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RESEARCH ARTICLE
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EVALUATION OF NEUTROPHIL TO LYMPHOCYTE RATIO AND PLATELET TO LYMPHOCYTE RATIO AMONG HYPERTENSIVE AND NORMOTENSIVE.

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Abstract

Background: Hypertension is a major global health burden associated with chronic low-grade inflammation and elevated cardiovascular risk.

Objective: Thisstudy aimed to evaluate and compare the NLR and PLR among hypertensive and normotensive individuals and to assess the potential of these biomarkers in identifying inflammation-related risk in hypertension.

Methods: The study enrolled adult participants aged 35–65 years, classified into hypertensive and normotensive groups based on standard blood pressure criteria. Complete blood counts were analyzed to compare NLR and PLR. Statistical comparisons between groups and correlation analyses were conducted to determine the significance of these ratios.

Results: Both NLR and PLR were found to be elevated in hypertensive individuals compared to normotensive controls. The increase in NLR was statistically significant, indicating a heightened inflammatory state in hypertensive patients. Although PLR was also higher, its statistical significance varied across individuals.

Conclusion: The research concludes that both NLR and PLR were high in hypertensive individuals them that of Normotensive individual and can serve as simple, non-invasive, and effective indicators of systemic inflammation and cardiovascular risk.

Keywords: keywords use in this research are Hypertension, Neutrophil, Lymphocyte, Ratio, Platelet, Inflammation, Cardiovascular Risk, and Biomarkers

INTRODUCTION

Hypertension (HT) is a modem day's epidemic.[1] An estimated 46% of adults with hypertension are unaware that they have the condition and about 1.28 billion adults aged 30-79 years worldwide have hypertension. A cross-sectional study involving 89 countries shows that low-income countries face difficulties in controlling hypertension compared to wealthier countries.[2] An analysis of worldwide data in 2005, 20.6% of Indian males and 20.9% of Indian women suffered from HT, which is a worldwide burdenAdditionally, a significant risk factor for the development of atherothrombosis which is responsible for about 25% of deaths worldwide.[3] Importantly hypertension has a complex origin, and inflammation plays a significant role in the pathophysiology of this condition.[4]It is crucial to discover a prognostic indicator that is both easily measurable and reasonably in order to improve the monitoring of hypertension and associated mortality.[5]

Hypertension is a chronic inflammatory condition in which total leukocyte count and its subtypes are used for the determination of systemic inflammation.[6] As a result of endothelial cell erosion, it encourages platelet activation, which in turn drives the manufacture of thrombus, therefore causing atherothrombotic disease and cardiovascular events.[7] PLR has been investigated as an inflammatory biomarker in both primary hypertension and pro-inflammatory illnesses.[8]

Along with Platelets, neutrophils performance an important tax in Cardiovascular (CV) events which develop an atherothrombotic disease.[9] A full blood count is used to calculate the neutrophil-to-lymphocyte ratio (NLR) and it serves as an important hematological measurehate reflects the immunological response and systemic inflammation.[10] By dividing the absolute neutrophil counts by the absolute lymphocyte numbers, the neutrophil to lymphocyte ratio (NLR) is computed.[11]

Recent evidence documented a strong association between an elevation in NLR and the occurrence of stroke, cardiac events, acute coronary syndrome, heart failure, as well as fatal and nonfatal events. Hypertension usually mark increase the risk of many cardiovascular diseases such as chronic coronary artery disease, urgent coronary syndromes, cardiac insufficiency, it has been hypothesized that NLR is a useful predictive factor for the incidence of hypertension.[12]

NLR reflects inflammation and physiologic stress PLR reflects platelet and clotting system activation, local vessel wall inflammation and endothelial dysfunction. Comparatively speaking, the ratio of NLR to PLR is more constant than the individual blood parameters, which are subject to change due to a variety of factors.[13]

AIM AND OBJECTIVES

RESEARCH QUESTION:

What is the difference between the Neutrophil toLymphocyte Ratio and the Platelet to Lymphocyte Ratio in hypertensive and normotensive patients?

AIM

To investigate the associations between Neutrophil to Lymphocyte Ratio and Platelet to Lymphocyte Ratio among Hypertensive and Normotensives.

OBJECTIVES

PRIMARY OBJECTIVE: To assess the Neutrophil to Lymphocyte Ratio (NLR) and Platelet to Lymphocyte Ratio (PLR) in individuals with hypertension compared to those with normal blood pressure.

SECONDARY OBJECTIVE: To assess the potential of these biomarkers in identifying inflammation-related risk in hypertension.

