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Clinical Profile of Neonates born to Hyperglycemic Mothers Delivering at a Tertiary Hospital in Tanzania

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Abstract

Background

Hyperglycemia in pregnancy is among the commonest health challenges among pregnant women. Infants born from these women are at risk of developing complications such as macrosomia, hyperglycemia, perinatal asphyxia, cardiac and respiratory problems, birth injuries, and congenital malformations. This study aims at assessing the clinical profile of neonates born to hyperglycemic mothers at a tertiary hospital in Tanzania.

Methods

A cross-sectional study was done among women who had hyperglycemia during pregnancy, admitted from January 2020 to September 2021 at Muhimbili National Hospital (MNH). A total of 130 files (of hyperglycemic women) were reviewed. Data were analyzed descriptively using SPSS version 26,categorical variables were analysed using frequencies. Mean and standard deviation were used to summarize continuous variables. The chi-square test was used to assess associations of Glucose control measures and the neonates' characteristics. The p-value < 0.05 was considered as statistically significant.

Results

A total of 130 files of mothers with hyperglycemia were included in the study. There was a total of 130 newborn deliveries, two-thirds, 67.7% being through cesarean section (CS) whereby elective CS and emergency CS accounted for 47.7% and 20% respectively. For newborns, 45.4% had abnormal birth weight (low birth weight 22.3% and macrosomia 23.1%). Moreover, 20% of these children presented with a low Apgar score**,** however there was no documented neonatal death.

Conclusion

The prevalence of neonatal complications in mothers with glucose intolerance is high in our settings. Emphasis on lifestyle modification among pregnant women as primary prevention should be advocated to minimize neonatal complications.

Recommendation

Further studies should be done to explore on the long-term neonatal outcomes. Care providers should be ready to take care of these newborns who need special attention at delivery.

Keywords: *Neonatal profile, Hyperglycemia in pregnancy, Tanzania.*

Introduction

Hyperglycemia in pregnancy refers to abnormally high blood sugar levels diagnosed for the first-time during pregnancy. It is categorized into diabetes mellitus in pregnancy (DIP) and gestational diabetes mellitus (GDM). Diabetes in pregnancy is defined as type 1, type 2, or rarer forms of diabetes before pregnancy while GDM is diabetes diagnosed for the first-time during pregnancy (1).

In 2013, WHO adopted diagnostic criteria for hyperglycemia in pregnancy (GDM and DIP). One is diagnosed with GDM when fasting blood glucose is ≥ 5.1 - 6.9 mmol/l, 1-hour and 2-hour blood glucose post 75g oral glucose tolerance test is ≥ 10.0 mmol/l, and 8.5 - 11 mmol/l respectively. DIP is diagnosed when fasting blood glucose > 7mmol/l, 2-hour blood glucose post 75g oral glucose > 11mmol/l, and random blood glucose > 11mmol/l (1). Diagnostic evaluation during pregnancy is recommended to be done at 24-28 weeks of gestation age, where all women with GDM are to be subjected to specialized care to prevent resultant maternal and neonatal complications. Apart from the diagnostic criteria that are used in evaluating the differences, the resulting morbidities as well are more in DIP than in GDM (2). Some of the symptoms of GDM include increased thirsty, easy tiredness, blurred vision, genital itching and increased urinary frequency (3).

If GDM is left untreated, the fetus is exposed to excess glucose which further stimulates the fetal pancreas to produce increased insulin to meet the glucose demand (4). Since Insulin stimulates growth, the fetus will unproportionally grow more than what is expected at its gestation age (5). Due to the unproportional weight gain in-utero, the risk for complicated delivery also increases due to shoulder dystocia, perineal tears due to difficult delivery, puerperal sepsis and eventually difficulty in milk let down during breastfeeding (6). Following delivery, these neonates are also at risk of future Diabetes mellitus and complications that can occur before, during or after delivery (7) (8).These complications may increase the chances for cesarean section as a mode of delivery, low APGAR score, prolonged hospital stay, birth asphyxia, early neonatal death(9–12).

In United States of America, the risk of still birth is more among mothers with hyperglycemia (5.9%) compared to those with normal glucose levels (4.0%) per 1000 live births (13). Studies have also shown babies with large birth weight are more common from mothers with hyperglycemia than those with no hyperglycemia during pregnancy (14,15,16),which further necessitate Cesarean delivery(17,16).Low Apgar score is as well increased among mothers with poor glycemic control during pregnancy(18).

