CONGENITAL ANOMALIES IN INFANTS OF DIABETIC MOTHERS, A RETROSPECTIVE STUDY IN SOHAG TEACHING HOSPITAL

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ABSTRACT

Background: *Infants of diabetic mothers (IDMs) have experienced a nearly 30-fold increase in morbidity and mortality rates since the development of specialized maternal, fetal, and neonatal care for women with diabetes and their offspring* ***(Peace et al., 2010)****.*

Objectives: *We aimed to evaluate infants of diabetic mothers and congenital anomalies associated with them.*

Design: *This is prospective study that was performed between November 2019 to May 2020 on "one hundred" "100" cases group of newborn at Neonatal Department at Sohag Teaching Hospital.*

Patient and Methods: *Cases consist of one hundred neonates born to mothers with diabetes mellitus (D.M), either gestational DM or pre-gestational DM.*

Inclusion criteria:

- *Term Infants born to diabetic mothers (gestational or pre gestational).*
- *Those term Infants and their mothers received prenatal care.*
- *Mother with no other disease "only DM".*

Exclusion criteria:

- *Preterm infant.*
- *Mother not received prenatal care.*
- *Mother with other disease (Hypertension or taking drugs affecting her new born…).*

Results:

- *The mean maternal age was 32.94 years and mean duration of disease was 6.5 years.*

- *Most of patients had DM type II 50% of them and 20% had DM type I and GDM presented in 30 %.*
- *34% of cases had positive history of congenitally abnormal baby, 60% of cases delivered by CS and 40% by NVD, mean gestational age 36.64 weeks and 60 % of babies were males and 40% were females with mean birth weight 4450 kg. Mean Apgar at 1st min was 6.84 and at 5th min was 7.68.*
- *26% of cases had low serum calcium but 74% of them serum calcium level within normal and as regard first random blood sugar was 56 mg /dl an hour after birth.*
- *As regard anomalies founded 72% of cases had no anomalies but 28% had anomalies either single in 16% cases or multiple in 12% cases*
- *There were significant differences in presence or absence of anomalies regarding maternal age and duration of disease 0.006 and 0.029 respectively.*
- *Higher percentage of cases with anomalies was founded among mothers with type I diabetes with significant differences.*

Conclusion: *Pregnant women with diabetes (Type I, Type II and gestational) are all at increased risk for adverse pregnancy outcomes. DM in mother has been suggested an important risk factor for the development of congenital anomalies among the offspring. Congenital heart disease remains a major contributor of all the congenital malformations seen in IDMs.*

Keywords: *Infants of diabetic mothers (IDMs), gestational diabetes mellitus, macrosomia.*

INTRODUCTION

Gestational diabetes mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy. GDM can classify as Type A1 gestational diabetes mellitus (A1GDM) and type A2 gestational diabetes mellitus (A2GDM). Gestational diabetes managed without medication and responsive to nutritional therapy is diet-controlled gestational diabetes (GDM) or A1GDM. On the other side, gestational diabetes managed with medication to achieve adequate glycemic control is A2GDM **(Jawad and Ejaz, 2016)**.

Gestational diabetes affects around 2 to 10% of pregnancies in the United States of America. Women with gestational diabetes (GDM) have an increased 35 to 60% risk of developing diabetes mellitus over 10 to 20 years after pregnancy **(Quintanilla Rodriguez B and Mahdy, 2020)**.

In Egypt, the incidence was reported to be 8% in rural family center in Menoufia governorate **(Agarwal, 2015)**.

Recommendations are for screening for gestational diabetes at 24 to 28 weeks of pregnancy with a 50-g, 1-hour oral glucose challenge test. If the values are abnormal, greater than or equal to 130 mg/dL (7.22 mmol/L), or greater than or equal to 140 mg/dL (7.77 mmol/L), a confirmatory test is necessary with a 100-g, 3-hour oral glucose tolerance test, with the following values: first hour over 180 mg/dL, second hour over 155 mg/dL, third hour more than 140 mg/dL **(Rani and Begum, 2015)**.

Infants of diabetic mothers (IDMs) have experienced a nearly 30-fold increase in morbidity and mortality rates **(Peace et al., 2010)**.

