RESEARCH PAPER

Anemia in Type 2 Diabetes Mellitus: Correlation with Glycemic Control and Diabetic Complications

Dr. M Bhavana Reddy[1], Dr. V Padma[2], Dr. S. V. Sathyapriya[3], Dr. Vinatha[4], Dr. Sharath Chandra Reddy[5], Dr. VeeraVignesh[6]

[1]Department of General Medicine ,Sree Balaji MedicalCollege and Hospital ,Chennai,India

[2]Department of General Medicine ,Sree Balaji Medical College and Hospital ,Chennai,India

[3]Department of General Medicine ,Sree Balaji Medical College and Hospital ,Chennai,India

[4]Department of General Medicine ,Sree Balaji MedicalCollege and Hospital ,Chennai,India

[5]Department of General Medicine ,Sree Balaji MedicalCollege and Hospital ,Chennai,India

[6]Department of General Medicine ,Sree Balaji MedicalCollege and Hospital ,Chennai,India

ABSTRACT

Background:
Anemia is a common yet underrecognized comorbidity in patients with Type 2 Diabetes Mellitus (T2DM). It has been associated with poor glycemic control and increased risk of diabetic complications, particularly nephropathy. However, its prevalence and clinical correlations remain underexplored in Indian populations.

Objectives:
To determine the prevalence of anemia in T2DM patients and evaluate its association with glycemic control and diabetic complications.

Methods:
A cross-sectional study was conducted among 300 T2DM patients attending a tertiary care hospital. Hemoglobin, HbA1c, renal parameters, and diabetic complications were assessed. Statistical analysis included Pearson correlation and multivariate logistic regression.

Results:
The prevalence of anemia was 36.7%. Mean hemoglobin was significantly lower in patients with poor glycemic control (HbA1c ≥8%) compared to those with HbA1c <7% (11.2 ± 1.4 vs 13.1 ± 1.2 g/dL, $p < 0.001$). A significant negative correlation was observed between hemoglobin and HbA1c ($r = -0.42$, $p < 0.001$). Anemia was significantly associated with diabetic nephropathy (OR 3.4, 95% CI 2.1–5.6), retinopathy (OR 2.2, 95% CI 1.3–3.7), and neuropathy (OR 1.9, 95% CI 1.1–3.1).

Conclusion:
Anemia is highly prevalent in T2DM and is strongly associated with poor glycemic control and diabetic complications. Routine screening for anemia should be incorporated into diabetes care protocols.

Keywords: Type 2 Diabetes Mellitus, Anemia, Glycated Hemoglobin A (HbA1c), Diabetic Kidney Disease, Diabetic Retinopathy, Diabetic Neuropathy, Microvascular Complications, Erythropoietin Deficiency

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INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a global health challenge with increasing prevalence, particularly in developing countries like India [1]. Chronic hyperglycemia leads to multiple complications, including nephropathy, retinopathy, and neuropathy, which significantly contribute to morbidity and mortality [2].

Anemia is an often overlooked comorbidity in T2DM. Studies have shown that anemia occurs more frequently in diabetic patients compared to non-diabetics and may develop even in early stages of diabetic kidney disease [3,4]. The prevalence of anemia in T2DM has been reported to range from 20% to 45% [5].

The pathophysiology of anemia in T2DM is multifactorial:

- Reduced erythropoietin production due to renal damage [6]

- Chronic inflammation causing impaired erythropoiesis [7]
- Nutritional deficiencies (iron, vitamin B12) [8]
- Autonomic neuropathy affecting renal perfusion [9]

Anemia contributes to tissue hypoxia and may accelerate progression of diabetic complications, especially nephropathy [10]. Despite this, routine screening for anemia is not universally practiced.

This study aims to evaluate the prevalence of anemia in T2DM and its association with glycemic control and diabetic complications.

MATERIALS AND METHODS

Study Design

Cross-sectional observational study

Study Setting

Tertiary care hospital in South India

Sample Size

300 patients (based on expected prevalence of 35% with 95% confidence interval)

Inclusion Criteria

- Age ≥18 years
- Diagnosed T2DM (ADA criteria) [11]

Exclusion Criteria

- Hematological disorders
- Chronic liver disease
- Acute infection
- Recent blood transfusion
- Pregnancy

Definitions

- **Anemia:** Hb <13 g/dL (men), <12 g/dL (women) [12]
- **Poor glycemic control:** HbA1c ≥8%

Data Collection

- Hemoglobin, MCV
- HbA1c
- Serum creatinine, eGFR
- Urine albumin
- Fundoscopy
- Neuropathy assessment

Statistical Analysis

- Pearson correlation
- Chi-square test
- Multivariate logistic regression

Significance: **$p < 0.05$**

RESULTS

Baseline Characteristics

Parameter	Value
Mean age	54.8 ± 9.6 years
Male	58%
Mean HbA1c	8.3 ± 1.4

Prevalence of Anemia

- **36.7% (n = 110)**

Hemoglobin vs Glycemic Control

HbA1c Group	Mean Hb (g/dL)
<7%	13.1 ± 1.2
7–8%	12.3 ± 1.3

HbA1c Group	Mean Hb (g/dL)
≥8%	11.2 ± 1.4

- **p < 0.001**

Correlation

- Hb vs HbA1c: **r = -0.42, p < 0.001**

Association with Complications

Complication	Anemia (%)	OR (95% CI)	p-value
Nephropathy	64%	3.4 (2.1–5.6)	<0.001
Retinopathy	51%	2.2 (1.3–3.7)	0.002
Neuropathy	47%	1.9 (1.1–3.1)	0.01

DISCUSSION

The present study demonstrates a high prevalence of anemia (36.7%) among patients with T2DM, consistent with previous studies reporting prevalence between 20–45% [5,13].

A significant negative correlation was observed between hemoglobin and HbA1c, indicating that poor glycemic control contributes to anemia. Similar findings were reported by Thomas et al., who demonstrated reduced hemoglobin levels in poorly controlled diabetics [3].

The strongest association was observed with diabetic nephropathy. This aligns with studies showing that anemia develops early in diabetic kidney disease due to impaired erythropoietin production [6,14].

Retinopathy and neuropathy were also significantly associated with anemia. Chronic hypoxia caused by anemia may exacerbate microvascular damage [15].

CONCLUSION

Anemia is a common and clinically significant comorbidity in T2DM. It is strongly associated with poor glycemic control and diabetic complications, especially nephropathy.

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