus and also has a respiratory, excretory, endocrine and immunological function. There is a very close association exists between embryo and mother. So, in the case of placental mammals, there is a coexistence of two genetically different individuals happens for a long period. This will create some potential problems (D. R. J. Bainbridge 2000). Any disorders of pregnancy which in turn can be influenced by so many factors such as environmental, genetic or socio demography will have an impact on placenta as well as the neonatal outcome.

Among the complications of pregnancy hypertensive disorders ranks first worldwide for maternal mortality and morbidity (Gupta G 2018). 287,000 women die each year worldwide associated with pregnancy-related complications among which 10-15% is due to preeclampsia, 2-8% of all pregnancies affected by preeclampsia globally (WHO, UNICEF, UNFPA 2012). The etiology still unclear it can be due to hypoxia, oxidative stress, immune response. Imbalance in angiogenesis, placental genes, insulin resistance etc. (Ahn H.,1989; Fong FM.,2014; Solomon CG& Seely EW 2001; Fisher SJ 2015). Null parity, advanced maternal age, overweight/obesity, chronic hypertension, diabetes, previous preeclampsia, family history of preeclampsia, long time since previous pregnancy, and multiple pregnancies are important risk factors (Duckitt K& Harrington D 2005). For the proper development of the fetus, there should be a proper balance in the growth of fetus and growth of placenta if there is any distraction happens to this due to any maternal environment there will be an increased risk in future for cardiovascular diseases, immunological and metabolic disorders in adult life. Maternal factors can influence the placental structure and in turn fetus. Throughout gestation, placenta undergoes a lot of changes in its morphology and morphometric parameters. Therefore, having knowledge of extrinsic predisposing factors such as maternal and environmental factors may help in early diagnosis, prompt intervention and better management, which can ultimately lead to good obstetric care during complication related to pregnancy. Maternal race and ethnicity can also influence the outcome of hypertensive disorders of pregnancy (Goodwin AA &Mercer BM 2005). These aspects call for the collection of high-quality data to study overweight and obesity as risk factors of preeclampsia in indigenous Indian women. Sowe aimed to examine the association between age, parity pre-pregnancy weight, post-pregnancy weight, MI, and development of preeclampsia in a rural setting in Kerala. The aim of the present study to examine the effect of maternal parameters such as age, parity, height, pre-gestational weight, BMI and a gestational week on placental morphology and morphometric parameters.

MATERIALS &METHODS

Study design: Comparative descriptive study with analytical components.

Study setting: placenta collected from the Department of Obstetrics and Gynecology and the study conducted in the Department of Anatomy, P. K. Das Institute of Medical Sciences, Kerala.

Study Participants: 80pregnantwomen aged between18-40, parity1 - 4, gestational age between 37weeks-40weeks, who attended the antenatal clinic of the hospital and delivered by either vaginal route or caesarean section were included. Among 80 pregnant women 40 were normotensive and40 were hypertensive and Placentas from them collected immediately after delivery. Informed consent was taken from mothers. Medical, social and obstetric history was taken from the medical records, and clinical investigations of the mother were noted. The following criteria were used for selecting the participants.

Inclusion criteria

Group1- All control subjects had no history of raised blood pressure at any stage during their life and had no evident proteinuria or any other complications prior to the pregnancy.

Group 2-Hypertensive woman who had a history of hypertension before pregnancy or during the first 20 weeks of gestation and who had consistently recorded SBP and DBP of 140 and 90 mm Hg, respectively and with or without proteinuria.

Exclusion criteria

Pregnant women who did experience any complication during pregnancy like Diabetes. Mellitus, hypothyroidism, anaemia, abruption-placentae, multiple pregnancies, jaundice were excluded from the study.

Maternal parameters assessed

Age, parity height, pre-gestational weight, BMI, gestational weight gain, gestational week were assessed using standard methods mentioned in the literature.

Placental parameters assessed

Weight, diameter, surface area, thickness and shape of the placenta was assessed using standard methods (Pryse DJ et al.,1973).

Ethical consideration: The study protocol was approved by the institutional human ethical committee of P.K. das Institute of Medical Sciences, Kerala, India. (CRF/CRL/P11-1/Ph.D.)

Data analysis

Data were analysed using SPSS 23.0. Pearson's correlation coefficient r. Significance levels less than0.05(P-value <0.05). The degree of correlation between the Maternal parameters and some relevant placental parameters via weight, area, thickness, diameter and shape, cord insertion, membrane attachment and number of cotyledons were analysed using Pearson's correlation coefficient r.

