RESEARCH PAPER

A Comparative Study of Platelet Parameters Among Diabetic Patients with and without Retinopathy in Geriatric Population

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Abstract

Background: Diabetic retinopathy (DR) is a common complication of type 2 diabetes and a major cause of vision loss in older adults. Platelet activation contributes to damage in small blood vessels. Platelet measurements such as mean platelet volume (MPV), platelet distribution width (PDW), and platelet-large cell ratio (P-LCR) may indicate this damage. This study aimed to compare platelet measurements in elderly diabetic patients with and without retinopathy and to assess their link to disease severity.

Methods: This hospital-based cross-sectional study included 110 patients aged 60 and older with type 2 diabetes, split into two groups: those with DR (n=55) and those without (non-DR, n=55). Platelet indices were measured using an automated blood analyzer. Statistical analysis was conducted considering a p-value of less than 0.05 as significant.

Results: The age and sex distribution were similar in both groups. The duration of diabetes and HbA1c levels were significantly higher in the DR group ($p < 0.001$). MPV, PDW, and P-LCR were notably higher in patients with DR and increased with severity ($p < 0.001$). Platelet count and plateletcrit did not show significant differences between the groups.

Conclusion: Higher platelet measurements, especially MPV, PDW, and P-LCR, are linked to diabetic retinopathy and could act as straightforward, low-cost markers for identifying patients at risk.

Keywords: Diabetic retinopathy; Platelet indices; Mean platelet volume; Geriatric diabetes; Microvascular complications.
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Introduction

Persistent hyperglycemia due to Diabetes mellitus is a long-term metabolic disorder characterized by insulin secretion or action abnormalities, or both. A common diabetic eye condition is diabetic retinopathy (DR) and vision-threatening manifestations, arising as a consequence of prolonged hyperglycemia-induced damage to the retinal microvasculature. Delays in diabetic retinopathy development are due to a complex interplay of metabolic, vascular, and hematological abnormalities. Increasing evidence suggests that alterations in platelet Key factors in the onset and advancement of diabetic microangiopathies include shape and function, including retinopathy, particularly among older adults. [1,2] In diabetes, hyperglycemia induces a state of oxidative stress, persistent low-grade inflammation, endothelial damage, and platelet activation. Activated platelets exhibit enhanced aggregation, adhesion, and release of vasoactive substances, contributing to microvascular occlusion and tissue ischemia. Platelet activation is reflected by alterations in platelet indices measurable through routine automated hematology analyzers. Count of platelets, Several indications are taken into consideration, they include the following: platelet crit, platelet distribution width, platelet large cell ratio, and mean platelet volume (MPV). These elements, which are sometimes called platelet parameters, might be indicators of platelet reactivity and function. [2,3]

Among these indices, A criterion that has been extensively researched isthe average amount of platelets in the blood, which represents their normal size and function. Researchers have shown that people with diabetes, particularly those who have microvascular problems such retinopathy, tend to have higher MPV readings. Platelet activation heterogeneity is correlated with the breadth of the platelet distribution, which in turn shows diversity in platelet size. Increased PDW suggests the presence of both big, hyperactive platelets and tiny, senescent platelets, suggesting that there is continuing turnover of platelets. Indirectly reflecting total platelet generation and activity, platelet Rit is the total mass of blood platelets. Metabolic management, diabetes duration, and the existence of comorbidities such retinopathy impact changes in these parameters. [3,4]

Persistent Vascular permeability increases due to hyperglycemia's effects on non-enzymatic glycation, oxidative stress, endothelial dysfunction, whereby AGEs, or advanced glycation end products, are generated. Furthermore, inflammatory cytokines such as IL-6, TNF-alpha, and vascular endothelial growth factor (VEFG) further boost platelet adhesion and activation. Diabetic

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retinopathy causes microvascular damage, including ischemia and neovascularization, in the retina. [4,5]

