Section: Pathology

Original Research Article

MEASUREMENT OF PLATELET INDICES AND THEIR CORRELATION WITH SEVERITY OF COMMUNITY ACQUIRED PNEUMONIA

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ABSTRACT

Background: Pneumonia is a form of acute infection involving the lungs. It kills over 700000 children of age less than 5 years annually, which is equivalent to around 2000 per day including about 190000 newborns. It is the single largest infectious cause of death in children worldwide. The objective is to study the measurement Of Platelet Indices and their Correlation with Severity of Community Acquired Pneumonia. **Materials and Methods:** This hospital based, observational study was conducted in the Department of Pathology and Department of Pediatrics, Faculty of Medicine and Health Sciences, SGT University, Gurugram. Study participants were all patients diagnosed with community acquired pneumonia between age of 6 months to 5 years coming to Pediatrics department. **Result:** Platelet count was highest among the younger children. PLR correlated well with severity of pneumonia and can have a good diagnostic accuracy for predicting severe pneumonia. also showed significant differences. Other parameters did not show significant variation according to age. Out of the 45 severe cases, our auto analyzer flagged leukocytosis in 14 cases (31.1%) and thrombocytosis in one case. None of the mild cases had any flags. The results of this study provide valuable insight into the potential of automated hematology analyzer flags as a rapid and readily available tool for predicting pneumonia severity in children. This approach could aid in early identification of high-risk patients, enabling timely escalation of care and improved outcomes. **Conclusion:** Platelet indices like MPV, PDW, PLCC, PLCR, PCT are reported and can be readily available for analysis in advanced auto analysers. IPF was also included in this study as a research parameter and values were compared between mild and severe groups.

INTRODUCTION

Childhood pneumonia manifests in various forms and its causative agents include a range of pathogens like bacteria, viruses, and fungi. Clinical presentation of childhood pneumonia can vary from mild symptoms resembling common cold to severe illness requiring hospitalization.[1] The most common bacterial cause of pneumonia in children is Streptococcus pneumoniae. Viral pathogens like RSV and influenza also play significant roles.[1] Epidemiology of pneumonia is affected by multiple factors like geographic location, social and economic class, and availability of healthcare services.

In high-income countries, the incidence of childhood pneumonia has been reduced significantly through widespread vaccination programs, improved sanitation, and better healthcare access. However, disparities remain, and vulnerable populations continue to face high risks of morbidity and mortality from pneumonia. Conversely, in low-resource settings, challenges of diagnosing and treating pneumonia are compounded by factors such as limited access to medical facilities, inadequate health awareness, and poor living conditions. These problems necessitate a multifaceted approach in order to address both preventive and therapeutic aspects of pneumonia care.

Healthcare accessibility and quality are pivotal in managing and mitigating impact of pneumonia. Early

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diagnosis, classification of risk and appropriate treatment are essential to reduce morbidity and mortality. However, in many areas, especially those with limited resources, there are significant barriers to accessing timely and efficient medical care. These barriers include financial constraints, lack of healthcare infrastructure including manpower, and insufficient training of healthcare providers.[2]

In addition to vaccination, promoting good hygiene practices, improving nutritional status, reducing overcrowding in households and reducing indoor air pollution are critical components of pneumonia prevention. Public health initiatives aimed at improving living conditions, enhancing access to clean water and sanitation, and educating communities about respiratory health can play a significant role in reducing burden of pneumonia.

Future research should also focus on addressing disparities in healthcare by exploring ways to improve healthcare access and quality in underserved populations. Interdisciplinary approaches that combine medical research with social science insights can provide a more comprehensive understanding of the factors influencing pneumonia outcomes and help in forming more effective interventions to reduce incidence of pneumonia as well as reducing morbidity.

Childhood pneumonia remains a significant global health issue with profound implications for affected children and their families. Addressing this challenge requires a multifaceted approach that includes prevention through vaccination and improved living conditions, early diagnosis and treatment, and ongoing research to address existing gaps. By advancing our understanding and response to childhood pneumonia, we can work towards reducing its impact and improving the health and well-being of children around the world.

