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Neonatal Complications in Infants born to Diabetic Mothers

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ABSTRACT

Objectives: To determine the range and frequency of complications in neonates born to diabetic mothers.
Study Design: Cross-sectional study.
Place and Duration of Study: Department of Paediatrics, Pak-Emirates Military Hospital Rawalpindi, Pakistan from Nov 2021 to May 2022.
Methodology: We conducted this study on a total of 120neonates born to diabetic mothers. Neonates born to women with metabolic syndrome, polycystic ovarian syndrome, patients taking steroids, history of eclampsia, and patients with a history of heart disease were excluded. All patients were followed up for one month i.e., the neonatal period for the development of complications.
Results: Hypoglycaemia was seen in 62(51.67%) of the neonates, while hypocalcaemia affected 72(60.00%) of them. A total of 36(30.00%) of the new borns were born with macrosomia. Moreover, hyperbilirubinaemia affected 41(34.17%), while 30(25.00%), 12(10.00%) and 24(20.00%) neonates had polycythaemia, respiratory distress syndrome and low birth weight, respectively.
Conclusion: Neonates born to diabetic mothers are at risk of developing serious, sometimes life-threatening complications, and require constant vigilance to prevent morbidity and mortality.

Keywords: Neonatal Complications, Diabetes Mellitus.

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INTRODUCTION

The year 2017 saw an estimated 451 million people suffering from some form of diabetes mellitus globally, a number which is expected to rise to an incredible 693 million by 2045.[1] The National Diabetes Survey of Pakistan (NDSP) determined that the prevalence of diabetes mellitus in the country was approximately 26.3%, with an estimated 27.4 million people who were aged over twenty years being afflicted by the disorder, in 2016-17.[2,3] Neonates born to females who suffer from diabetes mellitus while pregnant have an increased risk of developing complications, regardless of whether the condition was gestational or otherwise, and the severity appears to correlate with the magnitude of hyperglycemia.[4,5]

A number of studies have been conducted on the subject of neonatal complications in diabetic mothers and have found that maternal hyperglycemia is associated with the increased risk of development of congenital anomalies, premature delivery, respiratory distress syndrome, macrosomia, birth asphyxia, cardiomyopathy, haematological disorders such as polycythemia, as well as metabolic complications such as hypocalcaemia, hypoglycemia, low iron stores and hyperbilirubinemia.[6,7] These complications are associated with significant morbidity and mortality, as compared with neonates born to non-diabetic mothers.[8] Despite advances in blood sugar control and antenatal care, the perinatal mortality rate in neonates born to diabetic mothers remains high.[9] It is pertinent to note that an increase in risk of complications is associated not only with the degree of hyperglycemia but also on maternal age and also with the time period during which the foetus is exposed to hyperglycemia i.e., foetuses exposed to high maternal blood sugar levels during the first trimester have a higher risk for the development of complications than those exposed at a later stage.[10]

We conducted this study with the express purpose of determining the incidence of different complications occurring in neonates born to mothers with gestational diabetes mellitus. We believe that determining the exact frequency of each complication will sensitize the treating clinician to remain vigilant for complications that occur more frequently as well as institute measures for prevention and control of these complications.

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METHODOLOGY

This was cross-sectional research study, conducted at the Department of Paediatrics, Pak-Emirates Military Hospital, Pakistan from Dec 2021 to May 2022. We obtained informed consent from the guardians of all participants who numbered 120. Approval was obtained for the ethical review board of the hospital before conducting the study via reference letter no. A/28/EC/416/EC. We used non-probability consecutive sampling to select our patients. The WHO sample size calculator was used to calculate the sample size keeping a confidence level of95%, an absolute precision of 0.099 and expected prevalence of neonatal complications was 54%.[11]

Inclusion Criteria: Neonates born to women between the ages 20 years and 40 years of age, who had gestational diabetes were included in this study.

