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Research Article

IMPACT OF GESTATIONAL DIABETES MELLITUS ON HEMATOLOGICAL PARAMETERS, LIVER FUNCTION, RENAL FUNCTION, AND LIPID PROFILE IN ANTENATAL WOMEN AT A TERTIARY CARE HOSPITAL

VIJAYA DEVI SHANMUGAM[1], DANASEGARAN MURUGESAN[2], SHRUTHII NANJUNDAPPAN[3]*

[1]Department of Obstetrics and Gynaecology, Mount Zion Medical College, Pathanamthita, Kerala, India. [2]Department of Physiology, Vinayaka Mission's Medical College and Hospitals, Karaikal, Puducherry, India. [3]Department of Surgical Oncology, PSG Institute of Health Sciences and Research, Coimbatore, Tamil Nadu, India.
***Corresponding author: Dr. Shruthii Nanjundappan; Email: shruthiinanjundappan@gmail.com**

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ABSTRACT

Objective: Gestational diabetes mellitus (GDM) is a condition in which glucose intolerance is first recognized during pregnancy. It affects a substantial percentage of pregnancies globally, with a significant prevalence in India. Iron supplementation is often recommended to prevent anemia, but caution is advised in GDM due to the potential inflammatory effects. Elevated hemoglobin (Hb) levels, associated with excess iron, may increase the risk of GDM. This study aims to investigate the differences in Hb and various other blood parameters between controlled and uncontrolled GDM mothers attending antenatal OPD for a regular check-up.

Methods: This cross-sectional study was conducted among 100 women diagnosed with GDM at a tertiary care hospital in Western Tamil Nadu after obtaining ethical clearance and informed consent from the participants. Routine blood investigations, like a complete hemogram, HbA1C, renal and liver function tests, and lipid profiles, were recorded. Participants were categorized based on HbA1C values (<6.5 as normal, >6.5 as abnormal). Differences in blood parameters between the two groups were statistically analyzed.

Results: The study found no significant differences in age, weight, height, or BMI between the controlled and uncontrolled GDM groups. Mean HbA1c levels were 5.58±0.41 and 6.98±1.23 in controlled and uncontrolled GDM groups, respectively. Comparing hematological parameters, the controlled GDM group exhibited higher mean red blood cell (RBC) levels (4.6±0.69 vs. 4.12±0.92) but lower Hb levels (12.25±2.26 vs. 11.01±3.59) than the uncontrolled GDM group. There were no significant differences in platelet, lymphocyte, and MCH levels. Urea, triglycerides, and globulin levels were higher in the uncontrolled GDM group, but all values remained within normal limits.

Conclusion: Elevated Hb levels were associated with uncontrolled GDM, indicating a potential risk factor. The study underscores the importance of monitoring iron levels in GDM patients. In addition, heightened white blood cell counts and altered hematological parameters suggest an inflammatory component in uncontrolled GDM. Further research is warranted to explore these associations and their clinical implications for managing GDM effectively.

Keywords: Gestational diabetes mellitus, Anemia, Glycemic control.

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INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as the glucose intolerance with onset or first recognition during gestation or pregnancy [1]. Gestational diabetes affects approximately 5–7% of pregnancies [2-4]. Annually, five million women are affected each year in India [5]. The role of iron in pregnancy is phenomenal, as it contributes to cellular functions for fetus development [6]. Iron is considered a two-edged sword since both iron shortage and iron excess may be detrimental [7].

The prevalence of anemia in pregnancy varies widely, ranging from 20% to 80%. The World Health Organization (WHO) defines anemia in pregnant women as having a hemoglobin (Hb) level <110 g/L. Complications of anemia during pregnancy include premature labor, susceptibility to infections, intrauterine growth restriction, and low birth weight. To prevent anemia, even when Hb levels are within the normal range, pregnant women are often advised to take iron supplements. The WHO recommends a daily intake of 30–60 mg of elemental iron during pregnancy to ensure adequate iron reserves for both the mother and the fetus.

Interestingly, iron supplementation has been associated with an increase in lipid peroxidation, potentially due to its activation of inflammatory processes. Therefore, some researchers suggest that women with GDM should exercise caution with regular iron supplementation. GDM is thought to be linked with elevated levels of serum C-reactive protein, which may indicate an inflammatory component. Previous studies have indicated that an excess of iron can heighten inflammation by promoting the production of free radicals through oxidative mechanisms.

Moreover, an increased Hb level has been correlated with an elevated risk of developing GDM, likely due to the oxidative damage induced by excessive iron. In cases of gestational diabetes, higher concentrations of blood ferritin have also been correlated with insulin resistance worldwide [6-9]. However, in India, high maternal Hb levels have not been definitively identified as a predisposing agent for GDM. Consequently, this study aims to investigate whether elevated Hb levels are indeed a causative factor for GDM when compared to normal Hb levels among women receiving antenatal care at a tertiary care medical college and hospital. The study also seeks to assess the differences in blood parameters between controlled and uncontrolled GDM mothers.

