



## Congenital Heart Disease in Infants of Diabetic Mothers

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**Abstract:** Women with diabetes in pregnancy (type 1, type 2, and gestational) are at increased risk of adverse pregnancy outcomes with higher fetal and neonatal mortality rate. The risk of congenital anomalies increased in infants of diabetic mothers with over -presentation of congenital heart defects. The aim of our study is to detect congenital heart disease in infants of diabetic mothers. A cross sectional study was carried out among sample of infants of diabetic mothers in Al- Zahraa teaching hospital at period from first of February to first of November, 2023. Information was gathered according to data collection sheet that included: name, age (gestational and postnatal), sex, mode of delivery, type of diabetes mellitus (type 1, 2, and gestational), maternal compliance to treatment, and other symptoms like macrosomia (body weight more than 4 kg), hypoglycemia, and hypocalcemia. Data have been obtained by standard laboratory procedures including random blood sugar, serum calcium, and echo study. A total of 80 infants were enrolled in this study between 1 to 40 days of age with mean age of 6.7 days, 43 were males and 37 were females. The percentage of congenital heart disease was 27.5% with a percentage of 27.9%, 27.09 in males and females respectively. The statistically significant difference in this study was between (macrosomia, advanced maternal age, low mean random blood sugar, low mean serum calcium) and abnormal echocardiographic.

**Key words:** Congenital Heart Disease, Infant, Diabetic Mothers.

### Introduction

Infants of diabetic mother (IDM) is defined as neonate born to mother who had diabetes mellitus, but this term refers specifically to the neonate born to a woman who had persistently elevated blood sugar during pregnancy [1].

About 3-10% of all pregnancies are complicated by diabetes [2][3]. Infants born to diabetic women are at increased risk compared to those of non-diabetic women [4][5].

Infants of diabetic mothers are at increased risk of adverse pregnancy outcomes with higher fetal and neonatal mortality rate at all gestational ages, especially after 32 weeks [6]. The exact teratogenic mechanism of maternal diabetes is not fully defined and is likely to be multifactorial [7][8].

Different studies showed that metabolic and congenital anomalies occur 3-5 times more commonly in infants of diabetic mothers (IDMs) than in the general population. These anomalies include hypoglycemia, hypocalcemia, hyperbilirubinemia, polycythemia, macrosomia, neural tube defect, caudal regression syndrome, renal malformations, duodenal or anorectal atresia, small left colon syndrome, and congenital heart disease [9]. IDMs often develop respiratory problems which need to be differentiated from cardiovascular problems. Diabetes mellitus affects fetal heart both structurally and functionally. They are prone to have structural congenital heart defect, hypertrophic cardiomyopathy, and cardiovascular mal-adaptation to extra-uterine life [10] [11].



Cardiomegaly is common (30%), and heart failure occurs in 5-10% of infants of diabetic mothers. Asymmetric septal hypertrophy may occur and may manifest like transient idiopathic hypertrophic subaortic stenosis [9].

### Materials and methods

The study is cross sectional, looked for congenital heart disease among sample of infants of diabetic mothers in Al- Zahraa teaching hospital in Al- Najaf city at period from first of February to first of November, 2023. A convenient sample of 80 infants of diabetic mothers; 43 were males and 37 were females; their age range was 1- 40 days with mean of 6.7 days. The families if agreed, infants were selected to participate in the study and being examined clinically and send for RBS, serial serum calcium and echo study. Echo device used in this study from GE Vingmed Ultrasound AS Strandpromenadon 45, N- 3191 Horten, Norway; of serial number GB14146-02; vivid equipment. All echo studies done by pediatric cardiologist.

Inclusion criteria included infants of diabetic mothers (gestational, type 1, and type 2), gestational age  $\geq$  30 weeks, and postnatal age up to 40 days. Exclusion criteria included mothers with hypertension or pre-eclampsia, drugs intake during pregnancy except insulin for DM, infants with down syndrome and other syndromes with congenital malformations, and gestational age  $<$ 30 weeks.