To our knowledge, Tanzania lacks evidence on the profile of neonates born from hyperglycemic mothers. With this study we describe the clinical profiles of neonates born from

mothers who had hyperglycemia during pregnancy with a focus on birth weight, APGAR score, stillbirths, and early neonatal deaths. Determining the clinical profile of neonates will provide data to the health system and professionals so as to add attention while dealing with mothers with hyperglycemia and create effective solutions to avoid the complications.

Materials and Methods

Study design and study area

This was a cross-sectional study design conducted among pregnant women with hyperglycemia admitted at Muhimbili national hospital (MNH) Upanga campus from January 2020 to September 2021. The MNH is a tertiary public hospital receiving patients from all over Tanzania. It has two branches, Upanga and Mloganzila, both located in Dar es Salaam, Tanzania. Files of 130 mothers with pathological intolerance were identified out of all pregnant women admitted in January 2020 to September 2021 from the MNH medical records computers, registration number of each one was obtained then via registration numbers, files were retrieved in the maternity files store. Details of the neonates were obtained from the mother's files, and they included Birthweight, Apgar score, Mode of delivery and Birth (still birth or live birth).

Study population and sampling technique

This study involved 130 files of pregnant women with hyperglycemia who were attended from January 2020 to September 2021. Files were consecutively recruited from 1st of January to attainment of the sample size. The sample size was calculated from the open Epi formula for descriptive study based on a Prevalence of 8.4 % (19) a standard deviation of 1.96, and a maximum error set of 0.05. The sample size was 118 and an adjustment sample of 10% was considered. The registration number of each one was obtained from the maternity block electronic database using an identifier (diagnosis of hyperglycemia or diabetes in pregnancy or gestational diabetes mellitus or diabetes) and via registration numbers, files were retrieved in the maternity records department. The files retrieved from the medical records were cross-checked for correctness of the diagnosis by the person from medical records, then maternal and neonatal details were extracted using a checklist.

Inclusion criteria

All casefiles of neonates born from mothers with hyperglycemia during pregnancy from January 2020 through September 2021.

Exclusion criteria

Case files with incomplete information of neonates born from mothers with pathological glucose intolerance from January 2020 through September 2021. Incomplete information was defined as having missed at least one of the following – APGAR score, birthweight, mode of delivery, admission status, date of birth or date of discharge.

Data collection & analysis

A structured checklist was used for data collection. Data obtained from this study were analyzed descriptively by using the statistical package for social sciences (SPSS), version 26.0. Data were cleaned by manual checking daily during data entry then cross tabulation was done for the variables for completion. We then presented the data using frequencies and percentages in tables and graphs, and neonatal profile frequencies were analyzed in all patients. The chi-square test was used to assess associations of Glucose control measures and the neonates' characteristics. The p-value < 0.05 was considered as statistically significant.

Analysis of the variables

Mode of delivery: Mode of delivery such as Spontaneous vaginal delivery, assisted vaginal delivery, and cesarean section was taken from the delivery notes of the baby. The delivery methods were recorded and analyzed by calculating the frequency to determine the most common mode of delivery among mothers with pathological glucose intolerance.

Apgar score: Apgar was recorded from the baby assessment form during delivery. The Apgar score was divided into two categories. Low Apgar score (less than 7) and normal Apgar score (7-10). The frequency was calculated, and a mean Apgar score was also computed.

Birthweight: Birth weight measured immediately after delivery was recorded and further categorized into three categories; Low birthweight was considered as less than 2.5kg, normal birthweight was considered as greater or equal to 2.5kg but less than 4kg and macrosomia was considered as greater or equal to 4kg.

Hospital stays: Length of hospital stay was calculated by counting the number of days since when the mother was admitted till the date of discharge. The days were categorized into three groups; Within 24 hours, less or equal to three days, and more than three days. The frequency was calculated to determine the most common days of hospital stay.

Glycemic control: The type of glycemic control that the mother was using till the time of discharge was recorded from the patient clinical notes in the management part. This included those who were on insulin therapy, metformin, and dietary modification. Frequency was calculated and the mostly used glycemic control was determined.

Maternal age: Maternal age was obtained from the patient personal particulars during the day of delivery. They were recorded according to WHO age groups and mean age and frequency were calculated.

Parity: Parity was obtained from the introductory details of the patient clinical history and obstetric history. Parity was into three categories; para 1, 2-4, and more than 5. Frequency was obtained and the most parity was determined.

Results

A total of 130 files of mothers with hyperglycemia in pregnancy were included in the study. More than half 52.3% of the participants were young adults aged 26-35 with a mean age of 33.6 (±5.929) and about 66.9% of the participants had given birth to 2-4 children. Insulin was the commonest medical therapy used at 60.77%, followed by metformin at 13.83% and the rest were on diet control.

