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Correlation between platelet counts, MPV, PDW, PCT and age in acute ischemic stroke patients

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Abstract

Background: Acute ischemic stroke occurs when blood clots obstruct blood vessels within the brain. Platelets (Plts) are integral to the pathophysiology of stroke. This research aimed to explore the relationship between Plt quality and Plt indices in the context of acute ischemic stroke.

Methods: This cross-sectional investigation involved 100 patients diagnosed with acute ischemic stroke at Kosti Teaching Hospital and Alyammama Hospitals. The diagnosis was confirmed using brain CT imaging and electrocardiography (ECG). Blood samples were collected in EDTA-containing tubes within 24 hours following the commencement of treatment and were subsequently analyzed for Plt count, mean Plt volume (MPV), Plt distribution width (PDW), and plateletcrit (PCT) utilizing a hematological analyzer. Data were analyzed using GraphPad Prism software.

Results: Platelet counts negatively correlated with PDW [r=-0.074, P=0.459; R=-0.023, P=0.815], MPV [r=-0.130, P=0.194; R=-0.081, P=0.417], and diastolic blood pressure [r= -0.023, P=0.818; R= -0.024, P=0.805]; and positively correlated with PCT [r= 0.103, P=0.308; R=0.143, P=0.155] and diastolic blood pressure [r=0.022, P=0.823; R= 0.008, P=0.932]. Moreover, PDW positively correlated with systolic blood pressure [r=0.105, P=0.298; R= 0.147, P=0.148] and diastolic blood pressure [r=0.146, P=0.145; R=0.173, P=0.084]. Based on Spearman but not Pearson correlation, PDW showed a negative correlation with PCT [r=-0.005, P=0.959; R=0.010, P=0.929].

Conclusion: The study shows a correlation between Plt count and indices in ischemic stroke patients. The research also presented evidence concerning the relationship between diastolic and systolic blood pressure and Plt counts and indices.

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Introduction

A stroke is defined as a neurologic deficit that is caused by a focal vascular cause. The incidence of stroke diseases increases with age (1-3). Strokes are classified into ischemic strokes, which are found in 80-85% of stroke cases and hemorrhagic strokes which are found in 15-20% of stroke cases. The diagnosis of ischemic stroke can be done clinically according to the World Health Organization (WHO) and confirmed by brain CT scan, which is a gold standard test for strokes (4). According to WHO, stroke is considered the second leading cause of death worldwide in 2016, and approximately 15.2 million deaths have been reported due to ischemic heart attacks and strokes (1). Acute ischemic stroke (AIS) mainly occurs due to thrombotic and embolic mechanisms. Hypertension, diabetes mellitus (DM), hyperlipidemia, and abnormal platelet (Plt) function are among the most important medical and risk factors for ischemic stroke (5).

Platelets are non-nucleated structures derived from fragmentation of megakaryocytes. Platelets have basic roles in homeostasis and thrombosis. Platelets contain three types of granules. The first type is known as the dense granules; 4–6 dense granules are packed into each Plt (6,7). The dense granule contains more than 200 small molecules, including calcium, ATP, ADP, 5-HT, and epinephrine. All these molecules play a pivotal process in Plt activation. The second type of granule is known as the alpha granules. It has been reported that each Plt contains between 60-80 alpha granules (8,9). The alpha granules contain a number of larger proteins that are released either to the surface of the Plt or into circulation following granule secretion (10). The third type of granules in the Plts is the lysosomal granule, which plays an important role in degrading protein (11). All these granules are bio-markers in Plt activation and aggregation (1). The important role of Plts in the pathophysiology of ischemic stroke probably qualifies Plt count as an easily, available and novel prognostic biomarker for ischemic stroke disease. Platelet counts and Plt indices can be easily obtained from complete blood cell counts (CBC) (2,6). Platelet indices contain mean Plt volume (MPV), Plt count (PC), Plt distribution width (PDW), and plateletcrit (PCT). These indices have been investigated in various diseases. Larger Plts are more metabolically and functionally active (12,13). MPV is used to measure Plt volume and determines the progenitor cells (Megakaryocytes) in the bone marrow (14). PDW directly measures the variability in Plt size and reflects the heterogeneity in Plt morphology. PCT is a measure of total Plt mass and is an effective screening tool for detecting Plt quantitative abnormality (15). This study aimed to analyze the correlation between Plt quality and Plt indices in AIS.

