

Problems and Immediate Outcome of Infants of Diabetic Mothers

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Summary:

Objective: The present study was undertaken to evaluate the problems and immediate outcome of infants of diabetic mothers (IDMs) in early neonatal period and to compare the results between infants of gestational and pregestational diabetic mothers.

Design: A hospital based prospective study. **Setting:** The study was done in Chittagong Medical College Hospital, a tertiary hospital in Chittagong city. **Method:** Within one hour of delivery 52 infants of diabetic [pregestational & gestational] mothers consecutively admitted were enrolled in the study. Study period was January 2002 to August 2002.

Results: Total number of IDMs were 52. Among them 31 were gestational and 21 were of pregestational diabetic mothers.

Significant number 82.6% of IDMs were delivered by caesarean section. The mean birth weight of IDMs was significantly high (3212 ± 563 g), 21% of IDMs had birth weight > 4000 g. Total 23% of the IDMs developed perinatal asphyxia. The 23% of IDMs developed hypoglycaemia. The incidence of hypoglycaemia was higher in infants of pregestational diabetic mothers as compared to that of gestational diabetic mothers (38.09% and 12.9% respectively), the difference was statistically significant ($P < 0.05$). In majority (66%) of IDMs cases hypoglycaemia was symptomatic. Significant number

(19.2%) of IDMs had hypocalcaemia. The incidence of polycythaemia was higher in infants of gestational diabetic mothers (GDMs) as compared to infants of pregestational diabetic mothers (25.8% and 9.5% respectively), difference was statistically significant ($P < 0.001$). 3 (5.7%) out of 52 IDMs had congenital malformation (each one in number polydactyly, cleft palate & preauricular skin tag). Total death was 3 (5.7%) all of them died within 72 hours of birth. Causes of death 1 each number: perinatal asphyxia, respiratory distress syndrome and meconium aspiration syndrome. 11 IDM was macrosomic, among them 1 had birth injury (Erb's palsy), hypoglycaemia and meconium aspiration syndrome and expired within first 24 hours of life.

Conclusion: Among the important problems the present study revealed perinatal asphyxia, hypoglycaemia, hypocalcaemia, polycythaemia top the list. These babies should be delivered at hospitals where special neonatal care available for management of high risks babies to reduce the morbidity and mortality. Screening for GDMs should be performed in all pregnant women. All diabetic women should have planned pregnancy and proper antenatal care in order to maintain strict glycaemic control, to have a satisfactory outcome in infants of diabetic mothers.

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Introduction:

Diabetes mellitus is characterized by hyperglycaemia, disturbance of carbohydrate, fat and protein metabolism that are associated with absolute or relative deficiencies in insulin action and/or insulin

secretion¹. Diabetes mellitus is the commonest endocrine disorder during pregnancy. In fact many prediabetics and potential diabetics may show chemical evidences of diabetes mellitus during the course of metabolic stress of pregnancy. Gestational diabetes where in glucose homeostasis returns back to normal after delivery, also increases various risk to the fetus and newborn. The duration and severity of maternal diabetes and quality of its control during pregnancy determine the outcome of the offspring²

Diabetes mellitus is prevalent among 2.1% people of Bangladesh³. Gestational diabetes mellitus (GDM) develops among 6.7% of all pregnancies in our population⁴. In western world 2 to 3% of all pregnancies are currently being diagnosed as GDM⁵.

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Infant of diabetic mothers have a 47% risk of significant hypoglycaemia, 22% risk of hypocalcaemia, 19% risk of hyperbilirubinemia, 34% risk of polycythaemia, 6-9% incidence of major congenital anomalies (congenital heart disease, central nervous system & vertebral anomalies)⁶, 4% risk of respiratory distress syndrome, 28% risk of macrosomia & cardiomegaly (30%).