Diabetes during pregnancy, whether Type I (insulin dependent) or Type II (non–insulin dependent), has many effects on the neonate. When a mother has poorly controlled diabetes, the fetus is subjected to high levels of glucose and responds with increased insulin levels to break down excess fuels (carbohydrates). This can result in macrosomia, which when combined with birth injury occurs ten times as frequently in infants of diabetic mothers (IDMs) as in the general population **(Moore, 2003)**.

The hormonal and metabolic changes that cause maternal problems in diabetic pregnancy also adversely affect the developing fetus. During organogenesis, at 3–8 weeks gestation, the abnormal metabolic environment is teratogenic, resulting in a higher incidence of congenital malformation, such as cardiac, musculoskeletal, and central nervous system (CNS) anomalies **(Armentrou, 2004)**.

Infants born to mothers with glucose intolerance are at an increased risk of morbidity and mortality related to the following:

- Respiratory distress.
- Growth abnormalities (large for gestational age [LGA], small for gestational age [SGA].
- Hyper viscosity secondary to polycythemia.
- Hypoglycemia.
- Congenital malformations.
- Hypocalcaemia, hypomagnesaemia, and iron abnormalities **(Peace et al., 2010)**.

These infants are likely to be born by cesarean delivery for many reasons, among which are such complications as shoulder dystocia with potential brachial plexus injury related to the infant's

large size. These mothers must be closely monitored throughout pregnancy. If optimal care is provided, the perinatal mortality rate, excluding congenital malformations, is nearly equivalent to that observed in normal pregnancies **(Said and Manji, 2016)**.

Congenital cardiac anomalies are the most common type of birth defect, and the rate of these anomalies is estimated at 6 to 8 cases in 1000 live births. The cause of this anomaly is usually unknown, with 1% of all cases relating to diabetes of pregnant mothers **(Wren et al., 2003)**.

AIM OF THE WORK

We aimed to evaluate infants of diabetic mothers and congenital anomalies associated with them.

PATIENTS AND METHODS

This Prospective study that was performed between November 2019 to May 2020 on "one hundred" cases group of newborn at Neonatal Department of Sohag Teaching Hospital.

Using the WHO sample size calculator with a population prevalence of 57.5% at 10% error that of precision sample size of (N=100) was calculated. Sampling technique was non probability consecutive sampling.

Cases consist of one hundred neonates that were born to mothers with diabetes mellitus, either gestational DM or pre-gestational DM admitted to NICU during this period.

Inclusion Criteria:

- Term Infants born to diabetic mothers (gestational or pre gestational).
- This term Infant and his mother received prenatal care.
- Mother with no other disease "only DM".

Exclusion Criteria:

- Preterm infant.
- Mother not received prenatal care.
- Mother with other disease (Hypertension or taking drugs affecting her new born …).

Ethical Consideration:

1- A written informed consent was obtained from the mothers/caregivers and they all gave consent for infant participation in the study.

2- An approval by the local ethical committee was obtained before the study.

3- The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

4- The author declared that no financial fund regarding study and publication.

5- The data of study are confidential and caregivers have right to keep it.

Methods:

Babies of mothers with pre-gestational diabetes mellitus (Type I and Type II) and gestational diabetes (GDM) were included. Maternal data were reviewed retrospectively. Information obtained included: a) characteristics of the mothers; age, parity, type and duration of diabetes, treatment received, presence or absence of other illnesses, pregnancy complications, mode of delivery, maternal outcome.

After selection of cases of infants of diabetic mothers, all infants were subjected to:

1. **General information, including:**

- Age.
- Gender.
- APGAR score at birth: to determine the need for resuscitation.
- Birth weight: Baby was weighed using a digital weighing scale.
- Gestational age at birth: using Modified Ballard's score.