Table 1: Sociodemographic and obstetric characteristics of women included in this study (N=130)

Characteristics	Count (N)	Percent
Maternal age(years)		
16-25	13	10.00
26-35	68	52.30
36-45	47	36.20
>45	2	1.50
Parity status		
Para 1	26	20.00
Para 2 - 4	87	66.90
Para ≥ 5	17	13.10
Blood glucose control measures		
Metformin	18	13.85
Insulin	79	60.77
Diet alone	33	25.40
Mode of delivery		
Normal vaginal delivery	39	30.0
Elective CS	62	47.7
Emergency CS	26	20.0
Assisted breech delivery	3	2.3

CS-Cesarean Section

The table 2 below shows the relationship between immediately neonatal outcome and the blood glucose control measures taken by an individual. there is strong evidence to support the

relationship between blood glucose control measures and birthweight of the neonates during delivery since the p-value <0.05.

Table 2: Cross tabulation between neonatal outcomes and glucose control measures

Parameters	Glucose control measures				P-value
	Metformin N (%)	Insulin N (%)	Diet alone N (%)	Total N (%)	
Birthweight					
Low birthweight	1(5.9)	11(64.7)	5(29.4)	29(22.3)	
Normal birthweight	10(11.5)	56(64.4)	21(24.1)	71(54.6)	0.045*
Macrosomia	5(35.7)	7(50.0)	2(14.3)	30(23.1)	
Apgar score					
Low Apgar score	3(12.0)	15(60.0)	7(28.0)	26(20.0)	0.723
Normal Apgar score	15(14.4)	63(60.6)	26(25.0)	104(80.0)	
Mode of delivery					
Vaginal delivery	7(18.2)	27(66.1)	7(15.9)	41(31.8)	0.079
Cesarean section	11(12.5)	51(58.0)	26(29.5)	88(68.2)	
Status at birth					
Still birth	2(10.0)	13(65.0)	6(25.0)	21(15.6)	0.762
Live birth	16(14.8)	64(59.3)	28(25.9)	108(84.4)	
Neonatal complications					
Still birth fresh	(0)	1(100)	0(0)	1(0.8)	
Still birth macerated	2(10)	14(70)	4(20)	20(15.4)	0.853
Early neonatal death	1(16.7)	3(50)	2(33.3)	6(4.6)	
Hospital stays					
Within 24 hrs.	1(50)	0(0)	1(50)	2(2.3)	
≤3days	4(14.8)	21(77.8)	2(7.4)	27(31.0)	0.083
>3days	8(13.8)	34(58.6)	16(27.6)	58(66.7)	

* p-value <0.05

Almost half (45.4%) of the children born from mothers with pathological glucose intolerance had abnormal birth weights. One-fifth 20% of these children presented with a low Apgar score immediately after delivery, and 78% of them succumbed to death. The majority of these children, 66.7%, were admitted to hospital for more than 3 days.

Discussion

Neonates born to half of the hyperglycemic pregnant women had abnormal birth weight during delivery. One-fifth had a low Apgar score at 5th minutes, two-thirds stayed in the hospital for more than three days and about one-fifth succumbed death either during delivery or a few days after delivery.

Prior research has indicated that the prevalence of gestational diabetes mellitus tends to be higher in women aged 36 and older (20). A case control study in China reported odds of having gestational diabetes among women above 35 years to be 2.11 times higher comparing to those below 35 years (21). Advanced maternal age is regarded as a risk factor for hyperglycemia in pregnancy (22). Most literatures have documented the age above mid-30s, however there is no consensus on the cut off age. Our research indicates that pregnant women at MNH experienced hyperglycemia during pregnancy at an age lower than the typically observed age for the common occurrence of GDM.

Hyperglycemia in pregnancy is linked to the parity, two-thirds of the women in this study were multiparous. Other studies have as well documented similar findings (23,24). During normal pregnancy, adipose tissues on which insulin acts on become resistant as a result of release of hormones that oppose the effect of insulin on peripheral tissues. This exposes the woman to more weight retention in subsequent pregnancies, from which it is already known that high body mass index increases the risk for hyperglycemia during pregnancy which explains the higher prevalence of GDM among multiparous women (25–27).