METHODS

This cross-sectional study was conducted among 100 gestational diabetic women who have attended the OG outpatient department of

a tertiary care hospital in Western Tamil Nadu after obtaining IHEC approval and written consent from the participants. The rights of the participant, the need for the study, and other ethical issues were explained clearly to them. The patient information sheet was given to them, and adequate time was given to understand the contents. Routine blood investigations, including CBC, HbA1C, lipid profile, liver function test, renal function test, serum ferritin, and total iron binding capacity were done. The study population was divided into two groups, with HbA1C values [10] <6.5 as normal and >6.5 as abnormal. The difference in blood parameters measured was compared between the two groups. A student-independent T-test was utilized to measure the association between the two groups. $p<0.05$ was considered significant.

RESULTS

The antenatal mothers with GDM were divided into two groups: those who had controlled blood levels and those with uncontrolled blood sugar levels. We observed no significant difference between the two groups with the age (26.13 vs. 26.2), weight (61.92 vs. 63.75), height (155.73 vs. 154.28), and BMI (25.6 vs. 26.7), and the mean HbA1c was 5.58±0.41 in the controlled GDM group compared to 6.98±1.23 in the uncontrolled GDM group (Table 1).

The hematological parameters between both groups were compared. The mean RBC level of the controlled GDM group was found to be higher than that of the uncontrolled group (4.6±0.69 vs. 4.12±0.92). Similarly, the mean Hb value of controlled GDM was significantly less than that of uncontrolled GDM (12.25±2.26 vs. 11.01±3.59) (Fig. 1). The mean white blood cell (WBC) count was significantly higher in the uncontrolled GDM group (8800±1123 vs. 9623±1098. The mean neutrophil levels (64.98±6.98 vs. 69.23±7.13) were significantly higher in the uncontrolled GDM group. Similarly, MCHC (33.15±3.65 vs. 28.65±4.89) was significantly less in the uncontrolled GDM group. There was no significant change in platelet (3.01±0.55 vs. 2.89±0.48), lymphocyte (28.23±5.13 vs. 29.51±4.93), or MCH (26.57±3.19 vs. 25.11 vs. 4.38) levels (Table 2).

The mean values of renal, lipid profiles, and liver function tests were studied. The mean urea levels were significantly different between both groups (24.95 vs. 20.77). Similar results were found with triglycerides (149.87 vs. 114.65) and globulin (2.93 vs. 2.59). But all the values were very well within the normal limits (Table 3).

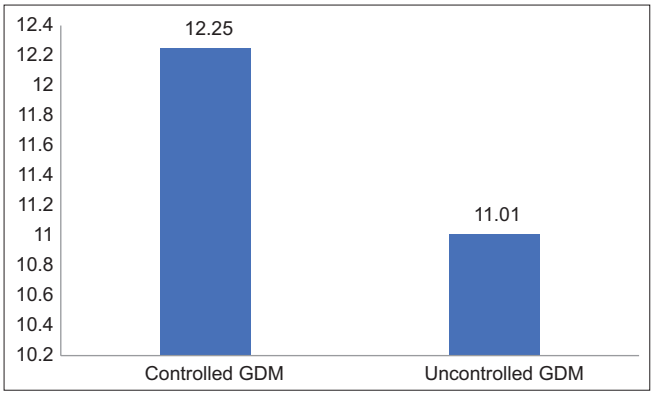

Fig. 1: Mean hemoglobin levels between controlled and uncontrolled diabetes mellitus

DISCUSSION

This cross-sectional study was done among 100 GDM mothers attending obstetric OPD in a tertiary care center. The antenatal mothers with GDM were divided into two groups: those who had controlled and uncontrolled blood sugar levels. 75 mothers had good glycemic control, while the rest 25 did not have adequate control. Differences in blood parameters were measured between both groups.

We observed no significant difference between the two groups with respect to height, weight, or BMI, signifying that both groups are comparable to each other. Similar results were observed in a study done by Rajab *et al*. [11].

The RBC, WBC, and neutrophil levels were significantly higher among GDM mothers in our study population, while Hb and MCHC were significantly lower in GDM mothers. Urea, TGL, and globulin were higher in GDM but within normal limits. No difference in platelet, lymphocytes, or MCH was noted.

Benny *et al*. [9] observed in their study on Hb parameters that the Hb levels were significantly higher in GDM mothers. Rajab *et al*. [11] and Hassan *et al*. [12] concluded in their study that GDM doesn't influence any blood indices. Kavya *et al*. [13] observed in Tamil Nadu that diabetes increases the WBC and platelet values. Lyu *et al*. [14] observed in their study in China that GDM influences blood parameters. RBC, neutrophils and WBC levels increased in GDM.

Vural *et al*. in their study, done in turkey, observed that participants with GDM showed notable elevations in platelet count, WBC count, neutrophil count, lymphocyte count, red cell distribution width, and mean platelet volume compared to the control group. It is noted that there were no significant disparities between the groups in terms of neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio levels. When employing binary logistic regression analysis, they determined that during the first trimester, mean platelet volume and red cell distribution width values were independently linked to the diagnosis of GDM [15].