MATERIALS AND METHODS

This hospital based, observational study was conducted among in the Department of Pathology and Department of Paediatrics, Faculty of Medicine and Health Sciences, SGT University, Gurugram. Study participants were all patients who were between age of 6 months to 5 years coming to Paediatrics department and had been diagnosed with community acquired pneumonia. Blood samples was collected from patients in Department of Paediatrics and was sent to laboratory at Department of Pathology. Duration of study was one and a half year after clearance from ethical committee

Total Sample Size

Total 90 patients were included in the study as per the sample size calculated by following formula.

n= (z)2pq/(L)2 n=sample size

z= level of confidence according to the standard normal distribution (for a level of confidence 95%;z=1.96)

p= 36 (prevalence of pneumonia among children in Haryana)

L= 10 (error)

q= 100-36= 64

Applying the above formula value obtained is 88.5. Hence a sample size of 90 is taken. Out of these 45 were severe cases and 45 were mild.

Inclusion Criteria

1. Patients of age group 6 months to 5 years.
2. Cases diagnosis as Community acquired pneumonia(CAP) as per WHO criteria

Exclusion Criteria

1. Other lung pathology (e.g. acute respiratory distress syndrome, bronchial asthma) – either new or coexisting
2. Premature neonates
3. Children who have received incomplete treatment for pneumonia
4. Children developing new onset signs of pneumonia 48 hours after hospital admission.

Methodology: In this study, blood samples were taken from the children (6 months to 5 years age group) presenting with signs and symptoms of community acquired pneumonia. Diagnosis of pneumonia was made by attending pediatrician as per IMNCI/WHO criteria.[3] They had also performed clinical examination for assessment of severity.

Pneumonia cases were classified into mild and severe cases as per Integrated management of neonatal and childhood illnesses classification.

Patients of community acquired pneumonia were first screened for the inclusion and exclusion criteria as explained above and those fit inclusion were tested. All the demographic, clinical details and other medical records were taken for this study.

Complete blood count was performed routinely as part of basic evaluation for all such patients and hence there was no added financial burden incurred upon the patient.

Study instrument: 7-part hematology analyzer

All the complete blood count samples were run in the auto analyser installed in the Department of Pathology.

Hematology auto analyzer is a quantitative analyzer used for screening of patient samples in clinical laboratories. Auto Analyzer can analyze and give the results of 15 parameters of a blood sample which include total leukocyte count, Total RBC count, Hb, HCT, red cell indices, platelet count, absolute counts. Additionally, it can report multiple research parameters like platelet indices including platelet counts, MPV, PDW, PCT, PLCC, PLCR, IPF, PLR.

Method: Fully automated method based on Volume, Conductivity, Scatter (VCS) technology.

RESULTS

The study included 90 children with community-acquired pneumonia, categorized into mild (n=45) and severe (n=45) cases. Age-wise distribution showed that the majority (58.89%) were infants (<1

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year), followed by 15.56% in the 1–3 years group and 25.56% in the 4–5 years group.

The sex-wise distribution showed that 35.56% of the patients were female, while 64.44% were male. This indicated a higher prevalence of pneumonia in male children compared to female children in the study group.

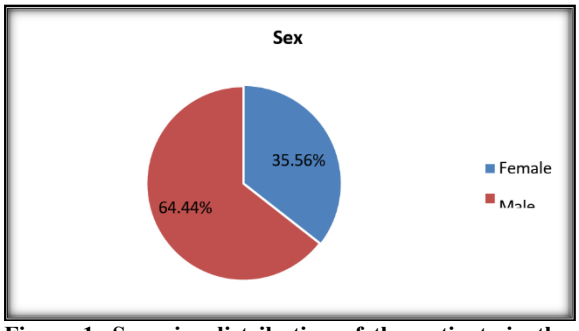

Figure 1: Sex-wise distribution of the patients in the study group

On analysis of samples, we noted that equal proportion of mild and severe cases were recruited.

