

Original research article

Congenital heart disease in infant of diabetic mother delivered at Trichy SRM MEDICAL College and Hospital

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Abstract

Introduction: The prevalence of impaired glucose tolerance in pregnancy ranges between 3 and 10% and varies according to the overall prevalence of diabetes. Cardiovascular malformations are among the most common in infant of diabetic mother and more common than in normal pregnancies. In this context, the study was conducted with objective to study neonates born to diabetes mellitus mothers to detect the spectrum of congenital heart disease (CHD)

Methodology: This is a cross sectional study conducted among 30 babies born to Diabetic mothers in Trichy SRM medical college and research institute. The semi structured questionnaire was administered to obtain data. All infants underwent thorough physical examination with special attention to cardiovascular system and then pulse oximetry, X ray and Echo cardiogram was conducted. The data collected were entered in Excel and analysed using Epi info version 7

Results: Among 30 infants, 23.3% were having Congenital heart disease. 10% had clinical manifestations and one baby had saturation less than 95%. 2 babies (6.66%) had xray positive changes and 6 babies (80%) had Echo cardio graphic changes. Also poor glycemic status, poor treatment compliance and LGA were significant risk factor of CHD

Conclusion: The higher prevalence of CHD in Diabetic mother suggest a need of good glycemic control and treatment compliance in mother during pregnancy. And also there is need of ECHO screening in all babies born to diabetic mothers irrespective of clinical presentation.

Keywords: Congenital heart disease, Gestational diabetes mellitus, Echo finding

Introduction

Diabetes during pregnancy can be de novo, arising during pregnancy for the first time and disappearing or persisting after delivery (gestational DM), or it can begin as pregestational, before the onset of pregnancy. The prevalence of impaired glucose tolerance in pregnancy ranges between 3 and 10% and varies according to the overall prevalence of diabetes ^[1].

Cardiovascular malformations are among the most common in infant of diabetic mother, accounting for 3%-9% of diabetic pregnancies and being 2.5-10 times more common than in normal pregnancies ^[2]. If the mother has gestational diabetes and develops insulin resistance in the third trimester, the relative risk for major cardiovascular defects is highest ^[3].

The foetal heart is targeted by pre-existing and gestational maternal DM through a complex multi-factorial pathogenesis that affects both the structure and function of the foetal heart and foetal-placental circulation. The DM type, HbA1c level in early pregnancy, and degree and duration of hyperglycemia and hyperketonaemia influence the severity of foetal cardiac damage ^[4,5].

Even with strict maternal glycemic control, hyperglycemia has a teratogenic effect in the period of organogenesis, inducing diabetic fetopathy with glucose-mediated disturbances of left-right patterning, congenital cardiac malformations, foetal cardiomyopathy, foetal venous thrombosis, altered placental villi vascularization, and pathological foetal heart rates ^[5,6].

Objective

In this context, this study was conducted with objective to study neonates born to diabetes mellitus mothers to detect the spectrum of congenital heart disease (CHD)

Material and Method

This is a observational study conducted among 30 term babies born to diabetic mothers (pre gestational and gestational diabetic mother) at Trichy SRM medical college hospital and research centre. The term babies were selected by convenience sampling. Still born, babies born with chromosomal abnormality, babies born to diabetic mothers with co- morbidities - hypothyroidism, hypertension, anemia complicating pregnancy & seizure disorder on AED and babies born in a family with history of heart disease were excluded. The study was conducted during August 2022 to Feb 2023.

After obtaining informed written consent from parents, semi structured questionnaire was administered to obtain data. All infants underwent thorough physical examination with special attention to cardiovascular system and then pulse oximetry, X ray and Echo cardiogram was conducted.

