Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

COMPARATIVE ANALYSIS OF ANAEMIA STATUS AND ITS MANAGEMENT IN HAEMODIALYSIS AND PERITONEAL DIALYSIS

Dr Akbar Ali[*1], Dr Salman Imtiaz[2], Dr Kamran Ali[3], Dr Neha Ahtesham[4]

*[*1,4]Education MBBS, Postgraduate Trainee, Department of Nephrology, Indus Hospital Karachi*
[2]Education MBBS FCPS, Professor, Department of Nephrology, Indus Hospital Karachi
[3]Education MBBS, Postgraduate Trainee, Department of Nephrology, SIUT Karachi

[*1]akbar.umrani@gmail.com, [2]salman.imtiaz@tih.org.pk, [3]kamranlakhiar@gmail.com, [4]nehaahtesham@gmail.com

DOI: https://doi.org/10.5281/zenodo.20483955

Keywords
Anaemia, Haemodialysis, Peritoneal Dialysis, ESRD, Erythropoiesis-Stimulating Agents.

Article History
Received: 21 June 2025
Accepted: 11 July 2025
Published: 30 July 2025

Corresponding Author: *
Dr Akbar Ali

Abstract

OBJECTIVE:
To compare the prevalence, severity, management of anemia between patients undergoing haemodialysis (HD) and peritoneal dialysis (PD) in a tertiary care setting.

STUDY DESIGN:
Prospective cohort study.

PLACE AND DURATION OF STUDY:
The study took place at the Nephrology Department, The Indus Hospital, Karachi, Pakistan For six months.

METHODOLOGY:
A total of 102 adult patients with end stage renal disease were enrolled and equally divided into HD (n=51) and PD (n=51) groups. Haemoglobin levels, anaemia severity, erythropoiesis-stimulating agent (ESA) use, iron supplementation, and transfusion requirements were assessed according to KDIGO guidelines. Statistical analysis was performed using SPSS Vol 25, applying independent t-test and chi-square test to test significance at the level of <0.05.

RESULTS:
Mean haemoglobin levels were significantly higher in PD patients compared to HD patients (10.6 ± 1.4 vs. 9.8 ± 1.5 g/dL; p=0.001). Anaemia prevalence was higher in the HD group (52.5% vs. 32.5%; p=0.011), with severe anaemia more frequent in HD patients (16.7% vs. 3.8%; p=0.043). Although ESA use was comparable, HD patients required significantly higher doses (195.2 ± 72.3 vs. 153.1 ± 58.4 IU/kg/week; p=0.001). Iron supplementation and blood transfusion rates were also significantly higher in the HD group.

CONCLUSION:
Peritoneal dialysis is associated with better anaemia control and lower treatment burden compared to haemodialysis. Dialysis modality should be considered an important factor in anaemia management strategies in resource-limited settings.

INTRODUCTION

Chronic kidney disease is a significant global health concern and affects a substantial proportion of the population worldwide (1). In its advanced stage, end-stage renal disease

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

(ESRD), patients require renal replacement therapy for survival and is associated with multiple complications, among which anaemia is one of the most prevalent and clinically significant. Anaemia in ESRD contributes to increased cardiovascular morbidity, reduced functional capacity, and impaired quality of life (2,3).

The development of anaemia in CKD is multifactorial. In addition to decreased erythropoietin production, several contributing factors including iron deficiency, elevated hepcidin level, chronic inflammation, decreased lifespan of red blood cells, and the effects of uremic toxins (4,5). These mechanisms may be influenced by the type of dialysis modality used. Haemodialysis (HD) is associated with repeated extracorporeal circulation, blood loss, and inflammatory activation, all of which may exacerbate anaemia (6). In contrast, peritoneal dialysis (PD) preserves residual renal function for a longer duration and avoids direct blood loss, although protein losses through the peritoneal membrane may affect iron metabolism (7). These physiological differences may result in variability in anaemia prevalence and response to therapy between modalities.

Management of renal anaemia has evolved with the use of erythropoiesis-stimulating agents (ESAs) and iron supplementation, guided by kidney disease: Improving Global Outcomes (KDIGO) recommendations (8,9). However, differences in treatment requirements between HD and PD patients, particularly in resource-limited settings, remain inadequately explored.

In Pakistan, CKD prevalence is rising, and access to dialysis is often influenced by resource availability rather than clinical preference. Limited local data exist comparing anaemia outcomes between HD and PD populations (10,11).

