

## Original Article

# Morbidity and mortality amongst infants of diabetic mothers admitted into Soba university hospital, Khartoum, Sudan

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## ABSTRACT

The prevalence of diabetes during pregnancy is increasing and this is associated with an increased risk of complications in both mother and fetus. The aim of this research is to study the neonatal complications of maternal diabetes. This was a prospective observational study that was conducted in Soba university hospital between September 2010 and March 2011. All infants born to diabetic mothers during the study period were admitted to the neonatal care unit for evaluation. Data on sex, gestational age, and birth weight, mode of delivery, complications, investigations, birth injury, and length of hospital stay were recorded. Maternal data were retrieved from records. Data was analyzed using Minitab 15. A total of 50 infants of diabetic mothers (IDMs) were included in the study. Thirty infants (60%) were females and 20 (40%) were males. Forty two (84%) of the neonates were born by caesarian section, only

7(14%) were born by spontaneous vaginal delivery. Birth injury was observed in 4% of them. The mean gestational age was  $37.2 \pm 2.051$  weeks. The median birth weight was 3.5 kg. 14 (28%) of the babies were macrosomic, and 17 (34%) were large for gestational age (LGA). Congenital anomalies were found in 3 (6%), hypoglycemia in 6 (12%), hyperbillirubinaemia in 10 (20%), hypocalcaemia and hypomagnesaemia each occurred in 2%, transient tachypnea of the newborn occurred in 5 (10%) of the neonates and respiratory distress syndrome in 2%. Cardiomyopathy occurred in 2% and mortality was 4%. We concluded that macrosomia, LGA, and hyperbillirubinaemia were the commonest complications in IDMs, maternal glycaemic control was found to have a significant effect on a number of outcomes.

**Key words:** Infant, diabetes mellitus, mother, macrosomia, Khartoum, Sudan.

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## INTRODUCTION

Diabetes mellitus (DM) is a global public health problem with expected 300 million diabetics by the year 2030 worldwide [1]. In many areas around the globe including the West as well as many developing and Middle Eastern countries, diabetes has become a major health burden affecting young adults and women in their reproductive age [2,3].

Diabetes is a common medical complication during pregnancy and abnormal maternal glucose regulation occurs in 3-10% of pregnancies and the prevalence is increasing [4]. Diabetes in pregnancy is associated with an increased risk of complications in both the mother and the fetus. Perinatal outcome is related to the onset and duration of glucose intolerance and the severity of the disease [5].

Studies have shown higher mortality amongst infants of diabetic mothers (IDM) compared to controls [6,7]. The neonatal mortality rate is over five times that of infants of non-diabetic mothers and is higher at all gestational ages and birth weight for gestational age (GA) categories. In the developed world, the perinatal mortality of infants of diabetic mothers (IDMs) has declined dramatically from 250 per 1000 live births in the 1960s to almost 20 per 1000 live births in the 1980s. This is probably due to advanced intervention and better health care [8,9].

The major morbidities associated with infants of diabetic mothers include, macrosomia; which is the greatest complication that has been associated with an increased rate of caesarian sections and even hypoglycemia. Others are hypoglycemia, hypocalcaemia, hypomagnesaemia, respiratory distress, congenital malformations, and hyperbilirubinaemia [10]. These risks can be minimized by optimal glycaemic control, both prior to and throughout the pregnancy [11, 12],

Although most of the morbidity and mortality data for the IDM improved with time, congenital anomalies remain a significant unresolved problem [13]. The

overall incidence of major anomalies was 6 to 9 per cent in several large studies of such infants, three to four times that is found in a general neonatal population [14]. In a population based study of 7,958 infants over 12 years, Becerra et al documented differences in congenital malformation between the IDM and the non IDM. The relative rate of major malformations in the neonate born to the mother who had insulin-dependent diabetes mellitus was 7.9% [15].

The aim of this study is to find out the neonatal complications of maternal diabetes whether gestational or preexisting and to show the importance of good glycaemic control and its effect on the outcome.

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## MATERIALS AND METHODS

This was a prospective observational hospital based study that was conducted in the neonatal unit at Soba university hospital in Khartoum, Sudan, between September 2010 and March 2011.

All IDMs born during the study period were admitted to the neonatal care unit after delivery. All of them were born to mothers with either gestational or pregestational (type 1 or type 2) diabetes.

An Apgar score was recorded for all neonates, and a complete physical examination was performed, in order to detect if there were any congenital anomalies, birth injuries, or jaundice and anthropometric measurements were performed, Laboratory investigations done for the neonates included: blood sugar, calcium and magnesium levels, also bilirubin levels in jaundiced neonates and complete blood count for polycythaemia.

Neonatal characteristics analyzed in this study include: (i) sex of the baby; (ii) gestational age (iii) birth weight and those who weighed 4 kg or more were classified as macrosomic); (iv) birth injuries; and (v) length of hospital stay.