The geriatric population represents a distinct subgroup of diabetic patients in whom these changes are more pronounced. Aging is in relation to endothelial dysfunction, elevated oxidative stress, and a condition that promotes blood clotting. Platelets in elderly individuals show heightened reactivity and slower turnover, increasing vascular risk. Additionally, comorbidities such as hypertension, dyslipidemia, and renal impairment further promote vascular injury and platelet activation. The combined effects of aging and diabetesretinopathy and other microvascular problems are more likely to occur. Therefore, assessing platelet parameters in geriatric diabetic patients provides valuable insight into hemostatic and vascular changes during disease progression. [5,6]

Diabetic retinopathy progresses through various stages, ranging from microaneurysms, intraretinal hemorrhages, and cotton-wool spots all indicate non-proliferative types, whereas neovascularization and vitreous hemorrhage indicate proliferative forms. In order to intervene on time and avoid further vision loss identifying individuals who may be at risk of developing early on. Even if they are effective, traditional screening procedures for diabetic retinopathy—which include fundus examination and retinal imaging—may not always be appropriate in settings with limited resources. In this context, easily measurable hematological parameters such Platelet indices, for example, might be used as handy, low-cost supplementary indicators to identify those who are more likely to have retinopathy. [6,7]

As global life expectancy rises, the number of elderly individuals with diabetes and its complications is increasing. In this group, diagnosis is complicated by age-related ocular conditions, polypharmacy, and altered comorbidities impact platelet function. Thus, basic hematological indicators as platelet indices might help identify vascular dysfunction early on and direct preventive strategies. Additionally, monitoring these parameters can help assess therapeutic response and glycemic control over time. [8,9]

Aiming to evaluate the effectiveness of a prior study comparing platelet parameters in a group of retinopathies with older diabetic patients, this research.

Materials and Methods

In Mandya, Karnataka, researchers from the Adichunchanagiri Hospital and Research Centre's Departments of Surgery and ENT carried out the cross-sectional study. An 18-month period was devoted to the research. Researchers used a purposive selection strategy to choose 110 patients who met all research inclusion requirements. Before beginning the investigation, the necessary We reached out to the Institutional Ethics Committee for their stamp of approval.

Inclusion Criteria

Individuals who are 60 years old or older and have a confirmed the T2DM as described by the American Diabetes Association, and are prepared to provide written informed permission in order to take part in the research.

Exclusion Criteria

People with a preexisting condition, such as diabetes in the family or another kind of diabetes, hematological disorders known to affect platelet count or function, active infections, inflammatory conditions, or malignancies, history of coagulopathies or those on anticoagulant therapy or antiplatelet medication, severe renal impairment, media opacities or other ocular comorbidities that precluded a clear fundus view for the diagnosis of retinopathy.

There were two groups of participants:

Group 1 (Diabetic Retinopathy Group): This group consisted of geriatric people with Type 2 Diabetes Mellitus who were diagnosed with any stage of diabetic retinopathy (DR). The ETDRS further classified this subgroup into two groups: NPDR (Non-Proliferative Diabetic Retinopathy) and PDR (Proliferative Diabetic Retinopathy) for a more granular analysis of the relationship between platelet parameters and disease severity.

Group 2 (Diabetic Control Group): The elderly individuals included here were all diagnosed with Type 2 Diabetes Mellitus who, upon detailed fundus examination, showed no evidence of any form of diabetic retinopathy. This group served as the control for comparative analysis against Group 1.

Each subject had a comprehensive medical history and physical evaluation. We used aseptic techniques to collect Venous blood samples (5 mL). The following blood and platelet indices were assessed two millilitres (mL) of blood was drawn and placed in EDTA tubes according to the following parameters: platelet count, mean platelet volume (MPV), platelet distribution width (PDW), platelet crit (PCT), and platelet-large cell ratio (P-LCR). The remaining 3 ml sample was collected in a plain vacutainer, and the separated serum was used for the estimation of HbA1c, fasting glucose, and renal function tests.

