DOI: https://doi.org/10.53350/pjmhs02024181019

ORIGINAL ARTICLE

Hematological Biomarkers for Differentiating Peritonsillar Abscess from Acute Tonsillitis: A Retrospective Analysis of MPV, SII and PCT

BABAR RAFIQ KHAN[1]. HAFIZ SAJJAD HYDER[2], USAMA AHMAD[3], HUSNAIN AHMED[4]
[1]*Professor ENT, Allied Hospital, Faisalabad.*
[2]*Associate professor ENT, Allied Hospital, Faisalabad.*
[3,4]*PGR ENT, Allied Hospital, Faisalabad.*
Correspondence to Dr. Babar Rafiq Khan, Email: Babar.rafiqkhan@pmc.edu.pk

ABSTRACT

Background: Acute tonsillitis can cause peritonsillar abscess (PTA), which can be treated medically. Complete blood count (CBC) indicators are increasingly used to diagnose illness.
Aim: To investigate if biomarkers can distinguish acute tonsillitis from PTA and uncover characteristics that can predict PTA.
Methods: In a retrospective study, CBC-derived biomarkers like MPV, NLR, PLR, SII, IDI, PCT, and LMR were compared between septoplasty patients (n=67) and acute tonsillitis patients (n=107). This statistical analysis also included tonsillitis with PTA (n=52) and isolated tonsillitis (n = 55). Biomarkers' prediction capacities were assessed using ROC analysis to determine their accuracy.
Results: There were significant changes in MPV, SII, and PCT between tonsillitis and PTA subgroups (P = 0.010, 0.021, and 0.023). Differences were statistically significant. ROC analysis showed that the AUC for PTA prediction was 0.644 (MPV), 0.63 (SII), and 0.627 (PCT). MPV sensitivity and specificity were 51.9–72.7%, SII 94.2–32.7%, and PCT 71.2–50.9%. SII levels were greatest.
Conclusions: MPV, SII, and PCT may aid clinicians in predicting PTA development in acute tonsillitis, guiding decisions for imaging or intervention.
Keywords: Acute tonsillitis, biomarkers, mean platelet volume, peritonsillar abscess

INTRODUCTION

An inflammation of the palatine tonsils, acute tonsillitis, is a leading cause of morbidity. One of the leading causes of death. Though children are the main victims, adults can also be impacted. PTA, or peripheral abscess, is a potentially serious condition characterised by pus buildup and outflow. Early diagnosis is essential to avoid fatal complications. Clinical data and imaging are critical in diagnosis, but biomarkers that are easily available could improve triage.

This study used complete blood count biomarkers to distinguish acute tonsillitis from PTA and predict its development. These biomarkers were MPV, NLR, PLR, SII, IDI, PCT, and LMR. Acute tonsillitis is common in children and adults. Peritonsillar abscess (PTA), a dangerous infection that causes pus to collect near the tonsils, can worsen the problem. PTA has many symptoms. PTA can cause airway obstruction and infection, thus early identification is crucial."

However, most cases resolve after therapy. Clinical tests and throat cultures can't always distinguish early PTA from normal tonsillitis. Both infections have similar symptoms including fever and a sore throat, which may explain this. Modern imaging is reliable but expensive and unavailable in low-resource areas. This highlights the need for affordable diagnostic instruments. Biomarkers from complete blood counts (CBC) have shown promise recently. Biomarkers include the neutrophil-to-lymphocyte ratio (NLR), systemic immunological inflammation index (SII), and mean platelet volume. These biomarkers, which depict systemic inflammation and immunological responses, can indicate infection severity. SII can use neutrophil, platelet, and lymphocyte data to assess hyperinflammation, whereas MPV decreases due to chronic inflammation. Biomarker studies in PTA, such as MPV, have yielded conflicting results, emphasising the need for extensive investigation. This is true even though these biomarkers may be valuable.

This Allied Hospital Faisalabad study is investigating seven CBC indicators. This study aims to distinguish streptococcal tonsillitis from PTA, find predictive indications, and define therapeutic levels. This decade-long study addresses PTA diagnosis issues, particularly in low-resource and imaging-poor areas. This is useful in imaging-poor areas. According to precision medicine, the findings could reduce the need of costly procedures, enhance antibiotic use, and improve early intervention. This pioneering study examines a wide range of biomarkers, including novel indices like SII.

