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Prevalence and Management of Anemia in Chronic Hemodialysis Patients in the Souss-Massa Region Morocco

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Abstract **Original Research Article**

Introduction: The prevalence of anemia in chronic kidney disease and among chronic hemodialysis patients is very high and is associated with significant morbidity and mortality. The aim of this study was to determine the prevalence of anemia in chronic hemodialysis patients in the Souss-Massa region and to evaluate its management. ***Materials and Methods:*** This was a retrospective, analytical, and descriptive study conducted between July 2023 and July 2024, including chronic hemodialysis patients from the Souss-Massa region. Anemia was defined according to the 2024 Kidney Disease Improving Global Outcomes (KDIGO) guidelines as hemoglobin levels <13 g/dL in men and <12 g/dL in women. ***Results:*** A total of 1,346 patients out of 1,800 participants were included, corresponding to an anemia prevalence of 74.7%. The mean age of the patients was 57.52 ± 15.54 years, with a male-to-female ratio of 1.12. Half of the patients had been on hemodialysis for less than 5 years. The leading causes of kidney disease were diabetic nephropathy and hypertensive nephropathy in 38.8% and 16.9% of cases, respectively. The mean hemoglobin, ferritin, and transferrin saturation (TSAT) levels were 10.02 ± 1.5 g/dL, 386.42 ng/mL, and 32.61% ± 15.4, respectively. Anemia management included erythropoietin (EPO) therapy, injectable iron, and blood transfusions in 85%, 13.4%, and 20% of patients, respectively. Multivariate analysis revealed significant correlations between anemia and history of hypertension (p=0.008), hepatitis C virus infection (p<0.001), secondary hyperparathyroidism (p=0.04), prior catheter-related infectious complications (p=0.003), and chronic inflammatory syndrome (p=0.02). ***Discussion and Conclusion*:** Our study confirms a high prevalence of anemia in hemodialysis patients. Despite therapeutic advances, blood transfusion reliance remains high, increasing the risk of immunologic complications and limiting access to kidney transplantation.

Keywords: Anemia, chronic hemodialysis, prevalence, KDIGO, erythropoietin.

INTRODUCTION

Anemia is a frequent and complex complication in hemodialysis, with a reported prevalence between 70% and 75% in the literature. Its pathophysiology is multifactorial, with severity varying according to sex, age, underlying pathology, and dialysis conditions. Anemia profoundly affects quality of life and prognosis in dialysis patients and is responsible for significant morbidity and mortality.

The objective of this study was to determine the prevalence of anemia in chronic hemodialysis patients in the Souss-Massa region, evaluate its management, and identify associated risk factors.

MATERIALS AND METHODS

This retrospective, descriptive, and analytical study was conducted over one year, from July 2023 to July 2024. It included all chronic hemodialysis patients in the Souss-Massa region, with an initial cohort of 2,024 patients. In accordance with the 2024 KDIGO guidelines, anemia was defined as hemoglobin <13 g/dL in men and <12 g/dL in women.

Exclusion criteria included incomplete medical records or unavailable/unusable essential data, resulting in a final analysis including 1,800 patients. Clinical and laboratory data were retrospectively collected from medical records and hemodialysis charts. Statistical

analysis was performed using SPSS (Statistical Package for Social Sciences) version 23.0.

RESULTS

From the initial cohort of 2,024 chronic hemodialysis patients in the Souss-Massa region, 1,800 met the inclusion and exclusion criteria. Anemia was reported in 1,346 patients, representing a prevalence of 74.7%, predominantly in patients over 60 years of age.