The study on the correlation of platelet parameters with the severity of CAP among children revealed that the patients were equally distributed according to the severity of their condition. Fifty percent (50%) of the patients had mild pneumonia, while the other fifty percent (50%) had severe pneumonia.

Table 1: Comparison of Platelet Indices of patients between severe and mild CAP

Laboratory findings	Mild	Severe	P-value
Platelet count (cells/µL)	360455.55 ± 167793.56	430155.55 ± 180907.78	0.06
MPV (fL)	10.32 ± 1.64	10.50 ± 1.67	0.5
PDW (fL)	15.63 ± 0.41	15.63 ± 0.37	<0.0001
PCT %	0.39 ± 0.14	0.41 ± 0.14	0.5
PLCC(cells/µL)	103.02 ± 34.87	108.75 ± 36.62	0.44
PLCR %	27.56 ± 12.01	29.42 ± 12.15	0.16
PLR %	94.75 ± 48.71	103.65 ± 66.16	0.47
IPF	4.73 ± 2.62	5.51 ± 2.60	0.16

The sex-wise distribution of patients according to the severity of childhood community- acquired pneumonia (CAP) revealed that in the mild pneumonia group, 40% of the patients were female and 60% were male. In the severe pneumonia group, 31.11% of the patients were female, while 68.89% were male. The P-value of 0.38 indicated that the difference in sex distribution between mild and severe pneumonia cases was not statistically significant.

Platelet indices, including platelet distribution width (PDW) (15.63 ± 0.37 vs. 15.63 ± 0.41, $p < 0.0001$), showed significant differences. Analysis revealed that children with severe pneumonia had higher platelet counts compared to those with mild illness (430,156 ± 180,908 cells/µL vs. 360,456 ± 167,794 cells/µL($p=0.06$), trend towards significance. Automated haematology analyser flags for thrombosis were more frequent seen in severe cases, supporting the association between increased platelet activation and disease severity.

MPV, PCT, PLCC and PLCR did not show statistically significant differences. However, subgroup analyses by age groups revealed significant increase in MPV, PDW and PLCR among severe cases especially in 3-5 years age group and PLCC in 6months to 1 year age group. Immature platelet friction (IPF) was higher in severe cases but did not reach statistical significance range.

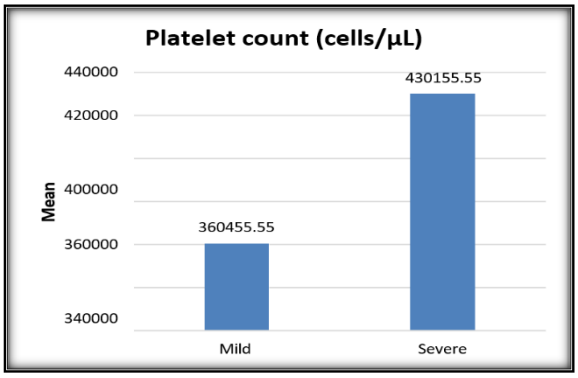

Figure 2: Comparison of platelet count findings of patients between severe and mild CAP