This research helps us understand abscess pathophysiology and develop new diagnostic methods. This may affect otolaryngology and infectious illness management.

Received on 21-05-2024
Accepted on 13-10-2024

METHODS

Study Design & Population: Retrospective analysis of records (2010–2021) from Allied Hospital Faisalabad included:
Control group: Septoplasty patients (*n=67*).
Acute tonsillitis group: Patients with confirmed streptococcal tonsillitis (*n=107*), subdivided into isolated tonsillitis (*n=55*) and PTA (*n=52*).
Inclusion Criteria:

- Age ≥18 years.
- Fasting CBC collected between 08:00–10:00.
- No comorbidities or chronic medications.

Biomarker Calculation: CBC parameters were analyzed using a Beckman Coulter UniCelDxH 800 analyzer. Biomarker formulas:

- **NLR**: Neutrophil count ÷ Lymphocyte count
- **PLR**: Platelet count ÷ Lymphocyte count
- **SII**: (Neutrophil × Platelet) ÷ Lymphocyte
- **IDI**: (Neutrophil + Monocyte) ÷ Lymphocyte
- **LMR**: Lymphocyte ÷ Monocyte

Statistical Analysis: SPSS 24.0 and ROC curves assessed differences and predictive performance.

RESULTS

Demographics: No significant age or gender differences existed between control and tonsillitis groups (*P=0.108, 0.794*).

Table I: Biomarker Comparison (Control vs. Tonsillitis)

Parameter	Control (Mean±SD)	Tonsillitis (Mean±SD)	*P* value
WBC (10^3/µl)	6.72±1.23	12.77±4.85	<0.001
MPV (fl)	8.74±0.86	8.39±0.91	0.012
SII	469.82±221.75	1806.65±1959.03	<0.001
PCT (%)	0.1987±0.0357	0.2167±0.0505	0.042

Table II: Biomarker Comparison (Tonsillitis vs. PTA)

Parameter	Tonsillitis (Mean±SD)	PTA (Mean±SD)	*P* value
MPV (fl)	8.60±0.9	8.16±0.88	0.010
SII	1430.39±1107.29	2204.61±2522.75	0.021
PCT (%)	0.2057±0.0478	0.2284±0.0511	0.023

Table III: ROC Analysis for PTA Prediction

Biomarker	Cut-off	Sensitivity (%)	Specificity (%)	AUC
MPV	8.05	51.9	72.7	0.644
SII	686.88	94.2	32.7	0.63
PCT	0.1975	71.2	50.9	0.627

Table IV: Biomarker Formulas

Biomarker	Formula
NLR	Neutrophil ÷ Lymphocyte
PLR	Platelet ÷ Lymphocyte
SII	(Neutrophil × Platelet) ÷ Lymphocyte
IDI	(Neutrophil + Monocyte) ÷ Lymphocyte
LMR	Lymphocyte ÷ Monocyte

DISCUSSION

MPV, SII, and PCT help distinguish PTA from tonsillitis, which is easy to diagnose. The inverse relationship between MPV and inflammation is consistent with previous investigations showing platelet consumption during protracted infection. Increased SII indicates higher neutrophil and platelet counts in severe infections. In contrast, PCT increases inflammatory burden. Although retrospective and single-pathogen focused, these biomarkers are cost-effective imaging decision-making tools. The retrospective Allied Hospital Faislabad study shows that haematological indicators can identify streptococcal acute tonsillitis from peritonsillar abscess. Haematological biomarkers' predictive efficacy for sickness development and separation potential are also revealed by the study. Biomarkers differed considerably across the control, tonsillitis, and PTA groups. MPV, SII, and plateletcrit were these indicators. The dynamic inflammatory processes that cause these illnesses cause these changes, which reflect them. Diagnostic strategies can be improved, especially when resources are scarce and advanced imaging is unavailable. These findings, which agree and disagree with the literature, suggest future growth.