Patients were classified according to the relationship between intrauterine growth and gestational age into appropriate for gestational age (AGA) defined as the baby's weight between 10th and 90th percentile of the gestational-age weight, small for gestational age (SGA) defined as baby's weight less than the 10th percentile for gestational-age, and Large for gestational age (LGA) was defined as birth weight greater than the 90th percentile. Infants whose birth weights were at least 4000 g regardless of gestational age were defined as macrocosmic, while those who weighed less than 2500 g were defined as low birth weight. [(10)]

2. **Complete clinical and physical assessment:**

After birth, the neonate was dried and placed under a preheated warmer. Neonates were then screened for presence of major congenital anomalies. Congenital heart diseases (CHD), acute respiratory distress syndrome (ARDS), and transient tachypnea of newborn were also included. All babies born to diabetic mothers were admitted to the NICU and hourly feeds were started. The first feed was usually given within 30 minutes of birth

and babies were fed hourly for the first 6 hours and then two-hourly if blood glucose values were normal. Once normoglycemia was established on two-hourly feeds, babies were transferred back to the mother and started on breast feeds. Babies who remained hypoglycemic despite adequate feeds were started on intravenous (IV) dextrose infusion, Bolus IV dextrose was given only if the baby was symptomatic or blood glucose level was less than 25mg/dl.

3. Laboratory investigations including:

- Random blood sugar: Blood glucose levels were checked at 1, 2, 3, 6, 12, 24, 36 and 48 hours using glucometer. Hypoglycemia was defined as blood glucose concentrations <2.6 mmol/ l (≤ 47mg/dl) in any infant regardless of gestational age and whether or not symptoms were present **(Dixon et al., 2017)**.
- Serum calcium and serum magnesium: Hypocalcaemia was defined by total serum calcium values lower than 1.50 mmol/L (6 mg/dL) and hypomagnesaemia as serum magnesium level of less than 1.7mg/dl. (Oden and Bourgeois, 2000)
- Complete blood content (CBC): Polycythemia was defined as a peripheral venous hematocrit greater than 0.65 or a venous hemoglobin concentration in excess of 22gm/dl. **(Ramamurthy and Brans, 1981)**.

4. Echocardiography, Abdominal ultra sound (US):

Routine echocardiography could be done for all the babies.

Statistical Analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data were described using range (minimum and maximum), mean, standard deviation, median and interquartile range (IQR). Significance of the obtained results was judged at the 5% level.

RESULTS

Table (1): Maternal and neonatal data of studied groups (n = 100):

	No.	%
Type of diabetes		
Type I	20	20.0
Type II	50	50.0
GDM	30	30.0
Maternal age (years)		
Min. – Max.	23.0 – 43.0	
Mean ± SD	32.94±4.45	
Median (IQR)	33.0 (32.0- 34.0)	
Duration of disease (years)		
Min. – Max.	1.0 – 20.0	
Mean ± SD.	6.50±6.10	
Median (IQR)	4.50 (1.0 – 8.0)	
History of maternal congenitally abnormal baby		
No	66	66.0
Yes	34	34.0
Mode of delivery		
Normal vaginal delivery (NVD)	40	40.0
Caesarean section (CS)	60	60.0
Gestational age/ weeks		
Min. – Max.	35.0 – 39.0	
Mean ± SD.	36.64±1.10	
Median (IQR)	36.0 (36.0 – 37.0)	
Sex of neonate		
Male	60	60.0
Female	40	40.0
Birth weight/kg		
Min. – Max.	3500.0 – 5500.0	
Mean ± SD.	4450.0 ± 667.1	
Median (IQR)	4400.0 (4000.0 – 5000.0)	
Apgar	**1st min.**	**5 min.**
Min. – Max.	6.0 – 8.0	7.0 – 8.0
Mean ± SD.	6.84± 0.71	7.68± 0.47
Median (IQR).	7.0 (6.0 – 7.0)	8.0 (7.0 – 8.0)

This table shows descriptive clinical data of mothers and neonates of studied groups.

Table (2): Classification of studied cases according to birth weight

	No.	%
Birth weigh		
Macrosomia	28	28.0
AGA	72	72.0
SGA	0	0.0

This table shows that the weight of the majority of babies 72 (72 %) was in the AGA class. Macrosomia in our sample affected 28 babies (28 %).

Table (3): Distribution of the studied cases according to serum calcium and first random blood sugar an hour after birth (n = 100)

	No.	%	P
Serum calcium (mg/dl)			0.0001
Normal (≥ 9 mg/dl)	74	74.0	
Low (< 9 mg/dl)	26	26.0	
First random blood sugar (mg/dl)			0.0001
Normal (≥ 40 mg/dl)	86	86.0	
Low (<40 mg/dl)	14	14.0	

Table (3): showing that 74% of cases had normal serum calcium and 26% had low serum calcium and mean first blood sugar was 56 mg/dl.

