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Evaluation of peripheral inflammatory markers in children and adolescents with epilepsy: a cross-sectional comparative study

Abstract

Background: Emerging evidence suggests that inflammation plays an important role in the pathophysiology of epilepsy. Haematological inflammatory markers such as neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR) are simple and cost-effective indicators of systemic inflammation, though their clinical relevance in epilepsy remains uncertain. **Aim:** To evaluate the levels of NLR, MLR, and PLR in patients with epilepsy and assess their diagnostic significance. **Methods:** This hospital-based cross-sectional comparative study included 80 participants (40 epilepsy patients and 40 age- and gender-matched healthy controls) aged six to 18 years. Participants with recent infections, inflammatory disorders, or major systemic illnesses were excluded. Blood samples were analysed to calculate NLR, MLR, and PLR. Statistical analysis included Mann-Whitney U test, receiver operating characteristic (ROC) curve analysis, and binary logistic regression. **Results:** WBC count, NLR, MLR, and PLR were significantly higher in epilepsy patients compared to controls. MLR demonstrated the highest diagnostic accuracy [area under the curve (AUC)=0.799], followed by NLR (AUC=0.749) and PLR (AUC=0.642). Logistic regression showed significant associations of NLR, MLR, and PLR with epilepsy, with MLR emerging as the strongest predictor. **Conclusion:** Inflammatory markers, particularly MLR and NLR, are elevated in epilepsy and may serve as accessible biomarkers for diagnosis and risk assessment. Larger longitudinal studies are required for validation.

Keywords: Neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), platelet-lymphocyte ratio (PLR)

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INTRODUCTION

Epilepsy is a long-term condition of the brain where a person has repeated seizures without any immediate cause. When brain's electrical activity has an abnormal sudden burst then seizures occur. Around 50 million people worldwide live with epilepsy, which makes it one of the most common neurological disorders. It does not just affect physical health it also has emotional, social, and psychological impacts. Over time, our understanding of epilepsy has changed. It is no longer seen as only an electrical problem in the brain; researchers now know that it also involves immune responses and inflammation.[1,2]

In recent years, scientists have started paying more attention to inflammation in the brain and its role in epilepsy. Studies show that when a seizure happens, it can trigger several inflammatory reactions. These include activation of certain brain cells (called glial cells), release of inflammatory chemicals, damage to the blood-brain barrier, and increased oxidative stress.[1,2] These changes can make brain cells more sensitive and increase the chances of more seizures happening. In other words, seizures and inflammation complement each other. Clinical studies also support this idea, showing that people with epilepsy often have higher levels of inflammatory markers in their blood.[3]

Because of this link, researchers are now looking at simple blood-based markers to understand inflammation in epilepsy. Some of these include ratios like neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR). These ratios reflect how different immune cells behave during inflammation.[4,5] The advantage is that they are easy to measure, inexpensive, and already available through routine blood tests. Another important marker is C-reactive protein (CRP), which is produced by the liver during inflammation and is widely used to detect inflammatory activity in the body.

However, even though these markers look promising, their exact role in epilepsy is still not fully clear. Some studies have found higher levels of NLR, MLR, PLR, and CRP in people with epilepsy, while others have not found any significant difference compared to healthy individuals.[3] These differences could be due to many factors, such as the type of seizures, duration of the disease, other health conditions, or

differences in study methods. Also, there is limited research from many regions, including our own, which makes further study important.

Understanding whether these blood markers are truly linked to epilepsy can help us learn more about how the disease works. In the future, they might even help doctors track disease activity or predict outcomes, although more research is still needed before they can be used in routine practice.

With this in mind, the present study aims to measure the levels of MLR, NLR, PLR in people with epilepsy and compare them with healthy individuals of similar age and gender. The study also tries to understand how these markers may be related to the disease process.

MATERIALS AND METHODS

Study design and participants

A hospital-based cross-sectional comparative study was conducted among children and adolescents aged six to 18 years. The study included 40 patients with confirmed epilepsy in the interictal phase and 40 age- and gender-matched healthy controls.

