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Neonatal Morbidity Pattern among Infants Born to Diabetic Mothers at Jamhouria Hospital, Benghazi-Libya

Munera Awad Radwan [a*], Najia Abdelati El Mansori [a], Mufeda Ali Elfergani [a], Faiaz Ragab Halies [a] and Mohanad Abdulhadi Lawgali [a]

[a] Department of Pediatrics, Faculty of Medicine, University of Benghazi, Benghazi, Libya.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Diabetes has long been associated with maternal and perinatal morbidity and mortality. The infant of a diabetic mother have higher risks for serious problems during pregnancy and at birth. Problems during pregnancy may include increased risks of abortions and stillbirths. Abnormal fetal metabolism during pregnancy complicated by maternal diabetes mellitus results in multiple neonatal sequallae, including abnormalities of growth, glucose and calcium metabolism, hematologic status, cardio- respiratory function, bilirubin metabolism, and congenital anomalies. The causes of the fetal and neonatal sequallae of maternal diabetes are Multifactorial. However, many of the perinatal complications can be traced to the effect of maternal glycemic control on the fetus & can be prevented by appropriate periconceptional & prenatal care.
Objective: to describe the morbidity pattern among infants of diabetic mothers (IDMs) either gestational or preconception diabetes mellitus.
Methods: A cross sectional study was conducted in Jamhouria hospital/ neonatal ward & enrolled 120 consecutive infants born to diabetics mother either gestational or preconception diabetes mellitus over one year period.
Results: 120 babies were diagnosed as IDMs and were admitted to Neonatal intensive care unit,

**Corresponding author: Email: mohanad.lawgali@uob.edu.ly;*

male, female, 74(60.8%) were gestational diabetes, and 46 (38.3%) with preconception diabetes, full term comprise 98 cases (81.6%) while premature were 22 cases (18.3%). For birth weight 20 case [16.7%} were low birth weight, macrosomia represent 16 case (13.3%).
Most common congenital anomalies was cardiac lesion 36 cases, for GDM 18 case =24.3% were PCDM 18 case around 40.0%.
Central nervous system 11 case (9.1%) all of them dilated ventricular system& only 2 of them need surgical intervention with shunt.
Gastrointestinal anomalies 4 cases {3.4%} 2 of them ectopic anus & 2 short bowel syndrome.
Most common metabolic disturbance was Hypocalcemia 17 case (14.1%), followed by hypoglycemia 11 case (9.1%), followed with hyper bilirubinemia 3 cases (2.5%)
Followed by Respiratory distress syndrome 26 case (21.6%), 17 case hyaline membrane disease (14.1%) ,transient tachypnea of neo born 9 cases (7.5%) , Birth trauma 3 cases Erb,s palsy one of them birth asphyxia.
Conclusion: Most common type of diabetes in pregnancy is gestational diabetes, and most common congenital anomalies is the cardiac lesion & the most common metabolic disturbance is the hypocalcemia. Macrosomia associated with large birth weight as well as birth trauma. Large for gestational age and hypoglycemia associated mainly with poor maternal glycemic control.

Keywords: Hypoglycemia; diabetes; overnutrition; fetal metabolism

1. INTRODUCTION

Diabetes mellitus is a disorder of glucose metabolism resulting from a deficiency of insulin action that has a plenty of physiologic as well as pathologic effects on homeostasis. When it affects a pregnant woman, it constitutes a high risk factor to the fetus *in utero*. Maternal diabetes is characterized by the increased transport of glucose and other nutrients from the mother to the fetus resulting in fetal overnutrition.[1] It also induces an alteration in lipid metabolism, leading to maternal and fetal hypertriglyceridemia and hypercholesterolemia.[2],[3] Fetal hyperglycemia consequent upon maternal hyperglycemia stimulates pancreatic islet cells and induces fetal hyperinsulinemia .[4]. The combined effects of hyperglycemia and hyperinsulinemia in the fetus lead to both functional and structural abnormalities.

IT is well known that Diabetes has long been associated with maternal and perinatal morbidity and mortality. Infants of diabetic mothers (IDMs) have experienced a nearly 30-fold decrease in morbidity and mortality rates since the development of specialized maternal, fetal, and neonatal care for women with diabetes and their offspring. Before then, fetal and neonatal mortality rates were as high as 65%.

Today, 3-10% of pregnancies are affected by abnormal glucose regulation and control. Of these cases, 80-88% are related to abnormal glucose control of pregnancy or gestational diabetes mellitus. Of mothers with preexisting diabetes, 35% have been found to have type 1 diabetes mellitus, and 65% have been found to have type 2 diabetes mellitus.

Infants born to mothers with glucose intolerance are at an increased risk of morbidity and mortality, the infant of a diabetic mother have higher risks for serious problems during pregnancy and at birth. Problems during pregnancy may include increased risks of abortions and stillbirths. Abnormal fetal metabolism during pregnancy complicated by maternal diabetes mellitus results in multiple neonatal sequallae, including abnormalities of growth, glucose and calcium metabolism, hematologic status, cardiorespiratory function, bilirubin metabolism, and congenital anomalies. The causes of the fetal and neonatal sequallae of maternal diabetes are Multifactorial. However, many of the perinatal complications can be traced to the effect of maternal glycemic control on the fetus & can be prevented by appropriate periconceptional & prenatal care.

Despite advances in perinatal care, however, infants of diabetic mothers (IDMs) remain at risk for preterm birth with its attending problems, as well as a multitude of physiologic, metabolic, and congenital complications unique to fetal adaptation to maternal diabetes. Type 1 Diabetes Mellitus(T1DM) is associated with marked risk of embryopathy involving most systems (particularly neural tube defects, cardiac anomalies, caudal regression), poorly controlled T1DM with complications carries a higher risk of intrauterine growth restriction, asphyxia, and fetal death

[1,2]. In later life, IDM is predisposed to obesity, diabetes, and cardiovascular disease [3].

Successful management of these high-risk newborns requires close consultation between different specialists involved in the care of the mother and baby, encompassing pre-pregnancy planning, leading on to pregnancy, labour and delivery, and post pregnancy care

The delineation of the mechanisms and impact of the altered intrauterine environment on the fetus and neonate, as pioneered by Pedersen, Freinkel, and most recently Barker, has improved the outcome of pregnancy for the woman who has pregestational or gestational diabetes. Nonetheless, the neonatal and long-term consequences of maternal diabetes, particularly pregestational disease, on the offspring still exist, despite 80 years of effort. Although rigidly controlled trials are lacking, observational reports suggest that tight glycemic control before and during pregnancy can minimize morbidity in infants of women who have pregestational diabetes. Some of these associations require further delineation, such as the association of improved maternal metabolic control with a reduced incidence of neonatal hypocalcemia.

1.1 Complications Associated with Diabetes

Fetal congenital malformations are most common when maternal glucose control has been poor during the first trimester of pregnancy. As such, the need for preconceptional glycemic control in women with diabetes cannot be overstated. Maternal hyperglycemia during late gestation is more likely to lead to fetal macrosomia, hypoxia, polycythemia, and cardiomegaly with outflow tract obstruction.[1, 2]

1.2 Fetal Macrosomia

Fetal macrosomia (>90th percentile for gestational age or >4000 g in the term infant) occurs in 15-45% of diabetic pregnancies. It is most commonly observed as a consequence of maternal hyperglycemia. When macrosomia is present, the infant appears puffy, fat, ruddy, and often hypotonic.[3, 4, 5] Fetal growth is assessed by plotting birth weight against gestational age on standard growth curves. Infants whose weight exceeds the 90th percentile for gestational age are classified as large for gestational age (LGA). Maternal hyperglycemia during late pregnancy is commonly followed by excessive fetal growth.

1.3 Impaired Fetal Growth

Infants whose birthweight is below the 10th percentile, when plotted against gestational age on a standard growth curve, are considered small for gestational age (SGA). Impaired fetal growth may occur in as many as 20% of diabetic pregnancies, compared with a 10% incidence (by definition) for infants born to mothers without diabetes. Maternal renovascular disease is the common cause of impaired fetal growth in pregnancies complicated by maternal diabetes. Perinatal asphyxia, more common in infants with impaired fetal growth, may be anticipated by prenatal history; this demonstrates the importance of communication between the obstetrician and the pediatrician [6].

