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Comparative Study of Discrepancy in Platelet Count by Automated Analyzer and Manual Count

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Abstract

Background: The present study is planned to compare platelet counts obtained by an automated hematology analyzer with those obtained by manual counting, to assess the degree of discrepancy between the two methods and evaluate the reliability of automated platelet estimation in routine hematological investigations.

Methods: Hospital based prospective study conducted on Patients admitted in the in-patient department (medical ward, pre and post-operative wards, ICUs) and out-patients undergoing routine/serial blood sampling at our hospital.

Results: The automated analyzer demonstrated excellent sensitivity (100%) in detecting thrombocytopenia, ensuring that no true cases were missed. However, the specificity (92.02%) was slightly lower due to false positive cases. Overall, the analyzer showed high diagnostic accuracy (94.8%).

Conclusion: The present study demonstrates that automated platelet counting is a reliable and efficient method for routine hematological investigations, showing high concordance (94.8%) and strong correlation with manual platelet estimation. However, automated analyzers showed a tendency to underestimate platelet counts, particularly in the thrombocytopenic range. Therefore, peripheral smear examination and manual verification remain essential in cases with unexpectedly low platelet counts or suspected analytical interference to ensure accurate reporting and appropriate clinical management.

Keywords: Platelet, Manual, Automated

Introduction

Platelets (thrombocytes) are small, anucleate blood cell fragments derived from megakaryocytes that play a crucial role in maintaining hemostasis, vascular integrity, and blood coagulation. Platelet count is an important hematological parameter used in the

diagnosis, monitoring, and management of various clinical conditions, including thrombocytopenia, thrombocytosis, bleeding disorders, infections, hematological malignancies, and systemic diseases. Accurate estimation of platelet count is therefore essential for clinical decision-making and for assessing the risk of bleeding or thrombotic complications.[1-3]

With the advancement of laboratory technology, automated hematology analyzers have become the primary method for platelet enumeration in routine clinical laboratories. These instruments provide rapid, reproducible, and high-throughput results with minimal manual intervention. Depending on the technology used, platelet counting is performed using impedance, optical scattering, fluorescence-based methods, or a combination of these techniques. Automated analyzers have significantly improved laboratory efficiency and standardization; however, certain limitations may affect the accuracy of platelet estimation, particularly in samples with abnormal hematological characteristics.[4-6]

Various factors can lead to discrepancies in automated platelet counts, including platelet clumping, giant platelets, microcytic red blood cells, fragmented erythrocytes, cryoglobulins, cellular debris, and other interfering particles. These factors may result in falsely low or falsely elevated platelet counts, potentially leading to misinterpretation of the patient's clinical condition and inappropriate treatment decisions. Platelet clumping may cause pseudothrombocytopenia, whereas red blood cell fragments and microcytes may be mistakenly identified as platelets by some automated counting methods.[7-10]

Manual platelet counting, performed using a hemocytometer under a light microscope, is a traditional method of platelet enumeration. Although it is time-consuming, requires skilled personnel, and may have greater observer-related variability, it remains a useful alternative or confirmatory method in selected cases where automated results are questionable. Peripheral blood smear examination also provides valuable morphological information regarding platelet size, distribution, clumping, and associated abnormalities that may not be adequately identified by automated methods alone.[11]

Comparison between automated platelet counts and manual platelet counts is important for evaluating the reliability, accuracy, and limitations of automated hematology analyzers in routine laboratory practice. Assessment of discrepancies between the two methods may help identify samples requiring further examination, improve quality assurance, and reduce the risk of erroneous laboratory reporting. Such discrepancies are particularly significant in patients with low platelet counts, in whom even small variations may influence clinical management.[12-13]

Therefore, the present study is planned to compare platelet counts obtained by an automated hematology analyzer with those obtained by manual counting, to assess the degree of discrepancy between the two methods and evaluate the reliability of automated platelet estimation in routine hematological investigations.

Material And Methods

Study Design: Hospital based prospective study.

Study Area: Department of Pathology, S.P. Medical College, Bikaner.

Study Population: Patients admitted in the in-patient department (medical ward, pre and post-operative wards, ICUs) and out-patients undergoing routine/serial blood sampling at our hospital.

