ORIGINAL ARTICLE

Unfavorable Effects of Pre-eclampsia on the Morphology of the Placenta

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ABSTRACT

Aim: To correlate the placental morphometric parameters with newborn weight between the two groups i.e. normal vs. patients of preeclampsia

Study design: Case-control study

Place & duration of study: Department of Anatomy, Sheikh Zayed Medical College, Rahim Yar Khan in collaboration with Departments of Anatomy, Pathology and Obstetrics and Gyanecology, Quaid-e-Azam Medical College Bahawalpur, from August 2011 to November 2012.

Results: One hundred human placentae, 50 were from normal pregnant women as control and 50 from pregnancies complicated by preeclampsia were taken for this study. Samples were grouped as Group A and Group B on the basis of absence and presence of preeclampsia respectively. All samples were studied morphologically. There was significant reduction in weight, diameter, thickness, volume and number of cotyledons of placenta in pre-eclamptic group. Weight and diameter of placenta had significant positive correlation with the weight of newborn in both groups.

Key words: Placenta, Morphology, Hypertension, Preeclampsia

INTRODUCTION

Maternal Mortality Ratios in Pakistan continue to remain high regardless of attention paid to maternal health. The status of maternal health is poor in Pakistan. In estimation, 30,000 women die each year due to pregnancy associated causes. Latest estimates place the statistics about 270/100,000 live births (USAID, 2008), but actuality it may be higher because of under registration of deaths in country and absence of cause of death information. Placenta is a leading cause of maternal and perinatal mortality (Roberts & Cooper, 2001) and an important factor in fetal growth retardation as it is commonly associated with placental insufficiency (Udainia & Jain, 2001).

Preeclampsia, a most important cause of maternal and fetal mortality and morbidity, is a potentially devastating condition with an unidentified etiology. Though the basic cause of preeclampsia is still not clear; the placental ischemia/hypoxia is thought to be primarily involved in the pathogenesis of this disorder. The prevalence, complications and its correlation with maternal and fetal outcome in Pakistani women, showed high incidence of pre-eclampsia about 19% (Rubina & Tabassum, 2007).

Pregnancy-induced hypertension (PIH) i.e. preeclampsia is the most common cause of maternal and fetal morbidity worldwide and also shows a major long-term cardiovascular danger for both mother and child (Lindheimer & Umans, 2006). Trophoblast incursion and maternal uterine vessels modification are essential to normal pregnancy. Initial role may be played by reduced trophoblastic invasion in preeclampsia that is consequently proselytized by other mechanisms (Roberts & Cooper, 2001). Trophoblasts are derived from the outer layer of the blastocyst, occupy the maternal deciduas, and subsequently arrive at the spiral arteries, where vascular remodeling is important for the outstanding product interchange occurring between mother and fetus.

In normal pregnancies, the wall of the spiral arteries is invaded by trophoblastic cells and changed into large, tortuous channels that carry a large amount of blood to the intervillous space and are resistant to the effects of vasomotor agents as they are converted to low-resistance, high-capacity vessels (Pijnenborg et al. 2006). Trophoblastic invasion begins from 16-20 weeks of gestation causing destruction of the muscularis layer of spiral arteries and is completed by 24 weeks' time. These physiologic changes are restricted in patients with

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preeclampsia. The resulting vascular morphology has some similarity to atherosclerosis and was termed "acute atherosis" by early researchers (Meekins et al. 1994). Preeclampsia like normal pregnancy is associated with a local inflammatory response but to a smaller extent (Redman & Sargent, 2005).

Nowadays, stress and strain, increased maternal age, change in everyday life of Pakistani women, and the number of pregnancy-induced hypertension (PIH) cases are increasing. For anatomists, it is very important to be familiar with the macroscopic changes in the placenta of hypertensive women in relation to the normal ones. Most of the studies on the placenta have been done by obstetricians and gynecologists with very little contribution by an anatomist. Being a vital organ in pregnancy, the placenta fascinated the interest of many workers for its study, in relation to its morphology. Until 1996, nobody had taken efforts to study the exact morphology of the placenta of preeclamptic mothers. The incidence is high in developing countries having low socioeconomic status, nutritional deficiencies, anemia, hypoproteinemia, co-morbid diseases and poor obstetric facilities.

The present study is undertaken to compare the morphometric changes in the placenta of normal and preeclamptic mothers. The aim of our study is to observe the adverse effects of maternal hypertension on the morphology of the placenta and its subsequent influences on the neonatal outcome.

