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Histomorphometry of Umbilical Cord in Gestational Diabetes Mellitus

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ABSTRACT

Aim: The aim of present study was to determine the adverse effects of gestational diabetes on the histomorphological features of the umbilical cord.

Materials and Methods: Total 60 umbilical cords with the placenta were examined. The relevant data were collected from patients delivered in C.R. Gardi hospital,Ujjain within 36th to 40th weeks of gestation. Control cords (n = 30) were from healthy women whose pregnancies were not complicated by any major disease. GDM cords (n = 30) were from mothers with gestational diabetes mellitus (GDM group). All the placentas with cords were treated identically in a standard manner. All placentas were fixed in 10% buffered formalin for 2 weeks. The diameter of the umbilical cord was measured in millimeters and the Circumference, the Cross-Sectional Area of the umbilical cord and Cross-Sectional Area of the Wharton's jelly were measured in millimeters and sq. millimeters respectively.

Result: The study demonstrated that in GDM group the mean diameter, the mean circumference, the mean CSA of the umbilical cord and the mean CSA of the Wharton's jelly were larger in the GDM group than the Control group. The difference was significant in case of the mean diameter while it did not reach to the significant level for the other parameters.

Key words: Umbilical cord, Gestational Diabetes, Histomorphometry

1. INTRODUCTION

The umbilical cord normally contains three vessels, two arteries and one vein, surrounded by a connective tissue known as "Wharton's jelly" (Singh and Pal, 2001). At term, the mean length of the umbilical cord is 55 cm. A short cord is less than 35 cm in length (lower 6th percentile), and a long cord measures more than 80 cm (upper 6th

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Table 1
Various parameters and their relationship between control and study group

S. no.	Variable	Control n = 30	GDM n = 30	P value
1	Diameter of the umbilical cord (mm) Range Mean ± SD	 8.6 – 13.7 11.5 ± 1.93	 9.4 – 17.10 12.9 ± 2.95	(P= 0.007) Significant
2	Circum. of the umbilical cord (mm) Range Mean ± SD	 27.0 – 43.01 37.3 ± 6.91	 29.51 – 52.59 40.03 ± 8.03	(P= 0.118) Not Significant
3	CSA of the umbilical cord (sq. mm) Range Mean ± SD	 58.05 – 147.33 86.54 ± 27.26	 69.36 – 229.54 103.07 ± 40.44	(P= 0.083) Not Significant
4	CSA of the Wharton's jelly(sq. mm) Range Mean ± SD	 40.06 – 136.66 74.03 ± 29.33	 45.38 – 170.39 90.66 ± 39.31	(P= 0.117) Not Significant

Results with $P < 0.05$ were considered significant

Table 2
Strength of the linear relationship between the mean diameter and mean circumference of the umbilical cord in the study Groups

Correlation variables	Group	Correlation coefficient (r)	Significance
The mean diameter and the mean circumference of the umbilical cord	GDM	0.663	Significant
	Control	0.814	Significant

Table 3
Strength of the linear relationship between the mean cross-sectional area of the umbilical cord and the Wharton's jelly in the study groups

Correlation variables	Group	Correlation coefficient (r)	Significance
The mean cross-sectional area of the umbilical cord and the Wharton's jelly	GDM	0.986	Significant
	Control	0.976	Significant

percentile). The mean umbilical cord circumference at 40 weeks is 3.6 cm (range 2.6 to 6.0 cm).The 90th percentile for the area of the umbilical cord at term is 1.3 cm square. It is two centimeters in diameter. The umbilical cord has an organ-like property. The morphology of the umbilical cord is important in understanding feto-maternal functional relationship. The umbilical cord diameter, circumference and cross-sectional area (CSA) are important measurements. Due to the increase in its Wharton jelly content, the umbilical cord is larger in diameter in the fetuses of mothers with gestational diabetes than in the normal population. Also the Wharton's jelly shows large empty spaces (Gill and Jarjoura, 1993; Weissman and Jakobi, 1997; Manuel et al., 2011).

2. MATERIALS AND METHODS

The study was done in the Department of Anatomy, R.D.Gardi Medical College, Ujjain from Dec'2012 to Jan'2014. The study included 60 subjects. They were divided into two groups. Group I consisted of umbilical cords obtained from normal non-diabetic pregnant women (n=30). Group II consisted of umbilical cord obtained from mothers with gestational diabetes mellitus (GDM group). The umbilical cord with the placenta was collected from different hospitals within 36 to 40th weeks of gestation. The vernier calipers were used to measure the mean diameter of the umbilical cords. [(Maximum diameter + Minimum diameter)/2] in millimeters. Measurement of the cross-sectional area of umbilical cord was performed on a plane adjacent to the insertion of the cord into fetal abdomen. Circumference and Cross-Sectional Area of the umbilical cord were measured in mm and mm^2 respectively using Partometer smart measure software. The cross-sectional areas of umbilical cord vessels were measured in mm^2 and the values were subtracted from the total cord cross-sectional area to assess the cross-sectional area of the Wharton jelly (Togni et al., 2007). The results were analyzed by applying Student t-test and Pearson's correlation.

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3. RESULTS

3.1. Correlation Co-efficient

It is a measure of the strength of linear association between two variables. Correlation will always between -1.0 and +1.0. If the correlation is positive, we have a positive relationship. If it is negative, the relationship is negative. Results with $P < 0.05$ are significant.

4. DISCUSSION

In the present study, the GDM group showed significantly higher values of mean diameter of the umbilical cord than the Control group ($P< 0.05$). Weissman et al. also found that the umbilical cord was significantly larger in the fetus of mothers with gestational diabetes than in the normal mothers. Increase in the width was because of increase in the Wharton's jelly. The mean umbilical cord circumference at 40 weeks is 3.6 cm (range 2.6 to 6.0 cm) (Dooley et al., 1986). In our study, the mean circumference of the umbilical cord was larger in the GDM group than in the Control group but statistically it was not significant ($P>0.05$).

The 90th percentile for the area of the umbilical cord at term is 1.3 cm square (Ghezzi et al., 2001; Patel et al. 1989). In our study, the mean cross-sectional area of the umbilical cord was larger in the GDM group than the Control group but statistically it was non-significant ($P>0.05$). In our study, within the GDM and in the Control group, we found a significant positive correlation between the mean diameter($r = 0.663$, $P < 0.001$) and mean circumference of the umbilical cord ($r = 0.814$, $P < 0.001$). We also found a significant positive correlation between mean cross-sectional area of the umbilical cord ($r = 0.986$, $P < 0.001$) and the mean of the Wharton's jelly ($r = 0.976$, $P < 0.001$).

In this study we found that in the GDM group, the mean cross-sectional area of the Wharton's jelly was much greater than in the Control group but the difference was not significant statistically. The reason for the increase in cross sectional area of the Wharton's jelly was due to presence of many empty spaces within it which could be due to degeneration process involving the connective tissue (Cromi et al., 2007; Predanic, 2009).

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