I. Socio-demographic parameters

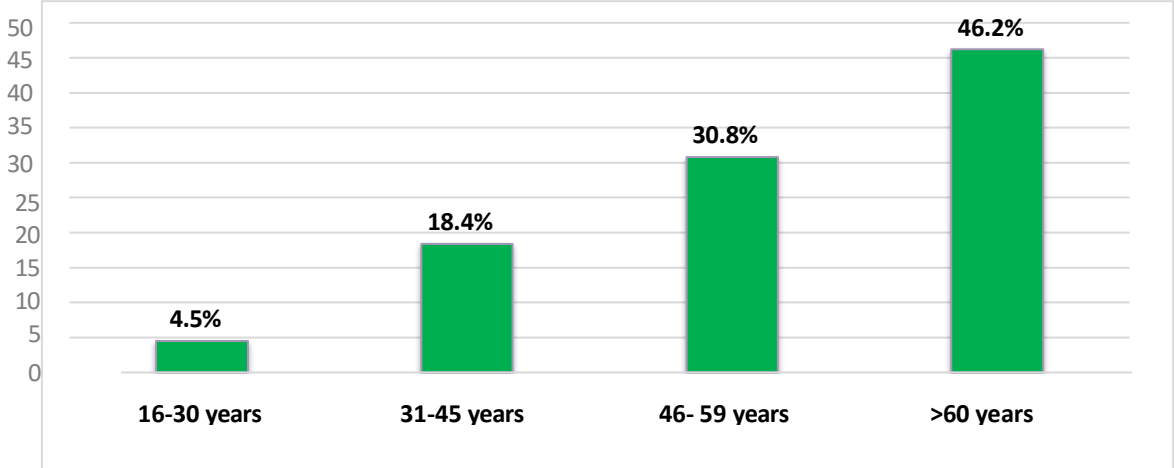

Figure 01: Distribution of patients by age group

1. Age distribution

Age distribution showed a strong concentration of anemia cases among older patients. The youngest age group (16–30 years) represented only 4.5% of patients. Patients aged 31–45 years accounted for 18.4% of the cohort, those aged 46–59 years represented 30.8%, and the majority, 46.2%, were over 60 years old.

Figure 01: Distribution of patients by age group

1. Distribution of patients by sex

The distribution of patients by sex revealed a slight male predominance. Across the entire cohort, 54.6% of the patients were men and 45.4% were women, corresponding to a Male/Female (M/F) sex ratio of 1.12.

2. Distribution of patients by socioeconomic level

Regarding social level, 66.8% of patients had a low level, 31.6% a medium level, and 1.6% a good level.

Clinical Parameters:

1. Distribution of patients based on causal nephropathies

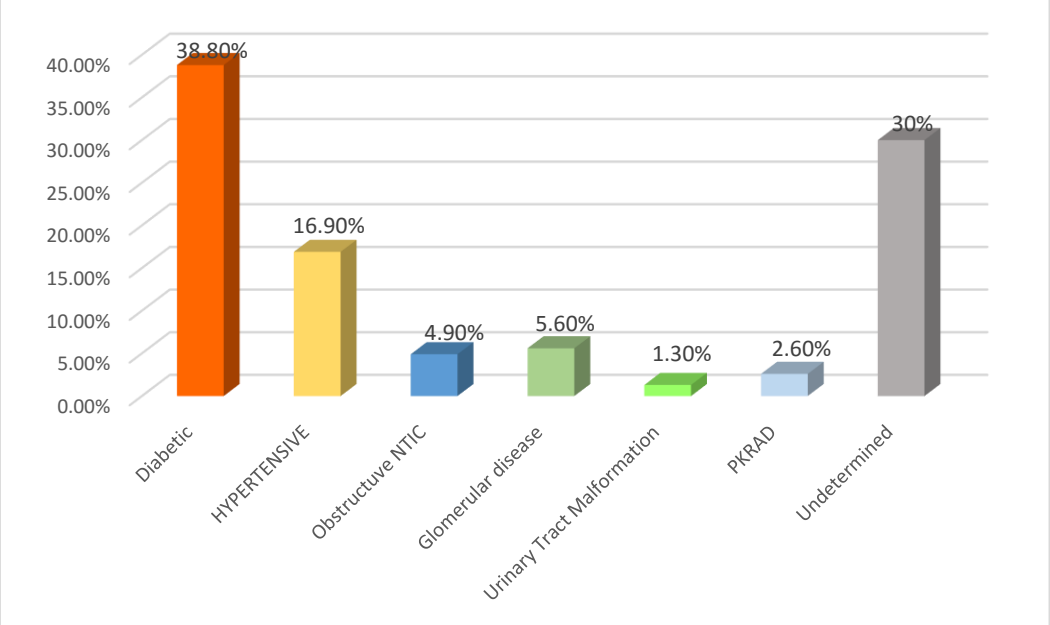

Figure 02: Distribution of causal nephropathies

The main causes of kidney disease were diabetes (38.8%), followed by hypertensive nephropathies (16.9%), tubulointerstitial nephritis (4.9%), glomerular diseases (5.6%), autosomal dominant polycystic kidney disease (ADPKD) (2.6%), and congenital malformations (1.3%). The cause remained undetermined in 30% of patients.

Half of the patients had been on hemodialysis for less than 5 years, and the current vascular access for hemodialysis was predominantly a native arteriovenous fistula (AVF), used in 60.2% of patients.