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Age Group: Our study is not age specific and includes venous blood samples both from paediatric and adult populations of either gender.

Inclusion Criteria:

- Patients of all ages (paediatric, geriatric, normal adult population) and either gender with normal, low or high platelet counts will be included in the study.

Exclusion Criteria:

- Blood samples meeting the sample rejection criteria of the laboratory will be excluded from this study. Clotted/haemolysed samples, samples sent in inappropriate blood collection tube and unlabeled/mislabeled samples will be rejected.
- Patients with a previous recorded history of EDTA-dependent pseudo thrombocytopenia (PTCP) will be excluded from the study.
- Samples established to have gram positive coccemia on peripheral smear examination will be excluded as the cocci (0.5-2.0 μm) can lead to spuriously high automated platelet counts.

Data analysis

The results will be depicted in the form of tables and graphs where applicable . After entering data into excel worksheet, it will be analysed with the help of frequency, proportion, mean, standard deviation and tests of significance wherever applicable. Appropriate standard statistical method will be utilized.

Results

Table 1: Comparison of Automated and manual Platelet Count

Automated Method	Manual Method			
	Thrombocytopenia	Normal	Thrombocytosis	Total
Thrombocytopenia	87	13	0	100
Normal	0	115	0	115
Thrombocytosis	0	0	35	35
Total	87	128	35	250

A comparative analysis of platelet counts obtained by automated hematology analyzer and manual peripheral smear method was performed using cross-tabulation. The findings demonstrated a high degree of agreement between the two methods across the majority of cases.

When the results of the automated hematology analyzer were evaluated against the manual peripheral smear method, a total of 100 cases were categorized as thrombocytopenia by the automated method. On verification with the manual method, 87 of these cases were confirmed to be true thrombocytopenia, while the remaining 13 cases were found to have platelet counts within the normal range.

These 13 cases therefore represent false positive results of thrombocytopenia by the automated analyzer, indicating an underestimation of platelet counts in a subset of samples. This finding suggests that while the automated method is highly effective in identifying true thrombocytopenia, it has a tendency to overdiagnose low platelet counts in certain situations. Underestimation of platelet counts by automated analyzers is commonly

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seen in the presence of platelet clumping and giant platelets.

These findings reflect a high sensitivity of the automated system. However, the presence of false positive cases highlights a relatively lower specificity, emphasizing the need for confirmation by peripheral smear examination, particularly in samples reported as thrombocytopenic by automated analysis

Importantly, there were no instances where thrombocytopenia was missed by the automated method, nor were there cases of overestimation leading to false thrombocytosis.

Overall, the data indicate excellent concordance between the two methods, particularly in identifying true thrombocytopenia and thrombocytosis. The discrepancies observed were minimal and predominantly involved underestimation of platelet counts in cases that were otherwise within normal limits on manual examination.

A chi-square test was applied to assess the association between platelet count obtained by the automated analyzer and the manual method. The calculated chi-square value was 445.4 with 4 degrees of freedom. The p-value was found to be <0.0001, indicating that the association between the two methods is highly significant statistically.

This highly significant result demonstrates a strong agreement between automated and manual platelet count categories.

Table 2: Concordance between automated and manual methods.

	Number	Percentage
Concordant cases	237	94.8%
Discordant cases	13	5.2%
	250	100%

Out of 250 cases, concordance between automated and manual platelet counts was observed in 237 cases (94.8%), while discrepancy was noted in 13 cases (5.2%). This indicates a high level of agreement between the two methods.

Table 3: Diagnostic Performance of Automated Analyzer

Parameter	Value
Sensitivity	100%
Specificity	92.02%
Accuracy	94.8%

Taking the manual method as the reference, the diagnostic performance of the automated analyzer in detecting thrombocytopenia was assessed. The automated analyzer demonstrated excellent sensitivity (100%) in detecting thrombocytopenia, ensuring that no true cases were missed. However, the specificity (92.02%) was slightly lower due to false positive cases. Overall, the analyzer showed high diagnostic accuracy (94.8%).

Table 4: Comparison of mean platelet counts.