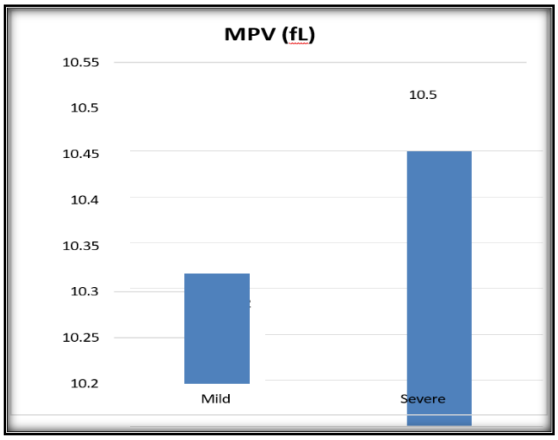

Figure 3: Comparison of MPV findings of patients between severe and mild CAP

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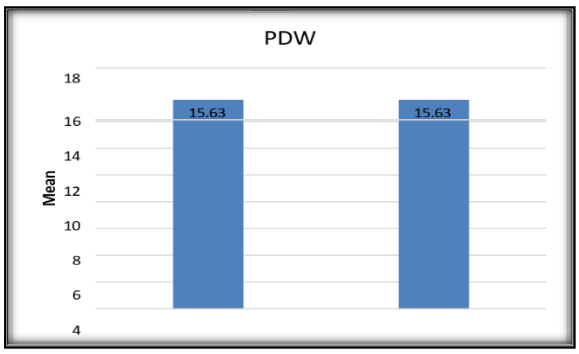

Figure 4: Comparison of PDW% findings of patients between severe and mild CAP

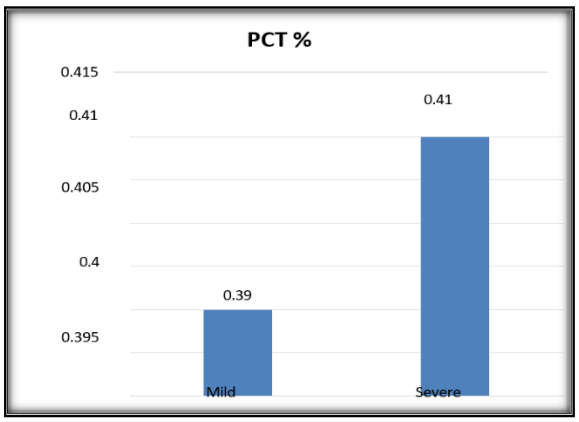

Figure 5: Comparison of PCT% findings of patients between severe and mild CAP

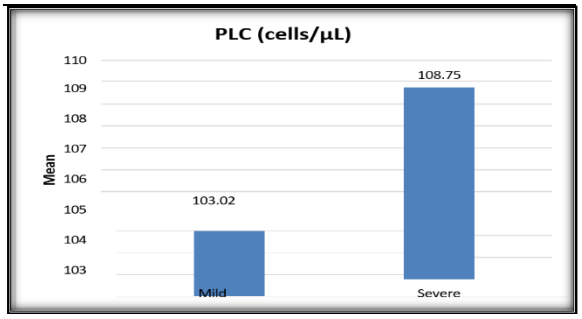

Figure 6: Comparison of PLC% findings of patients between severe and mild CAP

ROC analysis for Mild pneumonia cases

The ROC curve for PLR in mild pneumonia shows an AUC of 0.362, indicating poor predictive ability. With an AUC closer to 0.5, PLR lacks strong discrimination between mild and severe pneumonia cases.

ROC analysis for Severe pneumonia cases

The ROC curve for PLR in severe pneumonia (AUC = 0.618) suggests poor to fair discriminatory ability, indicating that PLR has limited usefulness in distinguishing severe pneumonia cases.

ROC analysis was done for all the significantly different parameters. Area under curve was >0.5 for PLR suggested that these correlate well with severity of pneumonia and can have a good diagnostic accuracy for predicting severe pneumonia. However no specific cut off values could be calculated which could differentiate between mild and severe cases due to small sample size.

DISCUSSION

The mean age of patients was 1.99+/- 1.59 years. Majority (58.89%) of the cases were infants (<1 year). 64.44% cases were male. While male patients were more common in both mild as well as severe as similar findings were noted in other study.[3]

In the study by Guven et al, mean age of patients was 2.40+/-3.20 years. In his study also, male patients were around 62% which matched with our data though ours is a study with less number of patients.[4]

Coming from a rural population of northern India, most of our patients came from areas with poor sanitary conditions, overcrowded households and many a times uncertain vaccination history making them more susceptible to pneumonia and other infections. Other studies did not contain similar background data, so no comparison could be made.