Eligibility criteria

Inclusion criteria (cases)

- Age between six and 18 years
- Diagnosis of epilepsy as per standard diagnostic criteria
- Illness duration of more than and equal to six months
- Interictal state (≥48 hours since last seizure)

Exclusion criteria (both groups)

- Recent infection or febrile illness
- Chronic inflammatory or autoimmune disorders
- Haematological disorders or malignancy
- Significant hepatic or renal dysfunction
- Current use of steroids, immunosuppressants, or anti-inflammatory medications

Procedure

After obtaining informed consent, five mL of fasting venous blood was collected under aseptic precautions. Complete blood count was performed using an automated analyser. NLR, MLR, and PLR were calculated from differential counts.

Statistical analysis

The study employed the Shapiro–Wilk test for normality assessment, independent t-test for comparison of means, Chi-square/Fisher's exact test for categorical variables, Mann–Whitney U test for non-parametric comparisons, receiver operating characteristic (ROC) curve analysis for diagnostic accuracy, and binary logistic regression for assessing associations and risk estimation.

RESULTS

A total of 80 participants were included in the study, comprising 40 patients with epilepsy (cases) and 40 healthy individuals (controls). The demographic characteristics of the study population are presented in Table 1. The mean age of the control group was 15.97 ± 2.25 years, while that of the case group was 16.98 ± 4.16 years. There was no statistically significant difference in age between the two groups ($p = 0.186$). Similarly, the distribution of sex, residence, and family income did not differ significantly between cases and controls ($p > 0.05$), indicating that the groups were comparable. The mean white blood cell (WBC) count was significantly higher in the case group (9883.15 ± 3865.57 cells/mm^3) compared to the control group (6926.80 ± 1817.70 cells/mm^3), and this difference was statistically significant ($p < 0.001$).

The comparison of inflammatory ratios between cases and controls is shown in Table 2. Since the data were not normally distributed (Shapiro–Wilk test, $p < 0.05$), non-parametric tests were applied. The median NLR was significantly higher in cases [3.06 (2.23–6.46)] compared to controls [1.95 (1.66–2.59)] ($p < 0.001$). Similarly, MLR was elevated in the case group [0.32 (0.24–0.47)] compared

Table 1: Demographic and clinical characteristics of study population

Variable	Control (n=40)	Case (n=40)	p-value
Age (years)	15.97±2.25	16.98±4.16	0.186
WBC (cells/mm^3)	6926.80±1817.70	9883.15±3865.57	<0.001
Sex			0.502
Female	19 (47.5%)	23 (57.5%)	
Male	21 (52.5%)	17 (42.5%)	
Residence			0.101
Rural	28 (70.0%)	35 (87.5%)	
Urban	12 (30.0%)	5 (12.5%)	
Family income			0.245
<10000	11 (27.5%)	14 (35.0%)	
10000	0 (0.0%)	1 (2.5%)	
10000–25000	18 (45.0%)	12 (30.0%)	
25001–50000	4 (10.0%)	9 (22.5%)	
>50000	7 (17.5%)	4 (10.0%)	

The demographic characteristics of the study population, including age, sex, residence, and family income, were comparable between cases and controls, as no statistically significant differences were observed (p>0.05). However, the mean white blood cell (WBC) count was significantly higher in patients with epilepsy compared to controls (p<0.001), indicating a possible inflammatory response associated with the disease

Table 2: Comparison of inflammatory ratios (NLR, MLR, PLR)

Parameter	Control (n=40)	Case (n=40)	p-value
NLR	1.95 (1.66–2.59)	3.06 (2.23–6.46)	<0.001
MLR	0.19 (0.15–0.25)	0.32 (0.24–0.47)	<0.001
PLR	0.09 (0.06–0.12)	0.11 (0.07–0.19)	0.029

The inflammatory ratios neutrophil-lymphocyte ratio (NLR), monocyte-lymphocyte ratio (MLR), and platelet-lymphocyte ratio (PLR) were significantly higher in patients with epilepsy compared to healthy controls. NLR and MLR showed highly significant differences (p<0.001), while PLR also demonstrated a statistically significant elevation (p=0.029). These findings suggest the presence of systemic inflammation in individuals with epilepsy

