International Journal of Multidisciplinary Research and Development

Volume: 2, Issue: 9, 666-669
Sep 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 4.342

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Study of Shape of Placenta and Its Relation to Placental Weight in Normal and Diabetic Pregnancies

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Abstract
Introduction: The fetus, placenta and mother constitute a triad of contributors to pregnancy outcome. The diabetic pregnancy affects maternal health as well as architecture and functions of the placenta.
Aim: To study the shape and weight of placenta in diabetic mothers and compare them with normal pregnancies.
Material and methods: : A prospective observational study was carried out on 70 placenta (20 placenta from Control Group and 50 placenta from Diabetic Group) from August 2013 to July 2014 in the Department of Anatomy, King George's Medical University (K.G.M.U.) UP, Lucknow.
Results: Majority of diabetic mothers had circular placenta (52%), however, majority of controls showed oval placenta (70%). The study also revealed increase in placental weight of diabetic mothers as compared to controls.
Conclusion: The placenta with diabetic mothers significantly differs from normal pregnancies which may be associated with alteration in physiological functioning of placenta and ultimately fetal outcome.

Keywords: Placental shapes, Gestational Diabetes mellitus, Placenta, Placental weight.

Introduction

The prevalence of diabetes mellitus (DM) among women of childbearing age is increasing due to more sedentary lifestyles, changes in diet and the virtual epidemic of childhood as well as adolescent obesity. It affects nearly 2-5% of all pregnancies [1]. Diabetes in pregnant women may be categorized into clinical diabetes (pregestational diabetes) i.e. previous to her pregnancy female is diagnosed with type 1 or type 2 diabetes and gestational diabetes (GDM) i.e. any degree of glucose intolerance first recognized during pregnancy [2, 3]. GDM represents nearly 90% of all pregnancies complicated by DM.

The word placenta is a latin word meaning a flat plate or cake [4]. It is a discoidal mass, having two surfaces (maternal and fetal) and a peripheral margin. Maternal surface is finely granular, mapped into 15-30 lobes by fissures or grooves. Fetal surface is covered by amnion with the umbilical cord attached to it. The umbilical vessels radiate out on the fetal surface from the umbilical cord below the amnion. The placenta is considered as a window through which maternal dysfunctions and their impacts on fetal well being can be understood. The placenta begins to meet the demand of the embryo as early as 3rd week of intrauterine life. It continuously undergoes change in shape, weight, structure and functions. Abnormalities of the shape of placenta like bidiscoidal, lobed, diffused, placenta succenturiata, fenestrated placenta, circumvallate and circummarginate placenta have been encountered in literature [5]. These abnormal shapes of placenta are associated with reduced placental efficiency which may lead to impaired placental and potentially fetal development.

The placenta of diabetic women has attracted much interest because it is associated with a variety of placental abnormalities like increased placental weight [6]. The extent of placental abnormalities in diabetic mothers depend on a number of factors particularly the quality of glycemic control achieved during the critical periods in placental development [7]. More abnormal maternal glycemic levels may alter the placental morphometric characteristics related to maternal-fetal exchanges [8].

Alterations in placental function due to uncontrolled diabetes results in fetal complications like macrosomia, congenital malformations and intrauterine growth retardation [9, 10]. These pathological changes in the placenta of diabetic mothers are in turn important risk factors contributing to fetal anoxia and fetal compromise in pregnancy. This study is aimed to detect possible changes in the shape of placenta and its relation to placental weight in diabetic mothers as compared to normal pregnancies.

Material and Methods

The study was carried out in Department of Anatomy, KGMU UP Lucknow, on 70 placenta, collected from Obstetrics and Gynecology, Department of Queen Mary's Hospital, KGMU UP, Lucknow. The control group (Group A) comprised of twenty placenta obtained from normal term pregnant women (without diabetes mellitus and without any other medical disease) while the study group (Group B) consisted of fifty placenta from term pregnancies complicated by pregestational or gestational diabetes mellitus.

The diabetic mothers, either on Medical Nutritional Therapy (MNT) or on insulin, were included in the study and pregnant females having normal glucose level and any of the other maternal illnesses (hypertension, anaemia, preeclampsia, eclampsia, hypothyroid) were excluded from the case group. The informed consent was taken from the patients.

Term placenta along with membranes and attached umbilical cord were collected, irrespective of their mode of delivery i.e. normal vaginal delivery, instrumental delivery or lower segment caesarian section (LSCS). Thereafter placenta were examined for any structural abnormality, tagged with a specific number and was preserved in 10% formalin. The shape of the placenta was noted visually and recorded by digital camera. The placental weight (along with membranes) was recorded with the help of weighing machine of 2 kg. capacity. The measurements were taken to nearest possible to avoid errors.

Results

The present study revealed that in control group 70% placenta were of oval shaped (Fig.1) and 20% placenta were of round shaped, while in study group 52% of placenta were round shaped (Fig.2) and 42% were oval shaped. Statistically, the difference in shape of placenta between two groups was found to be significant i.e. p=0.050 (Table1). In both the groups, minimum proportion of women showed irregular shaped placenta (Fig.3).

Table 1: Distribution of Placental Shape between Diabetic and Normal Pregnant Mothers

Placental Shape	Total	Cases (n=50)		Control (n=20)	
		No.	%	No.	%
Circular	30	26	52.0	4	20.0
Irregular	5	3	6.0	2	10.0
Oval	35	21	42.0	14	70.0

χ^2=5.97 (df=2); p=0.050

In the present study, **s**tatistically significant (p<0.05) difference was observed between the placental weight of two groups. The cases in study group had higher mean value as compared to control group (Table 2).