### Results:

**Table (1) Demographic characteristics of infants**

Items	Min.	Max.	Mean	S.D.
<b>Gestational age</b>	30.00	40.00	37.2375	1.511
<b>Age/days</b>	1.00	40.00	6.7125	6.756
<b>Weight/kg</b>	1.50	5.00	3.5388	0.646
<b>Maternal age/years</b>	15.00	38.00	27.8250	5.703
<b>Mean RBS (mg/dl)</b>	25.00	123.00	63.9375	22.896
<b>Mean serum calcium (mg/dl)</b>	6.70	9.20	8.1125	0.5176

The result of this study included 80 infants. The mean gestational age of infants was  $37.2 \pm 1.5$  weeks with postnatal age range (1- 40) days with mean of 6.7 days. The percentage of congenital heart disease among infants of diabetic mothers was 27.5% with a percentage of 27.9%, 27.09 in males and females respectively

**Table (2) Distribution of the studied sample according to the gender and echo result.**

Features		ECHO		Total No.	p.value
		Normal	Abnormal		
Gender	Male	31 (72.09)	12 (27.9)	43 (100)	0.930
	Female	27 (72.97)	10 (27.09)	37 (100)	
Total no. (%)		58 (72.5)	22 (27.5)	80 (100)	

In table (2) there was no significant association between gender and abnormal echo results.

**Table (3) Association between result of echo and type of DM**

Items			ECHO		p.value
			Normal	Abnormal	
Type of DM	Gestational	No.	21	56	0.183
		%	95.5	96.6	
	Type1 DM	No.	0	2	
		%	0.0	3.4	
Type2 DM	No.	1	0		



		%	4.5	0.0	
<b>Total</b>		<b>No.</b>	<b>22</b>	<b>58</b>	
		<b>%</b>	<b>100.0</b>	<b>100.0</b>	

In table (3) there was no significant association between gender echo results and type of DM.

**Table (4) Association between result of echo and type of treatment of DM**

Items			ECHO		p.value
			Normal	Abnormal	
Type of DM	No treatment	No.	6	3	0.003
		%	27.3	5.2	
	On diet	No.	2	22	
		%	9.1	37.9	
	On insulin	No.	14	33	
		%	63.6	56.9	
<b>Total</b>		<b>No.</b>	<b>22</b>	<b>58</b>	
		<b>%</b>	<b>100.0</b>	<b>100.0</b>	

In table (4) there was significant association between echo results and type of treatment. So higher rates of abnormal results were among those with either no treatment or on insulin compared to those with mothers on diet only.

### Discussion

Congenital cardiovascular malformations form common birth defects. In most cases the cause is unknown although some are genetic in origin and a few are known to have an environmental cause. Maternal diabetes is known to have teratogenic effect on the cardiovascular system with a reported risk of malformations in published studies [12].

According to the present study, the percentage of congenital heart disease among infants of diabetic mothers was 27.5% with a percentage of 27.9%, 27.09 in males and females respectively. PDA was the commonest cardiac anomalies followed by ASD secundum, LVH, and PFO in sequence with a percentage of 54.54%, 22.7%, 13.63%, and 13.63% respectively [13].

In a study in Saudi Arabia (Abu- Sulaiman RM,2004) [14], the overall incidence of congenital heart disease among infants of diabetic mothers was 15% after excluding PDA and HCM. The most common echocardiographic findings were patent ductus arteriosus 70%, patent foramen ovale 68%, HCM 38%, and atrial septal defect 5%.

In a study in Iran (Roodpeyma S, et al, 2013) [15], congenital heart disease was found in 65.6% of infants of diabetic mothers. The most common echocardiographic findings were HCM 46.9%. structural cardiac malformation was found in 18.7%, half of them were conotruncal malformations.

Our prospective population-based study of infants of diabetic mothers has confirmed the increased risk of cardiovascular malformations and the greatly increased risk of some specific malformations, notably patent ductus arteriosus, atrial septal defect, LVH, and PFO.

When we compare our study with the other studies above, we found that in our recent study the percentage of CHD among infants of DM mothers was less than the lower range of these previous reports, but like the studies done in Saudi Arabia and Pakistan in that commonest echocardiographic finding was PDA which was next to PFO in Bangladesh. Unlike the study which was done in Iran in which HCM was the commonest detected echocardiographic finding. HCM was common finding in infants of diabetic mothers in our study and the studies done in Saudi, Iran, and Bangladesh.

