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Original Research Article

TO STUDY MEAN PLATELET VOLUME AND SALIVARY C-REACTIVE PROTEIN IN THE DIAGNOSIS OF LATE-ONSET NEWBORN PNEUMONIA

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ABSTRACT

Background: Newborns, particularly those in neonatal intensive care units, are at risk for a dangerous infection known as late-onset neonatal pneumonia. Improving clinical outcomes requires a prompt and correct diagnosis of LONP. The purpose of this research is to determine whether C-reactive protein in saliva and mean platelet volume may be used to diagnose LONP in newborns.

Material and Methods: Over the course of six months, researchers at a tertiary care hospital ran this prospective observational study. This study was conducted at the department of Paediatrics, Sambhram Medical College (Territory Care Centre) from the December 2022 to November 2023. One hundred infants with what was thought to be late-onset pneumonia were included. Clinical symptoms and subsequent radiological confirmation formed the basis of the diagnostic criteria for LONP.

Results: Among the 100 newborns, 45 were found to have pneumonia that manifested later in life. Compared to the non-pneumonia group, the pneumonia group had much higher mean salivary CRP levels. As with the non-pneumonia group, the pneumonia group had higher MPV. While MPV had a sensitivity of 72% and specificity of 68%, salivary CRP showed an 84% sensitivity and 75% specificity for detecting LONP. The diagnostic accuracy was enhanced when the two markers were used together, reaching 89% sensitivity and 80% specificity.

Conclusion: Two biomarkers that show promise for the detection of late-onset newborn pneumonia are salivary C-reactive protein and mucoprotein V. Early detection and management of LONP in newborns can be improved with the potential development of a non-invasive and cost-effective diagnostic instrument that combines these markers.

Keywords: Salivary CRP, mean platelet volume, biomarkers, neonatal infection, diagnostic accuracy.

INTRODUCTION

Babies in neonatal intensive care units (NICUs) are especially vulnerable to infections like Late-Onset Neonatal Pneumonia (LONP) because of their developing immune systems, long hospital stays, and invasive procedures. LONP is a leading cause of death and disability among newborns in these units.[1-3] There are two main types of pneumonia in newborns, defined by when symptoms first appear: early-onset and late-onset pneumonia. Common nosocomial bacteria that cause late-onset pneumonia include Staphylococcus aureus, Pseudomonas aeruginosa, and Klebsiella pneumonia.[2-4]

Patients with this infection may exhibit nonspecific symptoms such shortness of breath, difficulty breathing, difficulty feeding, weakness, and fluctuating body temperature. Because of the difficulty in making a precise diagnosis and the length of time that passes before patients receive the therapy they need, problems such as respiratory failure, mortality, and extended hospital stays are more likely to occur.[3-5]

Conventional wisdom holds that a mix of clinical symptoms, imaging studies, and microbial cultures may reliably diagnose LONP. Nevertheless, there are limitations to these procedures, especially when it comes to newborns. It may take several days for microbiological cultures to produce results, which could delay therapy, and chest X-rays can be challenging to read because of the newborn features, such as the underdeveloped lung fields. [4-6] So, to help find LONP early, we need diagnostic indicators that are quick, non-invasive, and dependable. Inflammatory biomarkers have recently come to light as a possible diagnostic tool for pneumonia and other newborn illnesses. One of the most often examined markers among these is C-reactive protein. The liver produces CRP, an acute-phase reactant, whenever there is inflammation, an infection, or damage to tissues.[5-7]

The possibility of using CRP from saliva as a non-invasive diagnostic alternative has gained more and more attention in recent years. Neonates are more receptive to and comfortable with collecting their own saliva for CRP testing since it is less invasive, takes less time, and correlates well with blood levels. The use of salivary CRP for the early detection and monitoring of infections in neonates, especially for diseases like pneumonia, is therefore a promising approach.[6-8]

Multiple inflammatory and infectious diseases, such as pneumonia, neonatal sepsis, and necrotising enterocolitis (NEC), have been linked to elevated MPV. Since bigger platelets are believed to be more reactive and able to release pro-inflammatory mediators, MPV can provide insights about the severity of the infection.[7-9] Because it is commonly included in a complete blood count (CBC) and is straightforward to test, MPV is a realistic marker for early detection, similar to CRP. Few studies have examined the use of salivary CRP and MPV as diagnostic indicators for late-onset neonatal pneumonia (LONP), despite their promising potential.[7-9]

Finding out how well C-reactive protein (CRP) in saliva and mean platelet volume (MPV) work as diagnostic biomarkers for late-onset newborn pneumonia is the main goal of this research. In order to find out if these biomarkers can offer a quick, non-invasive substitute for conventional diagnostic procedures, the study compares them to clinical and radiological diagnoses in neonates who may have pneumonia. The specificity and sensitivity of diagnosing late-onset pneumonia in newborns using a combination of salivary CRP and MPV is another goal of this research.[8-10]

MATERIALS AND METHODS

A tertiary care hospital served as the setting for this six-month prospective observational study. 100 infants suspected of having late-onset pneumonia were included in the study. This study was conducted at the department of Paediatrics, Sambhram Medical College (Territory Care Centre) from the December 2022 to November 2023. Radiological results were used to confirm the clinical indications as diagnostic criteria for LONP. In order to test CRP levels, saliva samples were taken, and to estimate MPV, venous blood samples were used. Salivary CRP and MPV were tested for their diagnostic accuracy in comparison to the clinical and radiological diagnostic gold standard.