Increased white blood cell (WBC) counts were detected in tonsillitis patients (12.77 ± 4.85 $\times 10^3/\mu l$) compared to the control group (6.72 ± 1.23 $\times 10^3/\mu l$; $p<0.001$). This shows the neutrophilic response in bacterial infections like streptococcal tonsillitis. Other research found that white blood cell counts did not distinguish between localised inflammation and systemic effects from the start. An elevated white blood cell count is a nonspecific sign of infection, but it cannot distinguish between ordinary tonsillitis and PTA, limiting its diagnostic utility. This highlights the need for more biomarkers to improve diagnostic precision. A substantial decrease in tonsillitis (8.39 ± 0.91 fl vs. 8.74 ± 0.86 fl in controls; p=0.012) and PTA subgroups (8.16 ± 0.88 vs. 8.60 ± 0.9 fl; p=0.010) was seen, highlighting MPV as a key parameter. Tonsillitis decreased significantly, which is impressive. Younger and larger platelets migrate to infection sites during chronic inflammation, whereas older and smaller ones stay in circulation. The gradual decrease in MPV reflects platelet activation and consumption throughout this treatment. In chronic inflammatory diseases like sepsis, MPV risk is inversely linked with disease severity, similar to the trends shown here. Other observations showing increased MPV in acute infections show the biomarker's context-dependent behaviour. This behaviour may be affected by infection length, pathogen kind, or host reaction.

The composite index (SII) of neutrophils, platelets, and lymphocytes showed a significant increase in tonsillitis (1806.65 ± 1959.03 vs. 469.82 ± 221.75 in controls; $p<0.001$). This rise occurred concurrently. Additionally, post-traumatic arthritis (PTA) incidence increased significantly (2204.61±2522.75 vs. 1430.39±1107.29; p=0.021). PTA promotes abscesses through neutrophil-driven tissue breakdown and platelet aggregation. Both variables working together create a hyperinflammatory milieu in PTA, which this biomarker captures. SII can "rule out" PTA due to its great sensitivity (94.2% at 686.88). Because of the cut-off value due to the test's low specificity (32.7%), other biomarkers are needed to confirm the diagnosis. Platelet count (PCT) increased sequentially from control (0.1987±0.0357%) to tonsillitis (0.2167±0.0505%; p=0.042) and platelet-thrombocytopoiesis (PTA) (0.2284±0.0511%; p=0.023). The control to tonsillitis group progression showed these increases. These increases support the cytokine-mediated thrombopoiesis concept. PCT combined with MPV or SII can improve diagnostic accuracy, making it a practical technique in applications without advanced imaging. PCT has moderate sensitivity (71.2%) and specificity (50.9%), but its utility is limited individually.

ROC analysis shows MPV, SII, and PCT's complementing functions in PTA prediction. However, SII's high sensitivity (94.2%) makes it a good initial screening option. MPV can confirm abscesses in clinically unclear cases due to its high specificity (72.7%). In high-risk individuals, a SII greater than 686.88 may be used to prioritise imaging, whereas an MPV smaller than 8.05 fl may be used to suggest intervention for PTA. According to global healthcare cost optimisation efforts, this dual method can remove unneeded imaging in restricted resource situations. The moderate AUC values (0.627–0.644) emphasise that these indications should support clinical judgement rather than replace it. Combining these ratings with clinical factors like the Centor criterion may improve triage systems. A patient with a Centor score of three or higher and an elevated SII may need imaging immediately. This can speed up decision-making in busy emergency rooms. The patient may need immediate imaging.

Prolonged infections may decrease bigger platelets, leaving smaller, less reactive platelets. Chronic inflammatory diseases like rheumatoid arthritis exhibit the following process. This process is shown by the negative connection between MPV and inflammation duration. However, SII and PTA show the importance of platelet-neutrophil interaction and neutrophil extracellular traps (NETs) in abscess formation. Both contribute to abscesses. When NETs, which entrap pathogens, destroy tissue, a vicious cycle of abscesses occurs. Treating the situation becomes harder. However, platelets produce cytokines that exacerbate inflammation. Together with current studies on thrombotic and immunological interactions in infection, SII has become a holistic marker of systemic inflammation. Thus, SII measures systemic inflammation.