Variables studied

1. Age of the mother- categorized into <20,20-30 years and more than 30 years
2. Maternal diabetes type – Gestational Diabetes mellitus (GDM) or pre gestational diabetes mellitus (DM)
3. Treatment given- Diet or insulin with diet
4. Maternal treatment compliance- In case of mother taking treatment regularly as suggested by treating physician they were considered to have good compliance and not following instructions as given by physician were considered poor compliance
5. Maternal glycemic status- controlled or uncontrolled based on recommended targets achieved or not as per American diabetic organization ^[18]
6. Mode of delivery- Labour natural (LN) or Lower segment cesarean section (LSCS)
7. Baby's sex – Male or female
8. Birth weight – Large for gestational age (LGA) / small for gestational age (SGA) / appropriate for gestational age (AGA) ^[19]
9. Clinical manifestation murmur/ cyanosis {SaO₂} finding
10. Oxygen saturation – SPO₂<95% or SPO₂>/=95%
11. X ray finding- Based on finding
12. Echo cardiogram- Based on diagnosis

Analysis method

The data collected were entered in Excel and analysed using Epi info version 7. The descriptive data were given in proportions. The chi square / Fisher's exact test was used to compare proportion. The p value <0.05 were considered significant

Result

In our study, 66.6% were of age above 30 years, only one mother was below the age of 20. 13.3% had pregestational diabetes mellitus and 86.6% had Gestational Diabetes mellitus (GDM). 80% were on insulin treatment. 16.7% had poor compliance and 6.67% had uncontrolled glycemic status. 17 babies were delivered by Cesarean section and 13 babies were delivered by labour natural. (Tab.1)

40% were female and 60% were male babies in our study and 43.3% were of large for gestational age in our study. (Tab.1)

In our study, 6 infant had acyanotic congenital heart disease (ACHD) and 1 infant had cyanotic congenital heart disease (CCHD). In total, 23.3% were having Congenital heart disease in our study. (Fig.1)

In our study as shown in tab.2, 10% had clinical manifestations. Among the 3 babies with clinical manifestation, one baby had respiratory distress, one baby had cyanosis and one baby had systolic murmur. No babies had shock or Congestive cardiac failure. 29 babies had saturation more than 95% and one baby had saturation less than 95%.

On studying the x ray and ECHO changes, 2 babies (6.66%) had x ray positive changes and 6 babies (80%) had Echo cardiographic changes. In Xray, one baby had cardiomegaly and one baby had abnormal heart shape. In ECHO diagnosis, two babies had hypertrophic cardiomyopathy (HOCM), one baby had Atrial septal defect (ASD), one baby had ventricular septal defect (VSD), one baby had patent ductus arteriosus (PDA) and one baby had teratology of fallot (Tab.2)

In table 3, one HOCM baby had positive finding in xray, VSD diagnosed baby had clinical and x ray finding. ASD diagnosed baby had no positive finding, Baby with PDA had positive clinical and pulse oximetry finding. TOF baby had only clinical finding.

As shown in table 4, 20% of mother above age 30 and 11.1% of mother ages 20-30 and none of the mother less than 20 years had CHD. Though incidence of CHD babies is higher in age more than 30 years mother, the results were not significant. Similarly, type of dm, treatment of DM, mode of delivery, gender of baby had no significant association with incidence of CHD in babies.

60% of mother with poor treatment compliance had CHD in babies and 12% of mother with good

treatment compliance had CHD babies and results were significant. Similarly, 100% of mother with uncontrolled glycemic status had babies with CHD. Among babies who were large of gestational age, 38.4% had CHD and only 5.8% had CHD. The results were significant. (Tab.4)
This shows poor glycemic status, poor treatment compliance and LGA were significant risk factor of CHD.

Discussion

Diabetes during pregnancy may be a de novo condition that develops for the first time during pregnancy and may disappear or persist after delivery (gestational DM), or it may begin as pregestational, before the onset of pregnancy. In gestational diabetes, β -cell dysfunction may occur as a result of increased stress on β -cells caused by excessive gestational weight gain and rising insulin resistance, or as a result of β -cell damage caused by autoantibodies against specific β -cell antigens. When compared to a normal pregnancy, the rate of insulin-stimulated glucose uptake is reduced by 54% in gestational diabetes^[5,7].