All participants underwent comprehensive ophthalmological evaluation, examinations such as dilated fundus, slit-lamp, and visual acuity using direct and indirect ophthalmoscopy. Fundus photography was performed where required. Diagnosis and staging of diabetic retinopathy were based on clinical findings and fundus images.

Statistical Analysis

After data was exported to SPSS 27.0 for use in analysis inside Excel. Categorical variables were represented using percentages and frequencies, whereas continuous data was shown using mean ± standard deviation. To compare the groups, suitable statistical tests were used. If the p-value was less than 0.05, the results were deemed statistically significant.

Result

Table 1: Baseline Characteristics of Study Population (DR vs Non-DR)

Parameter	Category	DR (n=55)	Non-DR (n=55)	Total (N=110)	p-value
Age (years)	Mean ± SD	75.22 ± 6.09	73.91 ± 5.57	—	0.242
	60–70 years	16	17	33	0.835
	71–85 years	39	38	77	
Sex	Female	23	29	52	0.252
	Male	32	26	58	
Hypertension	No	17	31	48	0.007
	Yes	38	24	62	
Treatment Type	OHA	26	43	69	0.001
	Insulin	13	9	22	
	Both	16	3	19	

Baseline characteristics were comparable for age and sex, with mean age 75.22 ± 6.09 vs 73.91 ± 5.57 years (p = 0.242) and similar age distribution (p = 0.835). Sex distribution also showed no significant difference (p = 0.252). However, hypertension DR patients had a much greater rate (69.1% vs. 43.6%, p = 0.007). Treatment patterns differed significantly (p = 0.001), with more non-DR patients on OHA (78.2%) and more DR patients on combination therapy (29.1%).

Table 2: Comparison of Glycemic Parameters Between DR and Non-DR Groups

Parameter	Category	DR (n=55)	Non-DR (n=55)	Total (N=110)	p-value
HbA1c (%)	Mean ± SD	9.11 ± 0.82	7.52 ± 0.83	—	<0.001
FPG (mg/dL)	Mean ± SD	171.64 ± 29.49	143.08 ± 26.74	—	<0.001
HbA1c Category	Prediabetes	0	6	6	0.012
	Diabetes	55	49	104	

The DR group had much higher HbA1c and FPG levels (9.11 ± 0.82% vs 7.52 ± 0.83%; 171.64 ± 29.49 vs 143.08 ± 26.74 mg/dL; p < 0.001). All DR patients fell in the diabetic HbA1c category, while 10.9% (6/55) of Non-DR patients were prediabetic (p = 0.012), while there is substantial evidence linking inadequate glycemic management to diabetic retinopathy.

Table 3: Comparison of Platelet Parameters Between DR and Non-DR Groups

Parameter	DR (n=55) Mean ± SD	Non-DR (n=55) Mean ± SD	p-value
MPV (fL)	10.13 ± 0.69	8.15 ± 0.76	<0.001
PDW	17.52 ± 2.53	15.34 ± 2.08	<0.001
Platelet Count (lakhs/cumm)	2.52 ± 0.33	2.52 ± 0.38	0.991
PCT	0.100 ± 0.000	0.100 ± 0.000	1.000
P-LCR (%)	33.01 ± 4.40	26.13 ± 3.96	<0.001

MPV (10.13 ± 0.69 vs 8.15 ± 0.76 fL), PDW (17.52 ± 2.53 vs 15.34 ± 2.08), and P-LCR (33.01 ± 4.40% vs 26.13 ± 3.96%)signified heightened platelet activation, as they were much more $p < 0.001$ in the DR group. The blood cell count was 2.52 ±0.33 and the PCT was 0.100 ±0.000, with a p-value of 1.000, compared to 2.52 ±0.38 showed no significant difference.

