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Research Article

HAEMATOLOGICAL ABNORMALITIES AND THEIR RELATIONSHIP WITH CD4 COUNT AMONG ADULTS LIVING WITH HIV: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Haematological abnormalities are common in people living with HIV and may reflect immune dysfunction, chronic inflammation, nutritional deficiencies, co-infections or treatment-related effects. This study evaluated the haematological profile of adults with HIV and examined its relationship with CD4 cell counts.

Methods: A hospital-based cross-sectional observational study was conducted in the General Medicine services of National Institute of Medical Sciences and Research, Jaipur, over 18 months. Adults aged ≥18 years with confirmed HIV infection who provided informed consent were included. Patients with pre-existing haematological or congenital blood disorders and pregnant women were excluded. Demographic and clinical data were recorded. Complete blood count, red-cell indices, peripheral smear examination and CD4 T-lymphocyte counts were assessed. Data were analysed using SPSS version 25 and Microsoft Excel.

Results: Fifty participants were included; mean age was 35.83±11.25 years and 58.0% were female. All participants were receiving antiretroviral therapy. Pallor was present in 26.0% and lymphadenopathy in 20.0%. Mean haemoglobin was 9.79±1.07 g/dL, total leukocyte count 5200.00±884.65 cells/mm³, platelet count 169,166.67±14,116.49 cells/mm³, mean corpuscular volume 87.00±1.67 fL, mean corpuscular haemoglobin 29.50±1.25 pg and mean corpuscular haemoglobin concentration 33.25±0.26 g/dL. Mean CD4 count was 424.62±168.45 cells/mm³. The source study described greater haematological abnormalities among participants with lower CD4 counts.

Conclusion: Anaemia was the principal haematological abnormality in this treated cohort, while mean leukocyte and platelet counts were relatively preserved. Routine complete blood count assessment alongside CD4 monitoring may provide a practical adjunct for identifying patients requiring further evaluation.

KEYWORDS: HIV, Haematological Abnormalities, Anaemia, CD4 Count, Antiretroviral Therapy, Complete Blood Count.

Introduction

Human immunodeficiency virus (HIV) infection remains a major global health problem despite major advances in antiretroviral therapy (ART). Current UNAIDS estimates indicate that more than 40 million people were living with HIV worldwide in 2025, with millions receiving ART[1]. Effective ART has substantially reduced HIV-associated morbidity and mortality, but chronic complications and

treatment-related abnormalities remain clinically relevant.

HIV affects the haematopoietic system through multiple interacting mechanisms. Anaemia, leukopenia, neutropenia, lymphopenia and thrombocytopenia may arise from chronic immune activation, impaired haematopoiesis, opportunistic infections, nutritional deficiencies, malignancy, hypersplenism and drug toxicity[2,3]. Anaemia is one of the most frequent haematological abnormalities in HIV and has been associated with disease progression and mortality[4,5].

CD4 T-lymphocyte count remains an important marker of immune status and is incorporated into HIV care and treatment monitoring[6]. Several studies have demonstrated that haematological abnormalities become more frequent or severe with declining CD4 counts. Indian data have similarly shown a high prevalence of anaemia and other cytopenias among people living with HIV, with haemoglobin showing an inverse relationship with CD4 count[7-9].

The clinical value of routine haematological testing is particularly important where sophisticated laboratory investigations are less accessible. Complete blood count is inexpensive, widely available and reproducible, and may provide an additional clinical signal when interpreted together with CD4 count, treatment history and other clinical factors[7,10]. However, haematological findings should not be regarded as substitutes for virological monitoring because cytopenias have multiple potential causes and may be influenced by ART, nutritional status and co-infections.

The present study was undertaken to characterize the haematological profile of adults with HIV attending a tertiary-care hospital in Jaipur and to examine the observed relationship between routine haematological parameters and CD4 counts.

Materials and Methods

Study Design and Setting

This hospital-based cross-sectional observational study was conducted in the various clinical departments of National Institute of Medical Sciences and Research and Hospital, Jaipur, Rajasthan, over 18 months. The study population comprised adults aged 18 years and above with HIV infection who presented to the hospital.

Participants

Adults with confirmed HIV infection who provided written informed consent were eligible. Patients unable or unwilling to provide consent, those with previously known haematological disorders, congenital haematological disorders, age below 18 years and pregnant women were excluded.

Data Collection and Laboratory Assessment

Demographic and clinical information, including age, sex, residence, occupation, symptom duration, ART status and relevant clinical findings, was recorded using a semi-structured proforma. HIV diagnosis was documented according to the institutional/NACO-based testing approach described in the source record. Venous blood samples were collected under aseptic conditions. Complete blood count was performed using an automated haematology analyser, and peripheral smears were prepared for morphological assessment. CD4 T-lymphocyte counts were measured by flow cytometry using standardized procedures. Haematological parameters included haemoglobin, total leukocyte count, differential count, platelet count and red-cell indices.