Methods

This cross-sectional study included 100 acute ischemic stroke patients who attended Kosti Teaching and Alyammama Specialized Hospitals. Acute ischemic stroke is diagnosed clinically and confirmed by CT brain and ECG. All admitted patients with AIS were subjected to medical investigations, including history, clinical examination, evaluation of risk factors, and treatments. In this study, the targeted subjects were patients with AIS confirmed by CT brain and ECG. The excluded subjects were patients with hemorrhagic stroke and a previous attack of ischemic stroke. Patients with co-morbid medical diseases likely to interfere with Plt function or morphology like chronic kidney disease, heart bypass surgery, chronic liver disease, malignancy, and autoimmune diseases were excluded. Patients receiving medication likely to interfere with Plt morphology or function like aspirin and other NSAIDs, antihistamines, and some antibiotics were also excluded.

Venous blood samples were collected in EDTA-containing tubes (3 ml). All samples were collected within the first 24 hours before starting the treatments and investigated using a hematological analyzer (Mindray BC 3,000 plus) for determining the Plt counts, MPV, PDW, and PCT. The data were analyzed using GraphPad Prism software version 7. Both Spearman and Pearson correlation tests were used to assess the correlation relationships. A P-value < 0.05 was considered statistically significant.

Results

The current study included one hundred patients with AIS. The mean age±SD (Minimum-maximum) [Mode] of the study participants was 69.7±9.9 (30 -90) [70]. Males represented 56% and females constituted 44% of the study individuals (Table 1).

Table 1. Study subjects

Mean	SD	Variance	Range	Minimum	Maximum	Mode
69.7	9.9	99.0	60.0	30.0	90.0	70.0

Figure 1A-D, Figure 2A-C, and Figure 3 show the findings of correlation analysis. Based on Spearman and Pearson correlation analysis, Plt counts negatively correlated with PDW [Spearman r=-0.074, P=0.459; Pearson R=-0.023, P=0.815] (Figure 1A), MPV [Spearman r=-0.130, P=0.194; Pearson R=-0.081, P=0.417] (Figure 1B), and diastolic blood pressure [Spearman r=-0.023, P=0.818; Pearson R=-0.024, P=0.805] (Figure 1D); and positively correlated with PCT [Spearman r= 0.103, P=0.308; Pearson R=0.143, P=0.155] (Figure 1C) and diastolic blood pressure [Spearman r=0.022, P=0.823; Pearson R=0.008, P=0.932] (Figure 1D).

Furthermore, PDW displayed a negative correlation with MPV [Spearman r=-0.185, P=0.064; Pearson R=-0.175, P=0.080] (Figure 2A). Based on Spearman but not Pearson correlation, PDW showed a negative correlation with PCT [Spearman r=-0.005, P=0.959; Pearson R=0.010, P=0.929] (Figure 2B). Likewise, PDW positively correlated with systolic blood pressure [Spearman r=0.105, P=0.298; Pearson R=0.147, P=0.148] (Figure 2C), and diastolic blood pressure [Spearman r=0.146, P=0.145; Pearson R=0.173, P=0.084] (Figure 2C).