MATERIALS AND METHODS

Weighing machine for placenta (2 kg), weighing machine for baby (10 kg), small bucket full of water, tray; measuring jar, tape and scale; scalpel with surgical blade, sterile gloves, forceps and surgical scissor. A total of 100 placentae were studied. Fifty were having normal blood pressure and 50 from hypertensive mothers (B.P > 140 / 90 mm of Hg). The placentae were collected from Obstetrics and Gynecology department of Sheikh Zayed Medical College/ Hospital Rahim Yar Khan. Most of the placentae were from the primipara immediately after delivery. In all cases the membranes were trimmed from the placenta. At a distance of 5 cm from the site of insertion the umbilical cord was cut. The placentae were washed thoroughly in running water mopped with the help of blotting paper. Samples were separated into two groups as Group A and Group B according to absence and presence of preeclampsia respectively.

Group A (Control Group): This group comprises pregnant women without preeclampsia, with normal blood pressure, and no proteinuria and edema.

Group B (Preeclampsia Group): This group comprises pregnant women with preeclampsia i.e. blood pressure above 140/90 mm of Hg on at least two occasions, six or more hours apart after 20th weeks of present pregnancy together with proteinuria and edema.

Variable Studied:

1. Shape
2. Diameter
3. Thickness
4. Volume
5. Number of cotyledons
6. Weight of newborn baby

Methodology

1. Shape of placenta: The shape of the placenta and presence of accessory lobe were recorded after proper inspection. Each placenta was categorized as oval, circular or irregular in shape (Figure 1).

2. Diameter: The placenta was placed in a flat tray after trimming and mopping. At first, the maximum diameter was measured with a metallic scale graduated in centimeters (cm). Then a second maximum diameter was taken at right angle to the first one. The mean of two measurements was considered as the diameter of the placenta expressed in centimeter (Kishwara, 2009) as shown in figure 2.

3. Thickness: With a long needle placental thickness was measured at five points of each placenta. After placing the placenta on fetal surface, the placenta was divided arbitrarily into three zones of equal parts by drawing two circles on the maternal surface. These circles cut the radius of the placenta into three equal parts. One thickness was measured from the centre of the central part, two from middle and two from peripheral part. The peripheral points were taken within the outer zone on a line perpendicular to the previous imaginary line. Finally the mean of all five measurements was calculated and considered as thickness of the placenta (Anwar, 1999) as shown in figure 3.

4. Volume: Volume of the placenta was calculated in milliliters (ml), by using Archimedes principle.

5. Number of Cotyledons: Each formalin-fixed placenta was held with both hands. The cotyledons on the maternal aspect were made prominent by applying gentle pressure on the central part of fetal surface with both thumbs while holding the periphery of the placenta with the other fingers. Then the placenta was placed on a flat tray with maternal side facing upward by placing a block of paraffin on the fetal side. Then the counting was completed in the manner of loops as depicted in figure 4 (Laskar, 1999). The total number of cotyledons was recorded.

6. Weight of newborn baby: Weight of baby was recorded in each case.

Statistical Analysis: The collected data were recorded on the excel spreadsheet, processed and analyzed by using SPSS 16.0 version. Data were analyzed by calculating mean, proportions and correlations. The tests of significance applied were paired t-test and Pearson correlation co-efficient.

RESULTS

All the morphometric parameters of the placentae like placental shape, weight, diameter, volume, thickness and number of cotyledons of the placenta were measured and compared with control group. In the present study, in group A and group B, the number of oval shaped placenta was 17(34%) and 16(32%), the number of circular shaped placenta was 29(58%) and 32(64%), the number of irregular shaped placenta was 4(8%) and 2(4%) respectively (Fig. 1a, 1b, 1c).

The mean weight of the placenta was 293±3.45 gm in study group and 502±4.66gm in control group. The mean diameter of placenta in study group was 14.53±0.25cm as compared to 24.13±0.49 cm in control group (Fig. 2). The mean volume of placenta in study group was 247±3.63mL as compared to 501±3.90 in control group. The mean thickness of placenta in study group was 1.99±0.35 cm as compared to 2.34 ± 0.04 in control group (Figure 3). The mean number of cotyledons of placenta in study group was 22.52 ± 0.57 as compared to 30.82 ± 0.41 in control group (Figure 4). The mean birth weight of newborn baby in study group was 2373 ± 6.70 grams and in control group 3296± 5.10 grams. All these variables were low in study group and the differences between the groups was statistically significant as shown in Table 1.