Table (4): Distribution of the studied cases according to number of anomalies (n = 100)

Number of anomalies	No.	%
No	72	72.0
Single	10	10.0
Multiple	18	18.0

Table (4): shows that 72% of neonates had no anomalies and the prevalence of congenital anomalies among cases was 28% with 10% had single anomaly and 18% had multiple anomaly

Table (5): Distribution of the studied cases according to name of anomalies (n = 28)

Name of anomalies	No.	%
Cardiac	10	10
VSD	1	1.0
ASD	4	4.0
Patent ductus arteriosus (PDA)	3	3.0
Fallot teratology	1	1.0
Transposition of great arteries	1	1.0
Pulmonary	5	5
RD	5	5.0
Neurological	5	5
Anencephaly	2	2.0
Encephalocele	1	1.0
Hydrocephalus	1	1.0
Meningocele	1	1.0
Renal	2	2
Renal agenesis/ dysgenesis –bilateral	2	2.0
Genital	2	2
Congenital hydrocele	1	1.0
Clitoromegaly	1	1.0
Face	2	2
Cleft lip and palate	2	2.0
GIT	2	2
Coanal stenosis	1	1.0
Diaphragmatic hernia	1	1.0
Skeletal	0	0
Caudal regression syndrome	0	0.0

Table (5): shows that the most common anomalies finding was cardiac anomalies in 10 % of cases followed by pulmonary and neurological anomalies in 5% and face, GIT, genital and renal anomalies in 2%.

Table (6): Relation between number of anomalies and maternal age (years) and duration of disease (n = 100)

	Number of anomalies		Test of Sig.	P
	No (n = 72)	Yes (n = 28)		
Maternal age (years)				
Min. – Max.	23.0 – 43.0	23.0 – 40.0	t= 2.915*	0.006*
Mean ± SD.	33.83 ± 3.74	30.64 ± 5.30		
Median (IQR)	33.0 (32.0 – 34.0)	32.0 (23.0 – 34.0)		
Duration of D.M in years				
Min. – Max.	1.0 – 20.0	1.0 – 20.0	U= 728.0*	0.029*
Mean ± SD.	5.42 ± 5.35	9.29 ± 7.07		
Median (IQR)	4.0 (1.0 – 7.0)	7.50 (1.0 – 15.0)		

Table (6): showing that there was significant positive correlation between maternal age and duration of diseases with prevalence of congenital anomalies p-value 0.006, 0.029 respectively.

Table (7): Relation between number of anomalies and type of diabetes (n = 100)

Type of diabetes	Number of anomalies				χ^2	P
	No (n = 72)		Yes (n = 28)			
	No.	%	No.	%		
Type I	8	11.1	12	42.9	13.757*	0.001*
Type II	42	58.3	8	28.6		
GDM	22	30.6	8	28.6		

Table (7): showing that there was positive significant relation between type of diabetes and presence of congenital anomalies as it was higher among cases with type I (p-value 0.001).

Table (8): Relation between number of anomalies and different parameters (n = 100)

	Number of anomalies				Test of Sig.	P
	No (n = 72)		Yes (n = 28)			
	No.	%	No.	%		
History of congenitally abnormal baby						
No	56	77.8	10	35.7	χ^2= 15.86*	<0.01*
Yes	16	22.2	18	64.3		
Mode of delivery:-						
ND	28	38.9	12	42.9	χ^2= 0.132	0.716
CS	44	61.1	16	57.1		
Gestational age:-						
Min. – Max.	35.0 – 39.0		35.0 – 38.0		t= 0.020	0.984
Mean ± SD.	36.64 ± 1.21		36.64 ± 0.73			
Median (IQR)	36.0 (36.0 – 37.0)		37.0 (36.0 – 37.0)			
Sex of neonate:-						
Male	44	61.1	16	57.1	χ^2= 0.132	0.716
Female	28	38.9	12	42.9		
Birth weight:-						
Min. – Max.	3500.0 –5500.0		3500.0 – 5500.0		t= 1.002	0.319
Mean ± SD.	4491.67 ± 704.26		4342.86 ± 557.39			
Median (IQR)	4400.0 (4000.0-5250.0)		4400.0 (4000.0–4500.0)			

χ2: Chi square test t: Student t-test
p: p value for association between different categories
*: Statistically significant at $p \leq 0.05$

This table shows that there was significant positive relation between presence of anomalies and History of congenitally abnormal baby (p-value <0.001).