RESULTS

Table 1 shows the age, pre-gestational weight and BMI shows a negative correlation in 2 groups except for height which shows positive correlation in

PIH with a diameter of the placenta. Pregestational weight shows a statistically significant negative correlation with p-value 0.04 in the normal group. Gestational week shows positive correlation but not statistically significant. Age, pre-gestational weight and BMI shows a negative correlation in 2 groups except for height which shows positive correlation in PIH with a surface area of the placenta, Gestational week shows positive correlation but not statistically significant (table 2). Age, height and gestational week show a negative correlation in normal group and positive correlation in PIH group except gestational week which shows negative correlation but not statistically significant. Pregestational weight shows a statistically significant positive correlation with the thickness in both group p-value 0.04 in normal and p-value 0.05 in PIH. and BMI shows positive correlation in both groups (table 3). Age, height, pre-gestational weight and BMI shows negative correlation and gestational week shows a positive correlation with placental weight in the normal group but shows a negative correlation in PIH group, statistically not significant (table 4). Age, height, pregestational weight shows a negative correlation with a number of cotyledons in normal group and gestational week and BMI shows a positive correlation with the number of cotyledons. Height shows a statistically significant negative correlation with p-value 0.01. In PIH group Age, height, pregestational weight shows a positive correlation with a number of cotyledons in normal group and gestational week and BMI shows a negative correlation with a number of cotyledons, statistically not significant (table 5).

DISCUSSION

In present study out of 40 cases 32 were primi and 8 cases multiparous. Pre-pregnancy BMI more in PIH cases compared to the normal pregnancies and this similar with the study conducted by Mamoru Morikawa et al., 2013 in Japanese women and reported PIH was more frequent in nulliparous women than multiparous. It also linearly increased with increasing maternal age. While considering pre-pregnancy BMI categories, the lowest frequency (2.7%) among lean (BMI < 18.5) women 20 – 34 years of age and the highest frequency (21.7%) among obese (BMI ≥ 30) women ≥ 40 years of age. Compared to those with normal BMI, overweight and obese women had a higher risk of preeclampsia. While underweight women had a lower risk Pre-pregnancy maternal overweight and obesity were associated wi.th an increased risk of preeclampsia in Tanzania. Risks were similar to those reported in high-income countries ((Dorah M et al.,2018). PIH is most frequently appearing in young primiparas and adult multiparas. Pregnancies with PIH, really often there were negative ending of previous pregnancies (Jasovic S E et al., 2011). In the present study, no association exists between the placental morphology such as shape, cord insertion, membrane attachment to the material parameters such as age, parity, height, pregestational weight, BMI, gestational weeks, in both the normal and PIH group.

Although placental weight is easily and reliably measured and often mirrors problems of fetal growth and development. Placental weight is a gross summary, unable to explain the biological and mechanical information. A multi-dimensional measure of placental growth provides more knowledge into the underlying mechanism of fetal adaptation and the gestational intervals at which the changes occur in the placenta (Baptiste KR et al., 2008). Factors influencing placental weight include parity, maternal height and weight, and serum ferritin concentration placental weight is a good pointer of birth size (weight, length and HC) and helps forecast childhood growth in full-term infants. Placental weight, as an indicator of fetal nutrition, can select thriving genes prenatally and hence can affect natal and postnatal growth (Ashraf TS et al.,2013). In our study in a normal group, placental weight has a negative correlation with Age, height, pre-gestational weight and BMI and gestational week shows a positive correlation. In PIH Age, height, pre-gestational weight and BMI show positive correlation and gestational week shows a negative correlation with the placental weight, statistically not significant. Haavaldsen C 2011 found an association between increased placental weight and maternal age; the mean placental weight increased with maternal age: 647.1 g in women below the age of 20 years and 691.3 g in women aged 45 years or older. and this finding may be important in understanding the causes of adverse events associated with high maternal age. According to studies of D. G. Altman et al., 1992 is a slight increase in mean placental weight with increasing parity with a reduction at parity of 3 Maternal heights did not show a positive correlation with placental weight Factors influencing placental weight includes gestational age. Factors influencing placental weight include gestational age. In the present study, there is no association exists between the parity and any of placental indices. Placental weight increases in neonates geometrically (proportionately) with gestational age and descend with the order of parity. The influence of maternal factors on placental weight has been studied by Nicholls V &Nye EB 2015. Placental weight correlates increasingly closely with maternal pregnant weight, non-pregnant weight, and weight-for-

Table 1: Correlation of age, height, pre-gestational weight and a gestational week with a diameter (*P<0.05 is significant)

	Normal		PIH	
	Pearson correlation coefficient (r)	P value	Pearson correlation coefficient (r)	P value
Age	-0.028	0.865	-0.080	0.625
Height	-0.158	0.331	0.102	0.530
Pregestational weight	-0.320	0.044*	-0.083	0.611
Gestational week	0.274	0.087	0.129	0.428
BMI	-0.159	0.327	-0.105	0.520

Table 2: Correlation of age, height, pre-gestational weight and a gestational week with surface area

	Normal		PIH	
	Pearson correlation coefficient (r)	P value	Pearson correlation coefficient (r)	P value
Age	-0.018	0.911	-0.071	0.662
Height	-0.143	0.380	0.107	0.510
Pregestational weight	-0.300	0.060	-0.082	0.615
Gestational week	0.280	0.080	0.109	0.505
BMI	-0.140	0.389	-0.084	0.607

Table 3: Correlation of age, height, pre-gestational weight and a gestational week with a thickness