Maternal data were obtained from records. Maternal characteristics include: (i) age, (ii) parity (iii) duration of diabetes, (iv) type of diabetes, (v) control status,

(vi) mode of control, (vii) maternal complications of diabetes, (viii) past history, and (ix) mode of delivery. Neonates whose birth weights lie above the 90th percentile for their gestational age were classified as large for gestational age (LGA). A diagnosis of hypoglycaemia was recorded for neonates with serum glucose levels below 2.2 mmol/L. A diagnosis of hypocalcaemia and hypomagnesaemia was recorded for neonates with serum calcium below 8 mg/dl and serum magnesium below 1.5 mg/dl respectively. A diagnosis of hyperbilirubinaemia was recorded for neonates with total serum bilirubin above 5 mg/dl, and for polycythaemia with hematocrit >65.

All data obtained were recorded on a structured questionnaire.

Frequencies of the distribution of neonatal complications among mothers with gestational or pregestational diabetes were evaluated.

Categorical variables were compared using the chi square test, and fisher's exact test when appropriate. All significance levels were set at 0.05. An independent t-test was used for the comparison of means of continuous variables.

Statistical analyses were performed using Minitab 15. Permission to conduct this study was granted by the Soba University Hospital administration. Consent was taken from the patients' parents. Only short term outcomes were assessed in this study.

## RESULTS

A total of 50 IDMs were included in the study. Thirty infants (60%) were females and 20 (40%) were males. Their gestational age ranged from 22 to 40 weeks, the mean gestational age was  $37.2 \pm 2.051$  weeks. Only 11 infants (22%) were preterm and 39 (78%) were term. The minimum birth weight was 0.4 kg and the maximum was 5.4 kg, median birth weight was 3.5 kg. 33 (66%) were of normal birth weight (NBW), 14 (28%) were macrosomic, 17(34%) were large for gestational age (LGA). 2 (4%) were of low birth

weight (LBW), and 1(2%) was of extremely low birth weight (ELBW). Table 1 shows the characteristics of the IDMs.

Length of hospital stay ranged from 0 to 7 days, with a median hospital stay of 5 days.

The age range of the mothers of IDMs was from 21 to 45 years with a median age of 30 years. Only 13 (26%) were primiparous, 30 (60%) were multiparous, and 7 (14%) were grand multiparous. 27 (54%) of the mothers had gestational diabetes while 23 (46%) had pregestational diabetes (15 (30%) type 1 and 8 (16%) had type 2. Thirty (60%) of the mother's had well controlled diabetes, while the remaining 20 (40%) were not well controlled.

Forty two (84%) of the mothers delivered by caesarian section, 12 (24%) were emergency caesarian sections and 30 (60%) delivered by elective caesarian section (ELCS). One woman delivered by hysterotomy, a baby who weighed 0.4 kg. Seven (14%) women delivered by spontaneous vaginal delivery (SVD).

It was observed that 34 (68%) infants had complications; 19 (38%) were born to mothers with gestational diabetes, while 15 (30%) were born to mothers with pregestational diabetes), and 16 (32%) had no complications. Multiple complications were observed in 11 (22%) babies.

Table 2 shows the frequency of neonatal complications among IDMs of mothers with gestational and pregestational diabetes.

The most common neonatal complication observed was macrosomia which occurred in 14 (28%) neonates, with the majority being neonates born to mothers with gestational diabetes. Congenital anomalies occurred in 3 (6%), these included cardiomyopathy, craniosynostosis, and limb defects; all of them were observed in neonates born to mothers with gestational diabetes. Respiratory distress syndrome occurred in only 1 neonate of a mother with gestational diabetes, while transient tachypnea of the newborn occurred in 4 neonates of mothers with gestational diabetes and

1 neonate of a mother with pregestational diabetes. Hyperbillirubinaemia occurred in 10 (20%) of the neonates, 3 born to mothers with gestational diabetes, and 7 born to mothers with pregestational diabetes. The mean total serum bilirubin level was  $14 \pm 2.867$  mg/dl in neonates with Hyperbillirubinaemia. Hypoglycaemia occurred in 6 (12%) of the neonates, 4 (8%) of them were born to mothers with gestational diabetes while the other 2 (4%) were born to mothers with pregestational diabetes. The mean blood glucose level in these neonates was  $1.772 \pm 0.317$  mmol/L. Hypocalcaemia (4.9 mg/dl) and hypomagnesaemia (1.2 mg/dl) each occurred once in the same neonate whose mother had pregestational diabetes. Neonatal death occurred in 2 (4%) of the neonates; one of them was a preterm baby who weighed 0.4kg and was born to a mother who had type 2 diabetes, and the other was a preterm large for gestational age baby who had hypoglycaemia and Hyperbillirubinaemia, and was born to a mother with gestational diabetes. 1 macrosomic neonate, born to a mother with type 1 diabetes had shoulder dystocia and brachial plexus injury.

A significant relationship was found between the incidence of macrosomia and maternal diabetes control ( $p$ -value= 0.0001). There was also a significant relationship between the occurrence of hypoglycemia and maternal diabetes control ( $p$ -value= 0.002439), and finally between congenital anomalies and diabetes control ( $p$ -value= 0.05). There was no association between Hyperbillirubinaemia, preterm delivery or transient tachypnea of the newborn with maternal diabetes control ( $P$ -Values = 0.170669, .735945 and 1 respectively).