DISCUSSION

Gestational diabetes mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy. GDM can classify as Type A1 gestational diabetes mellitus (A1GDM) and type A2 gestational diabetes mellitus (A2GDM). Gestational diabetes managed without medication and responsive to nutritional therapy is diet-controlled gestational diabetes (GDM) or A1GDM. On the other side, gestational diabetes managed with medication to achieve adequate glycemic control is A2GDM.

The prevalence of GDM varies worldwide due to difference education, food habits, place (urban or rural), and type of test and diagnostic criteria.

The presence of diabetes in pregnancy is associated with adverse outcomes in fetal, perinatal and late-postnatal life. Maternal hyperglycemia during conception and the first trimester of pregnancy can have deleterious consequences, including diabetic embryopathy, a principle cause of major birth defects and spontaneous abortions.

This study conducted on 100" neonate born to mothers with diabetes mellitus, either gestational DM or pre-gestational DM.

In the current study the mean maternal age was 32.94 years and mean duration of disease was 6.5 years **(Table 1)**.

This is in agreement with **Opara et al., (2010)** who also showed that the age range of the mothers of IDMs was 26 - 45 years with a mean of 33.15 ± 4.17 years **(Opara et al., 2010)**.

This is in disagreement with **Taslima, (2017)** who showed that onset of diabetes occurs at a later age, so most patient's duration of diabetes is < 5 years [68%] and least duration is 10 years (only 5%) **(Taslima, 2017)**.

In the current study, most of patients had DM type II (50%), 20% had DM type I and GDM presented in 30% **(Table 1)**.

This is in agreement with **Taslima, (2017)** who showed that most patients are Non- insulin dependent diabetes mellitus (NIDDM [type -II]) and out of 163 cases, majorities 58.3% [95cases] were diabetic. Among them 35% [57cases] were pre-gestational and 23.3% were gestational **(Taslima, 2017)**.

But this in disagreement with **Opara et al., (2010)** who showed that 18 (38.3%) had pre-gestational DM, while 29 (61.7%) had gestational DM. 31 (66%) had received insulin during pregnancy **(Opara et al., 2010)**.

Also **Al-Nemri et al., (2018)** showed that The GDM was observed in 84.5% of the study subjects, type I diabetes in 2.8% of subjects, and type II diabetes in 12.5% of all diabetic mothers who participated in the study **(Al-Nemri et al., 2018)**.

This is well explained as type DM II is common metabolic disorder all over the world **(Al-Nemri et al., 2017)**.

In the current study, 34% of cases had positive history of

congenitally abnormal baby, 60% of cases delivered by CS and 40% by NVD, mean gestational age 36.64±1.10 weeks and 60 % of babies were males and 40% were females with mean birth weight 4450.0 ± 667.1 kg. Mean Apgar at 1st min was 6.84 and at 5th min was 7.68 **(Table 1)**.

This in agreement with a study by **Opara et al., (2010)** showed that Thirty eight mothers (80.8%) delivered via Caesarean section either as emergency (42.5%) or elective (38.3%) while 28 (59.6%) had had previous fetal or neonatal deaths. Of the IDMs, 31 were males and 16 were females with a M: F ratio of 1.9:1. Gestational ages ranged from 31 - 41 weeks with a mean of 37.84 ± 1.88 weeks. The mean birth weight was 4.14 kg ± 0.838 (2.0 - 6.0 kg). 29 (61.7%) were macrocosmic. Mean Apgar scores at 1 minute was 6.96 ± 1.62; and at 5 minutes, 8.45 ± 1.16. 91.5% of the babies were admitted into the ward within the first hour of birth. Duration of admission was 1-21 days with a mean of 6.97 ± 2.63 days. The caesarian section (CS) rate in this study was very high with emergency CS rates being higher than elective CS rates even amongst the controls **(Opara et al., 2010)**.