Among the various metabolic errors these infants suffer, hypoglycaemia is the commonest and most dangerous⁷. Infants of diabetic mothers have hyperinsulinism at birth due to increased placental transfer of glucose and other nutrients stimulating hyperplasia of islets of Langerhans in the fetus and increased insulin secretion, raised amount of C-peptide and free insulin in cord blood. Once the maternal supply of glucose is cut-off by clamping the cord, the excess insulin circulating in the baby's system quickly rids the plasma of the remaining glucose and so blood glucose level may drop precipitously and alarmingly during the first few hours of life⁸. Hypoglycaemia is defined as a blood glucose level less than 2.6mmol/L. Symptoms of hypoglycaemia, are non specific, such as lethargy, apathy, limpness, apnea, cyanosis, weak or high pitched cry, poor feeding, vomiting, tremors, jitteriness, irritability, seizures, coma⁹. Neonatal hypocalcaemia may be due to hypoparathyroidism, abnormal vitamin D metabolism and hyperphosphataemia. Neonatal hypocalcaemia is defined as total serum calcium concentration of less than 7 mg/dl and an ionized calcium conc. of less than 4 mg/dl¹⁰. Polycythaemia (haematocrit of more than 0.651) occurs in 30 to 60% of IDMs causing the neonatal hyperviscosity syndrome. The main cause of polycythaemia is chronic intrauterine hypoxaemia, which occurs as consequence of fetal hyperinsulinism and hyperglycaemia.¹¹.

Macrosomia (birth weight > 4000 g) may be associated with increased incidence of primary caesarean section or obstetric trauma such as fractured clavicle, Erb's palsy or phrenic nerve palsy due to shoulder dystocia^{7, 9}.

Hypertrophic cardiomyopathy with asymmetric septal hypertrophy has been extensively documented¹⁰. The babies may also develop small left colon syndrome, a

transient delay in the development of left side of colon.^{4,5}. Despite improvement in diabetic care, the perinatal mortality still remains four times high than in nondiabetic women. Predominant causes of mortality are congenital anomaly, birth trauma, respiratory distress syndrome, prematurity and unexplained still birth¹².

Although in developed countries there has been significant improvement in the outcome of diabetic pregnancies largely due to better metabolic control before and during pregnancy and vigorous neonatal care, the management in our country still poses a major challenge.

Aims of this study were to find out problems of IDM during early neonatal period that threaten baby's life and with appropriate management to determine immediate outcome in hospitalized IDM. The study was designed to evaluate the problems and immediate outcome of infants of diabetic mothers in early neonatal period and to compare the results between infants of gestational and pregestational diabetic mothers in neonatal unit of Chittagong Medical College Hospital, Chittagong.

Materials and Method:

This hospital based prospective study was done in neonatal unit of Chittagong Medical College Hospital in collaboration with Department of Obstetrics and Gynecology of this hospital. Within one hour of delivery 52 infants of diabetic [pregestational & gestational] mothers consecutively admitted for observation and further management were enrolled in the study. Exclusion criterion was infants of diabetic mothers were admitted as referred case from other hospitals. Study period was January 2002 to August 2002.

After taking the verbal consent from the attendant, the relevant information from the history, physical examination and investigation findings were recorded in a purposely prepared questionnaire. Investigations routinely underwent were capillary blood glucose at 0 (cord blood), 2, 4, 6, 12, 24, 48 and 72 hours of age by using gluco-stix. Peripheral blood glucose was collected with single puncture non-squeezing procedure by trained technician and level measured by Glucose oxidase method in auto analyzer at 6, 12, 24, 48, 72 hours of age and whenever any

symptoms suggestive of hypoglycaemia developed. The glucoStix (capillary blood glucose) was used for screening purpose and for prompt diagnosis and management of hypoglycaemia and estimation of peripheral venous blood glucose level was done for further confirmation of diagnosis. Serum calcium level were measured routinely at 6, 24, 48 hours of age and later if the baby remains hypocalcaemic or symptomatic. Hematocrit at 1 hour & 24 hour of age was done routinely. Blood samples collected in each time in all cases by trained technician, results were measured by autoanalyzer and interpreted by expert person. Among other investigations: platelets count, CXR PA view, plain X ray of lumbosacral spine, Hb%, TC, DC, blood culture, ECG, echocardiography etc were done as indicated by clinical parameters, not done routinely in all cases as study population were admitted within one hour of delivery for management and further observation whether any problem developed. Results were analyzed by analyzing software SPSS.

