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FREQUENCY OF CONGENITAL HEART DEFECTS (CHD) AND ITS TYPES IN INFANTS OF DIABETIC MOTHERS

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Abstract

Introduction: *Many studies have proven that offspring of diabetic mothers have a fivefold incidence of congenital malformations compared to pregnancies in the general healthy population. In the mid 1980's the United Kingdom, the Diabetes Pregnancy Survey reported the presence of major congenital malformations, of which congenital heart disease (CHD) constituted a significant element of them. Further CHD are the most important single causes of perinatal mortality amongst the offspring of diabetic mothers.* ***Objectives:*** *To determine the frequency of congenital heart defects (CHD) and its types in infants of diabetic mothers.* ***Materials & Methodology:*** *This cross-sectional study was done in the Department of Pediatric Medicine, DHQ Hospital, Sahiwal during 6th July 2020 to 5th January 2021.A total of 100 neonates born to diabetic mother of age 18-45 years were included. Pre-term neonates (<37weeks), syndromic baby with dysmorphic features on clinical examination were excluded. After taking informed consent from patient's parents, all neonates were assessed for presence or absence of any congenital heart defect and its types.* ***Results:*** *Maternal age range in this study was from 18 to 45 years with mean age of 28.01 ± 4.73 years. Majority of the patients 69 (69.0%) were between 18-30 years. Mean gestational age was 38.33 ± 1.28 weeks. Mean weight of baby was 3.22 ± 0.49 kg. Out of the 100 patients, 58 (58.0%) were male and 42 (42.0%) were females with male to female ratio of 1.5:1. In this study, I have found the frequency of congenital heart disease in infants of diabetic mother as 63 (63.0%).* ***Conclusion:*** *This study has shown that the frequency of congenital heart disease in neonates born to diabetic mothers is quite high.*

INTRODUCTION

Diabetes mellitus is the most common metabolic disorder complicating pregnancy. About 1-14% of all pregnancies are complicated by diabetes mellitus, 90% of them are GestationalDiabetes Mellitus (GDM)[1] Diabetes has long been associated with maternal and perinatal mortality & morbidity. The Neonatal mortality rate is over five times that of infants of nondiabetic mothers & is higher at all gestational ages & in every birth weight for gestational age category[2]. The association of perinatal morbidity and mortality with maternal diabetes has been recognized. Out of all the pregnancies almost 2-3% are affected by diabetes and 90% amongst them suffer from gestational diabetes[3]. In fact the actual incidence of impaired glucose tolerance in pregnancy is variable according to incidence of diabetes in that population and varies between 3-10%[4]. Prevalence of gestational diabetes is reported as 8% in a study from Karachi

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whereas a study from Faisalabad reports 2% prevalence[5,6].

Many studies have proven that offspring of diabetic mothers have a fivefold incidence of congenital malformations compared to pregnancies in the general healthy population.[7,8]In the mid 1980's the United Kingdom, the Diabetes Pregnancy Survey reported the presence of major congenital malformations, of which congenital heart disease (CHD) constituted a significant element of them. Further CHD are the most important single causes of perinatal mortality amongst the offspring of diabetic mothers.[9] In a study, the frequency of CHD was 52.5% in infants of diabetic mothers. Following CHDs were found in neonates of diabetic mothers; Patent ductus arteriosus (PDA) in 16.8% cases, Ventricular septal defect (VSD) in 12.9%, Atrial septal defect (ASD) in 8.9%, Patent foramen ovale (PFO) in 7.9% and Transposition of the great arteries (TGA) in 5.9% cases[10] In another study, the frequency of different CHD were found in neonates of diabetic mothers as Patent ductus arteriosus (PDA) in 70.0% cases, Ventricular septal defect (VSD) in 4.0%, Atrial septal defect (ASD) in 5.0% and Patent foramen ovale (PFO) in 68.0%[11].

In Pakistan, the true incidence and prevalence of congenital heart disease is unknown due to limited access to medical care and limited resources to undertake intense population studies[12].There is no facility of diagnosis of prenatal CHD in the country. Thus the objective of this study is to determine the frequency of congenital heart disease in infants of diabetic mothers referred to Pediatrics department. By early detection/diagnosis of CHD in neonates of diabetic mothers, it will be helpful to prevent the possible complications of CHD and improve the quality of life.This study will also help us to maintain a proper data and frequency of CHD in infants of diabetic mothers at our department.

Objective:

To determine the frequency of congenital heart defects (CHD) and its types in infants of diabetic mothers.

Materials and methodology: A cross-sectional study was conducted in the Department of Pediatric Medicine at DHQ Hospital, Sahiwal during 6th July 2020 to 5th January 2021.The sample size was calculated to be 100 infants of diabetic mothers, using a 95% confidence level, 10% margin of error, and an expected prevalence of congenital heart defects in this population of 52.5%, based on previously published data.A non-probability, consecutive sampling technique was applied, including all eligible infants of diabetic mothers presenting during the study period who met the inclusion criteria.