After delivery, the neonate begins a critical process to adapt to the extra-uterine environment, which is known as the transitional period. When the foetal bypass shunts close and blood circulates normally, the most significant changes occur in the cardiovascular system. In gestational diabetes, metabolic changes in the intrauterine environment cause foetal cardiac dysfunctions that can persist after birth and impair neonatal transitional haemodynamics even in asymptomatic neonates^[8].

In this present study, 20% infant had acyanotic congenital heart disease (ACHD) and 3.3% infant had cyanotic congenital heart disease (CCHD). The prevalence of CHD in this study is 23.3%.

In the Saudi Arabian cohort study, the incidence of CHD among infants of diabetic mothers was 11.82%;^[9] similar studies by Al Abdul Gader *et al.*^[10] and Muhammad *et al.*^[11] reported a lower incidence of CHD among infants, which was 10.7% and 9.3%, respectively. However, Abu-Sulaiman and Subaih^[12] reported a 15% prevalence. Differences in CHD incidences across studies are due to different sample size selection and study period length. We had a very short study period of six months where as they conducted study for five years with large sample size.

In our study, GDM was most common DM type in diabetic mother. Arul *et al.* discovered that 17% of the mothers had pregestational diabetes and 83% had gestational diabetes in their study of 100 IDM babies.

10% had clinical manifestations. Among the 3 babies with clinical manifestation, one baby had respiratory distress, one baby had cyanosis and one baby had systolic murmur. No babies had shock or Congestive cardiac failure. One baby (3.33%) had saturation less than 95%. On studying the x-ray and ECHO changes, 2 babies (6.66%) had x-ray positive changes and 6 babies (80%) had Echo changes. Our study report shows poor glycemic status, poor treatment compliance and LGA were significant risk factor of CHD.

In the Arul *et al* study, 93% of mothers had well-controlled glycemic status, while 7% had poorly controlled glycemic status. ECHO abnormalities were found to be more prevalent in babies born to mothers with poorly controlled diabetes and a history of cyanotic heart disease^[13]. It demonstrated that the mother's glycemic status had a significant influence on cardiovascular anomalies, which is consistent with the findings of Khan *et al* and Mekwana *et al.*^[14, 15] Babies born to mothers with poorly controlled diabetes had poorer cardiac function.^[16, 17]

Increased blood sugar levels in the mother result in high blood sugar levels in the developing foetus, creating an abnormal biochemical environment that has a negative impact on genes responsible for normal development.

Congenital heart defects caused by maternal diabetes are known to form very early in pregnancy.

In the study by Arul *et al.*, IDM babies presented with a murmur, 5 with low SpO₂, and 3 with external congenital anomalies such as polydactyl and cleft palate. Eleven (78%) of the 14 babies with murmurs had ECHO abnormality, as did all babies with low SpO₂ and external congenital anomalies. IDM babies with cardiomegaly (9%) had an ECHO abnormality with septal hypertrophy^[13].

In our study, there was no relation between treatment plan and incidence of CHD in babies. Arul *et al.*, have shown results dissimilar to ours. In their study, babies whose mothers were on insulin had several ECHO abnormalities^[13]. This dissimilarity may be due to difference in sample size.

Conclusion

The higher prevalence of Congenital heart disease among diabetic mothers and also as poor glycemic index and treatment compliance are risk factor of CHD in our study we suggest a need of good glycemic control and treatment compliance in mother during pregnancy in order to prevent CHD in babies. And we recommend the ECHO screening to be done in all babies born to diabetic mothers irrespective of clinical presentation.

Ethical committee approval:

Our study is approved by Institutional ethical committee- Trichy SRM medical college and research institute.

