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Correlation of Wharton's Jelly with Birth Weight of Neonate of Pre-gestational and Gestational Diabetic Mother

Md. Rafiqul Alam[1], Md. Abdul Momen[2], Anjuman Ara Sultana[3], SM Nurul Hassan[4]

Abstract

Context: *The umbilical cord appears to have organ -like properties containing two arteries and one vein covered by a connective tissue called Wharton's jelly. Wharton's jelly holds the vessels together, regulate blood flow, plays a role in providing nutrition to the fetus and stores chemical substances for the onset of labour. The umbilical cord without much Wharton's jelly is prone to compression and complete absence is usually associated with fetal death. Gestational diabetes mellitus (GDM) is a common metabolic disorder One of the most relevant consequence of maternal gestational diabetes is excessive or accelerated growth of the fetus.*

For this reason, the present study was aimed at finding the correlation of the Wharton's jelly area of the umbilical cord with birth weight of neonate of Pre-gestational and Gestational diabetic mother and to find out any deviation from the controls.

Materials and Method: *The study was cross-sectional, analytical and observational type which was carried out in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka between July 2004 and December 2005. A total number of 60 Umbilical cords with placentae were collected within 34 to 40 weeks of gestation from BSMMU and BIRDEM. Among these, twenty were from mothers not suffering from diabetes(Control group), twenty had pre-gestational diabetes mellitus(PDM group) and twenty were suffering from gestational diabetes mellitus (GDM group). The umbilical cord cross-sectional area, vessel area and Wharton's jelly area were measured.*

Results: *Wharton's jelly area showed significant positive correlation with birth weight of neonate in all the three groups. But there was no significant difference between birth weight of neonates in the three groups.*

Key words: *Umbilical cord, Wharton's jelly, PDM, GDM*

Introduction

The umbilical cord is the communicating channel between the uterine vasculature and the fetal vascular tree. It is a fetal organ containing two arteries and one vein covered by a connecive tissue called Wharton's jelly[1] Diabetes mellitus is a chronic disorder of carbohydrate, fat and protein metabolism. A defective or deficient insulin secretor response resulting in impaired carbohydrate use, is a characteristic feature of diabetes mellitus. As a consequence hyperglycaemia occurs. Approximately 100 million people of the World suffer from diabetes mellitus which is about 3% of world population[2].

There is high prevalence of possible fetal and maternal complications in Gestational diabetes mellitus. Haver et al., found in a study, approximately 2% to 3% of pregnancies are affected by diabetes mellitus and 90% of them represent gestational diabetes mellitus[3]. Insulin acts as a growth hormone for the fetus. Due to maternal hyperglycemia there is excess fetal insulin

1. Associate Professor, Department of Anatomy, Dhaka Medical College, Dhaka
2. Assistant Professor, Department of Biochemistry, Ad-din Women's Medical College, Dhaka
3. Assistant Professor, Department of Anatomy, Shaheed Suhrawady Medical College, Dhaka
4. Professor & Head Department of Anatomy, Monno Medical College, Manikganj.

Correspondence: Dr. Md. Rafiqul Alam

which leads to over growth of fetus. Thus offspring of mothers with gestational diabetes mellitus have higher birth weight[6].

The umbilical cord consists of one vein and two arteries embedded in a gelatinous mass the "Wharton's jelly". The mucous connective tissue of the umbilical cord is "Wharton's jelly". The term Wharton's is named after the British Physician Thomas Wharton's who discovered it in the mid-1603, and the term "Jelly" was given from its gooey and viscous nature[4].

"Wharton's jelly" is a type of connective tissue. Here the matrix is the dominant component. The great bulk of this connective tissue matrix is glycoprotein rich, strongly PAS- positive amorphous substance. Fibres are very scanty and mostly of collagen type. Fibroblasts are scattered throughout and are pretty easy to see within the bulk of matrix[4].

The small stellate fibroblast with their long processes, anastomosing with each other form a network in the Wharton's Jelly. Wharton's Jelly forms a common tunica adventitia about the three vessels of the umbilical cord[12].

