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RANDOM BLOOD SUGAR AND KIDNEY PARAMETERS STATUS IN NEONATES FROM GESTATIONAL DIABETIC PREGNANCY

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ABSTRACT

Neonates from pregnant women with gestational diabetes mellitus (GDM) are at greater risk of neonatal adverse outcome than neonates from their healthy counterparts. This study was conducted to investigate the effect of gestational diabetes on random blood glucose, kidney function and electrolytes in neonates of gestational diabetic women. **Methods:** fifty women with GDM and fifty healthy pregnant women in their third trimester attending federal Teaching Hospital Ido Ekiti were recruited into the study. Concentrations of blood Glucose, Creatinine, Urea, Sodium, Potassium, Chloride, inorganic Phosphate and Calcium in the neonates were determined. **Results:** maternal anthropometric measurements showed significant increase ($p<0.05$) in weight (kg) in the test group (gestational diabetic women) (93.1±2.911) when compared with the control group (healthy pregnant women) (60.50±2.455) as well as BMI (kg/m^2) in the test group (34.90±1.059) when compared with the control group (24.0±0.966). Neonatal serum creatinine concentration was slightly elevated in thetest group (64.1000±3.48792) when compared with the control group (61.8000±4.98397). There was no significant difference in neonatal blood Glucose and Urea concentrations between the groups. Significantly decreased Calcium concentration ($p<0.05$) in the test group (2.7100±0.40372) when compared with the control group (3.3500±0.07032) was reported in this study.Also, concentration of Inorganic phosphorus decreased ($p<0.05$) significantly in the test group (1.0200±0.16586) when compared with the control group (1.5200±0.02906). However, no significant differences in the concentrations of serum Sodium, Potassium and Chloride were reported between the groups. **Conclusion**: Fetuses of pregnancies complicated with GDM are at increased risks of neonatal adverse outcomes. This study investigated clinical implications of GDM on neonates from pregnancies complicated with GDM and its effect on neonatal concentrations of blood glucose, electrolytes and kidney function.

KEYWORDS: Random Blood Sugar, Kidney Parameters, Neonates, Gestational Diabetic Pregnancy.

INTRODUCTION

Gestational diabetes and obesity are two pathologies associated with insulin resistance and inflammation which are profoundly modulated by adipokines and cytokines (Ategbo *et al.,* 2006). It is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels. Significant hormonal changes in pregnancy can result in elevated blood glucose levels in genetically predisposed individuals. Gestational diabetes usually resolves after the birth of the baby. However, after pregnancy approximately 5–10% of women with Gestational diabetes are found to have developed diabetes mellitus later in life, especially those who required insulin during pregnancy and those who are overweight (Reaven, 2000). Gestational diabetes is fully treatable, but requires careful medical supervision throughout the pregnancy. A neonate on the other hand is a newborn that is 28 days old or younger. It is the period when changes are very rapid. This is the period of occurrence of many critical events such as, establishment of feeding pattern, bonding between the infant and the parent, risk for infection that may become serious are higher and detection of birth or congenital defects. Neonates of mothers with GDM do suffer some complications that do warrant adequate management during the first few days or weeks at post-partum. These complications could be fatal at times if not well managed. Management of GDM may include dietary changes, blood glucose monitoring and in some cases, insulin may be required. Though it may be transient, untreated Gestational diabetes can negatively influence the health of the fetus or mother. Risks to the baby include macrosomia (high birth weight), congenital

heart and central nervous system abnormalities and skeletal muscle malformations. Increased levels of insulin in a fetus's blood may inhibit fetal surfactant production and cause infant respiratory distress syndrome. In severe cases, perinatal death may occur, most commonly as a result of poor placental perfusion due to vascular impairment. Labor induction may be indicated with decreased placental function. A caesarean section may be performed if there is marked fetal distress or an increased risk of injury associated with macrosomia, such as shoulder dystocia.

RESEARCH METHODOLOGY

The present study was conducted at the post-natal ward in the Department of Obstetrics and Gynecology at the Federal Teaching Hospital Ido-Ekiti, Ekiti State Nigeria. Ethical clearance was obtained from Research Ethics Committee of the Teaching Hospital. A total of 50 pregnant women who were diagnosed with GDM and have delivered between April and November 2019 were selected for this study. The inclusion criteria were pregnant women with diagnosed GDM, who have no history of diabetes mellitus, who are age 18 years and above and who have recently delivered. Pregnant women with major chronic diseases like cancer, tuberculosis, congestive cardiac failure (CCF), renal failure, liver failure, history of diabetes, HIV and endocrine disorder were excluded from the present study. Fifty healthy pregnant women (HPW) who did not have GDM, and have delivered during the same period were selected as control. A standard questionnaire was used to capture maternal anthropometric data such as age, body weight, height, body mass index (BMI), previous history of diabetes, medical and obstetric history. Details of the new-born, such as birth weight, length, gestational age (GA) at delivery, mode of delivery, >24 hours NICU admission and other metabolic events (hypoglycaemia, hyperbilirubinemia, hypocalcemia etc.) were also captured. Prior informed consent was taken from the mothers.