This finding is similar to that in another Nigerian study, **Ozumba et al., (2004)** who reported that Babies with birth weights in excess of 4 kg (fetal macrosomia) constituted 49% of our deliveries from diabetic mothers **(Ozumba et al., 2004)**.

Also **Begum et al., (2018)** reported that about 96% babies were delivered by cesarean section in GDM and pre-GDM group and Gestational age was about 36.5 weeks in each group **(Begum et al., 2018)**.

Macrosomia remains an important morbidity because it is associated with increased risk for traumatic birth injury, obesity, and diabetes in later life **(Hod et al., 1991)**.

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 **(Neiger, 1992)**.

In current study as regard first random blood sugar, mean first blood sugar was 56 mg/dl **(Table 3)**.

This is in agreement with **Girish, (2014)** who reported that most of the mothers with PGDM had good glycemic control which probably prevented fetal hyper-

insulanism and significant hypoglycemia **(Girish, 2014)**.

Also **Al-Qahtani, (2014)** reported that Hypoglycemia was found only in 26 babies (14.7%) affecting males almost 2 times more than females **(Al-Qahtani, 2014)**.

This is in disagreement with **Opara et al., (2010)** who showed that mean blood glucose levels of all IDMs within the first hour was 2.93 ± 1.51 mmol/l. Thirty (63.8%) developed hypo glycaemia within the first 24 hours. Hypocalcaemia was the other common metabolic problem in the study **(Opara et al., 2010)**.

The explanation may due to 90% of mothers with PGDM have good glycemic control in comparison to mothers with GDM. Glycemic control was better in mothers with PGDM may be due to the fact that, mothers with PGDM were diagnosed before pregnancy and were advised regarding the complications during pregnancy and possible neonatal outcome which enabled strict glycemic control with regular follow up. Most of the mothers with GDM were diagnosed late in pregnancy and were not on regular follow up **(Girish, 2014)**.

In current study, 26% of cases had low serum calcium but 74% of them serum calcium level within normal **(Table 3)**.

This is in agreement with **Al-Qahtani, (2014)** who reported that hypocalcaemia was found in 17% with equal gender affection, which is not far from other studies **(Al-Qahtani, (2014)**.

But **Stoll and Kliegman, (2003)** documented that Hypocalcaemia is a problem of IDMs **(Stoll and Kliegman, 2003)**.

Hypocalcaemia as asymptomatic transient biochemical complication of diabetes during pregnancy is caused by maternal loss of calcium in urine and transient unresponsiveness of the fetal parathyroid gland to this hypocalcaemia **(Al-Qahtani, (2014)**.

Tsang et al., (1972) advanced the hypothesis that hyperparathyroidism of diabetic mothers might suppress the fetal parathyroid function and lead to hypocalcaemia of the newborn **(Tsang et al., 1972)**.

In current study as regard anomalies founded 72% of cases had no anomalies but 28% had anomalies either single in 10% cases or multiple in 18% cases **(Table 4)**.

Lower percentage of anomalies founded by **Ghimire and Croce, (2020)** as Congenital anomalies were present in 12.1% (n = 35,401) of IDM **(Ghimire and Croce, 2020)**.

Another study by **Yang et al, (2006)** reported that there were 47 infants (9.1%) with one or more major congenital anomaly. Of these, the majority of anomalies were cardiac. The most common cardiac anomaly was ventricular septal defect. Musculoskeletal, central nervous system, and ear, nose, and throat anomalies, as well as hypospadias complex were also relatively overrepresented **(Yang et al, (2006)**.

Another study by **Metzger and Coustan, (1998)** showed that in a total of 3764 women with GDM and 416 women with known type II diabetes mellitus, 143 infants (3.4%) with major anomalies were identified, with a prevalence of 2.9% in GDM and 8.9% in type II diabetes. The most frequently affected organ systems were cardiac (37.6%), musculoskeletal (16%) and nervous system (9.8%) **(Metzger and Coustan, 1998)**.

The incidence of major congenital malformations has been reported to be 2-5 times greater in IDMs than in other infants with cardiac malformations recorded as the most common **(Reece and Homko, 1994)**.

In studies of pregnancies among women with diabetes, the risk of congenital abnormalities has been estimated to be between 5 and 12% compared with 2 to 3% in pregnancies among women without diabetes **(Farrel et al., 2002, Garne et al., 2012)**.