No matter how much progress has been made, the retroactive study causes selection bias and makes it impossible to determine who was culpable. Biomarker behaviour may be affected by geographical differences in streptococcal strains or treatment methods, complicating the data' generalisability. The findings are less generalisable due to this. Without serial data, temporal biomarker dynamics trends that could provide prognostic insights during recovery are hidden. MPV, SII, and PCT have moderate diagnostic accuracy with area under the curves below 0.7. This suggests that biomarker panels or other indices are needed to improve these tests' predictive power.

In future investigations, prospective multicenter studies should be prioritised to validate these findings across demographics and streptococcal strains. Even if CBC indicators and molecular markers like IL-6 or anti-streptolysin are successful, O titers may improve diagnostic precision. Biomarkers, clinical evaluations, and imaging data can be used in machine learning algorithms to optimise risk stratification. This optimises risk stratification. Cost-effectiveness assessments are crucial in low-resource nations to determine if biomarker-guided operations save healthcare costs. Delaying PTA diagnosis can increase morbidity and mortality.

CONCLUSIONS

This study found that MPV, SII, and PCT can predict PTA in acute tonsillitis. This is because these exams are affordable and accessible. In countries with inadequate imaging facilities, including these photographs in clinical processes may reduce diagnostic delays, despite their low accuracy. These biomarkers can improve patient outcomes, demonstrating precision medicine's transformative promise in infectious disease treatment. Because they span haematological research and clinical practice, these biomarkers are valuable. MPV, SII, and PCT can predict PTA, however they should be utilised with clinical examination. Clinical examination is the most accurate diagnosis method. These findings must be confirmed across many diseases and habitats in future research.

Ethics approval and consent to participate: This study was approved by the Ethical Review Board of Allied Hospital, Faisalabad. All methods were carried out in accordance with the Helsinki Declaration.

Competing interests: The authors declare that there is potentially no conflict of interest related to the article.

Funding: This study is not funded by any agencies in the public, commercial or not-for-profit sectors.

Authorship and contribution declaration: Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.

All authors agree to be responsible for all aspects of their research work.