Results:

Total number of IDMs were 52. Among them 31 (59.6%) were gestational diabetic mothers and 21 (40.3%) were of pregestational diabetic mothers (Table-I).

92.3% of the IDMs were term as compared to 7.6% preterm delivery and majority of the IDMs (82.6%) were delivered by caesarean section as compared to 17.3% normal delivery (Table-II).

Macrosomia was found in 21.1 % (Table-III).

12 (23%) out of 52 IDMs developed perinatal asphyxia. 25.8% of IGDMs developed perinatal asphyxia in comparison to 19% of IPGDMs, although the difference is not significant statistically ($P > 0.50$) as shown in Table-IV. Table-V shows 23% of IDMs developed hypoglycaemia. Among the 12 infants (23%) having hypoglycaemia, only 8 were symptomatic. Lethargy & jitteriness was most commonly observed. Only 2 newborns developed seizure. The occurrence of hypoglycaemia was higher in infants of pregestational diabetic mothers as compared to that of GDM mothers (38.09% and 12.9% respectively) the difference was statistically significant ($p < 0.05$) as in Table-VI. 10 (19.2%) of the IDMs developed hypocalcaemia. 16.1% & 23.8%

infants of gestational & pregestational diabetic mothers had hypocalcaemia respectively and the difference was not statistically significant ($P > 0.50$). Out of the 10, four had symptoms, mainly jitteriness (Table-VII).

In this study, 25.8% and 9.5% of infants of gestational and pregestational diabetic mothers developed polycythaemia respectively and the difference was statistically significant ($P < 0.001$) shown in Table-VIII.

In the present study, 3 (5.7%) out of 52 IDMs had congenital malformation (each one in number: polydactyly, cleft palate & preauricular skin tag). In the study undertaken, 2 (3.8%) of IDMs developed RDS (respiratory distress syndrome), one of which expired and another one survived. Out of 52 IDMs one developed meconium aspiration syndrome also had birth injury (Erb's palsy) and hypoglycaemia and expired within 24 hours of birth. Another IDM had severe perinatal asphyxia and expired (Table IX).

Total survival of IDM was 49 (94.2 %) and discharged within 7 days of admission.

Table-I

Distribution of neonates according to type of maternal diabetes (n= 52)

Group	No. of cases	Percentage
IGDMs	31	59.61
IPGDMs	21	40.38
IDMs (n=52)		

IGDMs = Infants of gestational diabetic mothers
IPGDMs = Infants of pregestational diabetic mothers
IDMs = Infants of diabetic mothers

Table-II

Frequency of gestational age & mode of delivery in IDMs (n= 52).

Features	No.	%
Gestational age:		
Term	48	92.3
Preterm	04	7.6
Mode of delivery:		
Normal	09	17.3
Caesarian	43	82.6

Table-III

Distribution of IDMs according to birth weight (n=52)

Birth weight(grams)	No. of cases	Percentage
1500 - 2499	04	7.6
2500 - 2999	06	11.5
3000 - 3499	15	28.8
3500 - 4000	16	30.7
>4000	11	21.1

Mean 3212±563

Table-IV

Frequency of perinatal asphyxia in IGDMs & IPGDMs.

Group	Perinatal sphyxia Present		Perinatal asphyxia absent		P value
	No	%	No	%	
IGDMs (n=31)	8	25.80	23	74.19	P>0.50
IPGDMs (n=21)	4	19.04	17	80.95	
IDMs (n=52)	12	23.07	40	76.92	

Table -V

Frequency of hypoglycaemia in IDM: Number 12(23%)

	IGDMs n=31		IPGDMs n=21		IDMs (Total, n=52)	
	No	%	No	%	No	%
Symptomatic	3	9.6	5	23.8	8	15.3
Asymptomatic	1	3.2	8	38.0	12	23.0
Total	4	12.9				

Table -VI

Frequency of hypoglycaemia in IGDMs & IPGDMs.

