Section: Pathology

Original Research Article

MEASUREMENT OF ABSOLUTE COUNTS, PERCENTAGES OF NEUTROPHILS, LYMPHOCYTES, EOSINOPHILS, BASOPHILS AND MONOCYTES ALONG WITH RATIOS LIKE NEUTROPHIL: LYMPHOCYTE, PLATELET: LYMPHOCYTE AND MONOCYTE: LYMPHOCYTE AND THEIR CORRELATION WITH SEVERITY OF COMMUNITY ACQUIRED PNEUMONIA

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ABSTRACT

Background: Pneumonia is one of the most common causes of morbidity and mortality in children worldwide. Despite significant advances in medical science and healthcare infrastructure, the incidence of this disease and morbidity due to childhood pneumonia have remained high. **Objective:** To study absolute leucocytes counts, percentages of Neutrophils, Lymphocytes, Eosinophils, Basophils and Monocytes along with ratios and their correlation with severity of community acquired pneumonia.

Materials and Methods: This hospital based, observational study was conducted in the Department of Pathology in collaboration with Department of Pediatrics, 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 Pediatrics department and had been diagnosed with community acquired pneumonia. Blood samples was collected from patients in Department of Pediatrics and was sent to laboratory at Department of Pathology.

Results: More than half of the patients (58.89%) were in the 6months to 1-year age group which showed that youngest children were the ones most frequently affected by pneumonia although there may have been a referral bias due to younger children being brought more frequently to our tertiary care center. Overall, male children constituted around 64% of the patients. Among the female patients, mild pneumonia was more frequent while the opposite was seen among male patients. Comparison of complete blood count parameters between mild and severe groups as a whole showed that total leukocyte count, neutrophil percentage, Absolute Neutrophil count (ANC), Absolute Lymphocyte Count (ALC), Absolute Eosinophil Count (AEC), Absolute Monocyte Count (AMC), Neutrophil Lymphocytes Ratio (NLR), Monocytes Lymphocytes Ratio (MLR) were significantly higher among the severe cases. Lymphocyte percentage, eosinophil percentage, Hemoglobin, platelet distribution width was lower among the severe cases. It is well known that common blood count parameters vary according to age also, more so in the paediatric population.

Conclusion: In light of our results, it can be concluded that various leucocyte counts and ratios, particularly NLR and MLR corelate strongly with CAP severity and may be incorporated into routine severity assessment.

Keywords: Correlation, Complete blood count parameters, Severity, Childhood Community acquired pneumonia.

INTRODUCTION

Pneumonia is characterized by inflammation of the lungs often caused by infection, pneumonia presents a critical health challenge, particularly in low- and middle-income countries where the burden of disease is most acute. Globally, the World Health Organization (WHO) estimates that pneumonia accounts for approximately 15% of all deaths among children under five, making it a leading cause of childhood mortality.[1] This statistic underscores the urgency for comprehensive strategies to prevent, diagnose, and treat this condition effectively.

The burden of childhood pneumonia extends beyond immediate health outcomes, impacting physical growth, milestone accomplishment, educational attainment, economic stability, and overall quality of life. Children suffering from pneumonia often experience long periods of illness, which can hinder their ability to attend school and engage in normal activities. This disruption can have significant effects on their educational and social development, perpetuating a cycle of exclusion, poverty and disadvantage. In regions with limited healthcare infrastructure, lack of timely and effective treatment can lead to increased hospitalization rates and, in severe cases, even death.

Several determinants contribute to incidence and severity of pneumonia in children. Socioeconomic factors such as poverty, malnutrition, and inadequate housing conditions are closely associated with increased susceptibility to pneumonia. Malnourished children have weak immune systems, making them more vulnerable to infections. Poor living conditions, including overcrowded housing and exposure to indoor air pollution from cooking fuels, exacerbate risk of pneumonia by increasing the likelihood of respiratory infections.[2]

In addition to socioeconomic determinants, environmental factors also play a crucial role in the epidemiology of childhood pneumonia. Regions having high levels of air pollution, limited access to clean water and sanitation, and frequent exposure to infectious agents are at increased risk. Climate change which is evident all across the globe, also poses emerging threats by altering patterns of infectious diseases and exacerbating environmental conditions that increase the risk of respiratory infections.