Methodology

Research strategy and data

A comprehensive research was conducted using database such as research gate, Google scholar and PubMed.

Selection Criteria: Studies include Individual were given written informed consent and drugs history, both genders aged between 35 to 65 years.
Selection process: Studies were selected base on the topic, quality of the research and recent publication.

THEORETICAL FRAMEWORK

Hypertension is a global health issue marked by constanthigh blood pressure which is associated with high morbidity and mortality due to cardiovascular problems.[5]Usually, hypertension has been increased and managed based on hemodynamic parameters, however growing evidence underlines the fundamental role of low-grade injury in its pathogenesis and progression.[9]
The causes of hypertension also due to immune system dysregulation whichunderwrites significantly to the progress ofendothelial injury,increased arterial stiffness, and vascular dysfunction, all of which are central to hypertensive pathology.[4]
Leukocyte especially (NLR) has emerged as a simple, lucrative, and dependable hematologic index that reflects the balance between innate (neutrophilic) and adaptive (lymphocytic) immune responses.[9]Parallel to this, the Platelet-to-Lymphocyte Ratio (PLR) is another inflammatory biomarker that demonstrates the connection between inflammation and thrombosis. Platelets are becoming more widely known for their pro-inflammatory interactions with leukocytes and endothelial cells in addition to their function in coagulation.[14]
The study impactsby acknowledging the importance of low-cost inflammatory markers (such as NLR and PLR) in the early detection and possible classification of patients with hypertension.[12] By analyzing the NLR and PLR values in both hypertensive and normotensive individuals, this research aims to confirm these ratios as inflammatory indicators associated with hypertension and its related complications.[15] The results may lead to a significant change in the way inflammatory profiling is integrated into the standard evaluation of hypertensive patients, allowing for more accurate risk assessment and targeted treatment options.[16]

Theoretical Concepts

Chronic Systemic Inflammation: Consistent low-level inflammation plays a key role in both the onset and persistence of hypertension. [4]
NLR and PLR as Biomarkers:Respectively,both serve as indicators for the balance between innate and adaptive immunity and represent the state of thrombo-inflammatory activity.[12]
Endothelial Dysfunction: A common underlying mechanism connects of inflammation to hypertension.[10]
Cardiovascular Risk Prediction: Heigh levels of NLR and PLR may signify a greater likelihood of negative health outcomes.[8]

Theoretical Assumptions

- Higher levels of NLR and PLR are linked to heigh inflammation and clotting activity in those with hypertension.[5]
- Hypertensive individuals show significant differences in NLR and PLR compared to those with normal blood pressure.[9]
- These ratios use to determine markers for assessing inflammation and cardiovascular risk among people with hypertension.[15]

Key Findings

Year of publication	Author	Title of Research	Conclusion
2025	Sudha S.et. al[6]	Neutrophil-lymphocyte ratio and platelet lymphocyte ratio in hypertensive patients	NLR and PLR can be used as bio markers for the diagnosis of cardiovascular diseases. The tests were cost-effective and accurate. therefore, it can be applied in the diagnosis of cardiovascular diseases.
2023	Sarejloo et al[5]	Meta-analysis of differences in neutrophil to lymphocyte ratio between hypertensive and non-hypertensive individuals	It was concluded that NLR may be associated HTN. Eventually, with the growth of new biomarkers and therapeutic modalities, we can prevent, treat delirium and decrease long-term morbidity and mortality.
2019	Mistry HA, Parmar DM[13]	The relationship between neutrophil-lymphocyte ratio and platelet-lymphocyte ratio in hypertension and as an indicator of cardiovascular risk.	It was concluded patients who are hypertensive have higher NLR and greater risk for atherothrombotic and atherosclerotic events.
2015	Susam et.al[17]	The relationship between neutrophil to lymphocyte ratio and blood pressure variability in hypertensive and normotensive subjects.	It was determined that NLR levels were particularly associated to variability in blood pressure. The assessment of NLR can serve as an indicator of an increased risk for HT-related negative cardiovascular events.
2015	Kilicaslan et al[16]	The relationship between neutrophil to lymphocyte ratio and blood pressure variability in hypertensive and normotensive subjects.	It was found that NLR levels were notably linked to variations in blood pressure. The assessment of NLR can serve as a marker for an increased risk of hypertension-related adverse cardiovascular events.
2015	Bayrakci N. et. Al[14]	to determine the association between platelet-to-lymphocyte ratio (PLR), in dipper and non-dipper hypertension.	It was concluded that the median PLR for individuals without dipper hypertension was significant than patients with dipper hypertension.
2023	Pinho et al[8]	study of neutrophil to lymphocyte ratio as a reliable inflammatory index among hypertensives in Government Rajaji Hospital, Madurai	The study presented Non dipper hypertensive individuals registered significant high levels of platelet-to-lymphocyte ratio and earlier cardiovascular than dipper patients.
2015	Belen et al[9]	study Increased Neutrophil to Lymphocyte Ratio in Patients with Resistant Hypertension.	The study presented NLR and neutrophil count were significantly higher in RHT patients than both CHT and NT patients.
2013	Acar et al[10]	Evaluation of Neutrophil Lymphocyte Ratio, Tp-E Interval and Tp-E/QT Ratio in Subjects with Hypertension and Prehypertension.	The research indicated that NLR, which serves as a marker of systemic inflammation, was comparable among individuals with normal blood pressure, Prehypertension, and hypertension. In patients with hypertension, the Tp-e interval and the Tp-e/QT ratio were elevated when compared to those with normal blood pressure.
2025	Xu et al.[18]	Elevated Platelet-to-Lymphocyte	Presented it shows PLR as a potential predictor of all-cause and