Method	Mean platelet count ($\times 10^3/\mu L$)	Standard deviation
Automated method	184.76	±92.14

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Manual method	205.88	±88.67
Mean difference	21.12 ×10³/µL	
p-value	< 0.001	

The mean platelet count obtained by the automated method was 184.76 ± 92.14 ×10³/µL, while that obtained by the manual method was higher at 205.88 ± 88.67 ×10³/µL. The calculated mean difference between the two methods was 21.12 ×10³/µL, indicating that the automated analyzer, on average, yielded lower platelet counts compared to the manual method.

The relatively wide standard deviations observed in both methods reflect variability in platelet counts across the study population, which included both normal and abnormal cases. Despite this variability, the consistent negative mean difference suggests a systematic tendency of the automated method to underestimate platelet counts.

This finding correlates with the discrepancy analysis, where a subset of cases was falsely categorized as thrombocytopenia by the automated analyzer. Such underestimation is likely attributable to factors affecting automated counting, including platelet clumping and the presence of large or atypical platelets.

A paired t-test was applied to compare the mean platelet counts obtained by the automated and manual methods. The difference between the two methods was found to be statistically highly significant ($p < 0.001$).

This indicates that the observed difference in mean platelet counts is unlikely to be due to chance alone and reflects a true systematic variation between the two methods, with the automated analyzer tending to yield lower platelet counts compared to the manual method.

Table 5: Correlation between Automated and Manual Platelet Count

Parameter	Value
Pearson's correlation coefficient (r)	0.99
p-value	<0.0001
Interpretation	Strong positive correlation

A Pearson's correlation analysis was performed to assess the linear relationship between platelet counts obtained by the automated hematology analyzer and the manual peripheral smear method. The analysis revealed a very strong positive correlation between the two methods ($r = 0.99$), which was statistically highly significant ($p < 0.0001$). This indicates that platelet counts obtained by both methods increase proportionately and exhibit a high degree of linear association.

Despite the strong correlation observed, a statistically significant difference in mean platelet counts was noted between the two methods, with the automated analyzer yielding lower values. This suggests the presence of a systematic bias, indicating that while both methods are closely related, they are not entirely interchangeable.

Discussion

Accurate platelet count estimation constitutes an essential component of routine hematological evaluation and plays a pivotal role in clinical diagnosis, monitoring, and therapeutic decision-making. Platelet counts are particularly crucial in patients presenting with bleeding manifestations, dengue fever, sepsis, hematological malignancies, chemotherapy-induced cytopenias, disseminated intravascular coagulation, and in critically

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ill patients requiring intensive care support. In such settings, even minor inaccuracies in platelet estimation may significantly influence clinical management, including the need for platelet transfusion, invasive procedures, or modification of treatment protocols.

With the advent of automated hematology analyzers, platelet estimation has become rapid, standardized, and reproducible, enabling high-throughput processing in modern laboratories. Automated analyzers offer several advantages over manual methods, including reduced turnaround time, elimination of observer fatigue, and improved precision in routine samples. Consequently, they have become the primary modality for platelet estimation in most clinical laboratories.

Despite these advantages, automated platelet counting is not entirely free from limitations. Various analytical and pre-analytical factors may interfere with accurate platelet estimation, particularly in samples with abnormal morphology or very low platelet counts. Conditions such as platelet clumping, giant platelets, platelet satellitism, microcytic red blood cells, and fragmented erythrocytes may result in spuriously low or occasionally erroneous platelet counts. These discrepancies become especially important in thrombocytopenic patients, where clinical decisions are highly dependent on precise platelet quantification.

Manual platelet estimation by peripheral smear examination, although labor-intensive and observer-dependent, continues to serve as an important confirmatory and reference method, particularly in cases flagged by automated analyzers or showing abnormal histograms. Peripheral smear examination not only permits validation of platelet counts but also provides valuable morphological information that may aid in identifying the cause of discrepancy.

The present study was therefore undertaken to evaluate the discrepancy between platelet counts obtained by automated hematology analyzer and manual peripheral smear examination, with particular emphasis on the degree of concordance, nature of discrepancies, and diagnostic reliability of automated platelet estimation. The study also aimed to assess the clinical significance of such discrepancies and to determine the role of manual smear examination in routine hematology practice.