In both groups there was a significant positive correlation between birth weight and placental weight (Correlation coefficient= 0.413, P=0.003) as shown in Table 2. In addition, significant positive correlation was also found between birth weight and placental diameter (Correlation coefficient=0.317, P=0.025) as shown in Table 3.

The mean newborn-placental weight ratio was significantly higher in study group than in the control group as shown in Table 1. The incidence of low birth weight (<2500gm) was more in the study group (100%) than control group (32%).

Fig.-1: Different shapes of placenta, a. Circular, b. Oval, c. Irregular

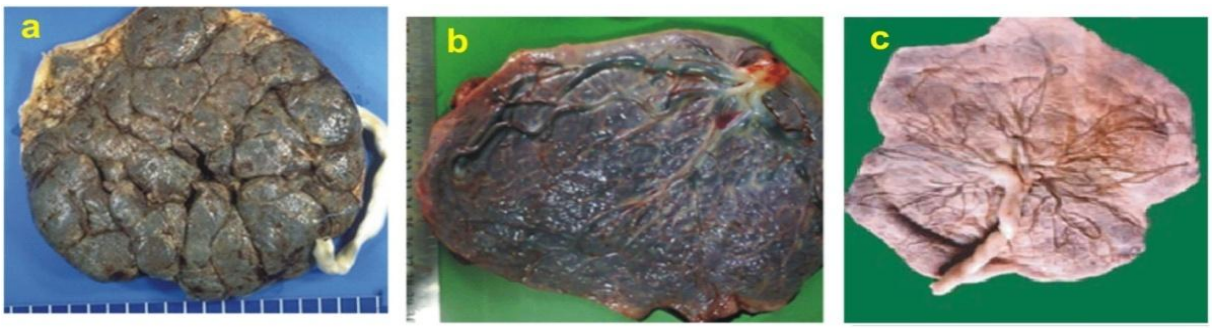

Fig.-2: Procedure of measurement of diameter of Placenta

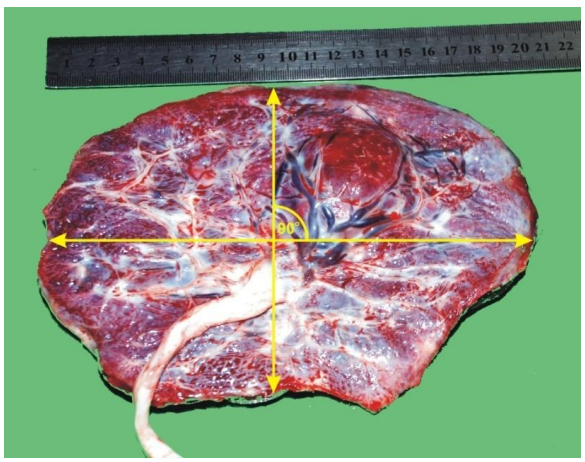

Fig. 3: Method of selecting sites from different zones of placenta for measurement of placental thickness. 1 represents the site in the arbitrary central zone; 2a and 2b the sites in the middle zone; 3a and 3b represent the peripheral zone.

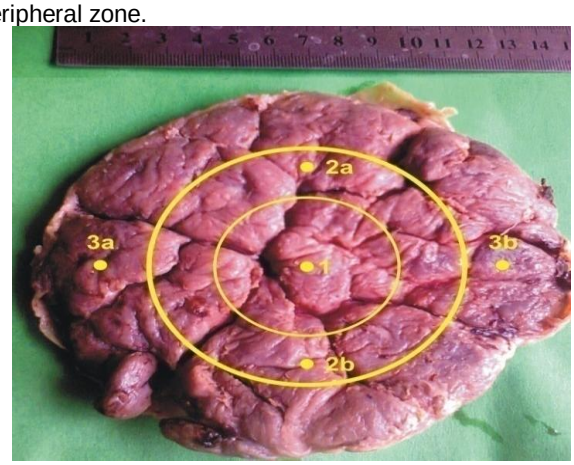

Fig. 4: Procedure of counting of cotyledons.