Exclusion Criteria: Neonates born to women with metabolic syndrome, polycystic ovarian syndrome, patients taking steroids, history of eclampsia, and patients with a history of heart disease were excluded.

Gestational diabetes (GDM) was defined as the presence of high serum glucose levels, detected for the first time after the start of the second trimester of pregnancy.12 High serum glucose levels were said to be present if blood glucose was found to be high in any of the following settings: (a) Fasting: >92 mg/dL (>5.1 mmol/L), or (b) One hour post-prandial: >180 mg/dL (>10 mmol/L), or (c) two hours post-prandial: >153 mg/dl (>8.5 mmol/L).[12]

The participants underwent a clinical history and examination on being included in the study. Patient were documented for demographic data for both mother and child. All participants were followed-up for one month i.e., the complete neonatal period to monitor for the development of any adverse outcome.We analyzed all data using the Statistical Package for the Social Sciences version 26.0. Mean and SD was calculated for quantitative variables while qualitative variables were recorded in terms of frequency and percentage. We compared the effect of maternal age on the development of each complication using the Chi square test, and a p value of ≤0.05 was considered significant.

RESULTS

A total of 34(28.33%) of the mothers were young aged between 20 to 30 years, while the majority (n=86, 71.67%) were older than 30 years. About 47(39.17%) neonates were less than seven days old, and 57(47.50%) were males. Most of the neonates i.e., 70(58.33%) were born to mothers living in an urban area. Patients demographic data is displayed in Table-I.

Table-I Demographic Data

Variable	Result
Maternal Age	
≤30 Years	34(28.33%)
>30 Years	86(71.67%)
Neonatal Age	
≤7 Days	47(39.17%)
>7 Days	73(60.83%)
Neonatal Gender	
Male	57(47.50%)
Female	63(52.50%)
Residence Status	
Urban	70(58.33%)
Rural	50(41.67%)

Hypoglycaemia was seen in 62(51.67%) of the neonates, and hypocalcaemia was noted in 72(60.00%). There were 36(30.00%) who were born with macrosomia, while 41(34.17%) had hyperbilirubinemia, and a further 30(25.00%) had polycythemia. Respiratory distress syndrome was seen in 12(10.00%) neonates, and 24(20.00%) were born with low birth weight. The results for the complications seen are shown in Table-II.

Table-II Results For Complications

Complication	Yes	No
Hypoglycaemia	62(51.67%)	58(48.33%)
Hypocalcaemia	72(60.00%)	48(40.00%)
Macrosomia	36(30.00%)	84(70.00%)
Hyperbilirubinaemia	41(34.17%)	79(65.83%)
Polycythaemia	30(25.00%)	90(75.00%)
Respiratory Distress Syndrome	12(10.00%)	108(90.00%)
Low Birth Weight	24(20.00%)	96(80.00%)

Influence of maternal age on complications revealed that hyperbilirubinemia and low birth weight were significantly common in older mothers as shown in Table-III.

Table-III Frequency Of Complications According To Maternal Age

Variable	≤30 Years	>30 Years	*p* value
Hypoglycaemia	19(30.65%)	43(69.35%)	0.56
Hypocalcaemia	20(27.78%)	52(72.22%)	0.87
Macrosomia	6(16.67%)	30(83.33%)	0.06
Hyperbilirubinemia	7(17.07%)	34(82.93%)	0.04
Polycythemia	12(40.00%)	18(60.00%)	0.10
Respiratory Distress Syndrome	1(8.33%)	11(91.67%)	0.10
Low Birth Weight	11(45.83%)	13(54.17%)	0.03

DISCUSSION

Our study demonstrated that neonates born to the older diabetic women had a higher rate of complications. The most frequently observed complications seen were hypoglycaemia, hypocalcaemia and macrosomia, followed by hyperbilirubinemia, polycythemia while respiratory distress syndrome and low birth weight were less commonly seen.