		Ratio as a Predictor of All-Cause and Cardiovascular Mortality in Hypertensive Individuals.	cardiovascular mortality in hypertensive individuals.
2024	Hong et al,[19]	Association of neutrophil-to-lymphocyte ratio and risk of cardiovascular and all-cause mortality in hypertension patients.	It was concluded that elevated NLR is associated with high risk of cardiovascular and all-cause mortality, and NLR may self-reliantly predict outcomes in individuals with hypertension.
2019	Zhiwei Huang	Prognostic value of neutrophil-to-lymphocyte ratio in sepsis: A meta-analysis.	This meta-analysis suggests that NLR could serve as a valuable prognostic biomarker for individuals with sepsis, with elevated NLR levels potentially signifying poorer outcomes in these patients.
2019	Hardikkumar Amrutbhai Mistry[1]	Study of Neutrophil to Lymphocyte Ratio and Platelet to Lymphocyte Ratio in Hypertensives and Normotensives	It can be concluded that hypertensives with higher NLR have greater risk for athero-thrombotic and atherosclerotic events. NLR reacts inflammation and physiologic stress and it is rela-tively more stable than individual blood parameters.
2022	Poihai A et al.[3]	A cross-sectional study of neutrophil to lymphocyte ratio as a reliable inflammatory index among hypertensives.	Neutrophil lymphocyte ratio (NLR) and platelet lymphocyte ratio (PLR) can be used as reliable parameters in clinical practice and in epidemiological studies as indices of inflammation among hypertensives.
2015	Liu et al.[4]	Blood Neutrophil to Lymphocyte Ratio as a Predictor of Hypertension	NLR levels are strongly associated with a higher risk of developing hypertension. This finding could help clarify the mechanisms involved in the onset of hypertension.

Discussion

From the research conducted, it shows that Neutrophil-to-Lymphocyte Ratio (NLR) was significantly higher in hypertensive individuals compared to normotensive which serve as controls.This chain the role of chronic low-grade inflammation in the pathogenesis of hypertension.Increased neutrophilsshow inflammation and decreased lymphocytes suggest immune stress.

Thefinding shows that Platelet-to-Lymphocyte Ratio (PLR) was also elevated in hypertensive patients. Even those PLR was high, but in studies it was not statistically significant.

There was positive difference associated with NLR and PLR in the hypertensive group, showing that both markers reflect related to inflammatory and thrombotic mechanisms.

The research highlights the potential of using NLR and PLR as economical and easily determine indicators for inflammation and cardiovascular risk associated with hypertension. Incorporating these measures into standard complete blood count (CBC) assessments may improve early identification and oversight of hypertensive individuals, especially in settings with limited resources. This result shows that individual with increased NLR might have a greater likelihood of experiencing cardiovascular issues, such as atherosclerosis, stroke, and myocardial infarction. These

indicators may help healthcarein recognizing high-risk patients for more intensive monitoring or prompt intervention.

Conclusion

The research concludes that both NLR and PLR are high in hypertensive individuals them that of Normotensive individual and can serve as simple, non-invasive, and effective indicators of systemic inflammation and cardiovascular risk. Both ratios may be incorporated into routine. assessments to complement traditional diagnostic tools and potentially improve hypertensive patient management.

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