1.4 Pulmonary Disease

These infants are at an increased risk of respiratory distress syndrome and may present within the first few hours after birth with tachypnea, nasal flaring, intercostal retractions, and hypoxia. Operative delivery due to macrosomia also increases the risk for transient tachypnea of the newborn, whereas polycythemia predisposes the infant to persistent pulmonary hypertension of the newborn. Initially, the differential diagnosis includes transient tachypnea of the newborn, respiratory distress syndrome, pneumonia, and persistent pulmonary hypertension [6].

1.5 Metabolic and Electrolyte Abnormalities

Hypoglycemia may present within the first few hours of life. Although the infant is generally asymptomatic, symptoms may include jitteriness, irritability, apathy, poor feeding, high-pitched or weak cry, hypotonia, or frank seizure activity. Hypoglycemia that requires intervention may persist for as long as 1 week. Hypoglycemia is caused by hyperinsulinemia due to hyperplasia of fetal pancreatic beta cells consequent to maternal-fetal hyperglycemia. Because the continuous supply of glucose is stopped after birth, the neonate develops hypoglycemia because of insufficient substrate. Stimulation of fetal insulin release by maternal hyperglycemia during labor significantly increases the risk of early hypoglycemia in these infants. Perinatal stress may have an additive effect on

hypoglycemia due to catecholamine release and glycogen depletion. The overall risk of hypoglycemia is anywhere from 25-40%, with LGA and preterm infants at highest risk. Hypocalcemia or hypomagnesemia may also be apparent in the first few hours after birth. Symptoms may include jitteriness or seizure activity. Hypocalcemia (levels < 7 mg/dL) is believed to be associated with a delay in parathyroid hormone synthesis after birth. Sixty-five percent of all infants of diabetic mothers (IDMs) demonstrate abnormalities of iron metabolism at birth. Iron deficiency increases the infant's risk for neurodevelopmental abnormalities. Iron is redistributed to the iron-deficient tissues after birth, as the red blood cell (RBC) mass is postnatally broken down [6].

1.6 Hematologic Problems

Polycythemia, caused by increased erythropoiesis triggered by chronic fetal hypoxia, may present as a clinically "ruddy" appearance, sluggish capillary refill, or respiratory distress. Hyperviscosity due to polycythemia increases the IDM's risk for stroke, seizure, necrotizing enterocolitis, and renal vein thrombosis [7].

1.7 Thrombocytopenia

Thrombopoiesis may be inhibited because of an excess of RBC precursors within the bone marrow as a result of chronic in utero hypoxia and increased erythropoietin concentration [7].

1.8 Hyperbilirubinemia

This is common, especially in association with polycythemia. The increased red cell mass results in increased number of RBCs that are taken out of circulation each day and increase the bilirubin burden presented to the liver [8].

1.9 Cardiovascular Anomalies

Cardiomyopathy with ventricular hypertrophy and outflow tract obstruction may occur in as many as 30% of IDMs. The cardiomyopathy may be associated with congestive failure with a weakly functioning myocardium or may be related to a hypertrophic myocardium with significant septal hypertrophy and outflow tract obstruction. When cardiomegaly or poor perfusion and hypotension are present, performing echocardiography to differentiate between these processes is important. These infants are also at an increased risk of congenital heart defects, including (most commonly) ventricular septal defect (VSD) and transposition of the great arteries (TGA) [9].

1.10 Congenital Malformations

Central nervous system (CNS) malformations are 16 times more likely in IDMs. In particular, the risk of anencephaly is 13 times higher, whereas the risk of spina bifida is 20 times higher. The risk of caudal dysplasia is up to 600 times higher in these infants.[6] Neurologic immaturity, demonstrated by immature sucking patterns, has been found in infants born to insulin-managed mothers with diabetes.[7] Studies in fetal sheep indicate that this may be a reflection of the abnormal brain metabolism and electroencephalogram (EEG) findings as a result of the fetal hyperglycemia.[8] Renal (eg, hydronephrosis, renal agenesis, ureteral duplication), ear, gastrointestinal (eg, duodenal or anorectal atresia, small left colon syndrome), and, as mentioned earlier, cardiovascular (eg, single umbilical artery, VSDs, atrial septal defects, TGA, coarctation of the aorta, cardiomegaly [9].

2. LITERATURE REVIEW

A prospective study was conducted in Bangalore hospital during one year period from June 2014 to May 2015 to assess the outcome in infants of diabetic mother and association of various complications to glycaemic status of mother.

Results: The incidence of diabetes in pregnant mothers in their hospital was 3.5%. Various complications like hypoglycaemia, hypocalcaemia, polycythemia, hyperbilirubinemia, macrosomia, prematurity, respiratory distress syndrome, congenital heart diseases were observed in infants of diabetic mothers. Among them hypoglycaemia was most commonly observed complication with frequency of 28% followed by macrosomia (20%). Significant association was found between various complications and glycaemic control in mothers.

Conclusions: High frequency of complications is seen in infants born to diabetic mothers. Strict glycemic control in mother and proper monitoring in babies is required to prevent morbidity and mortality in infants of diabetic mother.

Another study was done in Bangladesh, it was prospective observational study in the newly established Special Care Neonatal Unit (SCANU)

to determine the morbidities and mortalities among IDM babies admitted in to Mymensingh Medical College Hospital (MMCH), Bangladesh from January to March 2015. A total 50 IDM patients who was admitted during this period were recruited in the study irrespective of their gestational age, birth weight, pattern and duration of maternal diabetes, their results showed Male and female patients were 29 (58%) and 21 (42%). Caesarian and vaginal delivery were 43 and seven cases. Gestational and pre-gestational diabetes mothers were 35 (70%) and 15 (30%) respectively. The important morbidities in order of frequency were found perinatal asphyxia (50%), macrosomia (48%), neonatal jaundice (44%), hypoglycaemia (40%), hypocalcaemia (36%), polycythemia (28%), CHD (20%), neonatal sepsis (20%), birth trauma (12%), TTN (6%), RDS (6%), GIT problem (2%) respectively. Mortality was recorded in three patient

In the same way the present study was a hospital based prospective study to know the occurrence of metabolic, hematological abnormalities and congenital anomalis in infant of diabetic mothers and to compare the outcome in gestational and overt diabetic mothers. Methods A prospective hospital based study conducted at Vanivilas Children Hospital and Bowring & Lady Curzon Hospital attached to Bangalore Medical College and Research Institute between January 2009 and December 2009. Gestational age, birth weight, relevant perinatal history and examination findings were recorded in predesigned proforma. Blood samples collected to perform relevant biochemical tests and managed accordingly. Echocardigraphy and ultrasound abdomen was done routinely for all the infants. Results Total number of IDMs was 54. Among them 40 were born to mothers with GDM and 14 to overt DM mothers. Most of the neonates (59.30%) were delivered by cesarean section, 92.6% of infants were born term. Majority of neonates were appropriate for gestational age (79.6%) with the mean birth weight of 3.20±0.66 kg. Hypoglycemia (51.8%) was the most common metabolic abnormality, occurrence of which was statistically significant ($p<0.01$) in infants born to GDM mothers. Hypocalcemia was observed in (42%) of IDMs.