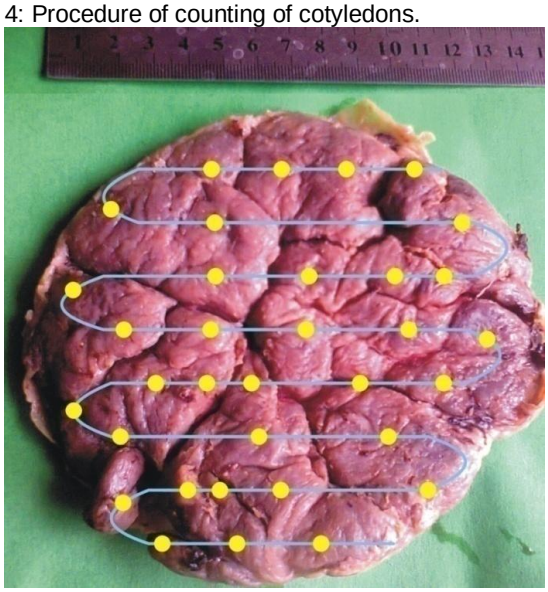

Table 1 Comparison of placental and new born characteristics among study and control groups

Variables	Control group	Study group	*P* value
	Mean±S.E	Mean±S.E	
Placental weight (grams)	502±4.66	293±3.45	0.0001
Placental diameter (cm)	24.13±0.49	14.53±0.25	0.0001
Placental thickness (cm)	2.34±0.04	1.99±0.35	0.0001
Placental volume (mL)	501±3.90	246±3.63	0.0001
No. of cotyledons	30.82±0.41	22.52±0.57	0.0001
Weight of New born (grams)	3296±5.10	2373±6.70	0.0001
New born – Placental Weight Ratio	6.57±0.11	8.01±0.23	0.0001

Table 2: Correlation between placental weight and the birth weight of new born

	Placental Wt.	Wt. of new born
Placental weight		
Pearson correlation	1	.413**
Sig. (2-tailed)		.003
N	50	50
Weight of new born		
Pearson correlation	.413**	1
Sig. (2-tailed)	.003	
N	50	

**. Correlation is significant at the 0.01 level (2-tailed)

Table-3 Correlation between Placental Diameter and the Birth Weight of New born

	Placental Wt.	Wt. of new born
Placental weight		
Pearson correlation	1	.317*
Sig. (2-tailed)		.025
N	50	50
Weight of new born		
Pearson correlation	.317*	1
Sig. (2-tailed)	.025	
N	50	50

*. Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

Pre-eclampsia has definite adverse influence on the morphology of the placenta. The placenta gives important information on the fetal outcome. The placenta is the only vital organ for the survival of foetus. This organ has been often described as the mirror of the perinatal life, but a mirror, which is not yet adequately polished. It depicts the most accurate record of the prenatal experience of an infant.

The present study was carried out to analyze and assess the morphological variations of the placenta like shape, weight, thickness, diameter, volume and number of cotyledons, and its influence on the weight of newborn. Morphometric parameters of placenta like, weight, volume were significantly reduced in preeclamptic group as compared to normal group were statistically significant ($p<0.01$). This study had similarities to the study conducted by Majumdar et al. 2005 and Virupaxi et al. 2011.

The placentae of group B patients were significantly smaller in diameter than the normal. The absolute volume of placenta was significantly lowered in the pre-eclamptic group than the control group **(**Zahra et al., 2010). It has also been reported by Nazmeen, (2006) that weight and volume of the placenta was less in pregnancy-induced hypertension cases. The mean fetoplacental weight ratio was more in hypertensive group than control group .The same ratio was found less in the hypertensive group than control group by Garg et al., 1996 and Priya, 2012. Cotyledon numbers were found to be significantly less in hypertensive group which is similar to the findings of the study by Sultana et al., 2007.

The mean birth weight of newborn baby was less in pre-eclamptic group. Relations between birth weight and placental volume have also been described by Udainia and Jain, 2001. Janthanaphan, 2006 and Virupaxi, 2003 also noted reduced placental weight and in its ratio to birth weight in normal pregnancy.

CONCLUSION

Preeclampsia has definite adverse effects on the morphology of placenta. Placental weight and diameter are directly proportional to the birth weight of babies. The early measurements of placenta by noninvasive technique like ultrasonography will be helpful in early recognition of fetus at risk and better management of such pregnancies. It is also noted that the placenta has a potential to give important information about foetal outcome. In these days of increasing medicolegal cases, this may also be of some help.

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