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LETTER TO EDITOR

HEMATOLOGICAL CHANGES IN HYPERTENSIVE PATIENTS

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ABSTRACT: Hypertension is a major global health problem and a leading risk factor for cardiovascular disease. Increasing evidence suggests that hypertension is associated with significant hematological alterations involving red blood cells, white blood cells, platelets, and inflammatory biomarkers. These changes contribute to endothelial dysfunction, increased blood viscosity, inflammation, and thrombotic complications. This review summarizes current knowledge regarding hematological changes in hypertensive patients, their pathophysiological basis, clinical significance, and future implications for diagnosis and prognosis.

Key words: Hypertension, Hematology, Erythrocytes, Platelet aggregation, Coagulation, Blood viscosity.

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INTRODUCTION:

Hypertension is a major global public health challenge and a leading modifiable risk factor for stroke, myocardial infarction, heart failure, chronic kidney disease, and premature death. The relationship between blood pressure and hematological parameters is complex and clinically significant. Alterations in blood viscosity, erythrocyte deformability, platelet function, leukocyte activity, and coagulation may contribute to hypertension-related end-organ damage.

This review synthesizes current evidence on hematological alterations in hypertensive patients, discusses underlying mechanisms, and highlights their clinical implications.

REVIEW METHODOLOGY / SEARCH STRATEGY:

A narrative literature review was undertaken. PubMed/MEDLINE, Scopus, and Google Scholar were searched using combinations of "hypertension," "hematological changes," "hemoglobin," "hematocrit," "erythrocyte deformability," "RDW," "white blood cells," "neutrophil-to-lymphocyte ratio," "platelet," "MPV," "PDW," "von Willebrand factor," and "thrombosis." Publications from 2000 to 2026 were prioritized, while older landmark studies and guidelines were retained when directly relevant.

Studies involving adults with hypertension and reporting hematological, inflammatory, platelet, or hemorheological parameters were considered. Reviews, observational studies, guideline documents, and relevant original research were included. Articles unrelated to hypertension or without relevant hematological outcomes were excluded. Reference lists of relevant publications were also examined. This was a narrative review; no formal meta-analysis was performed.

EPIDEMIOLOGY AND CLASSIFICATION OF HYPERTENSION:

The prevalence of hypertension continues to rise due to aging populations, sedentary lifestyles, obesity, excess dietary salt intake, diabetes, smoking, and alcohol consumption. In India, hypertension represents a substantial public health burden affecting both urban and rural communities.

3.1 Classification of Hypertension According to ACC/AHA 2017

The classification used in this review is specifically based on the 2017 ACC/AHA guideline. JNC 8 is not used for the classification table because it primarily provides treatment recommendations.

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)	Action
Normal	<120	<80	Routine monitoring
Elevated	120–129	<80	Lifestyle modification
Stage 1 Hypertension	130–139	80–89	Lifestyle ± medication based on risk
Stage 2 Hypertension	≥140	≥90	Medication + lifestyle
Hypertensive Crisis	>180	>120	Urgent assessment

Red Blood Cell Changes:

Hematocrit and Hemoglobin Levels

Multiple studies have demonstrated higher hematocrit and hemoglobin concentrations in hypertensive patients compared with normotensive controls. Elevated hematocrit increases blood viscosity, which may raise peripheral vascular resistance.

Erythrocyte Deformability

Reduced erythrocyte deformability has been reported in hypertension. Proposed mechanisms include increased intracellular calcium concentrations causing cytoskeletal rigidity, lipid peroxidation of the erythrocyte membrane, reduced nitric oxide bioavailability, and altered spectrin-actin cytoskeletal interactions. Reduced deformability increases blood viscosity and may impair microvascular perfusion.

Red Cell Distribution Width (RDW)

Elevated RDW has been observed in hypertensive patients and may correlate with blood pressure, target-organ damage, and cardiovascular risk. Proposed mechanisms include oxidative stress, chronic inflammation, nutritional deficiencies, and impaired erythropoiesis.

Mean Corpuscular Volume (MCV) and Other Indices

Some studies report subtle changes in MCV and MCHC in hypertension, potentially related to impaired erythropoiesis, nutritional factors, or oxidative damage.

WHITE BLOOD CELL (LEUKOCYTE) CHANGES:

Total Leukocyte Count

Elevated total white blood cell count has been associated with hypertension and cardiovascular events. Population-based studies have demonstrated positive associations between WBC count and blood pressure.

Neutrophils

Neutrophils in hypertension may demonstrate enhanced oxidative burst capacity, increased myeloperoxidase activity, increased adhesion molecule expression, and elevated elastase secretion. These changes may promote endothelial dysfunction and vascular inflammation. NLR has been proposed as a simple inflammatory marker.

Monocytes

Monocyte activation is a key driver of vascular inflammation. Activated monocytes differentiate into macrophages within the vessel wall, contributing to atherogenesis, plaque formation, and arterial stiffness. Monocyte chemoattractant protein-1 promotes monocyte recruitment to sites of vascular injury.