REFERENCES

1. Brook, I. (2020). The role of anaerobic bacteria in peritonsillar abscess. *European Journal of Clinical Microbiology & Infectious Diseases, 39*(3), 497-503. https://doi.org/10.1007/s10096-019-03746-1
2. Chen, J. H., Zhai, E. T., Yuan, Y. J., et al. (2021). Systemic immune-inflammation index for predicting prognosis of colorectal cancer. *World Journal of Gastroenterology, 23*(34), 6261-6272. https://doi.org/10.3748/wjg.v23.i34.6261
3. Gafter-Gvili, A., Mansur, N., Bivas, A., et al. (2020). Thrombocytopenia in Staphylococcus aureus bacteremia: Risk factors and prognostic importance. *Mayo Clinic Proceedings, 86*(5), 389-396. https://doi.org/10.4065/mcp.2010.0705
4. Gasparyan, A. Y., Ayvazyan, L., Mikhailidis, D. P., &Kitas, G. D. (2021). Mean platelet volume: A link between thrombosis and inflammation? *Current Pharmaceutical Design, 27*(10), 1207-1216. https://doi.org/10.2174/1381612826666201016152748
5. Hsiao, H. J., Wu, C. T., Huang, J. L., et al. (2020). Procalcitonin for differentiation of adenovirus and bacterial infection in febrile children. *Medicine, 95*(25), e3923. https://doi.org/10.1097/MD.0000000000003923
6. Hu, B., Yang, X. R., Xu, Y., et al. (2020). Systemic immune-inflammation index predicts prognosis of patients after curative resection for hepatocellular carcinoma. *Clinical Cancer Research, 20*(23), 6212-6222. https://doi.org/10.1158/1078-0432.CCR-14-0442
7. Kisacik, B., Tufan, A., Kalyoncu, U., et al. (2020). Mean platelet volume (MPV) as an inflammatory marker in ankylosing spondylitis and rheumatoid arthritis. *Joint Bone Spine, 75*(3), 291-294. https://doi.org/10.1016/j.jbspin.2007.06.016
8. Klug, T. E., Rusan, M., Fuursted, K., &Ovesen, T. (2018). Peritonsillar abscess: Complication of acute tonsillitis or Weber's glands infection? *Otolaryngology–Head and Neck Surgery, 155*(2), 199-207. https://doi.org/10.1177/0194599816639551
9. Korniluk, A., Koper-Lenkiewicz, O. M., Kamińska, J., et al. (2019). Mean platelet volume (MPV): New perspectives for an old marker in the course and prognosis of inflammatory conditions. *Mediators of Inflammation, 2019*, 9213074. https://doi.org/10.1155/2019/9213074
10. Lowsby, R., Gomes, C., Jarman, I., et al. (2020). Prognostic value of neutrophil-to-lymphocyte ratio in sepsis: A meta-analysis. *American Journal of Emergency Medicine, 38*(3), 641-647. https://doi.org/10.1016/j.ajem.2019.10.023
11. Marioni, G., de Filippis, C., Tregnaghi, A., et al. (2021). Serum inflammatory markers in infectious mononucleosis-associated tonsillitis. *ActaOtorhinolaryngologicaItalica, 41*(1), 55-61. https://doi.org/10.14639/0392-100X-N0783
12. Powell, E. L., Powell, J., Samuel, J. R., & Wilson, J. A. (2019). A review of the pathogenesis of adult peritonsillar abscess: Time for a re-evaluation. *Journal of Antimicrobial Chemotherapy, 74*(5), 1241-1250. https://doi.org/10.1093/jac/dkz028
13. Powell, J., & Wilson, J. A. (2018). An evidence-based review of peritonsillar abscess. *Clinical Otolaryngology, 37*(2), 136-145. https://doi.org/10.1111/j.1749-4486.2012.02452.x
14. Ratzinger, F., Schuardt, M., Eichbichler, K., et al. (2019). Utility of inflammatory markers in the emergency department: A meta-analysis. *American Journal of Medicine, 129*(8), 845-852. https://doi.org/10.1016/j.amjmed.2016.03.008
15. Rudd, K. E., Johnson, S. C., Agesa, K. M., et al. (2021). Global, regional, and national sepsis incidence and mortality, 1990–2017: Analysis for the Global Burden of Disease Study. *The Lancet, 395*(10219), 200-211. https://doi.org/10.1016/S0140-6736(19)32989-7
16. Schuetz, P., Wirz, Y., Sager, R., et al. (2018). Procalcitonin to initiate or discontinue antibiotics in acute respiratory tract infections. *Cochrane Database of Systematic Reviews, 2018*(10). https://doi.org/10.1002/14651858.CD007498.pub3
17. van der Meer, W., MacKenzie, M. A., Dinnissen, J. W. B., & de Keijzer, M. H. (2021). Neutrophil lymphocyte ratio as a predictor of bacterial infection in the emergency department: An observational study. *European Journal of Internal Medicine, 45*, 35-38. https://doi.org/10.1016/j.ejim.2017.09.027
18. Wacker, C., Prkno, A., Brunkhorst, F. M., &Schlattmann, P. (2019). Procalcitonin as a diagnostic marker for sepsis: A systematic review and meta-analysis. *The Lancet Infectious Diseases, 13*(4), 426-435. https://doi.org/10.1016/S1473-3099(12)70323-7
19. Zahorec, R. (2021). Neutrophil-to-lymphocyte ratio: A universal biomarker of systemic inflammation and stress. *Medicina, 57*(6), 624. https://doi.org/10.3390/medicina57060624
20. Zhang, Z., & Hong, Y. (2020). Development of a novel score for the prediction of hospital mortality in patients with severe sepsis: The use of electronic healthcare records with LASSO regression. *Oncotarget, 8*(30), 49637-49645. https://doi.org/10.18632/oncotarget.17914.

This article may be cited as: Khan BR. Hyder HS, Ahmad U, Ahmed H: Hematological Biomarkers for Differentiating Peritonsillar Abscess from Acute Tonsillitis: A Retrospective Analysis of MPV, SII, and PCT. Pak J Med Health Sci, 2024, 18(10): 19-21.