Polycythaemia was the most common hematologic abnormality, statistically significant ($p<0.04$) in infants of overt DM mothers. Hyperbilirubinemia seen in (51.2%) of infants born to GDM mothers and (21.4%) in infants of overt DM mothers, difference was statistically significant ($p<0.05$). Eight (14.8%) out of 54 IDMs had congenital malformations, 6(11.1%) were seen in the infants of mothers with GDM and 2(14.28%) in overt DM. Majority of them had congenital heart disease 6(75%) others being lumbosacral meningomyelocele 1(2.5%) and unilateral hydronephrosis secondary to pelvi-ureteric junction obstruction 1(2.5%).VSD was the commonest constituting 50% of all congenital heart diseases. Total birth injuries were 5(12.5%) of which 3 had erbs'palsy, 1 each had shoulder dislocation and clavicle fracture. There were 2(3.5%) neonatal deaths 1 in each infant GDM and overt DM mothers. Interpretation & Conclusions: Among the pregnancies complicated by diabetes, GDM continues to have a major contribution. Hypoglycemia remains the most common biochemical abnormality followed by, polycythemia and hyperbilirubinemia, statistically significant in infants of GDM mothers. Congenital heart diseases were the most common among congenital anomalies, VSD being the commonest. The occurrence of morbidities and mortality were more significant in the infants of GDM mothers when compared to overt DM mothers who had good glycemic control before and during the pregnancy.

A study was done by *Muhammad Hussain, Muhammad Irshad, Afzal Khan Khattak, Behram Khan* To determine the frequency of various complications occurring in infants of diabetic mothers. Methodology: it was a descriptive study and was conducted in the neonatal unit and obstetric units of Lady Reading Hospital, Peshawar from January to July 2010. Forty two consecutive cases of infants of diabetic mothers were enrolled in the study. Maternal history especially obstetric history and history regarding diabetes mellitus was obtained and complete neonatal examination was performed. The physical findings and anthropometric measurements were recorded into a printed Performa. Serum glucose, serum calcium,hematocrit and echocardiography was performed in all enrolled babies. Results: Out of 42 diabetic mothers, gestation diabetes was seen in 71.4% while pre-conceptional diabeteswas seen in 28.5%. The male Infants of Diabetic Mothers in this study were 69%. Infant of DiabeticMothers delivered by C-section were 45%. Macrosomia 40.4% (n=42) was found to be the most commoncomplication followed by hypoglycaemia 23.8%. The mortality rate in our study was 4.7% (n=2).Conclusion: This study confirms the high occurrence of complications in

newborns, born to diabeticmothers. Large for gestational age and hypoglycemia were the commonest complications.

Despite improvements in medical care provided during pregnancy to diabetic mothers, the cardiac complications in their infants are still more frequent than in the infants of general population. This problem was investigated by a group of doctors in Tahran, their primary objective was to explore the spectrum of cardiovascular complications in infants of diabetic mothers (IDMs). The study was also aimed at investigating probable relations between infants' heart lesions, the type of maternal diabetes, and the neonatal somatic data.it was done Between July 2010 to June 2011, two-dimensional/M-mode and Doppler echocardiography evaluations were performed in IDMs at the out-patient clinic of the pediatric cardiology ward of a University hospital in Tehran.Results reveled a total of 32 IDMs (18 male and14 female) were studied. Congenital heart disease (CHD) was found in 6 (18.7%) neonates and 3 of them suffered from conotruncal malformations. Hypertrophic cardiomyopathy (HCM) was observed in 15(46.9%) cases. There were 22 (68.8%) large for gestational age (LGA) infants. Gestational diabetes was found in 21(65.6%) mothers. We did not find a significant relation between the types of maternal diabetes and the frequency of CHD (P = 0.9), and the frequency of HCM in their infants (P = 0.9). Also a significant relation could not be found between LGA and the rate of CHD (P = 0.6) or the rate of HCM (P = 0.4).their Conclusions showed a high prevalence of CHD in IDMs in their pediatric cardiology clinic. Neither the types of maternal diabetes nor the somatic findings of newborns were related to the occurrence of cardiac complications.

Another study was conducted at King Fahd hospital of the university, this study was a retrospective analysis of 4 years period May 2008 to April 2012 at Al-Khobar, Kingdom of Saudi Arabia. All the diabetic pregnant mothers admitted to the hospital and their babies within that period were included into the study. The results showed that diabetic mothers constitute 2.9% of all the pregnant ladies. Multiparity was found in the majority of our diabetic mothers regardless of their type of diabetes. Around 70% of the IDM were born to mothers with gestational diabetes mellitus (GDM), while 26% were born to mothers with type 2 DM, and only 4.5% type 1 DM. Full term babies were 163 (92.0%), preterm were only 14 (8.0%). The most common IDM morbidities were Hypomagnesaemia, followed by macrosomia, which was found higher in infant of GDM. The least common complications were polycythemia and acute respiratory distress syndrome. A low percentage of asymptomatic thypoglycemia and hypocalcemia were found. There was no mortality among the IDM during the study period.their results proved that Gestational DM continues as health care problem with risks for both the mothers and their offspring. It is recommended to follow the international guidelines for early detection, proper diagnosis and management of the gestational diabetic mothers to improve the outcome and limit the complications.

This is another study regarding cardiac problems to show the Pattern of Congenital Heart Disease in Infants of Diabetic Mother, it was done by *Shormin Ara Ferdousi, Ferdousur Rahman Sarker, Nasim Jahan, Nurunnahar Fatema* .The aim of the study was to show the prevalence of different types of Congenital Heart Disease (CHD) through echocardiogram and to perceive the utility of Echocardiogram in diagnosis of CHD in Infant of Diabetic Mother (IDM).

It was done for one year from, July 2004 to June 2005. The study was done on 56 neonates of gestational diabetic mother, the study was carried out at Combined Military Hospital (CMH) Dhaka, Bangladesh over a period of one of their gestational age and birth weight who were delivered at CMH. All the patients were evaluated by echocardiography by an expert pediatric cardiologist of the same institute within 7 days of delivery. Out of 56 IDM 5.2% was normal. The most common Echo-cardiographic finding was patent Foramen Ovale (60.71%). Other different Echocardiographic findings were patent Ductus arteriosus 31 (55.3%) cases, Hypertrophic Cardiomyopathy in 12 (21.42%) cases and ASD in 6 (10.71%) cases. Some other uncommon findings include Ventricular Septal Defect (VSD), Tricuspid Regurgitation (TR) and Right ventricular hypertrophy (RVH). These findings of CHD of Infant of Diabetic Mother (IDM) could demonstrate that Echocardiogram might be used as an effective tool to diagnose CHD for the IDM.

This study was done in Department of Pediatric Medicine, National Institute of Child Health, Karachi. Their aim was to determine the range of complications occurring in infants of diabetic mothers (IDMs). It was an observational cross-

sectional study. In Federal Government Services Hospital, Islamabad and National Institute of Child Health, Karachi, from August 1999 to January 2000. All IDMs born during the study period were immediately admitted to the neonatal intensive care unit after delivery. Maternal history was obtained and a detailed physical examination was performed to detect congenital abnormalities. Babies were screened for hypoglycemia, hypocalcemia, hyperbilirubinemia, birth asphyxia, respiratory distress syndrome (RDS) and birth trauma. Outcome of IDMs and relative frequency were evaluated.

The results were as follow, number of 40 babies with IDM were included in the study. Out of diabetic mothers, only 19 (47.5%) were taking insulin albeit irregularly. No mother was taking oral hypoglycemic agents, 5 (12.5%) were following only dietary advice while 16 (40%) were not following any advice for control of diabetes. Twenty-two (55%) mothers were delivered by C-section and 18 (45%) had vaginal delivery. Seven (17.5%) mothers experienced birth injuries, all of them were delivered vaginally and majority of them were large babies. Fifteen percent IDMs suffered from birth asphyxia. Most (82.5%) were delivered vaginally. Congenital anomalies were found in 10 (25%) babies. Eighteen (45%) were macrosomic, 20 (50%) were appropriate for gestational age (AGA) and 02 (5%) were small for gestational age (SGA) or growth retarded. Hypoglycemia was noted in 35% and hypocalcemia in 15%. Hyperbilirubinemia was observed in 12 (30%) newborns. Mortality was 7.5%. CONCLUSION: The results of this study show a high frequency complications in IDMs. They reached to a conclusion that diabetic mothers should have regular antenatal follow-up and maintain good glycemic control throughout pregnancy. Cesarean section may be allowed more liberally, especially with clinical evidence of macrosomic baby, to avoid birth injury and asphyxia.