Half of the neonates who had abnormal birth weight had macrosomia. This corresponds to the study done in Sweden by Nilsson that showed GDM pregnancies increase the chances of fetal macrosomia (17). Similar findings were also obtained from a study conducted in Uganda (28). However, it is contrary to some studies done in developed countries (29,30) which showed no relationship between gestational diabetes and birthweight. Low APGAR score at 5th minute was also observed in most of the newborns. Similar findings were also obtained in a study done in Zimbabwe (31) where the prevalence of low APGAR score was 24.8%. The contextual difference between developed and developing countries in terms of resources such as late diagnosis of GDM due to delay of the first antenatal clinic visit and poor nutritional compliance and adherence to medication may explain the difference. As macrosomia and low APGAR score are anticipated, women should be encouraged to deliver in health facilities for proper management of labor and newborns. These complications explain the reasons for longer hospital stay (more than 3 days) of the newborns which was also a significant finding of this study and another study in China (32)

Furthermore, a significantly higher prevalence of neonatal death was noted in this study; neonatal death accounted for 20.8% of the complication and it is twenty times higher compared to studies done in Saudi Arabia and India (33,34). Such a big difference might be due un-coordinated screening practices for GDM (35,36) in our locality which risks late initiation of required antenatal management. A discrepancy is seen between guidelines for diabetes in pregnancy, the 2018 antenatal care guideline recommends screening for

hyperglycemia in pregnancy to be done through urine (glycosuria) (37). This contradicts the standard national guideline which recommends blood sugar tests from 24th to 28th week for women with no risk factors (38). Late diagnosis and initiation of management contribute to poor outcome of the neonates. Also, good glycemic control is hardly achieved as seen in this study whereby the majority of the women were on insulin therapy which is a medical management considered after the failure of diet modification and use of metformin. The poor the control of hyperglycemia the higher the likelihood of having poor neonatal outcome including intrauterine fetal death and early neonatal death.

These study findings give an overview of the neonatal complications associated with diabetes among pregnant women at MNH. The results can be used for further large studies but cannot be generalized because it was a cross-sectional study and done at a tertiary hospital which receives complicated presentations of patients. However, these results are valid and give a highlight of a need for health care providers to be vigilant in detecting and caring for women with hyperglycemia during pregnancy, as their neonates suffer from multiple complications.

Limitation

The present study is subject to several limitations. Firstly, its retrospective nature inherently restricts our ability to establish causal relationships and draw definitive conclusions, as it relies on historical data. Secondly, the utilization of a convenient sampling method limits the external validity of our findings, as the results may not be readily generalizable to the broader population. Furthermore, the study's reliance on information extracted solely from patients' clinical files imposes constraints on our ability to explore additional potential risk factors and undocumented clinical features that may have influenced the outcomes of this study.

Conclusion

In conclusion, our research underscores a concerning reality: a significant prevalence of neonatal complications persists among mothers with glucose intolerance in our specific healthcare environment, even when adhering to established national and institutional guidelines for clinical practice. To mitigate this issue and enhance maternal and neonatal health outcomes, we emphasize two critical strategies. First, there is an urgent need for comprehensive community sensitization initiatives to promote early antenatal clinic visits among expectant mothers with glucose intolerance. Second, we must invest in strengthening our healthcare system's capacity to effectively manage these women throughout pregnancy, ensuring that they receive the necessary care and support to prevent adverse neonatal outcomes. By addressing these challenges proactively, we can strive towards a healthier future for both mothers and their newborns in our community.

Recommendation

We suggest conducting additional research to better understand the long-term complications faced by infants born to mothers with gestational diabetes mellitus (GDM). A prospective study that tracks women from the time of diagnosis, through treatment initiation, and after delivery will provide more comprehensive insights into outcomes based on the timing of treatment initiation.

Declarations

Ethics approval

Ethical clearance for the study was sought from the research and publication committee of MUHAS with a reference number of (DA.282/298/28K). Permission to conduct the study was sought from the dean of students at MUHAS. A waiver of consent was obtained by the ethical board; Permission was obtained from the Muhimbili National Hospital (MNH) to have access to patients' files (Ref. No.: MNH/TRCU/Perm/2021/124). Furthermore, confidentiality and privacy of patient`s information were observed. For confidentiality reasons, all files were registered in the study using only hospital registration numbers.

Conflict of interests

The authors declare no conflict of interest.

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Authors' contributions

ML and BL; conceptualized the study, study design and drafted the first manuscript. ML, LK, BL, GN, and AM; Data collection, statistical analyses, data interpretation, and writing this manuscript. AK; conceptualized the study, study design, overall supervision of the work and proof read the final draft of the manuscript.

Abbreviations

APGAR	Appearance, Pulse, and Grimace, Activity Respiration
GDM	Gestational Diabetic Mellitus
HESLB	Higher Education Students' Loan Board
MNH	Muhimbili National Hospital
MUHAS	Muhimbili University of Health and Allied Science
SPSS	Statistical Package for Social Sciences

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