Addressing childhood pneumonia effectively requires a comprehensive approach including prevention, early detection, along with appropriate treatment. Vaccination is seen as one of the most effective measures for prevention. The introduction of vaccines against Streptococcus pneumoniae (pneumococcal conjugate vaccine) and Haemophilus influenzae type b (Hib) has significantly reduced the incidence of these infections. Similarly, the development of vaccines against influenza and RSV holds promise for further reducing burden of viral pneumonia.

Treatment of pneumonia typically involves antibiotics for bacterial infections. In case of viral infections, supportive care is mostly required. The justified use of antibiotics is crucial to avoid resistance and ensure effective treatment. In severe cases, hospitalization and ICU care may be required for more intensive care, including oxygen therapy and intravenous antibiotics. Effective management of pneumonia also involves pre-emptively addressing complications and coexisting conditions that may exacerbate the illness.

Despite progress in understanding and managing childhood pneumonia, there remain critical gaps in our knowledge and practice. Research is needed to further elucidate the interplay between various determinants of pneumonia so as to formulate more effective prevention and treatment strategies. There is a need for new innovative approaches to enhance vaccine coverage, improve diagnostic tools, and develop newer therapeutic options. Additionally, understanding the impact of climate change on pneumonia epidemiology and integrating this knowledge into public health strategies is becoming increasingly important in the modern era.

There is an unmet need for simple and easy to use indicators which can predict the severity of pneumonia cases early in the presentation which can help in judicious use of resources as well as prognosticating the patient's family members.

Complete Blood Count (CBC) is a commonly performed test which is done as a routine in almost every such patient who is admitted in healthcare facilities. In most tertiary care centers advanced hematology analyzers are being used which give rapid, accurate and reliable results within a short period of time. Also, these analyzers provide multiple additional parameters (both routine and research parameters) which can be analyzed to yield useful information regarding severity of inflammation. Whenever needed, peripheral blood smears of these patients can be performed on the same sample to look for additional hematological abnormalities.

CBC parameters like Hb, Total leukocyte count, neutrophils, lymphocytes, platelet count, platelet indices like MPV, PDW as well as the red cell indices like RDW have been suggested to be predictors of inflammation in multiple diseases.3,4 Many previous studies, mostly involving adult patients showed that it is possible to predict the severity of illness in pneumonias and other inflammatory disorders like Rheumatoid Arthritis, Sepsis.

We, hence, propose to conduct a prospective, observational study on the Complete blood count parameters at our center involving pediatric patients being admitted with a clinical diagnosis of pneumonia.

MATERIALS AND METHODS

This hospital based, observational study was conducted in the Department of Pathology in collaboration with Department of Pediatrics, 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 Pediatrics department and had been diagnosed with community acquired pneumonia. Blood samples was collected from patients in Department of Pediatrics 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)

= 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. Diagnosis and classification of Community acquired pneumonia as per IMNCI/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 symptoms of pneumonia 48 hours after hospital admission.

Methodology

In this study blood samples were taken for complete blood count 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 paediatrician as per IMNCI/WHO criteria1. 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 for 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 analyzer installed in the Department of Pathology. Simultaneously peripheral blood smear was examined for verification of the results of the counter and morphological changes in cells.

Our department uses 7 part hematology analyzer which works on the principles of impedance, laser scatter, SF (slide laser scatter, fluorescence signals) cube analysis and colorimetric method.

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 immature platelet fraction.

Method: Fully automated method based on VCS technology

Peripheral blood smears examination

The peripheral smear were examined systematically to correlate with the results of Automated Haematology Analyser.

Study parameters

Total leukocyte count

Differential leukocyte count (Neutrophil, Lymphocyte, Monocyte, Eosinophil, Basophil) Immature Granulocytes (%)

RBC Counts, Haemoglobin, Haematocrit, MCV, MCH, MCHC, ANC, ALC, NLR, PLR, MLR, and NRBCs.