The difference in the percentage may be related to the characteristics of the collected sample. In Iran and Bangladesh smaller samples were collected, while in Saudi Arabia and Pakistan larger samples



were collected. Type of DM, control of DM, and maternal age in the chosen sample may also affect the results.

### Conclusions and recommendations

It could be concluded from this study that maternal diabetes is a significant risk for development of CHD in their babies with a percentage of 27.5%. PDA, ASD secundum, LVH, and PFO were the commonest cardiac anomalies observed in this study. This study supports existing recommendations that all pregnant women with diabetes should be offered a specialist fetal echocardiogram. This device is reinforced by published evidence that antenatal diagnosis of cardiac malformations leads to an improved postnatal outcome. So careful evaluation and early diagnosis of CHD in this higher risk group are highly indicated.

### References

1. Suda-Calus, M., Dąbrowska, K., & Gulczyńska, E. Infant of a diabetic mother: clinical presentation, diagnosis and treatment. *Pediatric Endocrinology Diabetes and Metabolism*. 2024; 30(1), 36-41.
2. Shamoan, M., Ahsan, M., Maqbool, T., Aslam, R., & Yaseen, A. Congenital heart defects in neonates born to diabetic mother (IDM): A single center experience. *The Professional Medical Journal*. 2020; 27(05), 950-956.
3. Radwan, M. A., El Mansori, N. A., Elfergani, M. A., Halies, F. R., & Lawgali, M. A. Neonatal morbidity pattern among infants born to diabetic mothers at Jamhouria hospital, Benghazi-Libya.
4. Samanth, J., Padmakumar, R., Vasudeva, A., Lewis, L., Nayak, K., & Nayak, V. Persistent subclinical myocardial dysfunction among infants of diabetic mothers. *Journal of Diabetes and its Complications*. 2022; 36(1), 108079.
5. Nakano, H., Fajardo, V. M., & Nakano, A. The role of glucose in physiological and pathological heart formation. *Developmental biology*. 2021; 475, 222-233.
6. Foteva, V., Fisher, J. J., Qiao, Y., & Smith, R. Does the micronutrient molybdenum have a role in gestational complications and placental health?. *Nutrients*. 2023;15(15), 3348.
7. Zhang, D., Wang, X., Qu, J., Li, Y., Shi, T., & Zhang, W. Hypertensive Diseases in Female and Pregnancy. *Secondary Hypertension: Screening, Diagnosis and Treatment*. 2020; 569-638.
8. Mishra, V., Lui, K., Schelonka, R. L., Maheshwari, A., & Jain, R. (2024). Infants of Diabetic Mothers. *Principles of Neonatology*, 200-206.
9. Calvo, C. D. P., Capellini-Suárez, A., & Hernandez, A. P. M. Diabetic Fetopathy. *Med Clin Res Open Access*, 21(2), 4.
10. Redko, O. K., Petrashenko, V. O., & Loboda, A. M. *Neonatology*. (2021).
11. Yuan, S. M. Infantile Hypertrophic Cardiomyopathies: Starting from the Pathogenesis. *medp cardiol vasc med*. 2021; 1 (1): mpcvm-202110001. MedPress Cardiology and Vascular Medicine Shi-Min Yuan, Department of Cardiothoracic Surgery, Fujian Medical University, Putian, 351100.
12. Frier BM, Fisher M, Diabetes Mellitus. In: Nicholus AB, Nicki RC, Brain RW (eds) *Davidson's Principles and Practice of Medicine*, 21st edition. Churchill Livingstone. Edinburg. 2010; p 798-806.
13. Mansi, H. Types of Congenital Anomalies among Children at Bint Al-Huda Teaching Hospital in Al-Nasiriyah City, South of Iraq. *Bahrain Medical Bulletin*. 2022; 44(1).
14. Abu- Sulaiman RM, Subaih B. congenital heart disease in infants of diabetic mothers: echocardiographic study. *pediatrCardiol*. 2004; 25(2): 137-40.
15. Roodpeyma S, Rafieyan S, Khosravi N, Hashemi A. Cardiovascular complications in infants of diabetic mothers: An observational study in a pediatric cardiology clinic in Tehran. *J Compr Ped*. 2013; 3(3): 119-23.