This is a prospective study of 100 consecutive infants of diabetic mothers (IDMs) at King Khalid University Hospital in Riyadh it was done between July 2000 and June 2001 was undertaken. (5%), small muscular ventricular septal defect (4%), mitral valve prolapse (2%), and pulmonary stenosis (1%). Hypertrophic cardiomyopathy (HCMP) was observed in 38% of cases, mainly hypertrophy of the interventricular septum. Severe forms of CHD encountered were D-transposition of great arteries, tetralogy of Fallot, and hypoplastic left heart syndrome (1% each). Isolated aortic stenosis and coarctation of aorta were not encountered in this series. Overall incidence of congenital heart disease was 15% after excluding PDA and HCMP. Maternal IDDM is a significant risk factor for CHD. Careful evaluation and early diagnosis of CHD in this high-risk group are highly indicated.

3. AIM OF THE STUDY

Diabetes in pregnancy constitutes a high risk factor for increased maternal and perinatal morbidity and mortality. There is inadequate knowledge of the diabetic pregnancy and its impact on neonatal health in our environment, hence the need for more research. The aim of this study is to describe the morbidity pattern among infants of diabetic mothers (IDMs).

4. PATIENT AND METHOD

A case series design study for 120 cases of neonates born to mothers diagnosed as having diabetes mellitus gestational diabetes mellitus & preconception diabetes mellitus.

Sampling method was purposive sampling and data were collected as secondary data from files of admissions to Al-jmhoria hospital.

Inclusion criteria; neonates born to mothers admitted in labor or referred for elective cesarean section or admitted at antenatal ward as a high risk group.

All patients were investigated thoroughly using history and clinical examination, laboratory assays, abdominal and brain ultrasound scans and echocardiography.

Data collection sheet was structured to register identity information of the baby, gender, mode of delivery, maternal diabetes type, birth weight and details of complications and anomalies expected. Data were coded the entered into electronic data base (Microsoft excel 2007) then transferred to file of SPSS IBM 20.0 software for data analysis.

Analysis was conducted to calculate rates, compare rates and describe and compare birth weight. Further categories were created up on need to categorize birth weight according to WHO standard definitions and to collapse multiple categories in order to verify relationships or to make nominal tests feasible. Test of normality was applied before analyzing birth weight. We used median test for independent

samples for numerical variables, likelihood Chi square test for nominal variables and alternatively when table cells are not sizeable enough to conduct Chi square test safely we applied Fisher exact test.

All of results were considered at level of confidence of 95%. For purpose of difference analyses, any P values below 0.05 was considered significant to conclude difference between categories.

5. RESULTS

5.1 Demographic and General Characters

In our study 120 cases were included and all were from Benghazi public maternity facility. All of the birth were registered for Libyan fathers. Females represented 91 births (60.6%) and males represented only 59 births (39.3%). Cesarean delivery was the option of delivery in 65 cases (54.2%).

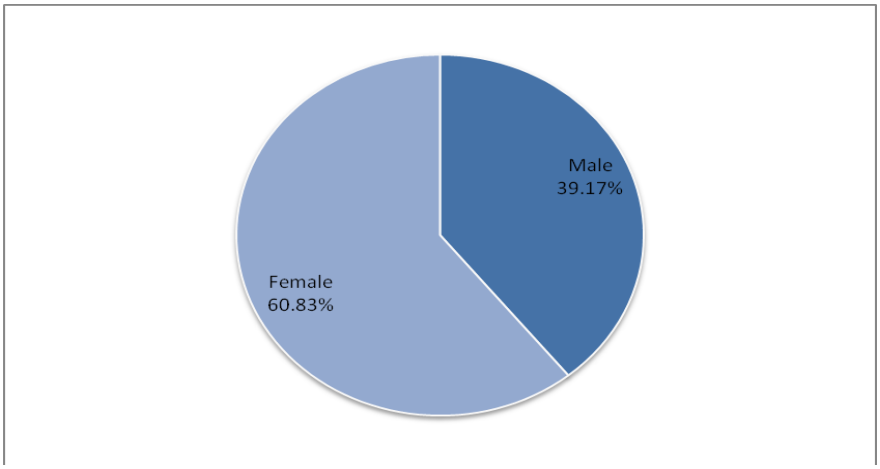

Fig. 1. Gender distribution of IDM, Benghazi 2010

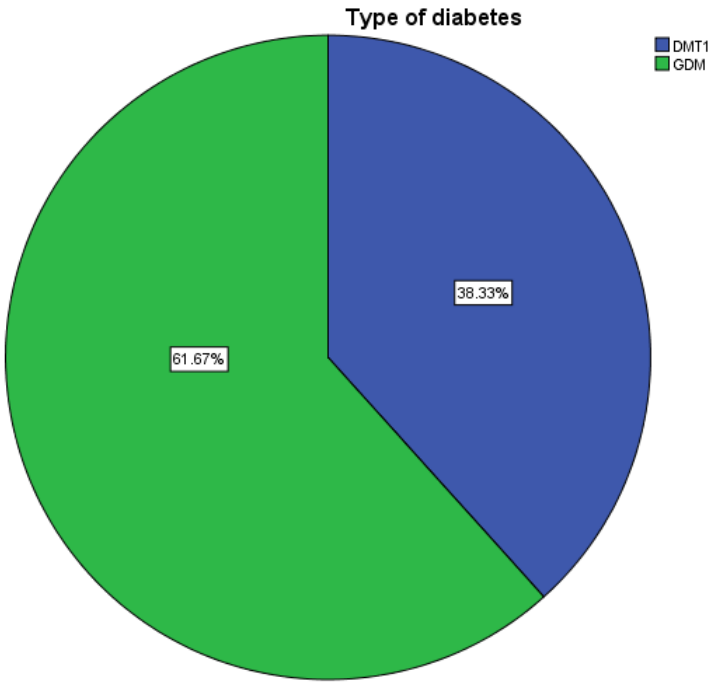

Fig. 2. Type of diabetes in mothers of IDM, Benghazi

5.2 Distribution of Cases According to Types of Diabetes

Gestational diabetes (GDM) counted the majority of IDM cases studied (N=74 %=69.3). preconceptional diabetes mellitus (PCDM) counted only for 38.3% of the total cases (N=46)

5.3 Birth Weight (BW) Distribution

Birth was not normally distributed variable as Kolmogorov-Smirnov test of normality 0.107 with P value = 0.002. Median birth weight was 3.72 kg with lowest value of 1.29 kg and maximum value of 5.5 kg. The median birth weight for GDM group was 3.95 kg in comparison to that for PCDM group of 3.24 kg. This difference was found to be significant with use of median test (test statistic =17.0, P <0.001).

After grouping cases according to birth weight categories using cutoff point of 4.5 kg for macrosomia and 2.5 kg for low birth weight (LBW), LBW cases were 20(16.8%),cases with macrosomia were 16 (13.4%). Comparing for LBW status between two types of diabetes revealed that significantly higher LBW among infants born to mothers with PCDM (Likelihood ratio = 13.45, P <0.001). And comparing for macrosomia between the two groups revealed significantly higher rate of macrosomia among GDM (Likelihood ratio = 6.0, P =0.014).