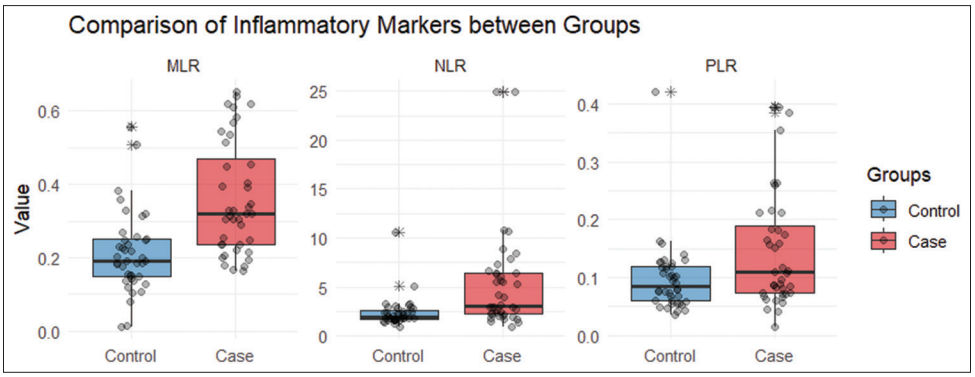

Figure 1: Comparison of inflammatory markers between groups. Boxplots showing the distribution of neutrophil-to-lymphocyte ratio (NLR), monocyte-to-lymphocyte ratio (MLR), and platelet-to-lymphocyte ratio (PLR) among cases and controls. The median and interquartile range are represented within each box. All three inflammatory markers are elevated in patients with epilepsy compared to healthy controls, with NLR and MLR showing more pronounced differences.

to the control group [0.19 (0.15–0.25)], showing a highly significant difference ($p < 0.001$). PLR was also higher in cases [0.11 (0.07–0.19)] than controls [0.09 (0.06–0.12)], and this difference was statistically significant ($p = 0.029$).

Figure 1 illustrates these differences using boxplots, showing a clear upward shift of inflammatory markers in the case group, particularly for NLR and MLR. The diagnostic performance of the inflammatory markers was evaluated using receiver operating characteristic (ROC) curve analysis (Table 3 and Figure 2). MLR demonstrated the highest diagnostic accuracy with an area under the curve (AUC) of 0.799 [95% confidence interval (CI): 0.704-0.895], followed by NLR with an AUC of 0.749 (95% CI: 0.639-0.858). PLR showed comparatively lower diagnostic performance with an AUC of 0.642 (95% CI: 0.518-0.765). The optimal cut-off value for MLR was 0.28, yielding a sensitivity of 65.0% and specificity of 82.5%. For NLR, a cut-off value of 3.64 provided high specificity (95.0%) but lower sensitivity (47.5%). PLR showed moderate specificity (92.5%) but lower sensitivity (42.5%).

Logistic regression analysis was performed to assess the association between inflammatory markers and epilepsy (Table 4). NLR was significantly associated with epilepsy, with an odds ratio (OR) of 1.62 (95% CI: 1.23-2.31, $p < 0.001$), indicating that higher NLR values increase the likelihood of epilepsy. After scaling, MLR showed a strong association with epilepsy, with an OR of 2.49 (95% CI: 1.63-4.31, $p < 0.001$), suggesting that even small increases in MLR substantially raise the odds of disease. Similarly, PLR was also significantly associated with epilepsy, with an OR of 2.23 (95% CI: 1.22-4.83, $p = 0.029$). Inflammatory markers (NLR, MLR, and PLR) were significantly elevated in patients with epilepsy. Among these, MLR demonstrated the highest diagnostic accuracy and strongest association with disease risk, followed by NLR and PLR.

DISCUSSION

The present study aimed to evaluate the role of inflammatory markers NLR, MLR, and PLR in patients with epilepsy and to assess their diagnostic and predictive value.

In this study, no significant differences were observed in age, sex, residence, or family income between cases and controls. This indicates that the two groups were comparable and reduces the possibility of confounding effects due to demographic or socioeconomic factors. Such comparability strengthens the validity of the findings and ensures that the observed differences in inflammatory markers are likely related to the disease process rather than external influences.

