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Study of hematological parameters in patients with chronic kidney disease on hemodialysis.

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Abstract

Background: Chronic kidney disease (CKD) is a progressive disorder associated with multiple hematological abnormalities, most notably anemia. Hemodialysis, while lifesaving, further influences hematological parameters due to blood loss, hemolysis, inflammation, and altered erythropoiesis.

Objectives: To study the hematological parameters in patients with chronic kidney disease undergoing maintenance hemodialysis and to assess the prevalence and pattern of hematological abnormalities.

Methods: This prospective observational study included 100 patients with CKD on maintenance hemodialysis. Complete blood counts and red cell indices were analyzed using an automated hematology analyzer. Peripheral smear examination was performed in all cases. Data were analyzed using descriptive statistics.

Results: Anemia was present in 96% of patients, with normocytic normochromic anemia being the most common type. Leukopenia was observed in 18% and thrombocytopenia in 22% of patients. Severity of anemia correlated with duration of dialysis.

Conclusion: Hematological abnormalities are highly prevalent in CKD patients on hemodialysis, with anemia being the most significant finding. Regular monitoring of hematological parameters is essential for early intervention and improved patient outcomes.

Keywords: Chronic kidney disease, Hemodialysis, Anemia, Hematological parameters, Pancytopenia

Introduction

A major cause of morbidity and mortality, chronic kidney disease (CKD) is a global public health concern that is becoming more and more common[1]. End-stage renal disease (ESRD), which necessitates renal replacement therapy in the form of hemodialysis, peritoneal dialysis, or kidney transplantation, is the result of a progressive and irreversible loss of renal function[2].

Hematological abnormalities are prevalent and clinically significant among the systemic consequences of chronic kidney disease. The most common hematological symptom is anemia, which is mostly caused by the damaged kidneys producing less erythropoietin. Iron deficiency, chronic inflammation, decreased red blood cell survival, dietary inadequacies, and blood loss during dialysis are further contributing causes[3-4].

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Through recurrent blood exposure to dialysis membranes, inflammatory pathway activation, mechanical hemolysis, and platelet activation, hemodialysis itself can affect hematological parameters[5]. Abnormalities in leukocytes and platelets may increase morbidity by putting patients at risk for infections and bleeding problems.

Hematological disorders are still common despite improvements in erythropoiesis-stimulating drugs and dialysis procedures. Optimizing patient care requires an understanding of the pattern and severity of these anomalies. This study was conducted at a tertiary care facility to assess the hematological parameters of CKD patients receiving maintenance hemodialysis [6-7].

Materials and Methods

This prospective observational study was conducted in the Department of Pathology in collaboration with the Department of Nephrology at Index Medical College, Indore over a period of 12 months.

Study Population

A total of 100 patients diagnosed with CKD and receiving maintenance hemodialysis were included in the study.

Inclusion Criteria

- Patients aged ≥18 years
- Diagnosed cases of CKD (Stage 5)
- On maintenance hemodialysis for at least 3 months

Exclusion Criteria

- Patients with known hematological malignancies
- Patients with acute infections or active bleeding
- Patients who received blood transfusion within the previous 4 weeks

Data Collection

Detailed clinical history including duration of CKD, duration and frequency of hemodialysis, and comorbidities was recorded. Blood samples were collected prior to dialysis sessions.

Hematological Investigations

- Complete blood count (CBC) including hemoglobin, total leukocyte count (TLC), platelet count, and red cell indices were performed using an automated hematology analyzer.
- Peripheral blood smear examination was done using Leishman stain to assess red cell morphology and white cell abnormalities.

Statistical Analysis

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Data were entered in Microsoft Excel and analyzed using descriptive statistics. Results were expressed as frequencies, percentages, mean, and standard deviation.

Results

Demographic Profile

Out of 100 patients, 62 were males and 38 were females, with a male-to-female ratio of 1.63:1. The age of patients ranged from 22 to 74 years, with a mean age of 49.2 years.

Table 1: Age and Sex Distribution of Study Participants

Age Group (years)	Male	Female	Total
21–30	06	04	10
31–40	12	08	20
41–50	18	10	28
51–60	16	10	26
>60	10	06	16
Total	**62**	**38**	**100**

Hemoglobin Levels and Severity of Anemia

Anemia was observed in 96% of patients. Moderate anemia was the most common presentation.

Table 2: Distribution of Patients According to Hemoglobin Levels

Hemoglobin Level (g/dL)	Number of Patients	Percentage
<7.0	18	18%
7.0–9.9	54	54%
10.0–11.9	24	24%
≥12.0	04	04%
Total	**100**	**100%**

Red Cell Morphology

Peripheral smear examination showed normocytic normochromic anemia as the predominant pattern.

Table 3: Peripheral Blood Smear Findings

Red Cell Morphology	Number of Patients	Percentage

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Red Cell Morphology	Number of Patients	Percentage
Normocytic normochromic	68	68%
Microcytic hypochromic	18	18%
Macrocytic	06	06%
Dimorphic	04	04%
Normal smear	04	04%
Total	**100**	**100%**

Leukocyte and Platelet Abnormalities

Leukopenia and thrombocytopenia were observed in a subset of patients, particularly those on long-term dialysis.

Table 4: Leukocyte and Platelet Count Abnormalities

Parameter	Normal	Decreased	Increased
Total leukocyte count	78 (78%)	18 (18%)	04 (04%)
Platelet count	72 (72%)	22 (22%)	06 (06%)

Discussion

One well-known side effect of chronic renal disease is hematological abnormalities, which are exacerbated by hemodialysis[8]. 96% of patients in the current study had anemia, which is in line with earlier research that found that anemia prevalence in ESRD patients ranges from 90% to 98%.

Reduced erythropoietin synthesis, shortened red cell lifespan, and persistent inflammation are the main causes of normocytic normochromic anemia. Iron deficiency brought on by frequent blood loss during dialysis and inadequate nutritional intake may be the cause of the microcytic hypochromic anemia seen in 18% of patients[9-10].

18% of patients had leukopenia, which could be caused by dialysis-induced leukocyte activation and sequestration or uremia-induced bone marrow suppression. The 22% of cases of thrombocytopenia may be caused by exposure to dialysis membranes, reduced survival, and platelet malfunction.

Longer dialysis periods were found to enhance the severity of anemia, underscoring the significance of routine hematological monitoring and prompt correction with erythropoiesis-stimulating drugs and iron supplements[11-12].

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Conclusion

Hematological abnormalities are highly prevalent in patients with chronic kidney disease undergoing hemodialysis, with anemia being the most common finding. Normocytic normochromic anemia predominates, while leukopenia and thrombocytopenia occur in a significant proportion of patients. Regular assessment of hematological parameters is essential for early detection and appropriate management, ultimately improving quality of life and clinical outcomes in CKD patients.

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