RESULTS

Table 1: Age-wise distribution of the study group

Age (In Years)	No of cases	Percentage
<1 year	53	58.89%
(1-3) years	14	15.56%
(4-5) years	23	25.56%
Total	90	100.00%
Mean ± SD	1.99 ± 1.59	

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 year), 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.

Table 2: Distribution of the patients according to severity of community acquired pneumonia (CAP)

Severity of CAP	No of cases	Percentage
Mild	45	50.00%
Severe	45	50.00%

On analysis of samples, we noted that equal proportion of mild and severe cases were recruited. The study on the correlation of CBC 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 3: Sex-wise distribution of the patients according to CAP

Sex	Mild Pneumonia		Severe Pneumonia		P-value
	No of cases	Percentage	No of cases	Percentage	
Female	18	40.00%	14	31.11%	0.38
Male	27	60.00%	31	68.89%	

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.

Table 4: Comparison of laboratory findings of patients between severe and mild CAP

laboratory findings	Mild	Severe	P-value
TLC (cells/µL)	11781.33 ± 5475.47	15289.78 ± 5512.82	0.003
Neutrophils%	51.13 ± 16.95	57.73 ± 17.75	0.07
Lymphocyte%	39.87 ± 16.31	33.53 ± 16.91	<0.0001
Monocyte%	5.90 ± 1.97	5.89 ± 1.97	0.98
Eosinophil%	3.07 ± 2.21	2.8 ± 2.03	0.55
Basophils%	0 ± 0	0.04 ± 0.30	-
ANC (cells/µL)	3722.6 ± 1589.02	9223.622 ± 5357.11	<0.0001
ALC (cells/µL)	3776.15 ± 1370.93	4747.489 ± 2644.03	0.03
AEC	283.04 ± 210.06	406.82 ± 302.25	0.026
ABC	0 ± 0	9.09 ± 60.97	-
AMC	507 ± 264.84	902.62 ± 468.97	<0.0001
Hb	11.93 ± 2.20	10. 70 ± 1.48	0.002
MCV (fL)	76.90 ± 10.67	75.37 ± 11.09	0.51
MCH (pg)	24.34 ± 4.14	23.51 ± 4.13	0.34
MCHC (g/dL)	31.64 ± 1.97	31.6 ± 1.65	0.92
HCT	35.07 ± 4.45	34.01 ± 3.18	0.2
NRBC (cells/µL)	0.005 ± 0.02	0.008 ± 0.02	0.49
NRBC %	0.025 ± 0.073	0.04 ± 0.086	0.37
NLR %	1.15 ± 0.68	2.58 ± 2.13	<0.0001
MLR %	0.15 ± 0.07	0.19 ± 0.10	0.03
Immature granulocyte (%)	0.29 ± 0.21	0.33 ± 0.22	0.38
RBC Count	4.49±0.57	4.51±0.61	0.87

Patients with severe childhood community-acquired pneumonia (CAP) had significantly higher total leukocyte count (TLC) (15,289.78 ± 5512.82 vs. 11,781.33 ± 5475.47, p = 0.003), absolute neutrophil count (ANC) (9223.62 ± 5357.11 vs. 3722.6 ± 1589.02, p < 0.0001), absolute monocyte count (AMC) (902.62 ± 468.97 vs. 507 ± 264.84, p < 0.0001), and neutrophil-to-lymphocyte ratio (NLR) (2.58 ± 2.13 vs. 1.15 ± 0.68, p < 0.0001). Lymphocyte percentage was lower in severe cases (33.53 ± 16.91 vs. 39.87 ± 16.31, p < 0.0001), while absolute lymphocyte count (ALC) was higher (4747.49 ± 2644.03 vs. 3776.15 ± 1370.93, p = 0.03). Haemoglobin (Hb) levels were significantly reduced in severe cases (10.70 ± 1.48 vs. 11.93 ± 2.20, p = 0.002). However, parameters like monocyte percentage (p = 0.98), eosinophils (p = 0.55), MCV (p = 0.51), RBC count and other red cell indices did not show statistically significant differences. These findings highlighted the role of inflammatory markers in assessing the severity of CAP in children.