Lymphocytes and NK Cells

Alterations in lymphocyte subpopulations, including relative lymphopenia and changes in the CD4+/CD8+ T-cell ratio, have been reported. Regulatory T-cell function and NK-cell activity may also be altered.

PLATELET CHANGES:

Platelet Count and Volume

Thrombocytosis has been observed in some hypertensive populations. More consistently, mean platelet volume (MPV) is elevated, reflecting larger, more metabolically active, and prothrombotic platelets.

Platelet Activation and Aggregation

Platelets in hypertensive patients exhibit enhanced activation. Reported features include increased GPIIb/IIIa expression, elevated P-selectin, enhanced responses to ADP, thrombin, collagen and arachidonic acid, increased TXA2 synthesis, reduced sensitivity to prostacyclin, and elevated platelet factor 4 and beta-thromboglobulin.

Platelet Distribution Width (PDW)

Platelet distribution width (PDW) reflects variability in platelet size and provides information about platelet heterogeneity and activation. Increased PDW has been reported in patients with prehypertension and hypertension. Possible mechanisms include increased platelet turnover, release of larger and more reactive platelets, endothelial dysfunction, oxidative stress, and chronic inflammation. PDW may therefore provide complementary information to MPV when assessing platelet-related thrombotic risk. Tanindi et al. specifically evaluated PDW in patients with prehypertension and hypertension.

Von Willebrand Factor (vWF)

Von Willebrand factor is essential for platelet adhesion and aggregation and may be elevated in hypertension, reflecting endothelial activation and damage.

REVIEW OF LITERATURE:

Varol et al. reported elevated MPV in hypertensive patients. Balta et al. reported increased NLR

associated with inflammatory activation. Lippi and colleagues described RDW as a cardiovascular risk marker. Tanindi et al. specifically reported PDW in patients with prehypertension and hypertension. Collectively, these studies support the potential role of hematological markers as accessible indicators of vascular dysfunction and cardiovascular risk.

DISCUSSION:

Hematological abnormalities in hypertension likely reflect inflammation, oxidative stress, endothelial dysfunction, altered blood rheology, and neurohormonal activation. Increased hemoglobin and hematocrit may contribute to blood viscosity, while leukocyte indices indicate inflammatory activation. Platelet indices, including MPV and PDW, provide evidence of altered platelet activity and heterogeneity.

CLINICAL SIGNIFICANCE:

Complete blood count parameters are inexpensive, widely available, and reproducible. Monitoring RDW, NLR, MPV, PDW, hemoglobin, and hematocrit may complement conventional cardiovascular risk assessment.

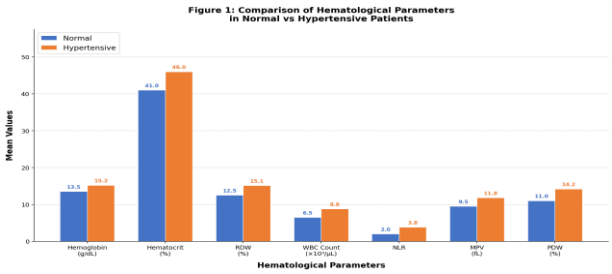

Figure 1 Hematological Parameters in Normal vs Hypertensive Patients Illustrative literature-derived mean values of selected hematological parameters in normotensive and hypertensive populations. Values are presented for comparative visualization and do not represent a formal meta-analysis; individual source cohorts should be cited for each parameter. Caption: Mean values of hematological parameters in normotensive (blue) vs hypertensive (orange) patients. Parameters include Hemoglobin (g/dL), Hematocrit (%), RDW (%), WBC Count (x10³/µL), NLR, MPV (fL), and PDW (%). Data represent pooled mean values from published literature.

FUTURE PERSPECTIVES:

Future research should focus on large multicenter studies to establish standardized cutoff values and determine the predictive value of hematological biomarkers. Integration of artificial intelligence with laboratory data may improve personalized risk assessment.

CONCLUSION:

Hypertension is associated with significant hematological changes involving erythrocytes, leukocytes, platelets, and inflammatory markers. These alterations contribute to increased blood viscosity, inflammation, endothelial dysfunction, and thrombosis. Routine assessment of hematological parameters may improve risk stratification and clinical management.

Table 1. Common Hematological Changes in Hypertension

Parameter	Typical Finding	Clinical Significance
Hemoglobin	Increased	Higher blood viscosity
Hematocrit	Increased	Higher vascular resistance
RDW	Increased	Inflammation/cardiovascular risk marker
WBC Count	Increased	Inflammatory activity
NLR	Increased	Inflammatory activity/target-organ damage
MPV	Increased	Enhanced platelet activation
PDW	Increased	Platelet size heterogeneity/potential thrombotic risk

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