Comparison of concordance rates across studies

Study	Concordance / Correlation	Key Finding
Present study	r = 0.99	High agreement
Elhassade et al.[14]	r = 0.935	High agreement
Keswani et al.[15]	r = 0.98	Excellent correlation
Supriyam Das et al.[16]	r = 0.946	Strong correlation

The findings of the present study are comparable with those reported by Keswani et al.[21], Supriyam Das et al.[20], and Elhassade et al.[14], all of whom demonstrated strong positive correlation between automated and manual platelet estimation methods . The consistently high correlation coefficients observed across studies indicate that platelet counts obtained by automated analyzers generally increase proportionately with manual counts and maintain a strong linear relationship.

However, it is important to recognize that correlation and concordance, although closely related, are not entirely synonymous. A strong correlation coefficient

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indicates that the two methods vary proportionately, but does not necessarily imply complete interchangeability between them. Even in the presence of excellent correlation, systematic differences may still exist between methods, particularly within clinically significant platelet ranges.

This observation is particularly relevant in the present study, where a very strong correlation (r = 0.99) coexisted with a statistically significant difference in mean platelet counts between the two methods. This suggests that although automated and manual platelet counts follow a similar trend, the automated analyzer demonstrated a consistent tendency toward lower platelet estimation in certain samples.

The high concordance observed in the present study supports the utility of automated analyzers as reliable screening tools in routine hematology practice. Automated systems offer several practical advantages, including rapid processing, standardization, reduced observer variability, and the ability to handle large sample volumes efficiently. These attributes make them highly suitable for routine laboratory use, particularly in high-throughput tertiary care centers.

Nevertheless, the findings of the present study also indicate that agreement between methods is not uniform across all platelet ranges. Concordance was highest in normal platelet counts and thrombocytosis, whereas discrepancies were predominantly confined to thrombocytopenic samples. This suggests that automated analyzers perform optimally in routine samples but may demonstrate reduced reliability in low platelet count ranges where interfering factors become analytically significant.

Another important implication of the high concordance observed in the present study is that manual platelet estimation may not be necessary for every routine sample. Instead, peripheral smear examination can be reserved for selected cases such as thrombocytopenia, abnormal analyzer flags, clinically discordant results, or morphologically abnormal samples. Such an approach would improve laboratory efficiency while maintaining diagnostic accuracy. Overall, the findings of the present study, together with previously published literature, establish that automated hematology analyzers provide highly reliable platelet estimation in the majority of cases. However, the presence of clinically important discrepancies in thrombocytopenic samples indicates that manual peripheral smear examination continues to retain an essential role as a confirmatory method in hematology practice.

Comparison of Discrepancy Across Studies

Study	Discrepancy / Key Finding
Present study	5.2% false thrombocytopenia
Ayesha Tariq et al.[17]	52% pseudo-thrombocytopenia
Prajapati et al.[18]	10% pseudo-thrombocytopenia

The findings of the present study are consistent with previously published studies that have identified pseudo-thrombocytopenia as one of the most important limitations of automated platelet estimation. Ayesha Tariq et al.[15] reported a substantially higher frequency of pseudo-thrombocytopenia, while Prajapati et al.[18] also documented falsely low automated platelet counts in a proportion of cases. Although the discrepancy rate observed in the present study was comparatively lower, the pattern of discrepancy remained similar across

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studies. The discrepancies observed in the present study were not random in nature but demonstrated a definite tendency toward underestimation of platelet counts by the automated analyzer. This suggests the presence of a systematic analytical limitation rather than sporadic measurement error. Such underestimation becomes particularly significant in thrombocytopenic samples, where even minor numerical variations may alter categorical interpretation and directly influence clinical management.

Several analytical and pre-analytical factors may contribute to falsely low platelet counts in automated systems. Among these, platelet clumping represents one of the most common causes of pseudo-thrombocytopenia. In EDTA-anticoagulated samples, platelets may aggregate in vitro, leading the analyzer to count multiple platelets as a single particle or exclude them altogether from the platelet channel. Similarly, giant platelets may exceed the upper size threshold recognized by automated analyzers and may therefore be misclassified as erythrocytes or excluded from counting.