Blood samples (5ml) were taken from neonates of GDM and HPW and transferred to fluoride oxalate and serum separating tubes (SST). About 1ml of whole blood was used for determination of glucose concentration.

The remaining 4ml in SST tubes were centrifuged at 4,000 rpm for 15 minutes to get serum. Separated serum were transferred to properly labelled Eppendorf tubes and stored at -20 °C for electrolytes and kidney function tests. Auto analyzer (Chem 240 Ray) was used for analysis. Reagents and chemicals were purchased from Randox Laboratories United Kingdom and Sigma Aldrich. Random glucose was determined by the enzymatic colorimetric method of Trinder. Urea concentration was determined by urease method of Monica and Creatinine concentration was determined by the modified Jaffe-Sloth's heat reaction method described by Burtis *et al*. Serum concentrations of Sodium and Inorganic Phosphorus were determined by flame photometry method described by Burtis and Edward while concentration of Potassium was measured by the method of Henry. Calcium concentration was measured following the procedure described by Lorentz andserum concentration of Chloride was determined following the protocol described by Burtis.

Stastical Analysis

Data are expressed as mean± Standard error of the mean (SEM). A two-sided $p<0.05$ was considered statistically significant for one-way analysis of variance (ANOVA) used to determine the differences between the groups.

RESULTS

Table 1 depicts anthropometric measurements of gestational diabetic and healthy pregnant women. From the table it can be deduced that there is significant increase ($p<0.05$) in weight (kg)of GDM women (93.1±2.911) when compared with HPW (60.50±2.455) as well as BMI (kg/m^2) of GDM women (34.90±1.059) when compared with HPW (24.0±0.966). There is no significant difference ($p<0.05$) in the mean age, height, number of previous pregnancy (gravidity) and number of surviving children (parity) between the groups.

Table 2 show anthropometric measurements of neonates from gestational diabetic and healthy pregnant women. From the table, there is no significant difference ($p<0.05$) in the mean neonatal age, length and weight between the groups.

Table 3 show random blood Glucose, Urea and Creatinine concentrations of neonates of gestational and non-gestational diabetic women. From the table, there is no significant difference($p<0.05$) in blood Glucose and Urea concentrations between the groups while there is significant raise in concentration of creatinine in the test group (64.1000±3.48792) when compared with the control group (61.8000±4.98397).

Table 4 show calcium and electrolytes concentrations in neonates from gestational diabetic and healthy pregnant women. From the table, significant decrease was observed ($p<0.05$) in Calcium concentration in the test group (2.7100±0.40372) when compared with the control group (3.3500±0.07032). Inorganic Phosphorus was also raised (1.0200±0.16586) in the test group when compared with the control group (1.5200±0.02906) while no significant differences in the concentrations of Chloride, Sodium and Potassium between the groups were observed.

Table 1: Anthropometric measurements of GDM women and HPW.

Women	GDM	HPW
Age (year)	34.30± 1.391[a]	32.70±1.415[a]
Height (cm)	1.6340±0.013[a]	1.5940±0.014[a]
Weight (kg)	93.10±2.911[***]	60.50±2.455[***]
BMI (kg/m^2)	34.90±1.059[***]	24.0±0.966[***]
Gravidity	1.90±0.504[a]	1.30±0.396[a]
Parity	0.90±0.233[a]	1.00±0.333[a]

Values with the same alphabet depict no significant difference. Values are significantly different at P <0.05 and P<0.001.
P<0.05 is represented as *
P<0.001 is represented as ***

Table 2: Anthropometric measurements of the neonates.

Neonates	Test	Control
Age (days)	2.20±0.200[a]	1.90±0.100[a]
Length (cm)	46.700±2.281[a]	45.960±1.860[a]
Weight (kg)	3.1550±0.123[a]	2.8400±0.815[a]

Values with the same alphabet depict no significant difference. Values are significantly different at P <0.05 and P<0.001.
P<0.05 is represented as *
P<0.001 is represented as ***

Table 3: Neonatal random blood Glucose and Kidney function.

Biochemical parameters	Test	Control
Random blood glucose (mmol/l)	1.1600±0.343[a]	1.7300±0.345[a]
Urea (mmol/l)	2.2900±0.243[a]	2.4400±0.239[a]
Creatinine (µmol/l)	64.1000±3.487[***]	61.8000±4.983[***]

Values with the same alphabet depict no significant difference. Values are significantly different at P <0.05 and P<0.001.
P<0.05 is represented as *
P<0.001 is represented as ***

Table 4: Neonatal calcium and electrolytes concentrations.