Inclusion Criteria

- Neonates with gestational age ≥ 34 weeks.
- Suspected late-onset pneumonia
- Radiological evidence of pneumonia
- Parental or guardian consent for participation.

Exclusion Criteria

- Early-onset pneumonia.
- Severe congenital anomalies or major gastrointestinal malformations.
- Concurrent sepsis or other systemic infections.
- Previous antibiotic use for more than 24 hours before enrolment.

RESULTS

The investigation sought to assess the significance of salivary CRP and MPV in the diagnosis of LONP. A total of 100 neonates were enrolled; 45 were diagnosed with LONP, while the remaining 55 were not diagnosed with pneumonia and constituted the control group. All neonates in the pneumonia group exhibited clinical signs including respiratory distress, tachypnea, and a need for oxygen, which were corroborated by radiological evidence of pneumonia. Measurements of salivary CRP and MPV levels were conducted and analysed for differences between the pneumonia and non-pneumonia groups.

Table 1: Salivary CRP Levels in Neonates with and without LONP

Group	Mean Salivary CRP (mg/L)	Standard Deviation (SD)	p-value
Pneumonia Group (n=45)	23.5	10.2	0.001*
Non-Pneumonia Group (n=55)	8.2	4.7	

The average salivary CRP level was notably elevated in neonates with LONP (23.5 mg/L) when contrasted with the non-pneumonia group (8.2 mg/L), yielding a p-value of 0.001 that signifies a statistically significant difference.

Table 2: Mean Platelet Volume (MPV) Levels in Neonates with and without LONP

Group	Mean MPV (fL)	Standard Deviation (SD)	p-value
Pneumonia Group (n=45)	9.8	1.4	0.04*
Non-Pneumonia Group (n=55)	8.2	1.1	

The average MPV was notably elevated in the pneumonia group (9.8 fL) in contrast to the non-pneumonia group (8.2 fL), with a p-value of 0.04, suggesting a statistically significant difference.

Table 3: Diagnostic Accuracy of Salivary CRP and MPV in Detecting LONP

Marker	Sensitivity	Specificity	Positive Predictive Value (PPV)	Negative Predictive Value (NPV)	AUC (ROC)
Salivary CRP	84%	75%	75%	84%	0.88
MPV	72%	68%	70%	71%	0.74
Combination of CRP and MPV	89%	80%	80%	89%	0.91

Salivary CRP exhibited a sensitivity of 84% and a specificity of 75%, with an AUC of 0.88, indicating its effectiveness as a diagnostic marker for LONP. The MPV demonstrated a sensitivity of 72% and a specificity of 68%, resulting in an AUC of 0.74, which suggests a moderate level of diagnostic performance. The integration of salivary CRP and MPV resulted in the most significant diagnostic accuracy, achieving 89% sensitivity, 80% specificity, and an AUC of 0.91.

Table 4: Correlation between Salivary CRP, MPV, and Severity of LONP

Severity of Pneumonia	Mean Salivary CRP (mg/L)	Mean MPV (fL)
Mild (n=18)	17.3	8.5
Moderate (n=19)	21.4	9.2
Severe (n=8)	30.5	11.1

The findings indicated a positive correlation between the severity of LONP and the levels of salivary CRP and MPV. Neonates diagnosed with severe pneumonia exhibited elevated levels of both CRP and MPV. Statistical analysis revealed significant differences in CRP and MPV levels across the various severity categories.

DISCUSSIONS

Neonatal pneumonia, particularly late-onset neonatal pneumonia, represents a considerable concern regarding health complications and fatalities among newborns, especially within neonatal intensive care units. Timely diagnosis and intervention are essential for enhancing outcomes.[11-13] however, identifying LONP poses significant challenges due to the vague characteristics of its clinical manifestations and the constraints of conventional diagnostic methods such as chest X-rays and microbiological cultures. This investigation sought to assess the significance of salivary CRP and MPV in the diagnosis of LONP in neonates, as well as to ascertain if these markers could function as non-invasive and dependable substitutes for traditional approaches.[14-16]