Group	Hypoglycaemia Present		Hypoglycaemia absent		P value
	No	%	No	%	
IGDMs n=31	4	12.90	27	87.09	P>0.50
IPGDMs n=21			13	61.90	
IDMs (total) n=52	8	38.09	40	76.92	
	12	23.07			

Table -VII

Frequency of hypocalcaemia in IGDMs & IPGDMs.

Group	Hypocalcaemia Present		Hypocalcaemia absent		P value
	No	%	No	%	
IGDMs n=31	5	16.12	26	83.87	P>0.50
IPGDMs n=21			16	76.19	
IDMs (total) n=52	5	23.80	42	80.76	
	10	19.23			

Table -VIII

Frequency of polycythaemia in IDMs.

Group	Polycythaemia Present		Polycythaemia absent		P value
	No	%	No	%	
IGDMs n=31	8	25.80	23	74.19	P>0.50
IPGDMs n=21	2	9.52	19	90.47	
IDMs (total) n=52	10	19.23	42	80.76	

Table – IX

Immediate outcome of IDMs in relation to problem.

Problems		Total survival=49		Total death=3		Total cases n=52	
		Number	%	Number	%	Number	%
Birth weight (gm)	1500-2499	03(6.1)	01(33.3)	04(7.6)			
	2500-2999	05(10.2)	01(33.3)	06(11.5)			
	3000-3499	15(30.6)	—	15(28.8)			
	3500-4000	15(30.6)	—	16(30.7)			
	>4000	11(22.4)	01(33.3)	11(21.1)			
Perinatal asphyxia	Yes	11(22.4)	01(33.3)	12(23.0)			
	No	38(77.5)	02(66.6)	40(76.9)			
Hypoglycaemia	Yes	10(20.4)	02(66.6)	12(23.0)			
	No	39(79.5)	01(33.3)	40(76.9)			
Hypocalcaemia	Yes	10(20.4)	—	10(19.2)			
	No	39(79.5)	03(100.0)	42(80.7)			
Polycythaemia	Yes	10(20.4)	—	10(19.2)			
	No	39(79.5)	03(100.0)	42(80.7)			
Congenital malformations	Yes	03(6.1)	—	03(5.7)			
	No	46(93.8)	03(100.0)	49(94.2)			
Birth injuries	Yes	01(2.0)	01(33.3)	02(3.8)			
	No	48(97.9)	02(66.6)	50(96.1)			
Respiratory distress syndrome	Yes	01(2.0)	01(33.3)	02(3.8)			
	No	48(97.9)	02(66.6)	50(96.1)			
Meconium aspiration syndrome	Yes	00(0)	01(33.3)	01(1.9)			
	No	49(100)	02(66.6)	51(98.0)			

Discussion:

Diabetes mellitus is prevalent among 2.1% people of Bangladesh.¹³ Among them a significant number are female. GDM (gestational diabetes mellitus) develops among 6.7% of all pregnancies in our population.¹⁴ In western world 2 to 3% of all pregnancies are currently being diagnosed as GDM.⁵ In this study, the total number of IDMs was 52. Among them 31 were gestational diabetic mothers and 21 were pregestational diabetic mothers. Begum A¹⁵ in a study of 105 newborns reported that 44.4% of diabetic mothers had GDM and remaining were pregestational. Begum N¹⁶ in her study found that among 112 diabetic mothers 58.9% had GDM and 41% had pregestational diabetes mellitus. 93% of the IDMs were term as compared to 7.6% preterm delivery in the present study. IDMs may need to be delivered prematurely due to maternal or fetal problems. Ranade *et al.*¹⁷ reported 36% of the IDMs to be preterm. Overall, 26% of the diabetic women deliver before 37 weeks gestation, compared with 10% in general population.¹² In this study majority of the IDMs (82.6%) were delivered by caesarean section as compared to 17.3% normal delivery. Mohsin F¹⁸ in her study found that the rate of caesarean section (80%) in IDMs. The mean birth weight was significantly high 3212 ± 563 g in the present study. Mohsin F¹⁸ and Begum N¹⁶ in their study found the mean birth weight of IDMs to be 3038 ± 69 g and 2970 ± 636 g respectively. Macrosomia, that is, a birth weight above the 90th percentile for gestational age or weight >4000 g. was found in 22.4% in the present study. The incidence of macrosomia in IDMs has been reported to be in the range of 20 to 32% by Gabee *et al.*¹⁹ and Elliot *et al.*²⁰. Perinatal asphyxia that occurs in IDMs is perhaps a result of multiple factors: maternal hypertension with resultant reduction of placental blood flow, premature labour, fetal macrosomia and maternal hyperglycaemia within 6 to 8 hours preceding delivery, which supposedly reduces placental blood flow.²¹ In the study undertaken, 12(23%) out of 52 IDMs developed perinatal asphyxia. Mohsin F¹⁸ and Begum N¹⁶ reported the incidence of perinatal asphyxia 12% and 20.53% respectively. In the present study, 25% of IGDMs developed perinatal asphyxia in comparison to 19% of IPGDMs, that was not significant ($P > 0.05$). Out of 12 cases, one was severely asphyxiated and expired few hours after birth.