Although the underlying mechanism for the association of diabetes with congenital anomalies is not understood completely, it is believed that hyperglycemia plays a critical role **(Correa et al., 2008)**.

Adverse outcomes in pregnancies among women with diabetes are in part related to preconception care, especially the level of glycemic control **(Evers et al., 2004)**.

This was probably because of the neonates were born to mothers with GDM who had poor glycemic control. These congenital malformations can be attributed to hyperglycemia induced teratogenesis during the periconceptional and organogenesis period **(Girish, 2014)**.

In current study, the most common anomalies finding was cardiac anomalies in 10 % of cases (the most cardiac anomaly was

ASD) followed by neurological and pulmonary anomalies in 5% and face, GIT, genital and renal anomalies in 2% **(Table 4)**.

This is in agreement with **Girish, (2014)** who show that among the neonates with congenital malformations, majority of them had congenital heart disease of which ostium secundum ASD was the commonest **(Girish, 2014)**.

But **Farooq et al., (2007)** reported that the rate for congenital anomalies was 2% **(Farooq et al., (2007)**.

In current study, there were significant differences in presence or absence of anomalies regarding maternal age and duration of disease 0.006, 0.029 respectively **(Table 5)**.

This in accordance with **Taslima, (2017)** as showed that most patients are between 30 - 34 years of age. Most congenital anomalies occur after 30 years of age and least patients are before 20 years of age. It reflects that most congenital anomalies occur in aged pregnancy than early **(Taslima, 2017)**.

In current study higher percentage of cases with anomalies were founded among mothers with type I diabetes with significant differences 0.001 **(Table 7)**.

Similarly **Murphy et al., (2011)** showed that Duration of diabetes and Type 1 diabetes approached increased risk factors for congenital malformation and perinatal mortality but did not quite reach significance (P = 0.06 and 0.07) **(Murphy et al., (2011)**.

In current study there was significant association between presence of anomalies and positive history of congenitally abnormal baby, but there was insignificant association between presence of anomalies and sex of neonate **(Figure 1& 2)**.

In agreement with study result, **Taslima, (2017)** showed that among babies born with congenital anomalies. Among 57 diabetic cases 2 had positive H/O congenitally abnormal babies in previous pregnancy. So, recurrence of congenitally abnormal babies positive in diabetic patient and not in other groups **(Taslima, 2017)**.

In contrary, **Ghimire and Croce, (2020)** showed that Males are more likely to have congenital anomalies than females, 13.5% (n = 21,452/159,015) vs. 10.4% (n = 13,932/134,346), p < 0.001 **(Ghimire and Croce, 2020)**.

CONCLUSION

Pregnant women with diabetes (Type I, Type II and gestational) are all at increased risk for adverse pregnancy outcomes. DM in mother has been suggested an important risk factor for the development of congenital anomalies among the offspring. There was significant differences in presence or absence of anomalies regarding maternal age , duration of disease and positive history of congenitally abnormal baby, higher percentage of cases with anomalies were founded among mothers with type I diabetes with significant differences. Congenital heart disease remains a major contributor of all the congenital malformations seen in IDMs.

RECOMMENDATIONS

1. Screening of all pregnant women for diabetes, good glycemic control and active management of their infants will reduce perinatal morbidity and mortality.
2. Adequate glycemic control before and during pregnancy is crucial to improve the outcome of neonates born to diabetic mothers.
3. Improving glycemic control of women during the preconception period and strict control of diabetes throughout pregnancy with regular follow up with obstetricians and physicians remain the only way of improving the maternal and neonatal outcome and are the most beneficial and cost-effective methods for promoting maternal and fetal health in the perinatal management of maternal diabetes.
4. As the risk of GDM increases with mothers' BMI, age, and low-income status, those factors should be taken into account when preventive intervention strategies are developed and the target risk group is established.
5. It is suggested to conduct a prospective study assessing all diabetic ladies from their initial visits to the time of delivery, which will correlate precisely the glycemic control level with the outcome in the mothers and their off springs.

LIMITATION

The study population was selected from single hospital and sample size was limited. Further study may be undertaken from multiple hospitals with large sample size.

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