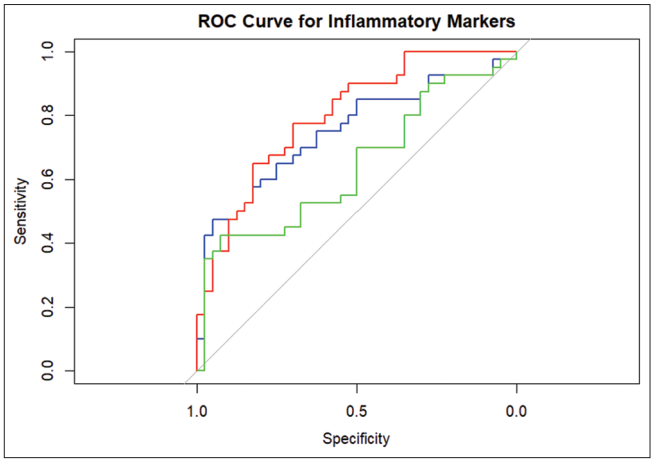

Figure 2: Receiver operating characteristic (ROC) curve for inflammatory markers. ROC curves comparing the diagnostic performance of neutrophil-to-lymphocyte ratio (NLR), monocyte-to-lymphocyte ratio (MLR), and platelet-to-lymphocyte ratio (PLR) in distinguishing epilepsy patients from controls. MLR demonstrated the highest area under the curve (AUC=0.799), followed by NLR (AUC=0.749) and PLR (AUC=0.642), indicating superior diagnostic accuracy of MLR.

Inflammation and epilepsy

A significant finding of this study was the elevated WBC count in epilepsy patients compared to controls. This supports the growing evidence that inflammation plays an important role in the pathophysiology of epilepsy. Neuroinflammation has been increasingly recognized as a contributing factor in seizure generation and progression, involving activation of immune cells and release of inflammatory mediators.

The significantly higher levels of NLR, MLR, and PLR in cases further support the presence of systemic inflammation in epilepsy. These markers are derived from routine blood parameters and reflect the balance between pro-inflammatory and anti-inflammatory components of the immune system.

Table 3: ROC curve analysis of NLR for predicting epilepsy

Parameter	AUC (95% CI)	Cut-off value	Sensitivity (%)	Specificity (%)
NLR	0.749 (0.639–0.858)	3.64	47.5	95.0
MLR	0.799 (0.704–0.895)	0.28	65.0	82.5
PLR	0.642 (0.518–0.765)	0.15	42.5	92.5

Parameter	Value	Clinical interpretation
Area Under Curve (AUC)	0.749	Fair to good accuracy
Optimal threshold	3.64	Predictive cut-off point
Specificity	95%	High confidence in control identification
Sensitivity	47.5%	Moderate detection of true cases

Receiver operating characteristic (ROC) curve analysis revealed that monocyte-lymphocyte ratio (MLR) had the highest diagnostic accuracy [area under the curve (AUC) = 0.799], followed by neutrophil-lymphocyte ratio (NLR) (AUC=0.749), while platelet-lymphocyte ratio (PLR) showed comparatively lower performance (AUC=0.642). MLR demonstrated a good balance between sensitivity and specificity, indicating its potential as a reliable biomarker for distinguishing epilepsy patients from healthy individuals

Table 4: Association of inflammatory ratios with epilepsy (logistic regression)

Parameter	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
NLR	1.62	1.23 – 2.31	<0.001
MLR (per 0.1 increase)	2.49	1.63 – 4.31	<0.001
PLR (per 0.1 increase)	2.23	1.22 – 4.83	0.029

Logistic regression analysis showed that all three inflammatory markers were significantly associated with epilepsy. Neutrophil-lymphocyte ratio (NLR) demonstrated a moderate increase in risk, while monocyte-lymphocyte ratio (MLR) and platelet-lymphocyte ratio (PLR) showed stronger associations after scaling. Among these, MLR emerged as the strongest predictor of epilepsy, suggesting its potential clinical relevance in assessing disease risk

Interpretation of inflammatory ratios

Among the markers studied, NLR and MLR showed highly significant differences between cases and controls. NLR is widely used as an indicator of systemic inflammation and has been associated with various neurological and non-neurological disorders. The elevated NLR observed in this study suggests increased neutrophil activity and relative lymphocyte suppression, indicating an inflammatory response in epilepsy.

