Research Article

Comprehensive Analysis of Complete Blood Count in ICU Patients at a Tertiary Medical Facility

*Shadma Siddiqui, ** Pinki Vishwakarma
* School of Paramedical Sciences, SAM Global University, Raisen, M.P.
** Department of Paramedical Sciences, NIMS University, Jaipur, RJ

Article information	ABSTRACT

Corresponding Author:

Dr. Shadma Siddiqui
Professor, SAM Global
University, Raisen (M.P),
Email:
shadma.10aug@gmail.com
Mobile:- 9993811145

The complete blood count (CBC) is a critical diagnostic tool in intensive care settings, providing valuable insights into haematological abnormalities that may influence patient prognosis. This study examines CBC variations in ICU patients at a tertiary healthcare centre, focusing on key parameters such as white blood cell (WBC) count, red blood cell (RBC) levels, haemoglobin concentration, and platelet count. Elevated WBC levels were often indicative of systemic infections, while anaemia and thrombocytopenia were prevalent in critically ill patients, correlating with increased mortality risks. Gender-based differences were observed, with male patients exhibiting higher haemoglobin levels than females. A strong association between severe CBC abnormalities and higher ICU mortality rates was identified, underscoring the importance of timely intervention. Statistical analyses confirmed significant deviations in CBC values from healthy reference ranges, reinforcing the role of routine haematological monitoring in critical care. Findings from this study highlight the need for integrated diagnostic approaches and tailored therapeutic strategies to enhance patient survival. Future research should explore longitudinal CBC trends and their predictive value in intensive care outcomes. This study emphasizes the necessity for continuous monitoring and personalized treatment to optimize ICU patient care.

INTRODUCTION

Intensive Care Units (ICUs) serve as specialized hospital departments where patients with life-threatening conditions receive constant medical supervision and treatment. Critical care medicine relies on a variety of diagnostic tools, among which the complete blood count (CBC) is one of the most frequently utilized tests. CBC analysis provides crucial insights into a patient's overall health status by evaluating key blood components such as white blood cells (WBC), red blood cells (RBC), and platelets.

This study examines CBC results from ICU patients, assessing their variations and significance in disease progression and management. A detailed statistical evaluation has been conducted, considering gender-based differences, normal distribution assessments, and significant deviations from standard values.

METHODOLOGY

A cohort of 100 healthy volunteers (56 males and 44 females) served as the control group for establishing normal CBC ranges. The study population included critically ill patients aged between 22 and 72 years who were admitted to the ICU. Statistical analysis was performed using the Shapiro-Wilk test to determine data distribution. For normally distributed parameters, results were presented as mean ± standard deviation (SD), whereas non-normally distributed variables were reported

using median and interquartile range (IQR). Gender-based differences were analyzed through the Mann-Whitney U test, with statistical significance set at $p < 0.05$.

Exclusion criteria included patients undergoing cardiac surgery, obstetric cases, and studies only available in abstract form or in non-English publications. Citations were screened independently by two reviewers to ensure accuracy and relevance.

RESULTS AND DISCUSSION

This study identified significant variations in CBC values among ICU patients, reflecting the impact of critical illness on haematological parameters. Findings include:

White Blood Cells (WBC) Variations

Elevated WBC counts were observed in patients with systemic infections and inflammatory responses, supporting their role as biomarkers for sepsis and immune dysfunction. Leucocytosis, commonly present in ICU patients, suggests an active immune response, whereas leukopenia indicates immunosuppression or severe systemic involvement. These variations play a crucial role in determining treatment protocols, including antibiotic administration and infection control measures.
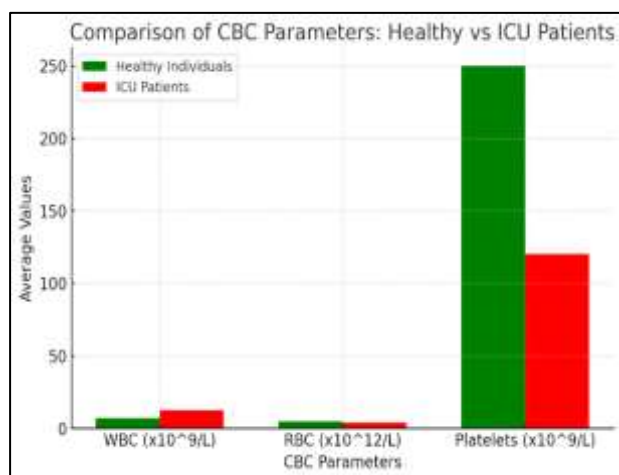
Red Blood Cells (RBC) & Haemoglobin Trends

Anaemia was prevalent among critically ill patients, often linked to underlying chronic conditions, nutritional deficiencies, or blood

loss due to medical interventions. A low RBC count and decreased haemoglobin levels were associated with poor oxygen-carrying capacity, leading to increased risks of organ dysfunction. Blood transfusions, iron supplementation, and erythropoiesis-stimulating agents were frequently utilized interventions for managing anaemia in ICU settings.