A significant difference was found between the average length of hospital stay in IDMs born to mothers with gestational diabetes and IDMs born to mothers with pregestational diabetes ( $p$ -value= 0.022), IDMs born to mothers with gestational diabetes were found to have a longer duration of hospital stay with a mean of  $5.33 \pm 1.33$  days.

**Table 1- Characteristics of infants of diabetic mothers.**

Characteristic	No	Percentage
Male	20	40%
Female	30	60%
Total	50	100%
<b>Gestation (weeks)</b>		
<37	11	22%
37-40	39	78%
>40	0	0%
Total	50	100%
<b>birth weight (kgs)</b>		
<2.5	3	6%
2.5-3.9	33	66%
$\geq 4$	14	28%
Total	50	100%

**Table 2- Neonatal complications among infants of diabetic mothers.**

Complication	Total	Percentage
congenital anomaly	3	6%
preterm birth	11	22%
Macrosomia	14	28%
Large for gestation	17	34%
Low birth weight	2	4%
Extreme LBW	1	2%
RDS	1	2%
TTN	5	10%
Hypoglycaemia	6	12%
Hypocalcaemia	1	2%
Hypomagnesaemia	1	2%
Hyperbillirubinaemia	10	20%
Cardiomyopathy	1	2%
Birth injury	1	2%
Neonatal death	2	4%

LBW- low birth weight, RDS- respiratory distress syndrome, TTN- transient tachypnea of the newborn.

## DISCUSSION

The majority of large for gestational age infants

(LGA), 70.5% (12/17) were born to mothers of ages 30-39. Increasing maternal age was associated with higher frequency of GDM, which was in accordance with other studies [16,17] showing that carbohydrate tolerance deteriorates progressively with age especially in females.

Majority of the mothers (84%) delivered by caesarian section, most of them delivered by elective caesarian section (60%) which is in contrast to the study done in Nigeria by Opara et al who found that most of the caesarian sections were emergency [8]. Our findings were however similar to the findings in a Sri-Lankan study [18] where elective C/S rates were much higher than emergencies. Sri Lanka holds a unique place in South Asia as one of the first of the less developed nations to provide universal health. This higher rate of operative deliveries is related to the higher incidence of macrosomia in the IDMS.

The most common neonatal complications observed were macrosomia and LGA which occurred in 14 (28%), 17 (34%) neonates respectively, with the majority being neonates born to mothers with gestational diabetes. This higher incidence of macrosomia is similar to that in another Nigerian study [19]. Macrosomia remains an important morbidity because it is associated with increased risk for traumatic birth injury, obesity, and diabetes in later life. Although some of the variation in incidence may be related to definition, most authors agree that macrosomia is in part related to maternal glucose control [20].

Neonatal jaundice was noted less frequent in our IDMs (20%), much more in those born to mother with pregestational diabetes, this is in contrast to the finding by Opara et al who found that 63.8% of the IDMs had hyperbillirubinaemia [8]. Hyperbillirubinaemia is a recognized problem of infants of diabetic mothers, and has been shown to occur with increased frequency in macrosomic infants of diabetic mothers [21].

There was a significant association between parity

and maternal gestational diabetes (p-value=0.01); 59.7% of mothers who had gestational diabetes were multiparous, 40.7% were primiparous. There was no significant relation between the type and duration of diabetes and birth weight for gestational age. But LGA neonates were born mostly to women with gestational diabetes; also there was an increased rate of emergency caesarian section among mothers with gestational diabetes. Norlander and associates [22] found that perinatal morbidity was significantly more frequent in women who had gestational diabetes (23%) than in the control group (13%). The occurrence of large-for-gestational age neonates did not differ between groups.

Mother's on diet control only, had the lowest control rate, and most of them (63.6%) gave birth to macrosomic babies. 73.9% of women who were on insulin only, had the best control. Hod and colleagues [23] reported data evaluating the effect of patient compliance, fasting plasma glucose on the oral glucose tolerance test, maternal body constitution, and method of treatment on perinatal outcome of patients who had gestational diabetes mellitus. Patient compliance reduced the rate of macrosomia (14.4%) and neonatal hypoglycemia (3.4%), but not to the level of the control population (5.2% and 1.2%, respectively).

The risk of congenital anomalies was 6%, and this is almost similar to other studies done by Loeken who found a risk of 6-9% [14] and Becerra et al 7.9% [15].

There was no significant relationship between the occurrences of macrosomia in a neonate with a mother who had a past history of macrosomic baby. There was a significant relationship between neonatal hypoglycaemia and neonatal macrosomia (P value =0.04)

## CONCLUSION

Maternal diabetic control was found to be an important factor that affects the outcome in IDMs. All mothers should be screened during pregnancy for diabetes. They should have regular follow up and better control for their glucose levels. This can only be achieved by combined clinics between the obstetrician and the endocrinologist. Delivery should be planned in order to decrease the risk of shoulder dystocia and birth injuries, and the rate of emergency caesarian sections. All babies born to mothers with diabetes should be

admitted to the neonatal care unit for a period of observation to improve the neonatal outcome.

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