Utilizing Automated Hematology Analyzer Flags for Predicting severity of pneumonia in Children

Flags are generated when the analyzer detects marked deviations from normal parameters or identifies potentially abnormal cell populations during analysis. These flags are crucial first-line screening tool, alerting laboratory personnel to potential

pathologies that require either manual review or further testing.

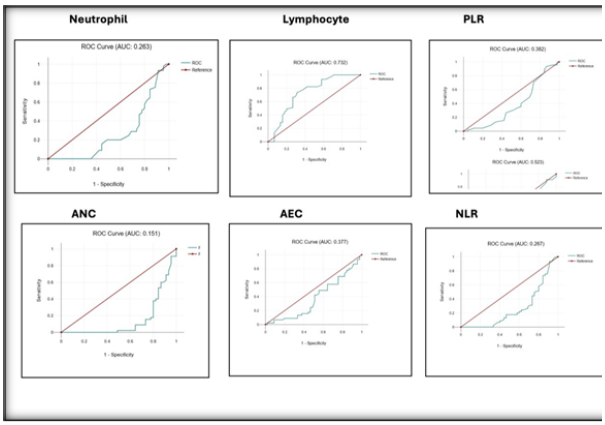
We anticipated that children with severe pneumonia will exhibit a higher frequency of neutrophil-related flags, particularly those indicating neutrophilia and the presence of immature granulocytes.

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 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.

The utilization of automated flags offers several advantages, including objectivity, speed, and cost-effectiveness. However, it is important to acknowledge that these flags are not specific to pneumonia and can be influenced by other factors like age specific reference intervals.

Correlation of significantly different CBC parameters and predictive ability

ROC analysis for mild pneumonia cases



Mild pneumonia

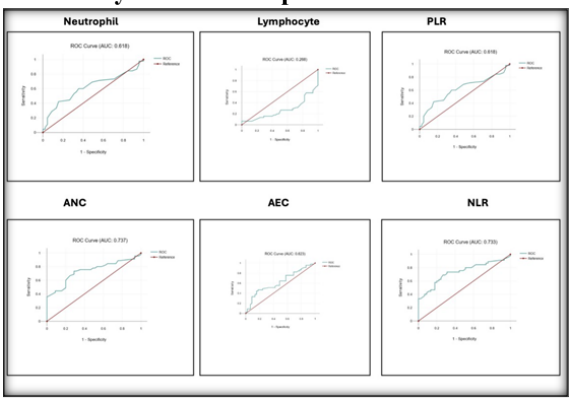
The ROC curve for neutrophils in mild pneumonia showed an AUC of 0.263, indicating low discriminatory power.

The ROC curve for lymphocytes in mild pneumonia showed an AUC of 0.732, indicating moderate discriminatory power. The curve deviated from the reference line, suggesting fair accuracy in distinguishing mild pneumonia cases.

The ROC curve for ANC in mild pneumonia showed an AUC of 0.377, indicating poor discriminatory power. Since an AUC closer to 0.5 suggests no predictive ability, this result implies that ANC had limited usefulness in distinguishing mild pneumonia cases from severe ones.

The ROC curve for AEC in mild pneumonia showed an AUC of 0.377, suggesting poor discriminatory ability. Since an AUC near 0.5 indicates no predictive power, this result implies that AEC was not effective in differentiating mild pneumonia cases from severe ones.

ROC analysis for severe pneumonia cases



Severe Pneumonia

The ROC curve for neutrophils in severe pneumonia shows an AUC (Area Under the Curve) of 0.737, indicating a moderate discriminatory ability. Since an AUC of 0.5 represents no predictive power and 1.0 indicates perfect classification, an AUC of 0.737 suggests that neutrophil count has a fair ability to differentiate severe pneumonia cases from non-severe ones.