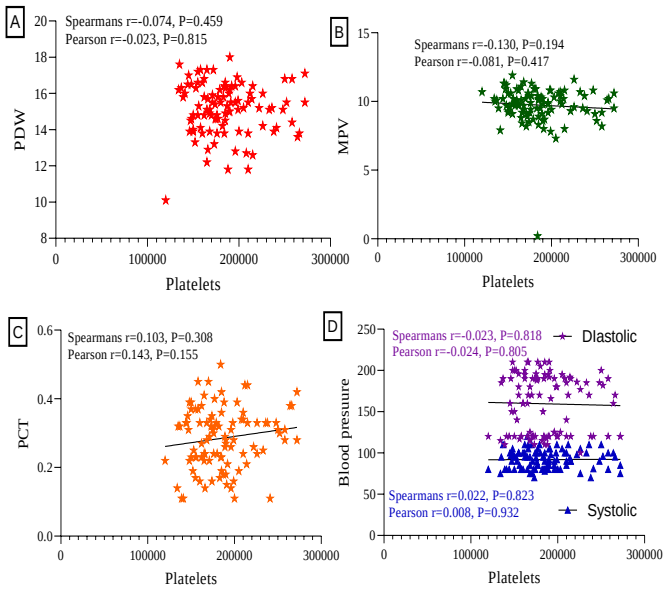

Figure 1. Correlation of Plts with PDW (A), MPV (B), PCT (C) and blood pressure (D)

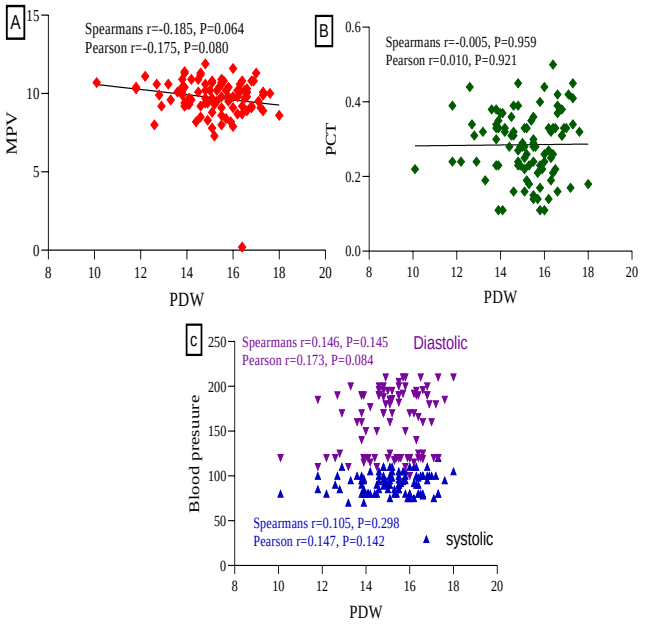

Figure 2. Correlation of PDW with MPV (A), PCT (B), and blood pressure (C)

In this study, PCT negatively correlated with diastolic [Spearman r=-0.094, P=0.417; Pearson R=-0.081, P=0.417] and diastolic [Spearman r=-0.046, P=0.649; Pearson R=-0.011, P=0.911] blood pressure (Figure 3). Additionally, age indicated a positive correlation with MPV, PDW, Plts, PCT, and diastolic and systolic blood pressure (Figure 4A-E).