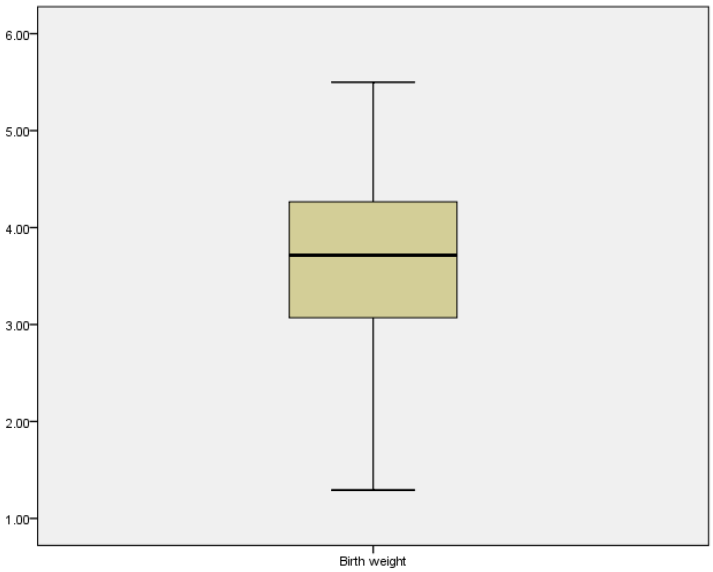

Fig. 3. Birth weight distribution of IDM, Benghazi

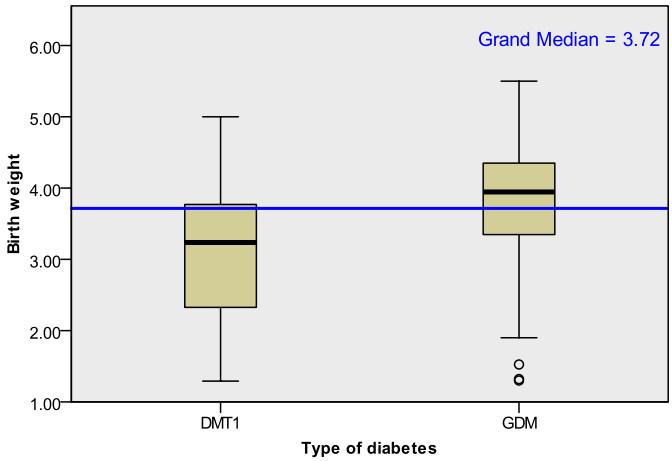

Fig. 4. Birth weight distribution according to type of diabetes in IDM, Benghazi 2010

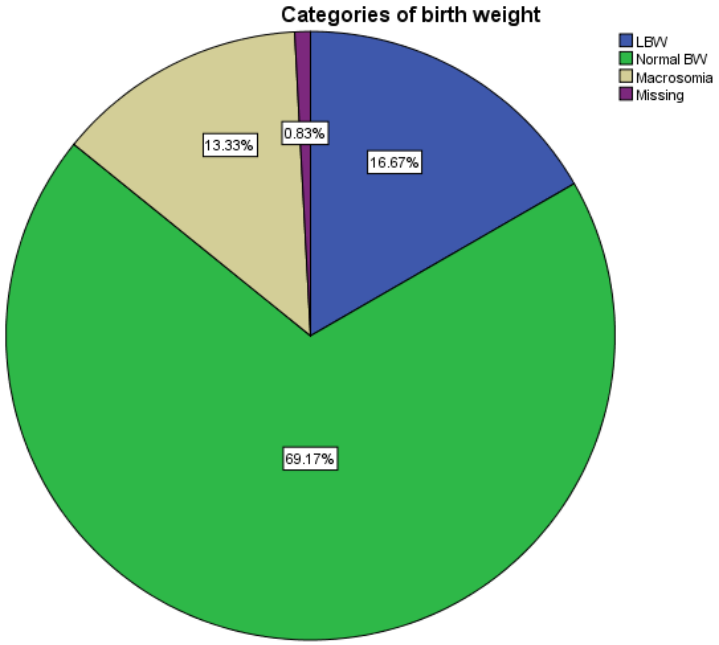

Fig. 5. Birth weight categories in IDM, Benghazi 2010

Table 1. Types of diabetes

Type of diabetes	LBW		Total
	Yes	No	
DMT1	15	31	46
(preconception)	32.6%	67.4%	100.0%
GDM	5	69	74
	6.8%	93.2%	100.0%
Total	20	100	120
	16.7%	83.3%	100.0%

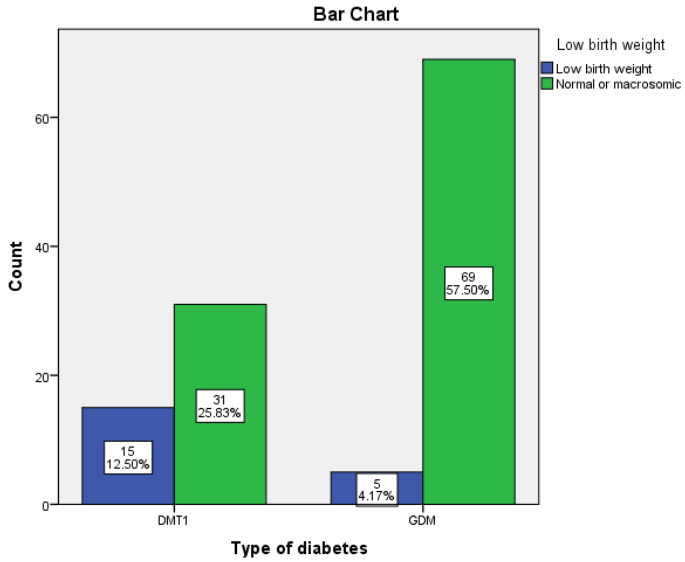

Fig. 6. Bar chart showing diabetes count

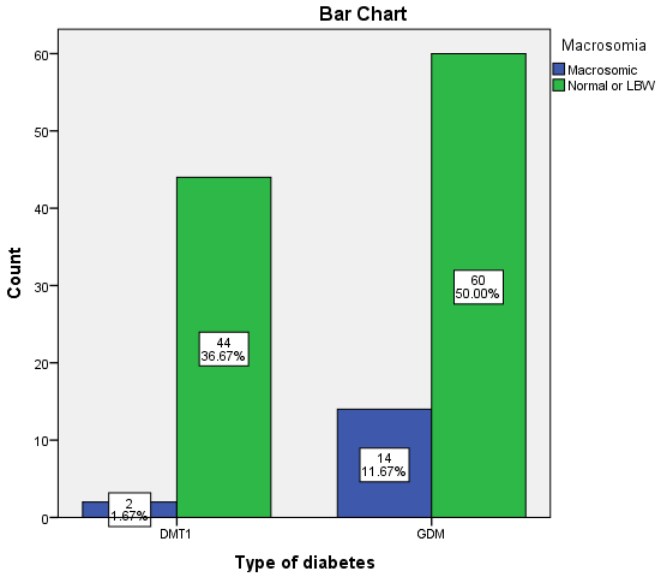

Fig. 7. Macrosomia with diabetes

Table 2. Macrosomia infection

Type of diabetes	Macrosomia		Total
	Yes	No	
DMT1	2	44	46
	4.3%	95.7%	100.0%
GDM	14	60	74
	18.9%	81.1%	100.0%
Total	16	104	120
	13.3%	86.7%	100.0%

6. NEONATAL COMPLICATIONS RATES

6.1 Overview of Complications

Abnormal birth weight and cardiac anomalies were the most frequent complications seen (each; N=36, %=30.3). See Table (3)

6.2 Analysis of Differences in Complication Rates According to Type of Diabetes

As shown in Table 3, the only significant differences were as demonstrated earlier between categories according to LBW status and macrosomia status. Other complications showed no significant difference in the rates between infants born to mothers with DMT1 and those born to mothers with GDM.

6.3 Findings of Ultrasound Abdominal Scanning

Ultrasound Abdominal Scanning has been depicted in Table 5.