The ROC curve for lymphocytes in severe pneumonia (AUC = 0.268) indicates poor discriminatory ability, suggesting that lymphocyte count is not a reliable predictor of severe pneumonia.

The ROC curve for ANC in severe pneumonia (AUC = 0.737) suggests moderate diagnostic accuracy, indicating that ANC has a fair ability to distinguish severe pneumonia cases from non-severe ones.

The ROC curve for AEC in severe pneumonia (AUC = 0.623) indicates poor to fair diagnostic accuracy, suggesting that AEC has a limited but somewhat useful ability to differentiate severe pneumonia cases.

ROC analysis was done for all the significantly different parameters. Area under curve was >0.5 for neutrophil percentage, AEC and ANC which suggested that these parameters 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

Common blood count parameters as reported in advanced hematology analyzer based on the principle of impedance, laser scatter, SF cube cell analysis technology and fluorescent flow cytometry were studied in children with pneumonia. The study population consisted of children admitted with a clinical diagnosis of pneumonia. There were equal number of mild and severe patients. All CBC parameters in the auto analyzer report were compared between the two groups. Comparison was also made after stratifying the mild and severe groups into 3

subgroups according to age (6months – 1 year, 1year-3 years, 3 years-5 years).

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 pneumonia groups, the difference was not statistically significant.

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 a smaller number of patients.[5]

In the study by Zheng et al, like our study, the proportion of male patients was higher (~56%) yet the difference was not statistically significant.[6]

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. This can be attributed to immature immune systems in infants, malnutrition or undernourishment.[7] Our finding was in contrast with that of Guven et al.[5] In their study, mean age of severe pneumonia patients was 2.92+/-3.8 while that of mild group was 2.18+/-2.88 years however this difference was not statistically significant.

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 and China.[5,6]

CBC Parameters in mild and severe pneumonia

We conducted a comparison of various CBC parameters between the mild and severe patients. A total of 30 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

Total leukocytes count values were greater in the severe pneumonia group (p=0.003). This result was similar to findings of Guven et al who studied ~400 patients in Turkey.[5]

Leukocyte percentage was also higher in severe cases however the difference was not statistically significant. Interestingly lymphocyte percentage was lower in severe group, while absolute lymphocyte count was higher in the severe group. This was due to higher overall total leukocyte count in the severe group. These results were also similar to those by Guven et al and Huang et al.[5,8] Huang found that WBC as well as neutrophils were higher in CAP cases when compared with age matched controls.

Patients with severe childhood community-acquired pneumonia (CAP) had significantly higher total leukocyte count (TLC) (15,289.78 ± 5512.82 vs. 11,781.33 ± 5475.47, p = 0.003), absolute neutrophil count (ANC) (9223.62 ± 5357.11 vs. 3722.6 ± 1589.02, p < 0.0001), absolute monocyte count (AMC) (902.62 ± 468.97 vs. 507 ± 264.84, p <0.0001), and neutrophil-to-lymphocyte ratio (NLR) (2.58 ± 2.13 vs. 1.15 ± 0.68, p < 0.0001).

Lymphocyte percentage was lower in severe cases (33.53 ± 16.91 vs. 39.87 ± 16.31, p < 0.0001), while absolute lymphocyte count (ALC) was higher (4747.49 ± 2644.03 vs. 3776.15 ± 1370.93, p = 0.03). Monocyte percentage were almost comparable in both groups in our study however absolute monocyte counts were significantly higher in the severe group. Guven et al reported that monocytes were higher in the severe group with a statistically significant difference.[5] Fan et al in their study from China reported that monocyte ratio was the most important difference between mild and severe LRTI in children caused by Human Adenovirus and that it can be used to predict severe cases.[9]

Eosinophil percentage was more in the mild cases however it was not significant (p=0.98). Absolute eosinophils counts were higher in the severe group and the difference was statistically significant. In the study by Guven et al, eosinophils were significantly high in severe group.[5]