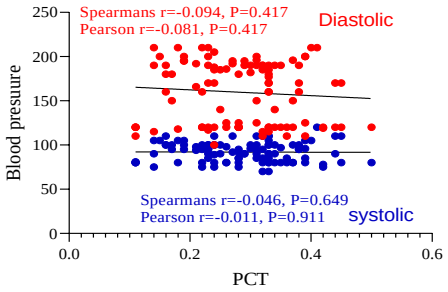

Figure 3. Correlation of PCT with blood pressure

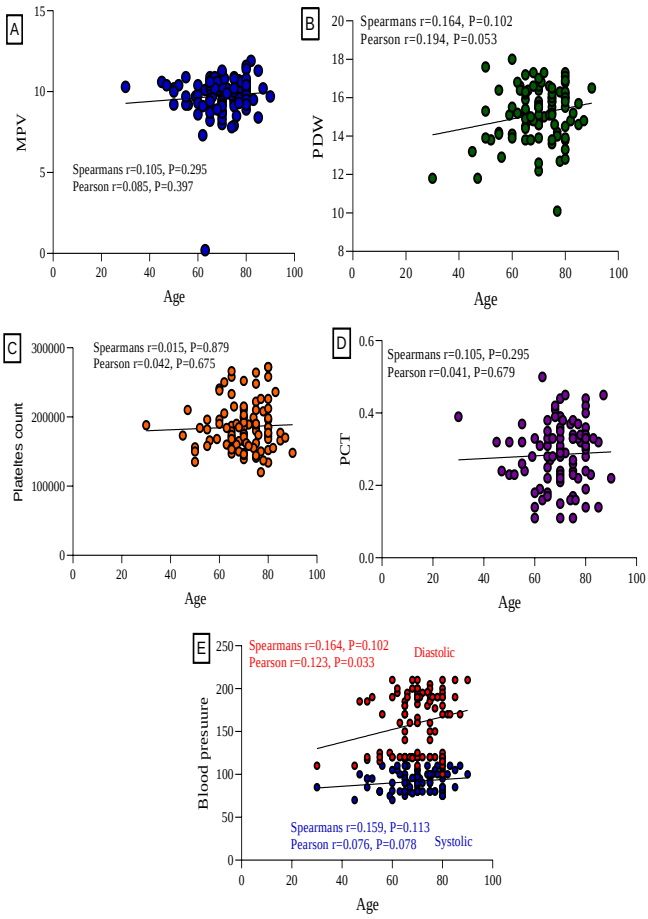

Figure 4. Correlation of Age with MPV (A), PDW (B), Plts (C), PCT (D), and blood pressure (E)

Discussion

Acute ischemic stroke (AIS) mainly occurs due to thrombotic and embolic mechanisms. Platelet indices, such as MPV, PC, PDW, and PCT have been investigated in various diseases. Larger Plts are more metabolically and functionally. In this study, we found a negative correlation between Plt counts and PDW. This finding is in agreement with Al-Tameemi et al. (16), Zhang et al. (17), and Yang et al. (18), who found a strong negative correlation. The PDW displayed a negative correlation with MPV and PC, which is inconsistent with findings by Zhang et al. (17). There is a positive correlation between PDW and MPV and PC.

In our study, we found a negative correlation between Plt counts and PDW and MPV. This finding was also reported by Zhang et al. (17). In addition, we indicated a positive correlation between Plt counts and PCT which has been demonstrated by Yang et al. (18). In the present study, we showed a negative correlation between MPV and PDW and diastolic blood pressure which is in agreement with Yang et al.'s findings (18). In this study, PCT negatively correlated with diastolic and systolic blood pressure which has been similarly reported by Yang et al. (18). Therefore, no significant relationship was found between PCT and blood pressure.

Conclusion

The study highlights the significance of Plt counts and their associated indices in patients with AIS, emphasizing the need for further research to enhance understanding of these relationships. Additionally, it provides valuable evidence of the connection between diastolic and systolic blood pressure and Plt counts and indices.

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Funding sources

None.

Ethical statement

The study was approved by the Ethics Committees of Kosti Teaching Hospital and Alyammama Specialized Hospital. Written informed consent was obtained from each subject.

Conflicts of interest

There was no conflict of interest.

Author contributions

All authors contributed to the manuscript equally.