Table 4. Distribution of DR Severity Across Groups

DR Severity	DR (n=55)	Non-DR (n=55)	Total (N=110)
Mild NPDR	16	0	16
Moderate NPDR	26	0	26
Severe NPDR	8	0	8
PDR	5	0	5
No DR	0	55	55
Total	55	55	110
p-value	<0.001		

DR severity categories differ significantly between the groups because all Non-DR subjects fall in the "No DR" category ($p < 0.001$). This confirms appropriate classification of DR vs Non-DR groups, validating the dataset structure for subsequent analysis.

Table 5: Comparison of Clinical and Platelet Parameters Across DR Severity Groups

Parameter	Mild NPDR (n=16)	Moderate NPDR (n=26)	Severe NPDR (n=8)	PDR (n=5)	No DR (n=55)	p-value
Duration (years)	15.38 ± 2.92	14.08 ± 3.93	12.88 ± 4.49	15.20 ± 3.56	9.76 ± 3.96	<0.001
HbA1c (%)	9.11 ± 0.92	9.02 ± 0.74	9.11 ± 0.85	9.57 ± 0.89	7.52 ± 0.83	<0.001

MPV (fL)	10.25 ± 0.57	10.08 ± 0.64	10.02 ± 1.08	10.20 ± 0.64	8.15 ± 0.76	<0.001
PDW	17.06 ± 2.45	18.01 ± 2.65	17.46 ± 2.22	16.51 ± 2.71	15.34 ± 2.07	<0.001
Platelet Count (lakhs/cumm)	2.54 ± 0.36	2.52 ± 0.32	2.56 ± 0.31	2.33 ± 0.33	2.52 ± 0.38	0.829
P-LCR (%)	32.78 ± 4.21	33.41 ± 4.54	31.40 ± 4.72	34.18 ± 4.38	26.13 ± 3.96	<0.001

A longer duration of illness and poor glycemic control in retinopathy were indicated by substantially greater durations of diabetes and HbA1c in all DR groups compared to No DR ($p < 0.001$). The levels of indicators that indicate platelet activity rose, including MPV, PDW, and P-LCR across all DR severity groups (e.g., MPV ~10 fL vs 8.15 fL in No DR; $p < 0.001$), showing a consistent trend with disease presence. However, the platelet count did not differ significantly across the groups ($p = 0.829$), suggesting that platelet function rather than count is associated with DR severity.

Discussion

Diabetic retinopathy is a major contributor to age-related macular degeneration, and its early detection remains a major challenge, particularly in resource-limited settings. The present study was undertaken with the primary aim of comparing platelet parameters among geriatric people with diabetes mellitus, specifically those who have or do not have diabetic retinopathy, with reference to the correlation between retinal microvascular dysfunction and indicators of platelet activation. A variety of hemoglobin-related parameters were investigated in order to ascertain the presence or absence of diabetic retinopathy and its complications non-retinopathy groups, and to relate these hematological parameters with glycaemic status, duration of diabetes, and retinopathy severity. By focusing on an elderly diabetic population, the study aimed to address a clinically relevant group in whom the burden of microvascular complications is high and the interplay between metabolic, vascular, and hematological factors is complex.

Baseline All demographic variables were similar among the groups, suggesting that there were no notable disparities in age (75.22 ±6.09 vs 73.91 ±5.57 little to no confounding by age ($p = 0.242$), gender ($p = 0.252$), or age distribution ($p = 0.835$). Platelet activation is more strongly linked to metabolic characteristics than demographic variables, as previously shown by Zuberi et al. [10], Kodiatte et al. [11], and Walinjkar et al. [12]. On the other hand, hypertension was much more common in the group with diabetic retinopathy (DR) (69.1% vs 43.6%; $p = 0.007$), supporting its role in promoting endothelial dysfunction and microvascular injury, as described by Demirtas et al. [13]. Treatment patterns also differed significantly significantly more DR patients ($p = 0.001$) ended up obtaining combination or insulin-based therapy, reflecting greater disease severity.