Age wise comparison showed higher proportion of severe cases occurring in infants (77.78%). Conversely, older children aged 4 to 5 years were more commonly affected by mild CAP (40%). Mean age in severe group was 1.36+/-1.24 years while that in mild group was 2.62+/-1.66 years and the difference was statistically significant (p=0.002) indicating that younger children are more susceptible to severe pneumonia as other researcher also find this.[5] This can be attributed to immature immune systems in infants, malnutrition or undernourishment.

Age wise comparison between mild and severe cases showed that in each group boys were more affected in the severe pneumonia group. Girls only dominated in the mild group in 1year - 3 years age group. This was also consistent with the previous studies performed in Turkey.[4]

Platelet Parameters in mild and severe pneumonia

This study highlights the potential diagnostic and prognostic significance of platelet indices in childhood community-acquired pneumonia. A total of 7 platelet parameters were recorded for each group and comparison was made as a whole, after dividing each group into 3 subgroups as explained previously as well as intragroup comparison after division as per age.

Comparison between mild and severe cases

Secondary thrombocytosis is often seen in children with pneumonia.[8,9] In our study, Platelet counts were higher among the severe cases however, it did not show statistically significant differences. Platelets are important part of inflammatory cascade. Previous studies showed that platelet counts were higher in children with CAP.[8,10] Guven et al reported platelet counts to be higher in CAP cases as compared with controls however there was no association between platelet counts and severity of pneumonia which is consistent with our results.[4] Platelet indices, including platelet distribution width (PDW) (15.63 ± 0.37 vs. 15.63 ± 0.41, $p < 0.0001$), also showed significant differences. PDW was seen to be higher in severe cases in our study. Sahin et al study

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showed PDW to be higher among CAP cases as compared to controls.[10] PWD elevation reflets increased variation in platelet activation and turnover linked to systemic inflammation in pneumonia. MPV levels did not show any significant difference between the two groups. In the study by Guven et al MPV and PDW levels were lower than in control group, while there was no association between MPV and severity of pneumonia.[4] Kiani et al reported MPV levels to be higher among the severe childhood pneumonia cases.[6] PLCC and PLCR values were not significantly different between mild and severe cases.

CBC ratios and their value in childhood pneumonia: PLR are the most extensively studied ratios in context of childhood infections including pneumonia. In our study, PLR lacks strong discrimination between mild and severe pneumonia cases.

PLR levels have been found to be elevated in CAP patients.[11-13] Some studies showed link to severity of disease while others did not.[11,14] In the study by Zheng et al children with bacterial pneumonia had significantly lower PLR values as compared to controls.[15] Guven et al study found PLR value to be significantly lower in CAP group, but found no correlation between PLR and disease severity.[4]

Immature platelet fraction was shown to be higher among ICU paediatric patients with coronavirus pneumonia as compared to non-ICU patients.[16] However, our study did not show any significant difference between mild and severe cases. As we did not have etiological data for our patients, any further elaboration over IPF data was not possible.

Subgroup analysis according to age: We also performed comparison of Platelet parameters after dividing the patients into 3 subgroups according to age i.e 6 months-1 year, 1–3 year, 3-5 year.

In the 6 months – 1 year group, the severe CAP children have significantly higher platelet count and PLCC.

In the 1year-3year group, severe cases had significantly higher platelet counts, PLR and RDW.

In the 3year-5year group, severe cases had significantly higher platelet count, MPV, PDW, PLCR.

Other parameters did not show significant variation according to age. Platelet count was highest among the younger children.

These parameters can have a good diagnostic accuracy for predicting severe pneumonia. However no specific cut off values could be calculated which could differentiate between mild and severe cases due to small sample size.

CONCLUSION

Platelet count and platelet distribution width show significant correlation with the severity of childhood community-acquired pneumonia. Platelet indices such as MPV and PLCR may provide additional information in older children. Routine CBC-derived platelet indices could enhance early risk assessment and optimize resource allocation in paediatric CAP management. Large-scale studies with pathogen identification and longitudinal follow-up are required to validate these findings and establish clinical cut-offs.

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