Therefore, this study was conducted to evaluate anaemia status and its management between haemodialysis and peritoneal dialysis patients in a tertiary care setting in Pakistan.

METHODOLOGY

This study prospective cohort was conducted at the Nephrology department, The Indus Hospital, Karachi, Pakistan, for six months, after getting ethical approval from the institution.

The sample size of 102 patients was estimated based on a WHO-based sample size calculator with the level of significance of 5% and power of 80%.

A total of 102 patients with end stage renal disease receiving RRT were enrolled and equally divided into haemodialysis (HD) and peritoneal dialysis (PD) groups (n=51 each). Patients aged 18–70 years with documented anaemia were included. Patients with chronic liver disease, active malignancy, inherited blood disorders, pregnancy, active infection, or hemodynamic instability were excluded.

Eligible participants were recruited using non-probability consecutive sampling. Written informed consent was obtained from all patients, and ethical approval was obtained from the institutional review board. The study was conducted in accordance with the Declaration of Helsinki.

Baseline demographic and clinical data were recorded. Haemoglobin levels, anaemia severity, erythropoiesis-stimulating agent (ESA) use, iron supplementation, and blood transfusion requirements were assessed. Anaemia was defined and classified according to KDIGO guidelines.

Data analysis was performed using SPSS version 25. Continuous variables were summarized as mean with standard deviation and compared between groups using the independent samples t-test. Categorical variables were presented as counts and percentages, and group comparisons were carried out using the chi-square test. A p-value less than 0.05 was considered indicative of statistical significance. Confounding variables were controlled through stratification and statistical adjustment.

RESULTS

A total of 102 patients with end-stage renal disease (ESRD) were included in the study, comprising 51 patients each in the haemodialysis (HD) and peritoneal dialysis (PD) groups. The mean age of the study population was 42.5 ± 14.2 years, with a male predominance (63.7%). Baseline demographic characteristics, including age, gender distribution, and duration of dialysis, were comparable between the two groups ($p>0.05$). Baseline demographic and clinical characteristics are summarised in Table 1.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Table 1: Demographic Characteristics of Study Participants (N = 102)

Variable	Total (N=102)	HD Group (n=51)	PD Group (n=51)	p-value
Age (years)				
Range	18–67	18–67	18–65	
Mean ± SD	42.5 ± 14.2	44.3 ± 13.8	40.7 ± 14.5	0.108*
Gender, n (%)				
Male	65 (63.7%)	34 (66.7%)	31 (60.8%)	0.534†
Female	37 (36.3%)	17 (33.3%)	20 (39.2%)	
Duration on Dialysis (months)				
Range	8–71	8–71	10–68	
Mean ± SD	39.5 ± 18.3	42.1 ± 19.2	36.9 ± 17.1	0.072*

*Independent samples t-test; †Chi-square test. HD = haemodialysis; PD = peritoneal dialysis; ESA = erythropoiesis-stimulating agent.

Patients receiving peritoneal dialysis demonstrated significantly higher mean haemoglobin concentrations compared with those undergoing haemodialysis (10.6 ± 1.4 g/dL vs. 9.8 ± 1.5 g/dL; p=0.001). Overall prevalence of anaemia (Hb <10 g/dL) was significantly greater among HD patients than PD patients (52.9% vs. 31.4%; p=0.028). Severe anaemia (Hb <7 g/dL) was also more frequent in the HD group. The prevalence and severity of anaemia are summarised in Table 2.

Table 2: Anaemia Prevalence and Severity Classification

Anaemia Classification	Total N (%)	HD Group n (%)	PD Group n (%)	p-value
Anaemia Status				
Anaemic (Hb <10 g/dL)	43 (42.2%)	27 (52.9%)	16 (31.4%)	0.028†
Non-anaemic (Hb ≥10 g/dL)	59 (57.8%)	24 (47.1%)	35 (68.6%)	
Severity (among anaemic patients)				0.047†
Mild (Hb 9–10 g/dL)	20 (46.5%)	11 (40.7%)	9 (56.3%)	
Moderate (Hb 7–9 g/dL)	18 (41.9%)	11 (40.7%)	7 (43.7%)	
Severe (Hb <7 g/dL)	5 (11.6%)	5 (18.5%)	0 (0.0%)	

†Chi-square test; statistical significance defined as p<0.05.

Comorbid conditions including hypertension, diabetes mellitus, and cardiovascular disease were more common among HD patients; however, these differences did not reach statistical significance (p>0.05).