Among the different metabolic errors these infants suffer, hypoglycaemia is commonest and most dangerous. In this study, 12 infants (23%) having hypoglycaemia, only 8 were symptomatic. Lethargy & jitteriness was most commonly observed. Only 2 newborns developed seizure. Ranade *et al.*¹⁷, Hossain *et al.*²² and Mountain⁸ reported the incidence to be 50%, 52.8% and 55.2% respectively. The occurrence of hypoglycaemia was higher in infants of pregestational diabetic mothers as compared to that of GDM mothers (38.09% and 12.9% respectively) the difference was statistically significant ($p < 0.05$) in this study. 61% IPGDMs had hypoglycaemia in contrast to 44.2% in IGDMs as reported by Mountain⁸. Hypocalcaemia is one of the important metabolic errors the IDMs suffer, probably due to functional hypoparathyroidism.²³ In this study, 10 (19.2%) of the IDMs developed hypocalcaemia. 16% & 23% infants of gestational & pregestational diabetic mothers developed hypocalcaemia respectively and the difference was not statistically significant ($P > 0.50$). Out of the 10, four had symptoms, mainly jitteriness. Marchant *et al.*²⁴, Ranade *et al.*¹⁷, Deorari *et al.*²⁵, and Mountain⁸ reported the incidence of hypocalcaemia to be 60%, 14%, 13% and 25-50% respectively. In this study, total 10 (19.2%) of IDMs developed polycythaemia, one case was symptomatic and needed partial exchange transfusion. Mohsin F¹⁸ reported incidence of polycythaemia 29% in her study. 25.8% and 9.5% of infants of gestational and pregestational diabetic mothers developed polycythaemia respectively and the difference was statistically significant ($P < 0.001$). In the present study, congenital malformation was noticed in 3 (5.7%) IDMs (each one in number: polydactyly, cleft palate & preauricular skin tag). Congenital malformations have been reported to be 2-4 times as common in the offspring of diabetic mothers as compared to non-diabetic mothers^{5, 12, 26}. Begum N¹⁶ in her study shown the frequency of congenital malformation in IDMs was 10.7%. In the study undertaken, 2 (3.8%) of IDMs developed RDS (respiratory distress syndrome), one of which expired and another one survived. Out of 52 IDMs one developed meconium aspiration syndrome also had birth injury (Erb's palsy) and hypoglycaemia and expired within 24 hours of birth. Another IDM had severe perinatal asphyxia and expired. Despite improvement in diabetic care, the perinatal mortality still remains four times higher than in nondiabetic

women. Predominant causes of mortality are congenital anomaly, birth trauma, respiratory distress syndrome, prematurity and unexplained still birth¹²

Conclusion:

Despite the curbing of our perinatal mortality rate, the IDMs are victims of significant mortality and morbidity. Among the important problems the present study revealed perinatal asphyxia, hypoglycaemia, hypocalcaemia, polycythaemia top the list. These babies should be delivered at hospitals where special neonatal care available for management of high risks babies to reduce the morbidity and mortality. Screening for GDM should be performed in all pregnant women. All diabetic women should have planned pregnancy and proper antenatal care in order to maintain strict glycaemic control and to have a satisfactory outcome in infants of diabetic mothers.

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