Table 2: Comparison of Placental weight between Diabetic and Normal Pregnant Mothers

Placental characteristic	Cases (n=50)		Controls (n=20)		Significance	
	Mean± SD	Range	Mean± SD	Range	t	p
Weight	506.3±107.75	300-740	430.25±73.83	325-575	2.891	0.005 (S)

In case study group, 23 cases (46%) had placental weight >500 g while 13 (26%) showed placental weight ≤400 g whereas in control group, 10 women (50%) had placental weight in the range ≤400 g and 3 women (15%) with placental weight >500 g. These contrasting differences in placental weight of cases and controls were also statistically (p=0.040) significant (Table 3).

Table 3: Comparison of two groups for different categories of placental weight

Placental weight	Total	Cases (n=50)		Control (n=20)	
		No.	%	No.	%
300-400 g	23	13	26.0	10	50.0
401-500 g	21	14	28.0	7	35.0
501-750 g	26	23	46.0	3	15.0

χ^2=6.424 (df=2); p=0.040 (S)

Fig 1: Photograph showing oval shape of placenta

Fig 2: Photograph showing circular shape of placenta

Fig 3: Photograph showing irregular shape of placenta

Discussion

The placenta forms a functional unit between the mother and the fetus, therefore any pathological event that concerns the mother or the fetus will influence the normal function, morphology and histology of the placenta. Diabetes mellitus is

a metabolic disorder and affects the placental efficiency and function, which may further lead to adverse fetal outcome [11].

Circular to oval shape placenta are common [5, 12]. The deviation in shape of placenta from normal may be due to the changes in placental function by complicated diseases like malnutrition, preeclampsia and diabetes etc [13, 14]. Salafia *et al*. (2010) studied that in diabetic mothers, maternal hyperglycaemia leads to fetal macrosomia. This macrosomia affects the fetus and fetal part of placenta, i.e. chorionic plate and all types of villi. These changes result in abnormal placental shapes. Adverse obstetric outcomes like non-reassuring fetal status, vasa previa, postpartum haemorrhage and retained placenta were also found to be associated with it [15].

In the present study circular and oval shape placenta were observed in both groups (cases as well as controls), but oval shape (70%) dominated in controls which signifies it as an indicator of normal pregnancies while in cases circular shape (52%) was found to be more common. As all subjects were apparently healthy and there was no evidence of malnutrition or any other associated medical illness, this may be the cause for normal shape of placenta. Ashfaq *et al*. (2005) also found that shape of placenta in diabetic and control groups were roughly oval or round except one placenta in diabetic group which was bilobed [16]. Altered irregular shapes like spindle, pear, heart, crescent, ring were reported without any clinical significance [12]. In the present study, minimum proportion of women showed irregular shaped placenta in both the groups. We propose that these variations in shape are due to changes in placental efficiency but further expansion of this study is required in the field of histology.

The weight of placenta is an important and functionally significant parameter as it is related to villous area and fetal metabolism. The normal placenta weighs about 500 g [17]. In the present study, the mean placental weight in cases (506.3±107.75 g) was found to be more as compared to controls (430.25±73.83 g). This difference was found to be statistically significant ($p < 0.01$). According to Teasdale (1981), placental weights of diabetic mothers showed tendency to be heavier than the gestationally matched controls due to significant accumulation of non-parenchymal tissue and only a moderate increase in parenchymal tissue [18]. According to Boyd *et al*. (1986) and Queenan *et al*. (1999) increased placental growth was a consequence of a co-existing metabolic or endocrine effect of hyperinsulinaemia in response to hyperglycemia in fetuses of diabetic mothers [19, 20]. Fetal hyperglycemia may derange the osmotic environment of the cell, resulting in injury or cell death of endothelial cells in fetal capillaries. The damaged endothelial cells may be replaced without subsequent removal of old basal lamina. New endothelial cells synthesize their own basal lamina leading to excessive thickness of basal lamina of fetal capillaries in the chorionic villi. The basal lamina of chorionic capillaries is the part of placental barrier, so its thickness will increase the whole thickness of placental barrier which may lead to reduced transport of oxygen and other nutrients across the barrier. In response to this low oxygen transport the terminal villi shows hyperplasia which may be partially responsible for increase in weight of placenta in diabetic group [21].

In the present study, placenta of diabetic mothers showed a definitive and distinct placental weight change in comparison to their controls and an improper functioning placenta may play a crucial role in the poor perinatal outcome in diabetic mothers.

Conclusion

The adverse effect of diabetes on the outcome of pregnancy is well established. The present study highlights variation in shapes of placenta between normal and diabetic mothers. The placenta of diabetic mothers also showed significant increase in placental weight that can be associated with impaired function of placenta, leading to adverse perinatal outcome. Further research using more sensitive measures and ultra structural details would help us to understand pathology behind diabetic placenta and its role on infants of diabetic mothers.

Acknowledgements

We are thankful to the Department of Obstetrics and Gynecology, Queen Mary's Hospital, King George's Medical University UP, Lucknow for their dedicated co-operation, and to all faculty and staff of the Department of Anatomy, K.G.M.U. UP, Lucknow without whose help our work could not have been completed successfully.

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