BIOLOGICAL PARAMETERS

Table 01: Biological data in our series

Parameter	Mean
Type of anemia	Normochromic normocytic: 86,3 % Macrocytic : 9,9 %
Hemoglobin level (g/dL)	10,02 ± 1,5
Ferritin level (ng/mL)	386,42 ± 100,5
Transferrin saturation (%)	32,61 ± 15,4
CRP	14,35 (0-321)
PTH	493,41 (1,2 – 4110)
Kt/V	1,48 ± 0,36

For our biological data, anemia was predominantly Normochromic Normocytic (NN) in 86.3% of cases, with a mean Hb level of 10g/dl, a mean ferritinemia level of 386.42 ng/ml, and a mean TSAT (Transferrin Saturation) value of 32%.

IV. Risk Factors

Table 02: Risk factors associated with anemia

Parameter	P value
HTA	P = 0,008
Hepatitis C virus infection VHC	P < 0,001
Catheter-related infectious complications	P = 0,003
Hyperparathyroidism	P = 0,04
Inflammatory syndrome	P = 0,02

Multivariate analysis revealed a significant correlation between anemia and a history of hypertension, hepatitis C virus infection, secondary hyperparathyroidism, previous catheter-related infectious complications, and chronic inflammatory syndrome.

Therapeutic management: Anemia management included the prescription of erythropoiesis-stimulating agents (ESA), injectable iron, and blood transfusion in 85%, 13.4%, and 20% of patients, respectively.

DISCUSSION

I. Demographic Data

1. Age and anemia prevalence

Our study included 1,800 chronic hemodialysis patients from the Souss-Massa region, with an age distribution showing that 46.2% of patients were over 60 years, 30.8% between 46 and 53 years, 18.4% between 31 and 45 years, and only 4.5% between 16 and 30 years. These results confirm that anemia primarily affects older patients, which is consistent with American, French, and Algerian series [1–3].

The increased prevalence of anemia with age can be explained by several pathophysiological mechanisms. On one hand, endogenous erythropoietin production naturally decreases with age. On the other hand, older patients often accumulate comorbidities such as diabetes, hypertension, or cardiovascular diseases, which promote chronic inflammation and impair bone marrow function [4]. Systemic inflammation, measured by CRP in our series (mean 14.35 mg/L), contributes to so-called "inflammatory anemia" by limiting iron bioavailability and reducing the response to erythropoiesis-stimulating agents (ESA).

In contrast, West African studies (Senegal and Mali) report a higher prevalence of anemia in younger patients (40–60 years) [5,6]. This difference may be related to demographic factors, such as lower life expectancy, delayed diagnosis of chronic kidney disease, and a younger hemodialysis population. This suggests that advanced age is a universal vulnerability factor for anemia, but socio-economic and demographic contexts modify the profile of affected patients.

2. Sex

In our series, men were slightly predominant (54.6%) compared to women (45.4%), which aligns with literature data [7]. This difference is consistent with studies showing that men with end-stage renal disease often exhibit more severe anemia, possibly due to hormonal and metabolic differences. Androgens

influence erythropoietin production and sensitivity to inflammation, which could partially explain this distribution.

3. Socio-economic status

The majority of patients (66.8%) came from a low socio-economic background, which may indirectly impact the prevalence and severity of anemia. Patients from disadvantaged backgrounds often have limited access to preventive care, iron supplementation, and optimized treatments [8]. This situation may delay anemia diagnosis and increase dependence on transfusions, thereby contributing to higher morbidity. European epidemiological studies have also established a link between low socio-economic status, reduced treatment adherence, and poorer quality of life in hemodialysis patients, with direct repercussions on anemia management and hemoglobin targets [9]. Low socio-economic status is often associated with malnutrition and more pronounced chronic inflammation, two aggravating factors of anemia in dialysis patients [10,11].

II. Clinical parameters and causes of nephropathy

Analysis of causal nephropathies in our series shows a predominance of diabetes (38.9%), followed by hypertension (16.1%), tubulointerstitial nephritis (6.3%), glomerulopathies (5.3%), autosomal dominant polycystic kidney disease (3.9%), and malformations (0.8%). The cause was undetermined in 33.9% of patients. These data confirm the major role of diabetes and hypertension as underlying factors for end-stage renal disease and, indirectly, anemia. Diabetes and hypertension cause vascular and tubuloglomerular alterations that reduce erythropoietin production and increase oxidative stress, contributing to anemia [7]. Recent studies highlight that diabetes, in particular, is an independent risk factor for ESA resistance and chronic inflammation, complicating anemia management [12].