Table 3. Complication rates among IDM cases in Benghazi, 2010

Complication / finding	All		DMT1		GDM	
	N/120	Rate %	N/45	Rate %	N/74	Rate %
Abnormal BW	36	30.3	17	37.8	19	25.7
Any cardiac finding	36	30.3	18	40.0	18	24.3
Prematurity	22	18.5	11	24.4	11	14.9
ASD	21	17.6	11	24.4	10	13.5
HMD	17	14.3	10	22.2	7	9.5
Cardiac hypertrophic change	16	13.4	7	15.6	9	12.2
Hypocalcemia	16	13.4	8	17.8	8	10.8
Hypoglycemia	13	10.9	7	15.6	6	8.1
NS malformation	11	9.2	6	13.3	5	6.8
TTN	9	7.6	2	4.4	7	9.5
Any abdominal finding	4	3.4	1	2.2	3	4.1

Complication / finding	All		DMT1		GDM	
	N/120	Rate %	N/45	Rate %	N/74	Rate %
Any gut problem	4	3.4	3	6.7	1	1.4
Hyperbilirubinemia	3	2.5	3	6.7	0	0
Erb's palsy	3	2.5	0	0	3	4.1

Table 4. Summary of analysis results for differences in complications according to type of diabetes in IDM cases, Benghazi, 2010

Outcome compared	Test Value	P value (2-sided)
Gestational age	1.519	0.218
Abnormal BW	1.917	0.166
Low birth weight	13.448	0.000
Macrosomia	6.001	0.014
Hypoglycemia	**	0.241
Hypocalcemia	1.038	0.308
TTN	**	0.480
HMD	3.415	0.065
Hyperbilirubinemia	**	0.054
Erb's palsy	**	0.285
Cardiac finding	3.783	0.052
Hypertrophic change by echo	.226	0.634
ASD	2.921	0.087
Abdominal uss finding	**	1.000
Gut problem	**	0.157
nervous system malformation	**	0.331

***= Fisher exact test, others; likelihood ratio chi square test*

Table 5. Abdominal findings by ultrasound (uss)

Finding	Frequency	Percent
Normal	116	96.7
Dilated ureters or hydronephrosis	2	1.7
Nephrocalcinosis	2	1.7
Total	120	100.0

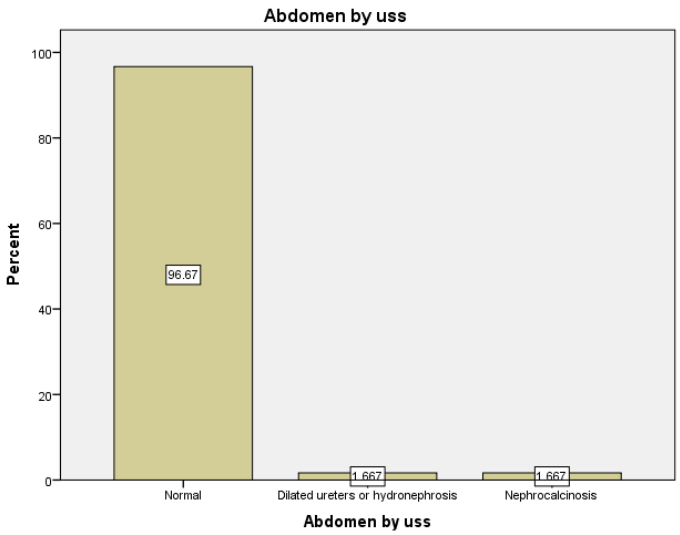

Fig. 8. Abdomes by uss

6.4 Findings of Cardiac Anomalies by Echocardiography

Around one third of cases had cardiac finding(s). The most frequently encountered single finding was atrial septal defect (ASD); (N = 22 cases, 18.3% of the total). ASD was encountered as an isolated finding in 14 cases (11.7%).

Hypertrophic cardiac changes were seen in 16 cases (13.3%). Those included left ventricular hypertrophy and increased interventricular thickness.

Table 6. Findings by echocardiography

Finding	Frequency	Percent
Normal	83	69.2
increased IVT	9	7.5
Hypertrophy	5	4.2
ASD secondum	14	11.7
ASD secondum+PDA	2	1.7
ASD secondum+VSD	1	.8
ASD secondum+TR	1	.8
Overriding aorta +ASD+VSD+ increased IVT	1	.8
Overriding aorta +ASD+VSD	1	.8
VSD	1	.8
AV canal malformation +ASD primum +VSD	1	.8
ASD+ increased IVT	1	.8
Total	120	100.0

ASD=atrial septal defect, IVT=interventricular thickness, PDA=patent ductus arteriosus, VSD=ventricular septal defect, TR=tricuspid reguirge, AV= Atrioventricular