References

1. Arikanoglu A, Yucel Y, Acar A, Cevik MU, Akil E, Varol S, Tasdemir N. The relationship of the mean platelet volume and C-reactive protein levels with mortality in ischemic stroke patients. European Review for Medical and Pharmacological Sciences. 2013;17(13):1774-7. [View at Publisher] [PMID] [Google Scholar]
2. Baburhan G, Ozkan H, Kabayel L. Mean platelet volume and peripheral blood count response in acute ischemic stroke. Trakya Universitesi Tip Fakultesi Dergisi. 2008;25(2):130-5. [View at Publisher] [Google Scholar]
3. Bath PM, Butterworth RJ. Platelet size: measurement, physiology and vascular disease. Blood Coagul Fibrinolysis. 1996;7:157-61. [View at Publisher] [DOI] [Google Scholar]
4. Berger JS, Eraso LH, Xie D, Sha D, Mohler ER. Mean platelet volume and prevalence of peripheral artery disease, the National Health and Nutrition Examination Survey, 1999-2004. 2010;213(2):586-91. [View at Publisher] [DOI] [Google Scholar]
5. Bianca L, Huwae S, Kaelan C, Muis A, Ilmu B, Saraf P, Hasanuddin U. Hubungan Kadar Neutrofil Dengan Luaran Klinis Penderita Strok Iskemik Akut. Universitas Hasanuddin Makassar. thesis. 2012. [View at Publisher]
6. Du J, Wang Q, He B, Liu P, Chen JY, Quan H, et al. Association of mean platelet volume and platelet count with the development and prognosis of ischemic and hemorrhagic stroke. International Journal of Laboratory Hematology. 2016;38(3):233-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
7. Voronov R, Muthard RW, Tomaiuolo M, Diamond SL. A systems approach to hemostasis: 1. The interdependence of thrombus architecture and agonist movements in the gaps between platelets. Blood. 2014;124(11):1808-15. [View at Publisher] [DOI] [PMID] [Google Scholar]
8. Yeung J, Hawley M, Holinstat M. The expansive role of oxylipins on platelet biology. Journal of Molecular Medicine. 2017;95(6):575-88. [View at Publisher] [DOI] [PMID] [Google Scholar]
9. Holinstat M, Tourdot BE. Coronary heart disease risk factors take a disproportional toll on women. Arteriosclerosis, Thrombosis, and Vascular Biology. 2015;35(4):750-1. [View at Publisher] [DOI] [PMID] [Google Scholar]
10. Koupenova M, Mick E, Mikhalev E, Benjamin EJ, Tanriverdi K, Freedman JE. Sex differences in platelet toll-like receptors and their association with cardiovascular risk factors. Arteriosclerosis, Thrombosis, and Vascular Biology. 2015;35(4):1030-7. [View at Publisher] [DOI] [PMID] [Google Scholar]
11. Ouseph MM, Huang Y, Banerjee M, Joshi S, MacDonald L, Zhong Y. Autophagy is induced upon platelet activation and is essential for hemostasis and thrombosis. Blood. 2015;126(10):1224-33. [View at Publisher] [DOI] [PMID] [Google Scholar]
12. Sadeghi F, Kovács S, Zsóri KS, Csiki Z, Bereczky Z, Shemirani AH. Platelet count and mean volume in acute stroke: a systematic review and meta-analysis. Platelets. 2020;31(6):731-9. [View at Publisher] [DOI] [PMID] [Google Scholar]
13. Kaito K, Otsubo H, Usui N, Yoshida M, Tanno J, Kurihara E, et al. Platelet size deviation width, platelet large cell ratio, and mean platelet volume have sufficient sensitivity and specificity in the diagnosis of immune thrombocytopenia. 2005;128:698-702 . [View at Publisher] [DOI] [PMID] [Google Scholar]
14. Borkataky S, Jain R, Gupta R, Singh S, Krishan G, Gupta K, et al. Role of platelet volume indices in the differential diagnosis of thrombocytopenia:A simple and inexpensive method Hematology. 2009;14:182-6 [View at Publisher] [DOI] [PMID] [Google Scholar]
15. Lanzkowsky's Manual of Pediatric Hematology and Oncology. Elsevier. 2016; Chapter 14-Disorders of Platelets, 6th ed, 239. [View at Publisher] [DOI] [Google Scholar]
16. Al-Tameemi WF, Ameen2 AMM. Significance of Platelet Indices in Patients with Acute Ischemic Stroke.IRAQI J MED SCI. 2012;10(4):383-9. [View at Publisher] [Google Scholar]
17. Zhang J, Mingyong Li, Yuan H. Large population study for age- and gender-related variations of platelet indices in Southwest China healthy adults. Hematol Transfus Int J. 2015;1(4):108-14 [View at Publisher] [DOI]
18. Yang K, Tao L, Mahara G, Yan Y, Cao K, Liu X, et al. An association of platelet indices with blood pressure in Beijing adults: Applying quadratic inference function for a longitudinal study. Medicine (Baltimore). 2016;95(39):e4964. [View at Publisher] [DOI] [PMID] [Google Scholar]

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