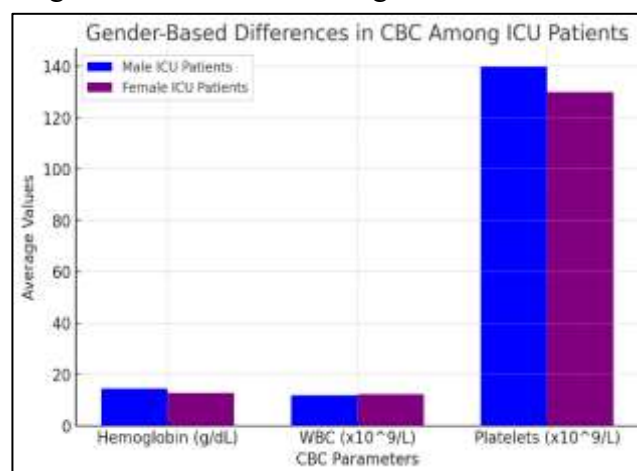**Platelet Count and Coagulation Concerns**

Thrombocytopenia was a common finding, correlating with an increased risk of bleeding complications and poor clinical outcomes. Platelets play a pivotal role in haemostasis and immune function, and their depletion in critically ill patients could result from sepsis, disseminated intravascular coagulation (DIC), or drug-induced effects. Monitoring platelet levels is crucial for managing bleeding risks and implementing appropriate therapeutic strategies, such as platelet transfusions and coagulation factor replacement therapies.

Graph-I: compares WBC, RBC, and platelet counts between healthy individuals and ICU patients. ICU patients show significant deviations, particularly in WBC (higher due to infections) and platelets (lower due to critical conditions).

Comparative Gender-Based Analysis

Gender differences were analyzed to determine CBC variations among male and female ICU patients. Statistical tests revealed significant disparities in haemoglobin levels, with male patients exhibiting slightly higher values than females. However, WBC and platelet counts showed minimal variation between genders, reinforcing the necessity of individualized patient assessments rather than relying solely on generalized reference ranges.
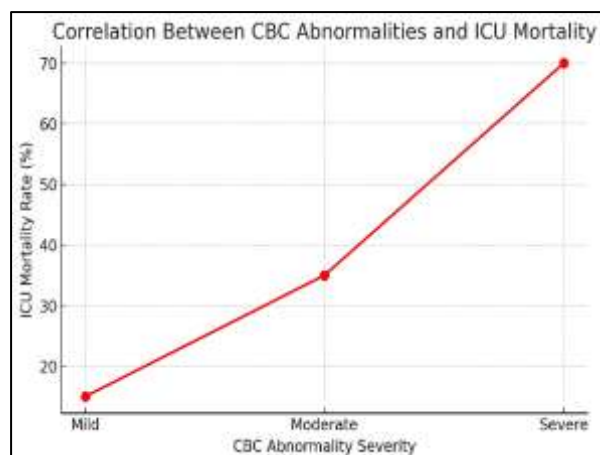

Graph-II: illustrates gender-based differences in CBC parameters among ICU patients. Male patients have slightly higher haemoglobin levels, while WBC and platelet counts show minor variations between genders.

Correlation Between CBC and ICU Mortality

This study also investigated the predictive value of CBC variations in determining ICU mortality rates. Patients with extreme deviations in WBC, RBC, and platelet counts were found to have higher mortality risks. Early recognition of these abnormalities and

timely medical interventions were instrumental in reducing ICU mortality and improving

patient survival rates.

Graph-III: shows the correlation between CBC abnormality severity and ICU mortality rates. As abnormalities become more severe, mortality rates increase significantly, emphasizing the importance of early detection and intervention.

ETHICAL CONSIDERATIONS AND RESEARCH LIMITATIONS

Ethical approval was obtained from relevant institutional review boards, and informed consent was secured from all participants. This study acknowledges potential limitations, including sample size constraints and the exclusion of specific patient populations that could influence findings. Future research should focus on expanding the dataset and incorporating additional biomarkers to enhance diagnostic accuracy.

CONCLUSION

This research underscores the critical role of CBC in managing ICU patients, highlighting its significance in detecting abnormalities and guiding treatment decisions. The study

advocates for integrating CBC with advanced haematological markers and continuous monitoring to optimize patient care and improve survival outcomes. Further investigations are recommended to explore the predictive value of CBC variations in long-term ICU patient prognosis.

FUTURE RESEARCH DIRECTIONS

Given the findings of this study, further research should explore:

Longitudinal Analysis: Tracking CBC trends over extended ICU stays to evaluate progressive changes and recovery indicators.

Multi-Parameter Integration: Combining CBC data with biomarkers like C-reactive protein (CRP) and procalcitonin for enhanced diagnostic accuracy.

Machine Learning Applications: Utilizing artificial intelligence to predict ICU patient outcomes based on haematological patterns.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest related to this research.

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