MLR demonstrated an even stronger difference between groups, suggesting that monocyte-mediated immune responses may play a key role in epilepsy. Monocytes are involved in cytokine production and immune regulation, and their elevation may reflect ongoing inflammatory processes affecting neuronal function.

PLR also showed a statistically significant increase, although the difference was less pronounced compared to NLR and MLR. This may indicate that platelet-related inflammatory pathways have a role, but possibly a secondary one, in the disease mechanism.

Diagnostic utility of markers

ROC curve analysis revealed that MLR had the highest diagnostic accuracy (AUC = 0.799), followed by NLR (AUC = 0.749) and PLR (AUC = 0.642). These findings suggest that MLR is a better discriminator between epilepsy patients and healthy individuals.

The high specificity observed for NLR indicates its usefulness in confirming the disease, while MLR provides a better balance between sensitivity and specificity, making it more suitable as a screening or diagnostic marker. PLR, although statistically significant, showed lower diagnostic performance, limiting its standalone clinical utility.

Association with disease risk

Logistic regression analysis demonstrated that all three inflammatory markers were significantly associated with epilepsy. NLR showed a moderate increase in risk, while MLR and PLR exhibited stronger associations after scaling.

The strong association observed with MLR suggests that even small changes in this marker may significantly increase the likelihood of epilepsy. This highlights its potential role not only as a diagnostic marker but also as an indicator of disease activity or severity.

Clinical implications

The findings of this study have important clinical implications. NLR, MLR, and PLR are simple, inexpensive, and easily obtainable from routine blood tests. Their use as inflammatory markers in epilepsy could aid in early diagnosis, risk assessment, and monitoring of disease progression.

Among these, MLR appears to be the most reliable and clinically useful marker, given its higher diagnostic accuracy and stronger association with disease risk.

Limitations of the study

Despite its strengths, this study has some limitations. The sample size was relatively small, which may affect the generalisability of the findings. Additionally, the cross-sectional design limits the ability to establish causal relationships between inflammation and epilepsy.

Other factors that may influence inflammatory markers, such as infections, medications, or comorbid conditions, were not extensively controlled. Future studies with larger sample sizes and longitudinal designs are needed to confirm these findings.

Future scope

Further research should focus on exploring the role of inflammatory markers in different types of epilepsy and their

relationship with disease severity, treatment response, and long-term outcomes. Combining these markers with other clinical and imaging parameters may improve diagnostic accuracy and provide deeper insights into the disease mechanism.

Conclusion

In conclusion, this study demonstrates that inflammatory markers, particularly MLR and NLR, are significantly elevated in patients with epilepsy and have potential diagnostic and predictive value.

AUTHOR CONTRIBUTIONS

MC: Definition of intellectual content, data acquisition, manuscript preparation, guarantor; **HAC**: Design, clinical studies, statistical analysis, manuscript editing, guarantor; **KN**: Concepts, data analysis, manuscript review, guarantor.

REFERENCES

1. Vezzani A, French J, Bartfai T, Baram TZ. The role of inflammation in epilepsy. Nat Rev Neurol. 2011;7:31-40.
2. Dey A, Kang X, Qiu J, Du Y, Jiang J. Anti-inflammatory small molecules to treat seizures and epilepsy: from bench to bedside. Trends Pharmacol Sci. 2016;37:463-84.
3. Liimatainen S, Fallah M, Kharazmi E, Haapala AM, Isojärvi J, Peltola J. High concentration of immunoglobulin A is associated with temporal lobe epilepsy. Epilepsy Res. 2013;103:54-61.
4. Zahorec R. Ratio of neutrophil to lymphocyte counts--rapid and simple parameter of systemic inflammation and stress in critically ill. Bratisl Lek Listy. 2001;102:5-14. English, Slovak.
5. Imtiaz F, Shafique K, Mirza SS, Ayoob Z, Vart P, Rao S. Neutrophil lymphocyte ratio as a measure of systemic inflammation in prevalent chronic diseases in Asian population. Int Arch Med. 2012;5:2.

Choudhury HA, Purkayastha RN, Singha YSK. Evaluation of peripheral inflammatory markers in children and adolescents with epilepsy: a cross-sectional comparative study. Open J Psychiatry Allied Sci. 2025 Dec 25. Epub ahead of print.

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