Wharton's Jelly, although apparently inert looking, may be an important chemical factory for the fetus. It is a specialized tissue serving many purposes for the developing fetus. Its specialized cells contain gelatine like mucous that encase fibres. These properties give it an elastic and cushion effect, which can tolerate the vibration, bending stretching and hasting of an active fetus. In addition, it holds the vessels together, may regulate blood flow, plays a role in providing nutrition to the fetus, stores chemistry for the onset of labour and protects the supply line[1].

The umbilical cords without much Wharton's Jelly are more prone to compression, and complete absence is usually associated with fetal death. So where the due date of delivery has been passed, the loss of Wharton's Jelly may put the fetus at risk of cord compression and, therefore, fetal harm. If an umbilical cord is twisted or knotted, it is more likely to tighten where there is less resistance, such as an area low in Wharton's Jelly[1].

It is believed that males have more Wharton's Jelly content than do females and that good nutrition increases the amount. Amount of Wharton's Jelly tends to be reduced with gestational age and can disappear when pregnancies go beyond 40 weeks . It has also been documented that umbilical cord was significantly larger in fetuses of mothers with gestational diabetes than in normal population and also that the main increase in width was attributed to increase in the Wharton's jelly content[7].

So, the present study was aimed at finding the correlation of the Wharton's jelly area of the umbilical cord with the birth weight of neonate of Pre-gestational and Gestational diabetic mother and to find out any deviation from the controls.

Materials and Methods

Sixty (60) umbilical cords with placentae were collected. Of these, twenty specimens were collected from mothers with normal blood glucose level, tweenty from mothers suffering from pre-gestational diabetes mellitus and twenty were from mothers developing diabetes mellitus during the gestational period. Mothers with Rh-negative blood group, positive VDRL test, eclampsia, preeclampsia, positive HBs Ag test, hypertension, multiple pregnancies (twin, triplet), giving birth to stillborn baby were excluded from the study.

One centimetre long tissue from the umbilical cord was processed for histological study. Steps in the processing of the tissue included fixation, dehydration, clearing, sectioning, staining and mounting.

The umbilical cord cross sectional area were measured by the help of the following materials: Projector, drawing sheet, pencil and computer with the software AutoCAD .The outline of the cross sectional area of the umbilical cord were traced and scanned into a computer and the area were measured using the AutoCAD soft ware. The cross sectional area of the umbilical cord was expressed in square millimetres. (mm^2).The AutoCAD values were converted into real value by dividing the magnification times.

The cross-sectional area of umbilical artery I, umbilical artery II and umbilical vein were all measured by the following equipments and

materials like binocular microscope equipped with a drawing tube (Olympus model CH40, RF200), stage micrometer, drawing sheet, pencil and measuring scale, light source for the drawing sheet and computer with the software AutoCAD. Tracing of the outline of the vessels were done by camera lucida drawing.

The traced vessel *areas* were scanned into a computer and the areas were measured using the AutoCAD soft ware.

Area of the umbilical vessels were expressed in square millimetres (mm^2). The AutoCAD value was converted into real value by dividing the magnification times.

Wharton's jelly area was measured using the following formula:

JA = UCA – VA, Where JA = Jelly area. UCA = Umbilical cord cross-sectional area.

VA = Total vessel area (Sum of the cross-sectional areas of umbilical artery I, umbilical artery II and umbilical vein).

After collection of the data groupwise results were prepared by calculating means, standard deviations (SD) etc. as applicable. Appropriate statistical analyses were done using a computer based programme (SPPS). In this study analysis of variance (ANOVA) was used to compare the quantitative value of all the three groups for any particular variables while ANOVA post hoc test was used to compare between any two groups for any quantitative variable. Pearson correlation test was done to observe the status of correlation between Wharton's jelly area and neonatal birth weight. Significance of difference was accepted at 5% level (i.e. $P < 0.05$)

Results

Table-I

Results of the birth weight of the neonate in the three groups

Variable	Control n = 20	PDM n=20	Significance of difference with Control	GDM n=20	Significance of difference with Control
Birth weight (kg)					
Range	(2 -3.60)	(2.2 – 3.70)	NS	(2.2 – 4)	NS
Mean ± SD	2.79 ± 0.46	2.84 ± 0.39		2.88 ± 0.54	