Hemoglobin (Hb) levels were significantly reduced in severe cases (10.70 ± 1.48 vs. 11.93 ± 2.20, p = 0.002). Coskun et al in their Turkish study compared CBC parameters across different age groups of pneumonia children and found that Hb levels were lower in children less than 5 years while inflammatory markers were higher in this age group. Huang et al reported that Hb levels were significantly lower in the pneumonia patients. There was no difference in MCV, MCH, MCHC between the two groups.[8,10]

Haematocrit, NRBC and NRBC percentage also were similar among the two groups. In 2022, a study from Egypt carried out by Muljono et al compared CBC parameters between non severe and severe childhood CAP cases. They reported that HCT was lower in severe pneumonia cases and so was hemoglobin. They concluded that a normal hematocrit was protective factor against severe pneumonia.[11]

In the 1year-3year group, severe cases had significantly higher TLC, ANC, ALC, AMC, platelet counts, neutrophil percentage, monocyte percentage, NLR, MLR. Haemoglobin, lymphocyte percentage, eosinophil percentage, haematocrit, MCV, MCH, MCHC, were significantly lower among the severe cases.

In the 3year-5year group, severe cases had significantly higher TLC, ANC, platelet count,

neutrophil percentage, monocyte percentage, NLR, MLR, MCV, MPV, PDW, PLCR, NRBC and NRBC percentage. The severe cases had significantly lower lymphocyte percentage, eosinophil percentage, MCHC, ALC.

We also divided mild group and severe group individually into age groups and performed intragroup comparisons. Among the mild cases, Hb levels increased with age as did hematocrit, MCH and MCHC. Monocyte percentage, ALC and AMC also showed significant differences. Other parameters did not show significant variation according to age.

In children with severe pneumonia, Hb levels were highest among the 3-5 year age group. TLC was highest among the 1year-3year group. Hematocrit, MCV, MCH and ALC also differed significantly among age groups.

ROC analysis was done for all the significantly different parameters. Area under curve was >0.5 for neutrophil percentage, NLR, AEC and ANC which 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.

CONCLUSION

This study comprehensively evaluated the role of absolute counts and percentages of neutrophils, lymphocytes, eosinophils, and monocytes along with inflammatory ratios—neutrophil:lymphocyte ratio (NLR), platelet:lymphocyte ratio (PLR), and monocyte:lymphocyte ratio (MLR)—in predicting the severity of childhood community-acquired pneumonia. The findings demonstrated that several hematological parameters, especially related to neutrophils and monocytes, showed statistically significant elevation in severe cases compared to mild cases, while lymphocyte percentages were correspondingly decreased.

The neutrophil percentage, absolute neutrophil count (ANC), and NLR emerged as the most robust markers with moderate diagnostic accuracy for severe CAP, as evidenced by ROC curve analysis. These indicators reflect the heightened inflammatory and immune response in more severe infections and can offer clinicians rapid, objective data to supplement clinical assessment and guide early decision-making. Monocyte-related indices, including absolute monocyte count (AMC) and MLR, were also significantly higher in severe pneumonia, indicating their contributory role in the inflammatory milieu. However, platelet-to-lymphocyte ratio (PLR) and eosinophil counts did not demonstrate strong predictive value in the current cohort, although slight trends were noted.

Our automated hematology analyzer showed different flags for CBC abnormalities which were particularly seen among the severe cases. Modern auto-analyzers are capable of flagging severe CBC abnormalities which can guide the clinician better and also make the laboratories more efficient.

The integration of these CBC parameters and derived ratios into routine evaluation holds great promise in enhancing risk stratification, especially in resource-limited settings where advanced diagnostics are not always available. Early identification of severe CAP cases using readily accessible laboratory markers could improve triage accuracy, facilitate timely escalation of care, and potentially reduce morbidity and mortality.

Despite these encouraging findings, the study's limitations, including modest sample size and lack of pathogen-specific data, emphasize the need for larger, multicentric studies incorporating clinical outcomes to validate and refine these hematologic predictors. Further research is also warranted to establish definitive cut-off values and explore their temporal dynamics during pneumonia treatment and recovery.

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