Biochemical parameters (mmo/l)	Test	Control
Sodium	120.4000±3.60925[a]	120.3000±3.48664[a]
Potassium	3.9900± 0.12152[a]	3.6500±0.14701[a]
Chloride	96.1000±1.47158[a]	98.5000±2.78189[a]
Calcium	2.7100±0.40372[***]	3.3500±0.07032[***]
Inorganic Phosphorus	1.0200±0.16586[*]	1.5200±0.02906[*]

Values with the same alphabet depict no significant difference. Values are significantly different at P <0.05 and P<0.001.
P<0.05 is represented as *
P<0.001 is represented as ***

DISCUSSION

There have been several reports of relationship between GDM and advancing maternal age. Pre-pregnancy weight is also an established risk factor for GDM. Seshiah *et al*, and Chu *et al* reported a positive correlation between maternal body weight and risk of developing GDM.Similar study from South India has shown that women of age 25 and above are at increased risk of developing GDM (Magoba*et al*, 2012).

This study reported 70% of GDM women being multiparous, as compared to 60 % of control group while there was also 70% gravidity in GDM women as compared to 60% of control group. Both observations were statistically insignificant but mean weight of GDM women were 93.10 vs 60.50 in the control group and the difference in BMI [34.90 (test group) vs 24.0 (control group)] were both statistically significant. Some studies have also attributed the risk of adverse outcomes associated with GDM to confounding characteristics such as obesity and advanced maternal age of women

with GDM (Torloni *et al*, 2009). The major objective of this study is to investigate the effect of gestational diabetes on concentrations of blood glucose, kidney function and electrolytes in neonates from gestational diabetic women. It is very important that pregnant women with gestational diabetes control their glucose levels to avoid complications during pregnancy and delivery.

In contrast to the reports of Hong et al. and Sudipta Pramanick *et a.l* (2017), who reported 6.5% and 6% macrosomia respectively in their studies with 0% in control groups, there were no reports of neonatal macrosomia and hypoglycemia in the GDM group in this study as no birth weight above 4.0kg was recorded. There was also no significant difference in the mean random blood sugar (RBS) in neonates of GDM women as compared with control group. This can be attributed to the dietary management women with GDM are made to undergo upon diagnosis.

Many conditions can affect the ability of the kidneys to carry out their important functions. Some conditions can lead to rapid and some to gradual decline in the kidney functions. A number of clinical laboratory tests that measure the levels of substances (such as urea, electrolytes and creatinine) normally regulated by the kidneys can help to determine the cause and extent of kidney dysfunction. No significant difference was observed in Urea concentrations of neonates of GDM women when compared with those of healthy pregnant women in this report. However, significant difference in the concentration of Creatinine between the groups was reported in this work with raised concentration in neonates from GDM women. This result corroborates the work of Radhia Khan *et al.* (2012), who reported significantly higher concentration of Creatinine in women with gestational diabetes than apparently healthy pregnant women with consequent adverse effect on neonates of GDM women. This is justified by supporting evidence that GDM is associated with subsequent dyslipidemia, hypertension, vascular dysfunction, and other cardiometabolic abnormalities which are risk factors for renal impairment (Rawal, Shristi *et al.*, 2018). Gestational diabetes may predispose women to early stage kidney damage, a precursor to chronic kidney disease according to a study by researchers at the National Institute of Health and other institutions on *Diabetes Care.*Significant decrease in concentrations of Calcium and Phosphorus in neonates from GDM women were reported in this study as compared with those of control group and this could be attributed to strict diet of GDM women in pregnancy. However, there were no significant differences in the concentrations of Chloride, Sodium and Potassium between neonates of GDM subjects and control group. Hypocalcemia can be defined as serum calcium concentration below 2mmol/L or ionized calcium concentration below 1.1 mmol/L, regardless of gestational age or birth weight (Schafer *et al.*,2016). Transient neonatal hypocalcemia has been mainly reported in neonates from pre-gestational insulin dependent- diabetic women and may be partly related to maternal hypomagnesemia and subsequent fetal hypomagnesemia, (Mimouni and Lougheade*tal*., 1990). The severity of hypocalcemia also appeared to be related to the severity of maternal diabetes, as calcium concentration in the neonates was negatively related to maternal HbA1c concentration. Hypocalcemia seems to be rarely of clinical significance, particularly in case of GDM, unless other complications are associated. Relationship between GDM and low maternal vitamin D status, particularly with poor blood glucose control has been previously reported. There are growing evidences that women who develop GDM are more likely to be vitamin D and calcium deficient, (Alzaim and Wood, 2013). Factors like prematurity and perinatal asphyxia can also contribute to low calcium concentration.

CONCLUSION

Health care facilities in under developed countries lack adequate facilities for diagnosis and care for gestational diabetic women. This poses great risk as it enhances adverse fetal and neonatal outcomes.

Reports from this study, indicated that predisposing factors such as maternal weight, BMI and age are implicated in gestational diabetes. Some notable neonatal adverse outcomes of those pregnancies complicated with GDM include impaired kidney function and hypocalcemia which could result in osteomalacia at infancy if not well managed. Activities such as diet control and physical exercise are effective ways of glycemic control in pregnancy which greatly reduces the risk of fetal and neonatal adverse outcome. Follow up studies to monitor these adverse outcomes on neonates of GDM till infancy should be considered. This will help in identifying those complications that resolves on their own, those requiring serious medical intervention and those that are likely to have long term consequences later in life or in adulthood.

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