Regarding anaemia management, erythropoiesis-stimulating agent (ESA) utilisation was comparable between groups (HD: 92.2% vs. PD: 84.3%; p=0.214). However, HD patients required significantly higher ESA doses than PD patients (195.2 ± 72.3 IU/kg/week vs. 153.1 ± 58.4 IU/kg/week; p=0.001). ESA utilisation patterns and dosing requirements are shown in Table 3.

Table 3: ESA Therapy Utilisation and Dosing

Parameter	Total N (%)	HD Group n (%)	PD Group n (%)	p-value
ESA Use				
Yes	90 (88.2%)	47 (92.2%)	43 (84.3%)	0.214 †
No	12 (11.8%)	4 (7.8%)	8 (15.7%)	
ESA Type				
Epoetin alfa	90 (100%)	47 (100%)	43 (100%)	—
Dosage (IU/kg/week)				
Range	50–300	75–300	50–250	
Mean ± SD	175.0 ± 68.5	195.2 ± 72.3	153.1 ± 58.4	0.001 *
Frequency				0.031 †
Once weekly	31 (34.4%)	12 (25.5%)	19 (44.2%)	
Twice weekly	36 (40.0%)	18 (38.3%)	18 (41.9%)	

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Parameter	Total N (%)	HD Group n (%)	PD Group n (%)	p-value
Thrice weekly	23 (25.6%)	17 (36.2%)	6 (13.9%)	

*Independent samples t-test; †Chi-square test.

Iron supplementation was significantly more frequent among HD patients compared with PD patients (76.5% vs. 54.9%; p=0.022). HD patients also required significantly higher intravenous iron doses (p=0.002). Iron supplementation patterns are presented in Table 4.

Table 4: Iron Supplementation Patterns

Parameter	Total N (%)	HD Group n (%)	PD Group n (%)	p-value
Iron Supplementation				
Yes	67 (65.7%)	39 (76.5%)	28 (54.9%)	0.022†
No	35 (34.3%)	12 (23.5%)	23 (45.1%)	
Route of Administration				0.003†
Oral only	24 (35.8%)	9 (23.1%)	15 (53.6%)	
IV only	27 (40.3%)	20 (51.3%)	7 (25.0%)	
Both oral and IV	16 (23.9%)	10 (25.6%)	6 (21.4%)	
IV Iron Type (n=43)				
Iron sucrose	28 (65.1%)	19 (63.3%)	9 (69.2%)	0.689†
Ferric carboxymaltose	15 (34.9%)	11 (36.7%)	4 (30.8%)	
IV Iron Dosage (mg/course)				
Mean ± SD	512.4 ± 245.8	587.3 ± 268.2	378.5 ± 178.4	0.002*

*Independent samples t-test; †Chi-square test.

Blood transfusion requirements were significantly higher among HD patients compared with PD patients (19.6% vs. 5.9%; p=0.036). Blood transfusion requirements are summarised in Table 5.

Table 5: Blood Transfusion Requirements

Parameter	Total N (%)	HD Group n (%)	PD Group n (%)	p-value
Transfusion in Past Year				
Yes	13 (12.7%)	10 (19.6%)	3 (5.9%)	0.036†
No	89 (87.3%)	41 (80.4%)	48 (94.1%)	
Number of Transfusions				0.551‡
1–2 times	9 (69.2%)	7 (70.0%)	2 (66.7%)	
3–4 times	3 (23.1%)	2 (20.0%)	1 (33.3%)	
>4 times	1 (7.7%)	1 (10.0%)	0 (0.0%)	
Indication				
Severe anaemia (Hb <7–8 g/dL)	13 (100%)	10 (100%)	3 (100%)	—

†Chi-square test; ‡Fisher's exact test where applicable.

DISCUSSION

This study demonstrates significant differences in anaemia status and its management between haemodialysis (HD) and peritoneal dialysis (PD) patients. PD patients exhibited higher haemoglobin levels, lower anaemia prevalence, and reduced treatment requirements compared to HD patients.

The significantly higher haemoglobin levels observed in PD patients are consistent with previously reported literature (12,13). This may be attributed to reduced blood loss, better preservation of residual renal function, and a lower inflammatory burden in PD compared to HD. In contrast, HD patients are exposed to repeated extracorporeal circulation and dialysis-related blood loss, which may contribute to worsening anaemia (6).