	Normal		PIH	
	Pearson correlation coefficient (r)	P value	Pearson correlation coefficient (r)	P value
Age	-0.236	0.142	0.141	0.386
Height	-0.116	0.475	0.168	0.301
Pre gestational weight	0.045	0.782	0.303	0.057
Gestational week	-0.213	0.186	-0.074	0.649
BMI	0.066	0.686	0.255	0.607

Table 4: Correlation of age, height, pre gestational weight and a gestational week with placenta weight

	Normal		PIH	
	Pearson correlation coefficient (r)	P value	Pearson correlation coefficient (r)	P value
Age	-0.256	0.110	0.33	0.842
Height	-0.022	0.892	0.098	0.548
Pre gestational weight	-0.041	0.802	0.256	0.111
Gestational week	0.273	0.089	-0.046	0.780
BMI	-0.071	0.918	0.203	0.209

Table 5: Correlation of age, height, pre gestational weight and a gestational week with cotyledons

	Normal		PIH	
	Pearson correlation coefficient (r)	P value	Pearson correlation coefficient (r)	P value
Age	-0.100	0.538	0.051	0.753
Height	-0.427	0.006	0.081	0.914
Pre gestational weight	-0.069	0.671	0.204	0.207
Gestational week	0.184	0.255	-0.053	0.746

height; it correlates more closely with all of these than with the baby's birth weight. Maternal obesity has a significant effect on placental weight independent of the possible fetal effect. Abnormal BMI and placental growth are independent risk factors for a range of pregnancy complications (Wallace JM et al.,2012). There were no differences in placental weight or morphometry between adult and teenage pregnancies., unable to detect any major differences in placental size or composition between growing and non-growing teenagers. Birthweight: placental weight ratio was higher in growth compared to non-growing teenagers. This suggests that maternal growth may affect placental function rather than development; maternal growth was not detrimental to fetal growth (Hayward CE et al.,2011). They hypothesized that placental nutrient transporter activity would be affected by maternal age and growth status. The significant correlation between mothers' weight and placental weight and between the placental weights and infants BMI at birth supported the idea that heavier mothers have larger placentas and consequently have larger babies. In addition, placental weights were correlated significantly with BMI of these infants during their early childhood. Effect of maternal weight (nutrition) on fetal and infantile growth can be mediated, at least partially, through the placenta weight and size (Ashraf TS et al.,2013). In favor of this view, in equids, maternal size has been shown to interact with both the maternal and fetal genotypes to control the rate and extent of fetal growth by influencing the gross area of the diffuse allantochorion, and the density, complexity and depth of the micro cotyledons on its surface. In mice, the adaptation in placental nutrient transfer capacity to meet fetal growth demands depends on placental size (AllenWR et al.,2002). JadhavBhaudas Khanderao 2016 in western Maharashtra reported no statistical association between placental weight and maternal and fetal parameters, though there is the numerical difference.

Age, height and gestational week show a negative correlation in normal group and positive correlation in PIH group except gestational week which shows negative correlation but not statistically significant. Pregestational weight shows a statistically significant positive correlation with the thickness in both group p-value 0.04 in normal and p-value 0.05 in PIH. And BMI shows positive correlation in both groups. Age, pre-gestational weight and BMI shows a negative correlation in 2 groups except for height which shows positive correlation in PIH with a diameter of the placenta. Pregestational weight shows a statistically significant negative correlation with p-value 0.04 in the normal group. Gestational week shows positive correlation but not statistically significant. Age, pre-gestational weight and BMI shows a negative correlation in 2 groups except for height which shows positive correlation in PIH with a surface area of the placenta, Gestational week shows positive correlation but not statistically significant. Age, height, pregestational weight shows a negative correlation with a number of cotyledons in normal group and gestational week and BMI shows a positive correlation with a number of cotyledons. Height shows a statistically significant negative correlation with p-value 0.01. In PIH group Age, height, pregestational weight, BMI shows a positive correlation with a number of cotyledons and gestational week shows a negative correlation with a number of cotyledons, statistically not significant. In normal - strong negative correlation exists between height and number of cotyledons with p-value 0.01, so as height increase there is a reduction in a number of cotyledons. Careful attention to placenta growth during pregnancy, for example by ultrasonography, can guide physicians to assess neonatal health (Afodun AM 2015). Differences in a hormonal environment in the utero and pathologic adaptation of placenta, due to racial factors, significantly contributed to the size of the newborn baby. The advent of sophisticated medical imaging modalities like Color Doppler Imaging (CDI) and adequate knowledge of anthropometric features of the placenta with its clinical relevance proves to be useful in the early assessment of placental sufficiency and state of fetal health. Generally, it seems that with documented clinical history relevant anatomic structural derivation from the questionnaire. The excellent reproducibility of our anthropometric measures is likely to yield valid estimates of placental associations with maternal parameters may clarify the complex interrelations among placenta, mother, and fetus to maintain pregnancy and support fetal development.

CONCLUSION

Positive as well as negative correlation exists among variables. Longitudinal studies in more samples are required, and results cannot be generalised. Examination placental parameters and its correlation with the maternal parameters will help to manage future pregnancies, fetal outcome and maternal health.

Conflicts of interest: None declared

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