Statistical Analysis

Data were entered and analysed using SPSS version 25 and Microsoft Excel. Descriptive statistics were used to summarize participant characteristics and laboratory parameters, and the relationship between haematological findings and CD4 count was assessed as described in the study protocol. The available source record does not provide correlation coefficients or exact inferential-test outputs; therefore, this article reports the numerical results explicitly documented in the source and interprets the CD4 relationship cautiously.

Ethics

Institutional Scientific and Ethics Committee clearance was obtained before enrolment. Written informed consent was obtained from all participants after explanation of the study purpose and procedures.

Results

A total of 50 adults with HIV were included. The mean age was 35.83±11.25 years. Females constituted 58.0% of the cohort and males 42.0%. All participants were HIV positive and receiving ART at the time of assessment. Participants were drawn from Jaipur and surrounding districts, and the recorded occupational categories were evenly represented.

The most common reported symptom duration was 4–6 months (42.0%), followed by 2 months (26.0%), 1 month (20.0%) and 3 months (12.0%). Pallor was observed in 26.0% of participants, while lymphadenopathy was present in 20.0%. No participant had icterus, clubbing, cyanosis or pedal oedema on examination. Mean pulse rate and respiratory rate were 76.00±2.95 beats/min and 17.92±1.41 breaths/min, respectively.

Haematological evaluation demonstrated a mean haemoglobin level of 9.79±1.07 g/dL, indicating a substantial burden of anaemia. Mean total leukocyte count was 5200.00±884.65 cells/mm³ and mean platelet count was 169,166.67±14,116.49 cells/mm³. Red-cell indices were predominantly normocytic and normochromic, with mean corpuscular volume 87.00±1.67 fL, mean corpuscular haemoglobin 29.50±1.25 pg and mean corpuscular haemoglobin concentration 33.25±0.26 g/dL.

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Table 1: Baseline demographic and clinical characteristics

Variable	Finding
Age	35.83±11.25 years
Female sex	29 (58.0%)
Male sex	21 (42.0%)
Receiving ART	50 (100%)
Pallor	13 (26.0%)
Lymphadenopathy	10 (20.0%)
Symptoms lasting 4–6 months	21 (42.0%)
BMI	24.81±4.83 kg/m²

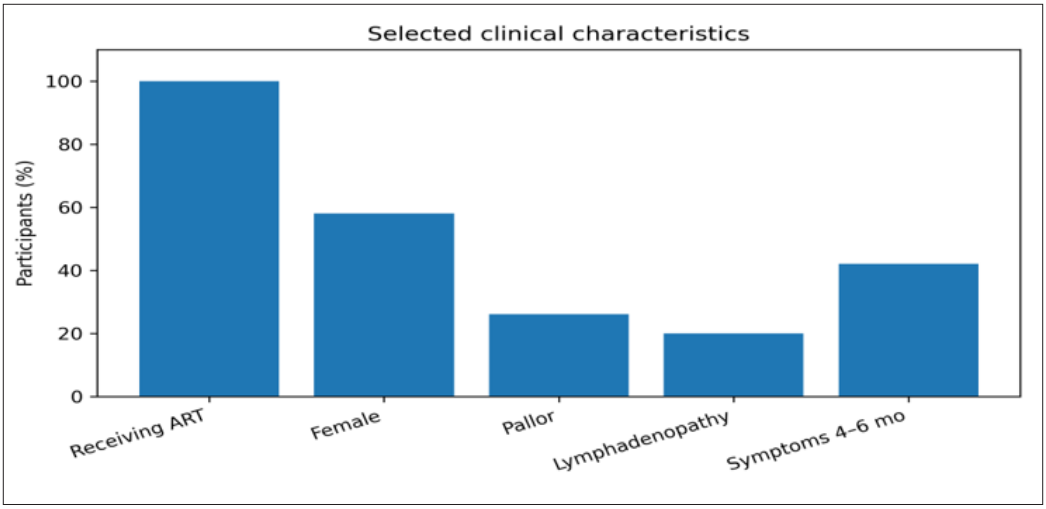

Figure 1.Selected clinical characteristics of the study cohort

Table 2: Haematological and immunological profile

Parameter	Mean±SD
Haemoglobin	9.79±1.07 g/dL
Total leukocyte count	5200.00±884.65 cells/mm³
Platelet count	169,166.67±14,116.49 cells/mm³
MCV	87.00±1.67 fL
MCH	29.50±1.25 pg
MCHC	33.25±0.26 g/dL
CD4 count	424.62±168.45 cells/mm³

The mean CD4 count was 424.62±168.45 cells/mm³. The source record describes greater frequency and severity of anaemia and other cytopenias among participants with lower CD4 counts. Because individual-level data and correlation coefficients were not reported, the strength and statistical significance of these relationships cannot be independently quantified from the available record.

All 50 participants were recorded as clinically improved, and none was reported as requiring hospitalization during the study period. This outcome should be interpreted in the context of the cross-sectional design and the fact that all participants were receiving ART.