Conflict of interest: Our authors declare no conflict of interest

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Abbreviation

GDM: Gestational diabetes mellitus

IDM: Infant of diabetic mother

ECHO: Echocardiography

CHD: Congenital heart disease

LGA: Large for gestational age

Tables

Table 1: Descriptive data of mother

Variable	n	%
Age of mother		
<20	1	3.33
20-30	9	30
>30	20	66.6
Type of DM		
GDM	26	86.6
Pregestational DM	4	13.3
Treatment regimen		
Only Diet	6	20
Diet + Insulin	24	80
Treatment compliance		
Good	25	83.3
Poor	5	16.7
Glycemic status		
Controlled	28	93.3
Uncontrolled	2	6.67
Mode of delivery		
LSCS	17	56.6
Labour natural	13	43.3
Gender		
Male	18	60
Female	12	40
Birth weight		
LGA	13	43.3
AGA	17	56.6

Table 2: Clinical and investigation finding

Variable	n	%
Clinical manifestation		
Yes	3	10
No	27	90
Spectrum of clinical finding		
Respiratory distress	1	3.33
Cyanosis	1	3.33
Systolic murmur	1	3.33
Shock	0	0
CCF	0	
Pulse oximetry		
Spo2<95	1	3.33
Spo2>95	29	96.67
Xray finding		
Yes	2	6.66
No	28	93.34
Spectrum of X ray finding		
Cardiomegaly	1	3.33
Abnormal heart shape	1	3.33
Echo cardiogram changes		
Yes	6	20
No	24	80
Diagnosis as per Echo		

HOCM	2	6.67
ASD	1	3.33
VSD	1	3.33
PDA	1	3.33
TOF	1	3.33

Tables 3: Investigative findings comparison among GDM/ Pregestational DM mothers

GDM/Pregestational DM	Clinical	Pulse oximetry	Xray	Echo
GDM	-	-	-	HOCM
GDM	-	-	+	HOCM
Pregestational DM	+	-	+	VSD
GDM	-	-	-	ASD
GDM	+	+	-	PDA
GDM	+	-	-	TOF

Table 4: Bivariate analysis of CHD with study

Variable	CHD present n,%	CHD absent n,%	P value
Age of mother			
<20	0, 0	1, 100	0.604
20-30	1, 11.1	8, 88.9	
>30	5, 20	15, 80	
Type of DM			
GDM	5, 19.2	21, 80.8	0.783
Pregestational DM	1, 25	3, 75	
Treatment regimen			
Only Diet	1, 16.6	5, 83.4	0.817
Diet + Insulin	5, 20.8	19, 79.2	
Treatment compliance			
Good	3, 12	22, 88	0.04
Poor	3, 60	2, 40	
Glycemic status			
Controlled	4, 14	24, 86	0.034
Uncontrolled	2, 100	0	
Mode of delivery			
LSCS	4, 23.5	13, 76.5	0.937
Labour natural	2, 15.3	11, 84.7	
Gender			
Male	4, 22.2	14, 87.8	0.999
Female	2, 16.6	10, 73.4	
Birth weight			
LGA	5, 38.4	8, 61.6	0.042
AGA	1, 5.8	16, 93.2	

Figures

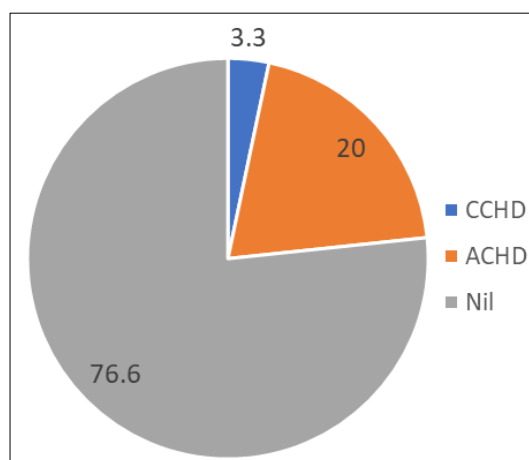


Fig1: Distribution of congenital heart disease

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