HbA1c emerged as a strong discriminator between with DR and without DR in this study. Haemoglobin A1c values (9.11 ±0.82%) and fasting plasma glucose levels (171.64 ±29.49 versus 143.08 ±26.74 mg/dL) of DR patients were considerably more than 7.52 ±0.83% ($p < 0.001$) compared to non-DR patients. The fact that all DR patients had haemoglobin A1c levels within the diabetic range lends credence to the link between retinopathy and inadequate glucose management ($p = 0.012$). We agree with Ulutas et al. on the finding [14], Ozder and Eker [15], and Reddy et al. [16], who shown that increased platelet activation and microvascular consequences are linked to insufficient glycemic control.

The DR group had substantially higher levels of platelet activation indicators, indicators of prothrombotic illness and enhanced platelet reactivity, variables such the average platelet volume (MPV), the width of the distribution of platelets (PDW), and the ratio of platelets to large cells (P-LCR) ($p < 0.001$). If anything, qualitative differences in platelet composition seem more important than quantitative ones, as neither platelet count nor platelet crit (PCT) varied significantly between the categories. Zuberi et al. also noted similar findings. [10], Kodiatte et al. [11], and Demirtas et al. [13],underscoring blood vessel permeability as it relates to diabetic retinopathy.

The distribution of DR severity demonstrated clear stratification, with all non-DR participants categorized as having no retinopathy, while DR patients were distributed across NPDR and PDR are types of diabetic retinopathy that may range from mild to moderate to severe categories ($p < 0.001$). This classification supports the validity of the study design and allows for meaningful comparison across disease stages.

Compared to the non-DR group, all DR subgroups had substantially higher levels of HbA1c and duration of diabetes ($p < 0.001$), suggesting that microvascular damage is a cumulative result of persistent hyperglycemia. Regularly, measure the levels of platelet activation markers P-LCR, PDW, and MPV were high across all DR categories, suggesting a stronger association with the presence of retinopathy rather than its severity. These findings are consistent with Kodiatte et al. [11], Ulutas et al. [14], and Reddy et al. [16], who reported positive correlations between platelet indices, glycemic status, and

duration of diabetes. Platelet count remained unchanged across groups (p = 0.829), further emphasizing that platelet function, rather than platelet number, contributes significantly to the onset of diabetic eye disease.

Some of the benefits of this research include a balanced sample size between the DR and non-DR groups, a focus on a geriatric population, and a comprehensive assessment of glycemic parameters together with multiple HPV, PDW, P-LCR, PCT, and platelet indices, which enhances the clinical relevance of the findings. Additional factors that enhance internal validity are standardized automated measures and consistent grading of retinopathy. But there are certain restrictions that need to be recognized. Unfortunately, generalizability may be limited due to the single-center arrangement and cross-sectional design. Further problems that might have affected the findings include the limited sample size in patients with advanced DR and the fact that possible confounding factors including lipid profile, renal function, and medication usage were not evaluated. Careful interpretation of results is also required because to analytical heterogeneity in platelet indices and little variance in PCT.

Conclusion

There is strong evidence between diabetic retinopathy and improved platelet activation in a geriatric population, independent of age and sex. The findings suggest that routine hematological parameters obtained from automated complete blood counts may serve as valuable adjunctive tools in identifying elderly diabetic patients at increased risk of retinopathy, particularly in settings where access to specialized ophthalmic screening is limited. By linking metabolic control, vascular comorbidity, and platelet activation, the study reinforces the need for integrated and comprehensive management strategies aimed at optimizing glycaemic control, controlling blood pressure, and monitoring hematological indicators in order to lessen the impact of diabetic retinopathy. Finally, relevant economic indicators and metrics related to diabetic retinopathy include platelet activation as well such as the average amount of platelets, the breadth of platelet dispersion, and the ratio of platelets to big cells, the elderly population and warrant further investigation for their potential role in early risk stratification and preventive care.

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