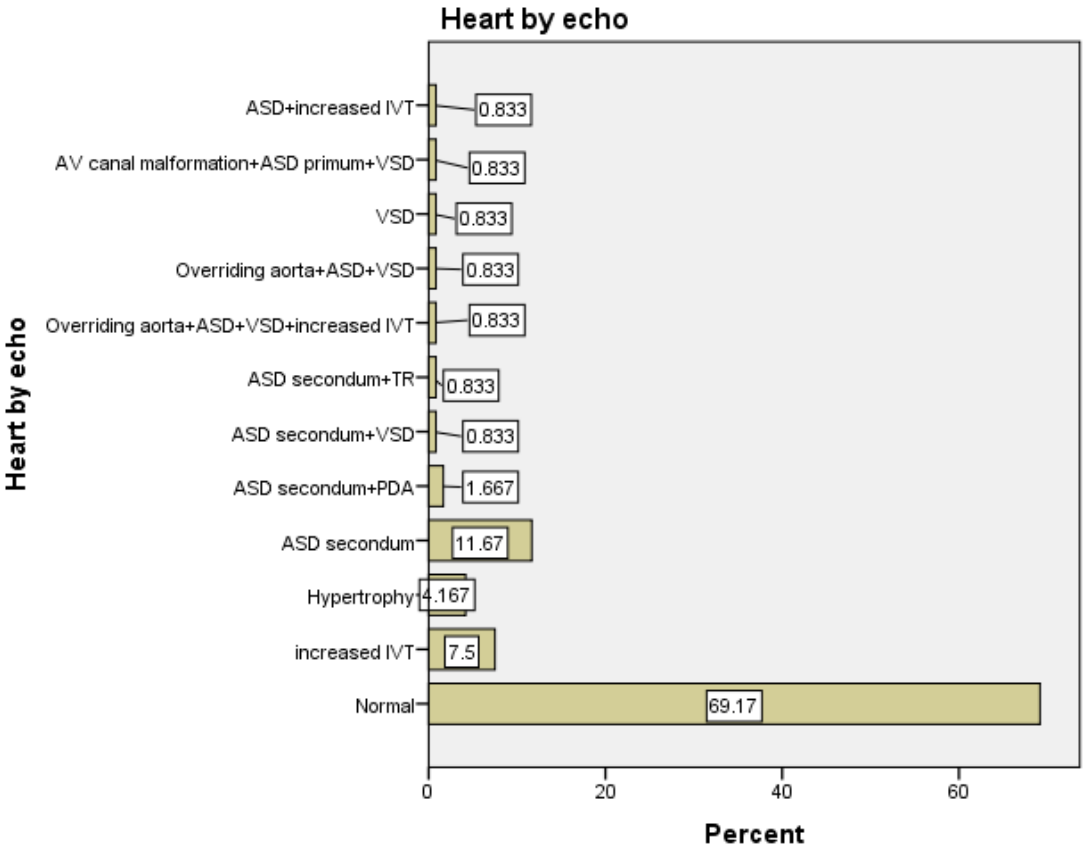

Fig. 9. Heart by Echo

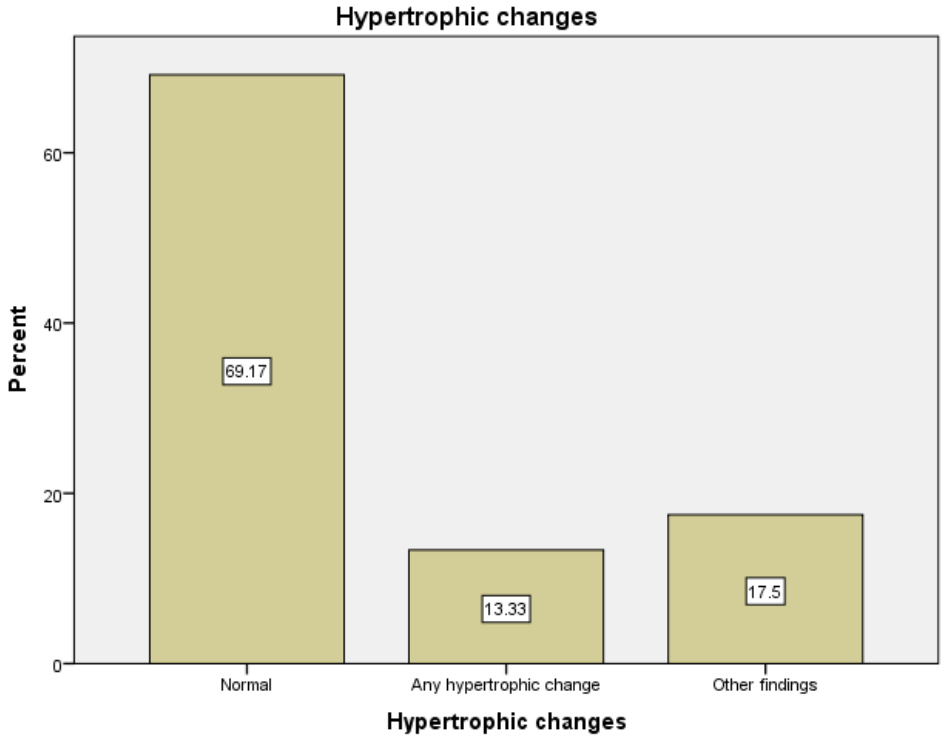

Fig. 10. Hypertrophic changes

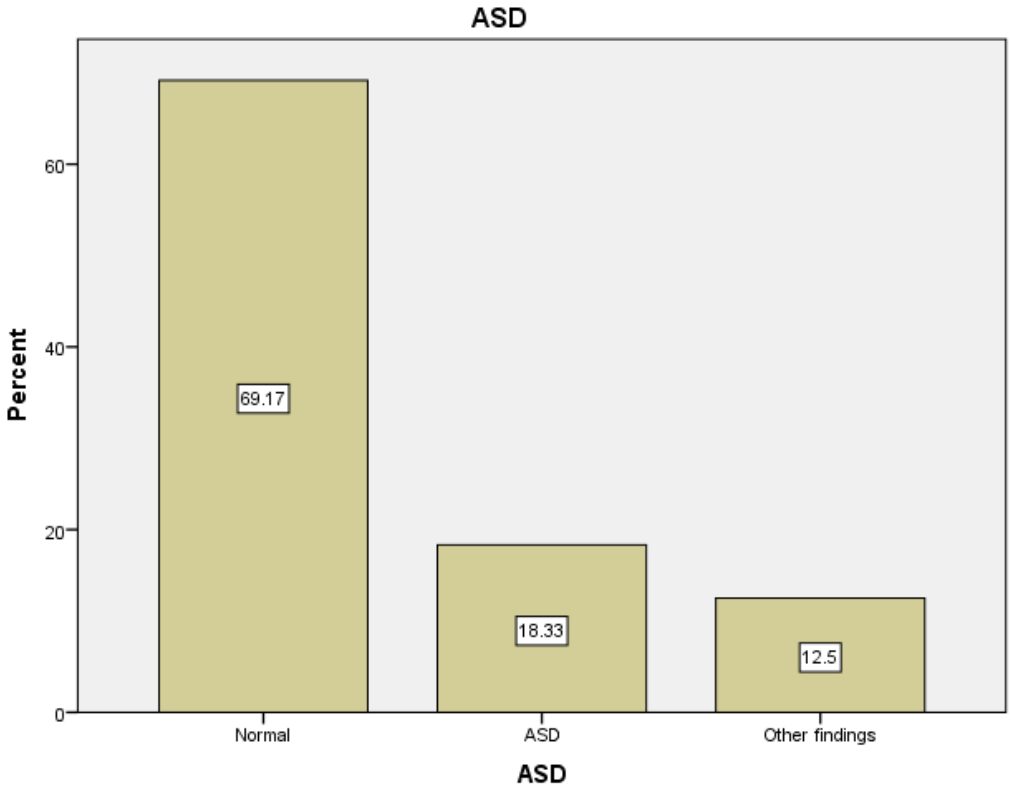

Fig. 11. ASD graph

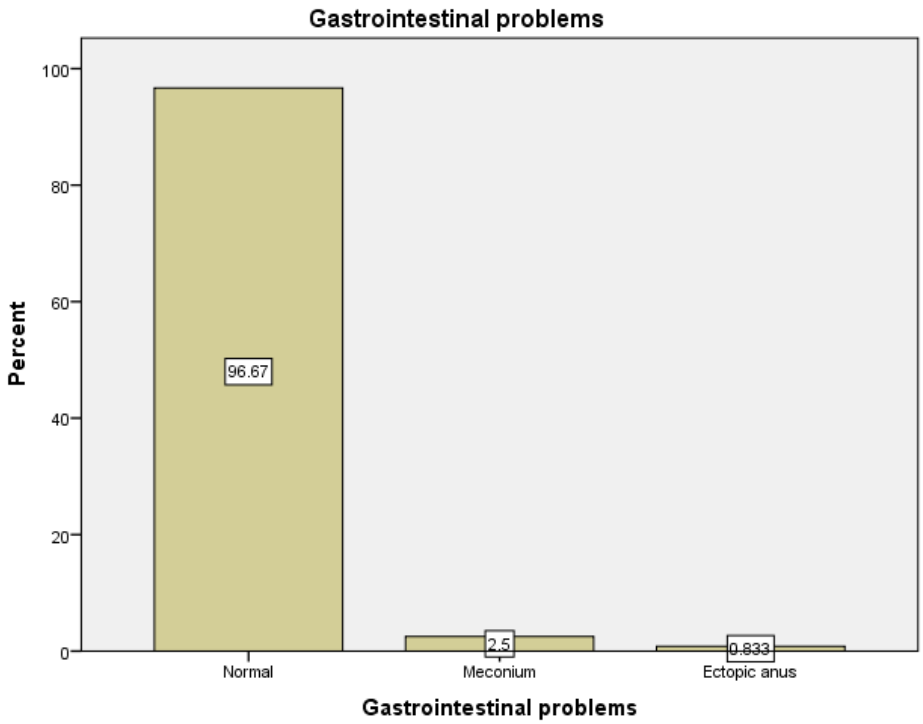

Fig. 12. gastrointestinal problem

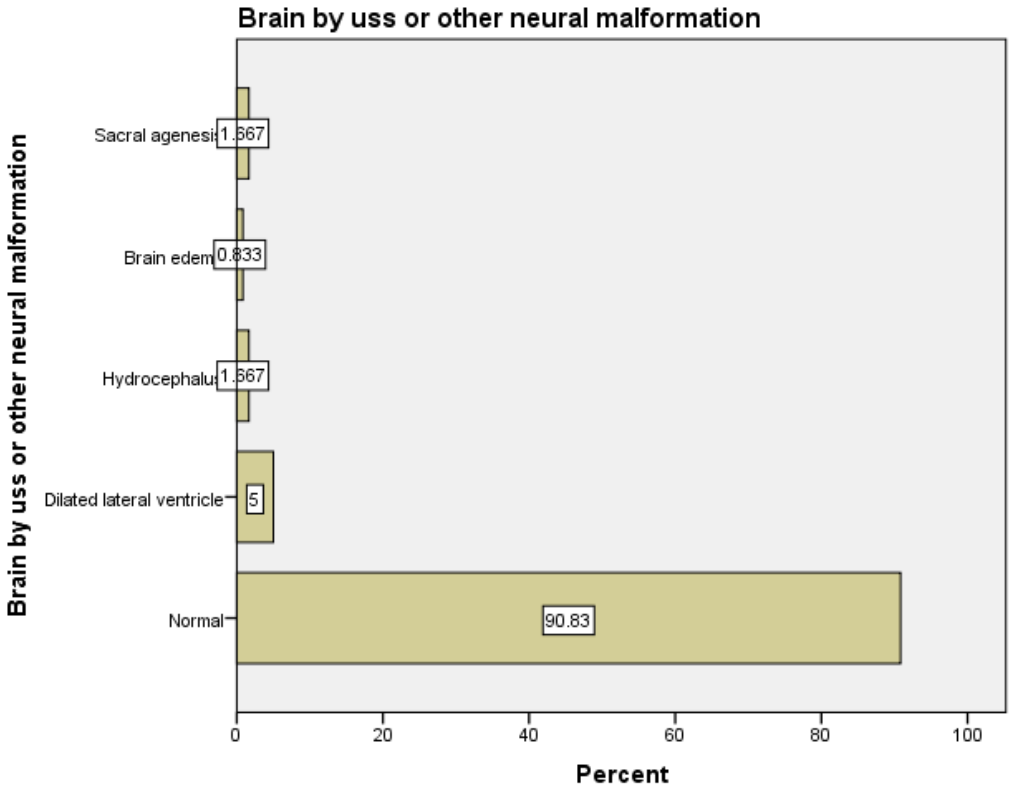

Fig. 13. Brain by uss

6.5 Gut Problems and Malformations

Only one case of ectopic anus was reported (0.8%). Three cases of meconium (2.5%).