Hypoglycaemia was also the most common complication noted in a study by Anjum et al where it was observed in 54.00% of the neonates, which was similar to our study where it had a frequency of 51.67%.[11] However, in an older study done in India, it was seen in only 21.00% of the neonates studied.13 In another research conducted by Alam *et al,* the incidence of hypoglycaemia was noted in 35% of the neonates born to hyperglycaemic mothers.14This difference in results can be attributed to a number of factors: The studies mentioned had varying definitions of gestational diabetes and the blood glucose level that signified hypoglycaemia, moreover, the studies were conducted in dissimilar populations, hence the variability. Neonates born to mothers who have diabeteshave disordered insulin secretion at the time of birth due to increased transfer of glucose across the placenta, which results in high foetal blood glucose levels causing a hyperplasia of islets of Langerhans and higher insulin secretion, raised amount of C peptide and free insulin in cord blood.[15] When the high supply of maternal glucose ceases at birth, the surplus insulin present in the neonate's blood produces hypoglycaemia.[15]

Macrosomia was noted in approximately a third of the neonates in our study. This fraction was somewhat centrally located between the results from other studies reported in literature: Anjum *et al* saw macrosomia in 15.00% of the neonates in their study, while Shirazi et al reported that 16.00% of their neonates were so-afflicted.[11,16] Conversely, Alam *et al* and Hussain *et al* reported that 45.00% and 40.00% of the neonates in their study suffered from macrosomia, respectively.[14,17] Again, the diverse populations and degrees of hyperglycemia may be responsible for the heterogeneity of the results. Insulin causes the excess glucose present in foetal blood to be deposited as adipose tissue, which leads to macrosomia.[18] Hypocalcaemia, in our study, was noted in 60.00% of neonates, which was slightly higher than that seen in Anjum *et al,* who reported a frequency of 43.00%.[11] Conversely, Deorari *et al* and Alam *et al* reported much lower rates of 13.00% and 15.00%, respectively.[13,14] Hypocalcaemia is thought to occur because of intestinal wall oedema due to high blood glucose levels, which cause a reduction in vitamin D and calcium absorption.[19] Hyperbilirubinaemia was noted in 34.17% of the neonates, similar to Anjum et al who noted a frequency of 42.00%.[11] High blood sugars are thought to induce prolonged haemolysis in neonates, which likely results in hyperbilirubinaemia in these patients.[20] In this study, 10.00% of neonates were affected by respiratory distress syndrome (RDS). Anjum et al reported a similar rate of 13.00%.[11] The occurrence of RDS has been attributed to increased levels of insulin that hinder the integration of choline into lecithin, thus generating a deficiency of phosphatidyl choline in the amniotic fluid and lungs; the decreased surfactant levels culminate in respiratory distress syndrome.[21,22]

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LIMITATION OF STUDY

Our study was limited by the population from which the sample was selected: Patients were wards of armed forces personnel and the distribution of iron deficiency anaemia and β-thalassemia trait may not be reflective of the general population. Secondly, our study was limited to a single center, with a comparatively small sample size; Pakistan is an ethnically diverse country and determining whether our results apply to all ethnicities is an aspect this study is lacking. Lastly,our study lacked a control arm consisting of non-diabetic mothers, with which to establish a basis for comparison.

CONCLUSION

Neonates born to diabetic mothershave a high rate of complications. The increasing trends in the rates of adverse outcomes seen in our study in comparison to previous literature is in keeping with the rising prevalence of diabetes mellitus in general, and maternal diabetes in particular. These pregnancies, and the neonates that are born of them, require specialized healthcare and management to prevent morbidity and mortality. The necessity of involving a pediatrician in the deliveries of diabetic mothers, so that such complications can be better addressed in a timely manner, is highlighted by results of this study.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SH: & ZA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

SI: & HZ: Data acquisition, data analysis, approval of the final version to be published.

BA: & HS: Critical review, concept, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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