Inclusion Criteria:

All neonates born to diabetic mother (as per operational definition), Gestational age 37-41 weeks (assessed on LMP), Age of neonate ≤28 days,Both genders (Male and female),Maternal age 18-45 years with parity 1-5 were included in this study..

Exclusion Criteria:

Syndromic baby with dysmorphic features on clinical examination (as syndromes have separate frequencies of CHD than general population), Preterm babies (born before 37weeks of gestation) were excluded from the study.

DATA COLLECTION PROCEDURE:

After permission from the ethical review committee, total number of 100 infants of diabetic mother presenting in Pediatric OPD and emergency for routine checkup or with some illness, fulfilling the Inclusion criteria were selected. After taking informed consent from patient's parents, all neonates were assessed for presence or absence of any congenital heart defect and its types (as mentioned in operational definition). All patients were given treatment according to the department protocol. This all data was recorded on a specially designed proforma.

DATA ANALYSIS PROCEDURE:

Statistical analysis was performed using SPSS version 25.0. Results were presented as mean and standard deviation for gestational age, neonatal age, maternal age, parity and weight of babies. Frequency and percentage were calculated for gender, type of maternal diabetes (type 1/type 2/GDM), place of living (rural/urban), status of diabetes (controlled/uncontrolled), congenital heart defect (present/absent) and type of defect (ASD/VSD/PDA/TGA). Effect modifiers like gender, place of living (rural/urban), gestational age,

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maternal age, parity and weight of babies were controlled through stratifications. Post-stratification chi square was applied and p-value ≤0.05 was considered as significant.

RESULTS :

Maternal age range in this study was from 18 to 45 years with mean age of 28.01 ± 4.73 years. Majority of the patients 69 (69.0%) were between 18-30 years as shown in Table I. Mean gestational age was 38.33 ± 1.28 weeks (Table II). Mean weight of baby was 3.22 ± 0.49 kg (Table III). Out of the 100 patients, 58 (58.0%) were male and 42 (42.0%) were females with male to female ratio of 1.5:1 (Figure I). Distribution of patients according to status of DM & place of living is shown in Table IV & V respectively. In this study, I have found the frequency of congenital heart disease in infants of diabetic mother as 63 (63.0%) as shown in Figure II.Distribution of patients according to type of defect is shown in Table VI

Stratification of congenital heart defects with respect to age and gestational age is shown in Table VII & VIII respectively. Table IX & X have shown the stratification of congenital heart defects with respect to gender of neonate and weight of baby. Stratification of congenital heart defects with respect to status of DM & place of living is shown in Table XI & XII respectively.

Table-I: Age distribution of patients (n=100).

Age (in years)	No. of Patients	%age
18-30	69	69.0
31-45	31	31.0
Total	100	100.0

Mean ± SD = 28.01 ± 4.73 years

Table-II: Distribution of patients according to gestational age (n=100).

Gestational age (weeks)	No. of Patients	%age
37-39	81	81.0
40-41	19	19.0
Total	100	100.0

Table-III: Distribution of weight of baby (n=100).

Weight (kg)	No. of Patients	%age
≤3	58	58.0
>3	42	42.0
Total	100	100.0

Mean ± SD = 3.22 ± 0.49 kg

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Figure-I: Distribution of patients according to gender (n=100).

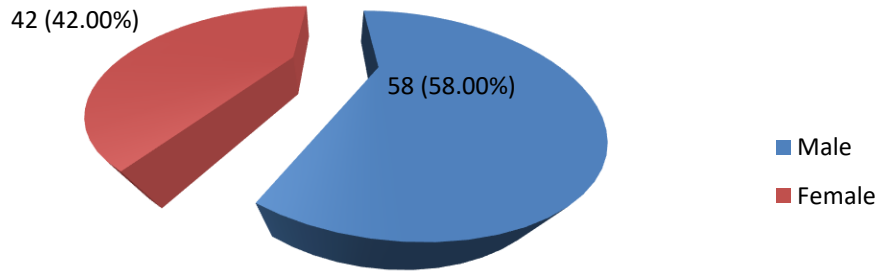

Table-IV: Distribution of patients according to status of DM (n=100).

Status of DM	No. of Patients	%age
Controlled	53	53.0
Uncontrolled	47	47.0
Total	100	100.0

Table-V: Distribution of patients according to place of living (n=100).

Place of living	No. of Patients	%age
Rural	52	52.0
Urban	48	48.0

Figure II: Frequency of congenital heart defects in infants of diabetic mothers (n=100).