Hope *et al*. [16] observed in their study that hb, PCV, platelets, WBC, and neutrophils were significantly increased in mothers with GDM. Zhang *et al*. [17] observed that neutrophils, lymphocytes, and monocytes increased in the second trimester but decreased in the third trimester. Thrombocrit was normal in the second trimester but elevated in the third trimester. RBC was continuously increased in the second and third trimesters.

Research findings indicate that subclinical inflammation may contribute to insulin resistance by negatively impacting β cell function and directly affecting insulin signaling [18]. This could potentially elucidate why conventional markers of inflammation, such as NLR and WBC count, are concurrently elevated in early pregnancy among women with GDM. Moreover, diabetes has been associated with platelet aggregation and the presence of glycated platelets, which are linked to a state of both acute and chronic inflammation sharing a similar cytokine environment as that implicated in the increased WBC count [19]. In terms of surrogate

Table 1: Comparison of mean demographic parameters between controlled and uncontrolled GDM subjects

Parameters	Controlled GDM		Uncontrolled GDM		MD	t-value	p-value
	M	SD	M	SD			
Age	26.13	4.75	26.20	5.36	0.067	−0.059	0.953
Weight	61.92	10.96	63.75	12.91	1.824	−0.688	0.493
Height	155.73	5.83	154.28	6.97	1.453	1.025	0.308
BMI	25.62	4.88	26.79	5.22	1.172	−1.022	0.309
HbA1c	5.58	0.41	6.98	1.23	1.4	−8.595	<0.001

GDM: Gestational diabetes mellitus

Table 2: Comparison of mean hematological parameters between controlled and uncontrolled GDM subjects

Parameter	Controlled GDM		Uncontrolled GDM		Mean Difference	t-value	p-value
	Mean	SD	Mean	SD			
RBC	4.6	0.69	4.12	0.92	0.48	2.76	0.007
Hb (g/dL)	12.25	2.26	11.01	3.59	1.24	2.028	0.045
WBC	8800	1123	9623	1098	823	-3.191	0.002
Platelet	3.01	0.55	2.89	0.48	0.12	0.974	0.333
Lymphocyte	28.23	5.13	29.51	4.93	1.28	-1.091	0.278
Neutrophil	64.98	6.98	69.23	7.13	4.25	2.594	0.011
MCV	78.29	5.29	71.14	8.95	7.15	4.85	<0.001
MCHC	33.15	3.65	28.65	4.89	4.5	4.884	<0.001
MCH	26.57	3.19	25.11	4.38	1.46	1.797	0.75
S. Ferritin	95.2	12.1	88.2	11.6	7.010	2.588	0.013
TIBC	312.21	22.71	306.05	23.53	6.16	1.165	0.247

GDM: Gestational diabetes mellitus

Table 3: Comparison of mean renal, lipid profiles and LFT parameters between controlled and uncontrolled GDM subjects

Parameters	Normal		Abnormal		MD	t-value	p-value
	M	SD	M	SD			
URIC ACID	5.20	1.29	5.46	2.78	0.260	−0.633	0.528
UREA	24.95	8.99	20.77	8.80	4.180	2.022	0.046
CREATINE	0.73	0.21	0.71	0.19	0.022	0.453	0.651
Total Cholesterol	153.24	47.92	134.60	50.64	18.64	1.661	0.100
LDL	95.86	34.73	89.56	42.47	6.305	0.742	0.460
TGL	149.87	79.28	114.65	58.99	35.221	2.038	0.044
HDL	42.36	19.86	44.23	22.54	1.867	−0.393	0.695
SGOT	21.31	10.53	21.62	9.92	0.304	−0.127	0.899
SGPT	21.92	14.12	18.09	12.51	3.837	1.208	0.230
ALBUMIN	4.37	0.53	4.11	0.62	0.253	1.956	0.053
GLOBULIN	2.93	0.70	2.59	0.36	0.340	2.293	0.024

markers for dietary improvement, higher levels of RBC and Hb are often accompanied by increased blood viscosity, a factor demonstrated to be associated with insulin resistance [20].

In addition to thromboembolic disorders, platelet indices are linked to inflammation and the level of disease activity in inflammatory conditions. The most prevalent alteration in platelet behavior observed in diabetes is heightened platelet aggregation, a phenomenon reported in patients with both type 1 and type 2 diabetes mellitus. Elevated glycation of platelet proteins in diabetic patients may lead to increased platelet activity [21-23].

Rahnemaei *et al.* [24] observed in their study that GDM increases lipid levels. In our study, we observed that the triglycerides were higher in uncontrolled GDM compared to controlled GDM, while all other parameters were normal. Khan *et al.* [25] observed that GDM affects creatinine levels and not urea. In our study, renal function and liver function tests were normal among both groups.

CONCLUSION

This study contributes valuable insights into the hematological and biochemical aspects of GDM, furthering our understanding of its underlying mechanisms and potential implications for clinical management. It is also worth noting that subclinical inflammation may play a role in insulin resistance among GDM mothers, potentially impacting β cell function and insulin signaling. Additionally, heightened platelet aggregation, often seen in diabetes, may be attributed to increased glycation of platelet proteins. However, continued research in this area is warranted to deepen our knowledge and refine treatment strategies for individuals with GDM.

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