Discussion

The present study demonstrates that anaemia remained a prominent haematological finding among adults with HIV despite universal ART coverage in the cohort. The mean haemoglobin concentration of 9.79 g/dL was substantially reduced, whereas mean leukocyte and platelet counts were relatively preserved. This pattern is consistent with the broader literature identifying anaemia as the most frequent haematological abnormality in HIV[7-9].

Indian data from Dikshit et al. found anaemia in 65.5% of HIV-infected individuals and reported a strong

negative correlation between anaemia and CD4 counts[7]. Bhardwaj et al. reported anaemia in 72.5% of patients and demonstrated significant relationships between anaemia, absolute lymphocyte count, thrombocytopenia and CD4 count[8]. Suja et al. similarly found a significant direct relationship between haemoglobin and absolute CD4 count, with normocytic normochromic and anaemia-of-chronic-disease patterns being common[9]. These observations are directionally consistent with the present cohort, in which anaemia was the dominant abnormality and lower CD4 counts were described as being associated with greater haematological disturbance.

The mechanisms underlying HIV-associated anaemia are multifactorial. Persistent immune activation and inflammatory cytokines can impair erythropoiesis and iron utilization, while opportunistic infections, nutritional deficiencies, renal dysfunction, malignancy and medications may contribute[2,3,11]. The present study did not systematically quantify iron, folate, vitamin B12, renal function, viral load or opportunistic infections, and therefore the precise cause of anaemia in individual participants cannot be established.

The mean MCV, MCH and MCHC in the study were 87.00 fL, 29.50 pg and 33.25 g/dL, respectively, supporting a predominantly normocytic normochromic pattern. Such a pattern is commonly reported in HIV-associated anaemia and may reflect chronic inflammation or chronic disease rather than a single nutritional deficiency[7,9]. However, red-cell indices alone cannot distinguish anaemia of chronic inflammation from iron deficiency or other causes, and further laboratory assessment would be necessary when clinically indicated.

The mean total leukocyte count and platelet count were relatively preserved. This does not exclude clinically important cytopenias in individual patients. Previous studies have shown that cytopenias may increase with advancing immunosuppression and can be influenced by sex, nutritional status, body mass index, co-infections and treatment exposure[10]. In a Ugandan cohort, cytopenias were associated with decreasing CD4 count and lower body mass index[10]. The relatively preserved mean counts in the present cohort may partly reflect universal ART exposure, although a causal effect cannot be established from this cross-sectional design.

The mean CD4 count of 424.62 cells/mm³ indicates that the cohort, as a whole, did not predominantly comprise individuals with profound immunosuppression. The coexistence of substantial anaemia with a moderately preserved mean CD4 count reinforces the point that haematological abnormalities may persist even when immune status is not severely depressed. Anaemia has independent prognostic significance in HIV; large observational studies have linked lower haemoglobin with faster disease progression and higher mortality[4,5].

From a clinical perspective, the findings support continued routine haematological assessment alongside established HIV monitoring. NACO guidance recommends structured clinical, immunological and virological monitoring during ART, while WHO guidance emphasizes regular assessment and optimization of HIV treatment[6,12]. Complete blood count is readily accessible and may alert clinicians to anaemia or other cytopenias that require evaluation for nutritional deficiency, drug toxicity, infection or other comorbidity.

The study has important limitations. Its single-centre cross-sectional design limits generalizability and prevents causal inference. The sample size of 50 participants limits subgroup analysis. Viral load, nutritional biomarkers, ART duration and regimen, opportunistic infections and other potential confounders were not fully characterized. Most importantly, the available study record does not report numerical correlation coefficients or p-values for the relationship between individual haematological parameters and CD4 count. Therefore, the observed relationship should be regarded as descriptive rather than as proof of a statistically quantified association. Larger longitudinal studies with complete virological, nutritional and treatment data are warranted.

Strengths

- Assessment of multiple routinely available haematological parameters together with CD4 count.
- Clinical evaluation combined with laboratory assessment in a tertiary-care setting.
- Focus on inexpensive and readily implementable investigations relevant to routine HIV care.
- Contemporary treated-cohort data with all participants receiving ART.

Conclusion

Anaemia was the principal haematological abnormality identified in this cohort of adults living with HIV, while mean leukocyte and platelet counts were relatively preserved. The mean CD4 count was 424.62 cells/mm³, and the source data described greater haematological disturbance among participants with lower CD4 counts. Routine complete blood count assessment, interpreted together with CD4 count, ART history and clinical context, remains a practical adjunct for identifying patients who require further evaluation. Future studies should use larger samples and longitudinal designs and should incorporate viral load, nutritional status, ART regimen and duration, and opportunistic infections to define the determinants of HIV-associated cytopenias more precisely.

Ethics Statement

Institutional Scientific and Ethics Committee clearance was obtained before participant enrolment. Written informed consent was obtained from all participants.

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None

Conflict of Interest

None

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