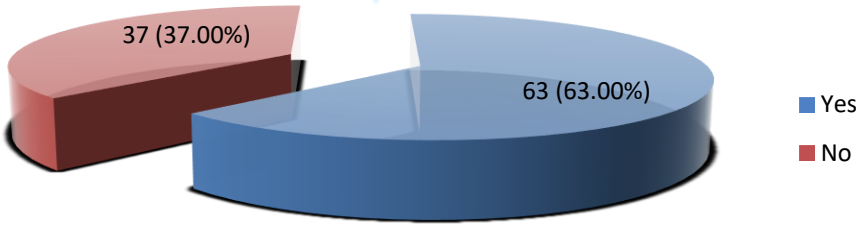

Table-VI: Distribution of patients according to type of defect (n=63).

Type of defect	No. of Patients	%age
Patent ductus arteriosus	33	52.38
Ventricular septal defect	14	22.22
Atrial septal defect	11	17.46
Transposition of the great arteries	05	7.94

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Table VII: Stratification of congenital heart disease with respect to age groups.

Age (years)	Congenital heart disease		p-value
	Present	Absent	
18-30	44	25	0.812
31-45	19	12	

Table VIII: Stratification of congenital heart disease with respect to gestational age.

GA (weeks)	Congenital heart disease		p-value
	Present	Absent	
37-39	50	31	0.587
40-41	13	06	

Table IX: Stratification of congenital heart disease with respect to gender.

Gender	Congenital heart disease		p-value
	Present	Absent	
Male	43	15	0.007
Female	20	22	

Table X: Stratification of congenital heart disease with respect to weight of baby.

Weight (kg)	Congenital heart disease		p-value
	Present	Absent	
≤3	33	25	0.137
>3	30	12	

Table XI: Stratification of congenital heart disease with respect to status of DM.

Status of DM	Congenital heart disease		p-value
	Present	Absent	
Controlled	32	21	0.564
Uncontrolled	31	16	

Table XII: Stratification of congenital heart disease with respect to place of living

	Congenital heart disease		p-value
Place of living	Present	Absent	
Rural	33	19	0.921
Urban	30	18	

DISCUSSION

Congenital heart disease (CHD) is a significant complication among infants of diabetic mothers (IDMs), typically attributed to the teratogenic effects of maternal hyperglycemia. The highest risk is associated with poorly controlled gestational diabetes and insulin resistance during the third trimester. Although some studies suggest a weak association between maternal glycemic control, indicated by hemoglobin A1c levels, and fetal CHD, hyperglycemia during embryogenesis remains a critical factor.In this study, CHD was identified in 63% of IDMs, higher than the 52.5% reported by a study in Peshawar. Common cardiac anomalies included Patent Ductus Arteriosus (PDA), Ventricular Septal Defect (VSD), Atrial Septal Defect (ASD), Patent Foramen Ovale (PFO), and Transposition of the Great Arteries (TGA). Similar findings have been reported in both local and international literature. For example, one study observed PDA in 70% and PFO in 68% of cases, while hypertrophic cardiomyopathy (HCMP) was seen in 38% of IDMs.

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The risk of CHD varies between different types of diabetes. Hunter et al. reported a CHD risk of 2.76% in gestational diabetes and 3.1% in type 1 diabetes, with an added risk of extracardiac anomalies in about 25-27% of cases. These variations may be explained by differences in glycemic control, maternal body mass index (BMI), insulin resistance, and undiagnosed pregestational diabetes.Studies consistently show that strict glycemic control in early pregnancy reduces the risk of fetal anomalies. Animal models confirm that diabetic embryopathy is a multifactorial process influenced by metabolic and genetic factors alongside hyperglycemia. While gestational diabetes typically develops later in pregnancy, pregestational diabetes has a stronger association with congenital anomalies, including CHD.

Several other studies, both regional and international, have reported a wide range of CHD frequencies in IDMs, ranging from 2.5% to 70%, depending on sample sizes, populations, and diagnostic techniques. A national cohort study from 1978 to 2011 reported that 318 per 10,000 live births to diabetic mothers were affected by CHD. Conversely, a study from the Joslin Clinic in Boston found a much lower CHD rate of 4%, suggesting possible population or methodological differences.

This study's findings reinforce the importance of prenatal screening, timely echocardiography, and meticulous antenatal care in diabetic pregnancies to improve neonatal outcomes and reduce the risk of undiagnosed CHD in this high-risk group.

CONCLUSION :

This study has shown that the frequency of congenital heart disease in neonates born to diabetic mothers is quite high with patent ductus arteriosus as the most common CHD. So, we recommend that to clinicians should be encouraged to perform an echocardiography of all neonates born to diabetic mothers to facilitate early diagnosis and prompt treatment. Moreover, proper management of diabetic mothers should be taken in order to decrease the incidence of congenital heart defects.

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