6.6 Neural Anomalies and Malformations

Only 11 cases (9.2%) have been discovered anomalies either sacral agenesis (N=2, %=1.7) or ultrasound detected problems (N=9, %=7.5%). The later included dilated lateral ventricle (N=6, %=5.0), hydrocephalus (N=2, %=1.7) and brain edema (N=1, %=0.8).

7. DISCUSSION

AS you notes from our results still the most common type of diabetes in pregnancy is the gestational diabetes mellitus where represent 61.6% of cases & preconceptional diabetes mellitus 38.3%. And we was compared our results with three studies done at different places such as study was conducted in the neonatal unit & obstetric unit of Lady Reading hospital, peshawer Pakistan ,& the results as follow gestational diabetes mellitus [GDM] was 71.4% & preconception diabetes mellitus [PCDM] 28.5% ,while in another study done at children hospital & BOWRING AND Lady Curzon hospital & the result as follow gestational diabetes mellitus was represent 74.07% where preconception diabetes mellitus represent 25.9 %, 3ed study was done at king fhid hospital of the university –Alkhobar kingdom of saudia Arabia & their results was foe GDM 70% of total diabetic mothers while PCDM was 29.6% . So our result with others comparable. And the most common congenital anomalies is the cardiac problems which represent 23% in gestational & 39.1% in known diabetic mother,& most common heart problems is A.S.D. SECONDUM 47.8 % for gestational diabetes &39.1 for known diabetes mellitus, followed by hypertrophic heart[HCM] [generalized or septal] 43.4% for gestational &38.8% for preconceptional diabetes. Others .08% for gestational diabetes [ventricular septum defect] & for preconceptional diabetes 11.1% [Tetralogy of falot &tricuspid atresia.] As we notice HCM &ASD2em more with gestational D.M. where more complicated congenital heart defect associated with PCDM & poorly controlled D.M.

AND if we compare our results with study done at king Khalid university hospital in Riyadh results which is as follow : The most common echocardiographic findings were patent ductus arteriosus (PDA; 70%), patent foramen ovale (68%), atrial septal defect (5%), small muscular ventricular septal defect (4%), mitral valve prolapse (2%), and pulmonary stenosis (1%). Hypertrophic cardiomyopathy (HCMP) was observed in 38% of cases, mainly hypertrophy of the interventricular septum. Severe forms of CHD encountered were D-transposition of great arteries, tetralogy of Fallot, and hypoplastic left heart syndrome (1%].
Another study done at the out – patient clinic of the pediatric cardiology ward of a University hospital in Tehran .and the result was Hypertrophic cardiomyopathy (HCM) was observed in 15(46.9%) cases.

Both studies relate their outcome to poorly controlled blood sugar in infants mothers. Same thing for us where we note that. All the infants born to the gestational diabetes & preconceptional diabetes mellitus mothers with cardiac lesion , their mothers suffering uncontrolled hyperglycemia because of different reasons most important one, is irregular follow up & late consultation for maternal health services & their following doctors.

Most common metabolic disturbance in gestational diabetes is hypocalcemia where represent 12.1% {N=9, out of 74}, while in preconception diabetes .17.3% {N=8, out of 46}. Hypocalcemia more with PCDM infants. Followed by hypoglycemia 9.4% [7 out of 74 GDM cases], 8.6% [4 out of 46PCDM cases}.

Hypoglycemia more with gestational diabetes infant as well as birth trauma {ERB,S PALSY } where both associated with large birth weight infants. And hyperglycemic mother.

Hypocalcemia represent a risk for preconceptional diabetes mellitus infants especially it is associated with pre mature babies =17.3%, intra uterine growth retardation=8.6% & large birth weight 10.8%.

Hyper bilirubinemia =4.3% in infants of preconceptional diabetic mothers no cases associated with gestational diabetes mellitus infants in our research.

No cases of significant polycythemia was reigestered most of hematocrit less than 65% no medical intervention was required.

For gastro intestinal anomalies the significant morbidity was with preconception diabetes mellitus infants which represent 6.5%of cases [2 ectopic anus which refereed to pediatric surgeon & 1 meconium plug which treated conservative .

Where gastro intestinal complication with gestational diabetes infants was 2 cases meconium plug & pass smooth.

Respiratory distress syndrome was complicate the clinical course of infants of gestational diabetes mellitus {18.9%] & infants of preconceptional diabetes mellitus[26.0%] hyaline membrane disease was more with infant of preexisting diabetes mellitus mothers =21.7%, & with infant of gestational diabetes was 9.2% .

Macrosomia affect infants of gestational diabetes more =18.9% & it is associated with maternal hyperglycemia, where infants of preexisting diabetes mother macrosomia was 4.3%.

And if we compare the metabolic disturbance & macrosomia with other studies we will find most common metabolic disturbance is Hypoglycemia was noted in 35% and hypocalcemia in 15% in study done at Services Hospital, Islamabad and National Institute of Child Health, Karachi. Also study conducted at Vanivilas Children Hospital and Bowring & Lady Curzon Hospital attached to Bangalore Medical and the result was Hypoglycemia (51.8%) was the most common metabolic abnormality, occurrence in infants born to GDM mothers. Hypocalcemia was observed in (42%) of IDMs.

Sacral agenesis affect only 2 cases & their mothers was >20 years, and bad control glycemic state.

Central nervous system; all babies tend to have an increase startle reflex &tremulous during 1st 3 days of live plus hypotonia ,lethargy and poor sucking.

And the risk of anomalies 1.3% for gestational diabetic infants, 2.1% for preexisting diabetes & both was hydrocephalus. And it was not significant.

8. CONCLUSTION

Mandatory to limit the post-natal complication & reduce the risk of congenital malformation. Hyperglycemia should be controlled before pregnancy and through the pregnancy

9. RECOMMENDATION

-Upgrading maternal health services.
-Expanding health education programs regarding blood sugar control & effects of high blood sugar on fetus & neonate.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nold JL, Georgieff MK. Infants of diabetic mothers. Pediatr Clin North Am. 2004;51:619–37. PubMedCrossRef
2. Schwartz R, Teramo KA. Effects of diabetic pregnancy on the fetus and newborn. Semin Perinatol. 2000;24:120–35. PubMedCrossRef
3. American Diabetes Association. Standards of medical care in diabetes. Diabetes Care. 2005;28 Suppl 1:S4–S36. CrossRef
4. Chu SY, Callaghan WM, Kim SY, et al. Maternal obesity and risk of gestational diabetes mellitus. Diabetes Care. 2007;30:2070–6. PubMedCrossRef
5. Cowett RM. The infant of the diabetic mother. Neo Rev. 2002;3:el73–89.
6. Crowther CA, Hiller E, Moss R, et al. Australian Carbohydrate intolerance Study in pregnant women (ACHOIS) Trial Group. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med. 2005;352:2477–86.
   PubMedCrossRef
7. Yang JB, Cummings EA, O'Connell CP, Jangaard KMD. Fetal and neonatal outcomes of diabetic pregnancies. Obstet Gynecol. 2006;108:644–50.
   PubMedCrossRef

8. Meur S, Mann NP. Infant outcomes following diabetic pregnancies. Paediatrics and Child Health. 2007;17:217–22. CrossRef

9. Cowett RM, Schwartz R. The infant of the diabetic mother. Pediatr Clin North Am. 1982;29:1213–31. PubMed.

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