PDM: Pre-gestational Diabetes Mellitus
GDM: Gestational Diabetes Mellitus
The Post Hoc option of ANOVA (analysis of variance) was used to compare each group with every other group
$p < 0.05$ was considered as the level of significance.
NS: Non significant
ND: Significance test was not done

Table-II

Cross sectional area of Wharton's jelly of the umbilical cord in the three groups

Variable	Control n= 20	PDM n= 20	GDM n= 20	Significance of difference
Wharton's jelly area (sq mm)				
Range	(21.21-53.18)	(24.67-53.84)	(19.49-52.22)	NS
Mean ± SD	33.41 ± 9.87	36.29 ± 8.86	36.05 ± 9.64	

PDM: Pre-gestational Diabetes Mellitus
GDM: Gestational Diabetes Mellitus

Table-III

Wharton's jelly area and neonatal birth weight in different groups and the status of co-relation between the two variables

Group	Variable		Significance (Pearson correlation)
	Wharton's jelly area (mm^2)	Birth weight (kg)	
Control (n=20)			
Range	(21.21 – 53.18)	(2.0-3.6)	r = 0.49*
Mean ± SD	33.41 ± 9.87	2.79 ± 0.46	p = 0.02S
PDM (n=20)			
Range	(24.67 – 53.84)	(2.2 – 3.7)	r = 0.61
Mean ± SD	36.29 ± 8.86	2.84 ± 0.39	p = 0.004**S
GDM (n=20)			
Range	(19.49 – 52.22)	(2.2 – 4)	r = 0.51
Mean ± SD	36.05 ± 9.64	2.88 ± 0.54	p = 0.02*S

PDM: Pre-gestational Diabetes Mellitus

GDM: Gestational Diabetes Mellitus

S: Significant.

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

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

Discussion

Gestational diabetes mellitus (GDM) reflects a metabolically altered fetal environment associated with high birth weight[6]. In GDM maternal hyperglycaemia lead to excess fetal insulin which itself is a growth hormone for the fetus[6]. Early in gestation, fetal growth is mainly under genetic control, whereas in the second and third trimesters, different factors play a role in determining the features of fetal auxology[11]. The most relevant fetal consequence of maternal gestational diabetes is excessive or accelerated growth of the fetus which resulted in macrosomia- a birth weight above 4000 gm[8]. The incidences of fetal and neonatal macrosomia are reported to be 8% & 26% among control and diabetic pregnancy respectively. Despite the recent clinical progress in the management of gestational diabetes, the likelihood of fetal macrosomia remains significantly higher in diabetic than in non diabetic pregnancies[8].

The third trimester maternal glucose levels is considered as one of the determinants of fetal growth. This reflects stimulation of fetal insulin secondary to transport of maternal glucose [11].

In a study, Barua found significantly higher neonatal weight in gestational diabetes mellitus in comparison to the controls in Bangladeshi mothers[5].

However contradictory finding was reported in a study carried out by Clarson et al. who found no variation in the neonatal weight between the diabetic and non diabetic groups[9]. In Bangladesh: womens, Rahman found no significant increase in the neonatal weight in diabetes[10].

In the present study, the mean neonatal birth weight in all the three groups was more or less the same and thus, no significant difference in the birth weight between the three groups were observed.

The results of the present study (i.e., no significant change in the birth weight) suggest that the placentae and the cords had tried to compensate the adverse maternal situations in diabetes mellitus both PDM and GDM with the help of their extensive functional reserve capacities.

In the present study, the mean Wharton jelly area was greater both in the GDM and PDM groups than

in the control group. These findings though statistically non-significant, was in conformity with the findings of Weisman and Jakobi (1997, p. 691) who found in their study that the umbilical cord was significantly larger in the fetuses of the mothers with gestational diabetes than in the normal population and that the main increase in the width was attributed to an increase in the Wharton's jelly content[7].

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