Half of the patients had been on dialysis for less than 5 years, and vascular access was mainly an arteriovenous fistula (60.2%). These elements are relevant because dialysis vintage and type of vascular access can influence anemia risk, either through repeated blood loss or increased risk of catheter-related infections, inducing persistent inflammation and refractory anemia [13].

III. Biological parameters

In our series, anemia was predominantly normochromic normocytic (86.3%), with a mean hemoglobin level of 10.02 ± 1.5 g/dL. Mean ferritin was 386.42 ng/mL, and transferrin saturation coefficient (TSAT) was 32.61%. These results indicate that most patients have multifactorial anemia, where iron deficiency coexists with chronic inflammation and renal dysfunction. Secondary hyperparathyroidism (mean PTH 493.41 pg/mL) may also contribute to refractory anemia by disrupting bone marrow function [5].

IV. Therapeutic management

Regarding management, our study shows extensive use of ESA in 85% of patients, while blood transfusion remains frequent (20% of patients). This transfusion dependence is concerning due to immunological risks and increased infection risk, particularly hepatitis C virus, which showed a significant correlation with hemoglobin levels below 8 g/dL ($p<0.001$) [3]. Injectable iron use was moderate (13.4% of patients), highlighting potential underdiagnosis or suboptimal management of iron deficiency [14]. Optimized intravenous iron use could improve ESA response and reduce transfusion needs [15]. International clinical guidelines (KDIGO) reaffirm the importance of intravenous iron administration in hemodialysis patients due to blood losses and inflammatory status that render oral absorption inefficient, with a target ferritin often >200 ng/mL and TSAT >20–30% [16,17].

V. Factors associated with anemia

Regarding risk factors, and compared to literature data, our study shows, unlike several studies, a significant association between hepatitis C virus infection and anemia, mainly explained by ESA resistance and chronic inflammation induced by HCV.

Furthermore, other predictive risk factors for anemia in hemodialysis patients, including malnutrition, iron deficiency, and the presence of inflammatory syndrome, have been highlighted in previous studies [10,18]. Our results are fully consistent with the literature. Conversely, a history of hypertension, identified in our study, is rarely reported as a factor associated with anemia, warranting further exploration. Although hypertension is primarily an etiology of CKD, its direct association with anemia could reflect more advanced renal vascular damage and, consequently, more severely impaired EPO production due to fibrosis and ischemia, even after adjustment for residual renal function [19].

Critical analysis:

The critical analysis of this work requires highlighting its strengths, which reinforce scientific validity, as well as its limitations, which should be considered when interpreting the results:

A. Strengths:

- Inclusion of a large sample (1,800 patients), providing good statistical power and regional representativeness.
- Multicenter nature, including both public and private centers, reflecting the real-world management in the Souss-Massa region.
- Collection of diverse data: socio-demographic, biological, comorbidities, and therapeutic strategies.
- Analysis of prevalence, management, and factors associated with anemia, allowing a comprehensive view of the problem.

- Comparison of results with international and Maghreb literature, reinforcing scientific relevance.
- Highlighting high transfusion use, providing original and contextualized information for the region.
- Opening perspectives for new therapeutic approaches (HIF-PHI), emphasizing the interest in future developments in management.

B. Limitations:

- Retrospective nature: dependent on medical records, with potential bias in data entry or completeness.
- Missing or insufficient data on essential parameters (treatment adherence, inflammatory markers, longitudinal follow-up).
- The study cannot establish causality, only associations.
- Lack of evaluation of qualitative aspects (quality of life, patient satisfaction, psychological impact of anemia).
- Absence of prospective follow-up limiting analysis of evolution over time and efficacy of different therapeutic strategies.
- Lack of detailed data on ESA use and actual adherence.

CONCLUSION

In conclusion, our study confirms a high prevalence of anemia (74.7%) among chronic hemodialysis patients in the Souss-Massa region. This anemia is multifactorial, strongly associated with chronic inflammation, HCV infection, hyperparathyroidism, and hypertension. The high reliance on blood transfusions (20%) represents a major limitation to care quality.

It is imperative to optimize anemia management strategies, particularly through improved intravenous iron use and proactive monitoring of risk factors, to reduce transfusion dependence and improve prognosis and quality of life in this vulnerable population.

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