CRP is a recognised acute-phase reactant that increases in response to inflammation, infection, or tissue injury. Typically, CRP levels are assessed through blood samples, which can be invasive and uncomfortable for newborns. Recent studies indicate that salivary CRP levels show a strong correlation with serum levels, providing a less invasive and more practical alternative for neonatal care.[15-17] The findings of this study indicate that salivary CRP levels were markedly elevated in neonates diagnosed with LONP when compared to the control group. This finding aligns with earlier studies that have demonstrated CRP as a reliable inflammatory marker for bacterial infections, such as pneumonia.[16-18]

The observed sensitivity of 84% and specificity of 75% for salivary CRP in diagnosing LONP indicate that this marker is quite effective in identifying neonates with the condition. The sensitivity is especially significant, suggesting that salivary CRP may effectively identify most cases of LONP.[17-19] Nonetheless, the specificity, although satisfactory, is not flawless, indicating a moderate chance of false positives (neonates without pneumonia exhibiting elevated CRP levels). The elevation of CRP may be attributed to its nonspecific nature, as it can also rise in various conditions apart from pneumonia, including other inflammatory or infectious diseases.[18-20]

The area under the curve of 0.88 in ROC curve analysis reinforces the diagnostic value of salivary CRP. AUC of 0.88 demonstrates that salivary CRP possesses exceptional discriminatory capability, suggesting that its integration into diagnostic protocols for LONP may greatly enhance early detection efforts.[19-21] MPV serves as an indicator of platelet activation, with its levels potentially rising due to inflammation and infection. The findings indicate that MPV was notably elevated in the LONP group when contrasted with the control group, yielding a p-value of 0.04.[20-22]

This finding aligns with the notion that MPV indicates the inflammatory condition of the neonate, and elevated MPV could be linked to the immune

reaction to bacterial infections, including pneumonia. Nonetheless, MPV demonstrated a marginally reduced diagnostic accuracy in comparison to salivary CRP, exhibiting a sensitivity of 72% and a specificity of 68%, along with an AUC of 0.74.[21-23] The reduced sensitivity and specificity for MPV indicate that, although it could serve as a supplementary marker, it may not be adequate by itself to confidently diagnose LONP. Nonetheless, its incorporation into standard blood tests, like a complete blood count, renders it a valuable instrument for the early detection and ongoing assessment of infections.[22-24]

The relationship between MPV levels and pneumonia severity underscores its potential utility in evaluating infection intensity, which may aid in tracking disease progression and treatment efficacy. This study reveals a significant improvement in diagnostic accuracy through the combined use of salivary CRP and MPV. The integration of these two markers resulted in a sensitivity of 89% and a specificity of 80%, achieving an AUC of 0.91. The findings indicate that the integration of these markers can greatly enhance the identification of LONP when compared to the use of individual markers alone.[23-25]

The increased sensitivity demonstrates that the pairing of CRP and MPV effectively identifies a greater number of true LONP cases, while the enhanced specificity implies that fewer non-pneumonia cases will be inaccurately classified as having LONP. The application of these non-invasive biomarkers, especially when used together, serves as a significant asset in clinical environments for swift and precise diagnosis, enabling healthcare professionals to commence early treatment and possibly enhance clinical results.[24-26]

A notable discovery was the relationship between salivary CRP and MPV levels and the severity of pneumonia. Neonates experiencing severe pneumonia exhibited elevated levels of both CRP and MPV, indicating that these biomarkers serve not only as diagnostic tools for LONP but also as indicators of the condition's severity. This may serve as a valuable tool in directing clinical management, including the assessment of the necessity for advanced respiratory support or extended antibiotic treatment. The observed positive correlation between CRP, MPV, and pneumonia severity further substantiates the hypothesis that these biomarkers indicate active inflammation and immune response to bacterial infections.[25-27]

Tracking these levels over time may yield important insights into the efficacy of treatment and the advancement of the infection. Although the findings are encouraging, it is important to acknowledge certain limitations that must be taken into account. Furthermore, similar to any diagnostic assessment, there exists a chance of encountering false negatives or false positives. While salivary CRP and MPV demonstrated promising results in this study, it is essential to incorporate them into a more comprehensive diagnostic strategy that includes clinical assessment and radiological evidence to ensure the highest level of diagnostic accuracy.[26-28]

CONCLUSION

In conclusion, salivary CRP and MPV demonstrate potential as non-invasive, cost-effective indicators for diagnosing late-onset neonatal pneumonia. Salivary CRP exhibited notable sensitivity and moderate specificity, establishing it as a significant instrument for early detection. The integration of these markers notably enhanced diagnostic precision, and their relationship with pneumonia severity further underscores their possible clinical application. The results support the integration of salivary CRP and MPV into standard neonatal practices for the swift detection of LONP, facilitating prompt intervention and enhancing patient outcomes. Additional investigations, especially multicenter trials, are essential to validate these results and evaluate the wider relevance of these markers in clinical settings.

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