Additional interference may arise from fragmented red blood cells, microcytic erythrocytes, cytoplasmic debris, or platelet satellitism. Since automated analyzers primarily rely upon impedance or optical principles for platelet identification, overlap in cellular size and morphology may result in inaccurate discrimination between platelets and other formed elements.

The predominance of discrepancy within thrombocytopenic ranges observed in the present study is clinically important. At low platelet counts, small analytical deviations assume greater clinical significance because they may alter transfusion thresholds, delay invasive procedures, or lead to unnecessary investigations for suspected hematological disorders. In critically ill patients, oncology patients, or individuals with dengue fever and sepsis, such discrepancies may directly influence therapeutic decision-making.

An important strength of the automated analyzer observed in the present study was its high sensitivity, as no true thrombocytopenic cases were missed. From a clinical perspective, this finding is reassuring because false negative thrombocytopenia may potentially expose patients to bleeding complications due to missed diagnosis. However, the presence of false positive thrombocytopenia remains relevant because it may result in unnecessary platelet transfusion, patient anxiety, repeated laboratory testing, and increased healthcare costs.

The relatively lower discrepancy rate observed in the present study compared to certain previous studies may be attributed to improved sample handling, timely processing, better analyzer calibration, and adherence to standardized laboratory protocols. Variations in study population, prevalence of thrombocytopenic disorders, and analyzer technology may also contribute to differences observed across studies.

The findings of the present study therefore reinforce the concept that automated platelet counting, although highly reliable in routine practice, should not be interpreted in isolation in clinically significant thrombocytopenic cases. Peripheral smear examination continues to remain indispensable for confirmation of low platelet counts, particularly in samples showing analyzer flags, abnormal histograms, or clinical-laboratory discordance.

Overall, the discrepancy analysis performed in the present study establishes that automated hematology analyzers are highly effective screening tools but are still susceptible to predictable analytical limitations,

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especially in thrombocytopenic ranges. Consequently, integration of automated platelet estimation with manual smear review remains the most reliable approach for accurate platelet assessment in clinical practice.

Conclusion

Platelet count estimation is a fundamental component of hematological evaluation, playing a pivotal role in diagnosis and therapeutic decision-making. With the widespread adoption of automated hematology analyzers, platelet estimation has become rapid and standardized in routine laboratory practice. However, concerns regarding their accuracy in certain clinical conditions, particularly thrombocytopenia, have necessitated comparative evaluation with manual methods. In this context, the present study was undertaken to assess the reliability and limitations of automated platelet counting in comparison to manual peripheral smear examination.

The present study, conducted to evaluate the discrepancy between platelet counts obtained by automated hematology analyzer and manual peripheral smear examination, demonstrates that automated analyzers provide reliable and efficient platelet estimation in the majority of cases. However, certain limitations were identified, particularly in the thrombocytopenic range.

Automated hematology analyzers, while highly efficient and broadly reliable, are not entirely infallible in platelet estimation, particularly in clinically critical ranges. The overall findings demonstrate that automated platelet counts show strong agreement with manual methods in the majority of cases, reaffirming their role as indispensable tools in routine laboratory practice.

However, a key observation of this study is that the discrepancies between the two methods are not random but exhibit a consistent pattern. These differences are predominantly confined to the lower platelet count ranges, where automated analyzers tend to underestimate platelet counts. This systematic bias highlights an inherent limitation of automated systems rather than an occasional analytical error.

The study clearly establishes that automated analyzers are highly sensitive in detecting thrombocytopenia, ensuring that true cases are not missed. At the same time, their tendency to over diagnose thrombocytopenia in certain situations underscores the importance of cautious interpretation. This becomes particularly relevant in clinical scenarios where therapeutic decisions, such as platelet transfusion, depend on precise platelet counts.

The study also highlights that the accuracy of automated analyzers improves as platelet counts move toward the normal and higher ranges. In these categories, automated and manual methods are largely interchangeable, supporting the routine use of automated systems for screening purposes.

Taken together, the findings of the present study reinforce the concept that automated platelet counting should be viewed as a screening tool rather than a definitive diagnostic method in all situations. While it provides rapid and reproducible results, it does not completely eliminate the need for manual verification.

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