The higher prevalence of severe anaemia in HD patients observed in this study is clinically important, as severe anaemia is associated with increased cardiovascular risk and poor outcomes in patients with ESRD (2,3). These results

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

underscore the importance of heightened surveillance and proactive treatment strategies for anaemia among patients on haemodialysis.

Although ESA utilisation was comparable between the two groups, HD patients required significantly higher doses, indicating relative ESA hypo responsiveness. This may be explained by chronic inflammation, iron deficiency, and uremic toxin accumulation, all of which impair erythropoiesis (4,14).

Similarly, the greater requirement for iron supplementation, particularly intravenous iron, in HD patients reflects increased iron loss and functional iron deficiency. While intravenous iron is effective, its use may be associated with potential risks, necessitating careful monitoring (8).

The significantly higher blood transfusion rate in HD patients is an important finding, as transfusions are associated with complications including iron overload and sensitisation, which may affect future transplant eligibility (15).

The higher burden of comorbid conditions in HD patients observed in this study may have contributed to poorer anaemia outcomes. However, this may also reflect selection bias, as patients with more severe disease are more likely to receive HD rather than PD (16).

This study provides important local data in a resource-limited setting, where dialysis modality is often determined by availability rather than clinical factors. The findings suggest that PD may offer advantages in anaemia management and should be considered when selecting dialysis modality.

LIMITATIONS

The present study is constrained by its single-centre design, which potentially limits the broader applicability of the results to diverse clinical environments. The relatively short duration of six months may not fully capture long-term outcomes. Additionally, inflammatory markers were not assessed, limiting the ability to explore underlying mechanisms. Residual confounding cannot be excluded.

CONCLUSION

Peritoneal dialysis is associated with better anaemia control compared to haemodialysis, as evidenced by higher haemoglobin levels, lower anaemia prevalence, and reduced requirements for ESA therapy, iron supplementation, and blood transfusions. Dialysis modality should consider an important factor in the management of anaemia in patients with ESRD, particularly in resource-limited settings.

DECLARATIONS

Ethical Approval: The study was approved by the Institutional Review Board of the Indus Hospital, Karachi (IRB No. [IHHN_IRB_2025_04_010]) and conducted in accordance with the Declaration of Helsinki.

Informed Consent: Written informed consent was obtained from all participants prior to enrolment.

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' Contributions: Akbar Ali conceived the study, collected and analyzed the data, and drafted the manuscript. My Co-Author assisted with statistical analysis and critically reviewed the manuscript. All authors approved the final version for submission.

REFERENCES

1. Bikbov B, Purcell CA, Levey AS, et al. Global burden of CKD. Lancet. 2020.
2. Stauffer ME, Fan T. Prevalence of anemia in CKD. PLoS One. 2014;9(1):e84943.
3. Atkinson MA, Warady BA. Anemia in CKD. Pediatr Nephrol. 2018;33(2):227–238.
4. Babitt JL, Lin HY. Mechanisms of anemia in CKD. J Am Soc Nephrol. 2012;23(10):1631–1634.
5. Ganz T. Anemia of inflammation. N Engl J Med. 2019;381(12):1148–1157.
6. Fishbane S, Spinowitz B. Anemia in ESRD. Am J Kidney Dis. 2018;71(3):423–435.
7. Mehrotra R, Devuyst O, Davies SJ, Johnson DW. Peritoneal dialysis. J Am Soc Nephrol. 2016;27(11):3238–3252.
8. Locatelli F, Bárány P, Covic A, et al. KDIGO anemia guidelines. Nephrol Dial Transplant. 2013;28(6):1346–1359.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

9. McMurray J, Parfrey P, Adamson JW, et al. KDIGO anemia guideline. Kidney Int Suppl. 2012.
10. Jessani S, Bux R, Jafar TH. CKD in Karachi. BMC Nephrol. 2014;15(1):90.
11. Jha V, Garcia-Garcia G, Iseki K, et al. CKD global perspective. Lancet. 2013;382:260–272.
12. Li PKT, Choy ASM, Bavanandan S, et al. Anemia in PD. Kidney Med. 2021;3(3):405–411.
13. Al Sharifi LM, Haddawi KH. Anemia in HD vs non-HD. J Appl Hematol. 2024;15(3):192–196.
14. Bamgbola OF. ESA resistance. Kidney Int. 2011;80(5):464–474.
15. Bonomini M, Di Liberato L, Sirolli V. Anemia treatment. Kidney Med. 2023;5(8):100681.
16. Chaudhary K. PD drop-out. Int J Nephrol. 2011;2011:434608.