Effect of Hemodialysis on Blood Cells Count Parameters among Renal Failure Patients Attending to Hemodialysis Center in Mukalla District, Yemen

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Abstract:

Background: Hemodialysis (HD) is a critical life-sustaining treatment for end-stage renal disease (ESRD). Hematological abnormalities, including anemia and platelet dysfunction, are common complications in these patients. This study aimed to evaluate the immediate effects of a single HD session on complete blood count (CBC) parameters among renal failure patients attending the Hemodialysis Center in Mukalla District.

Methods: A cross-sectional study was conducted from January to June 2019 at the Mukalla Artificial Kidney Center (MKC). A total of 105 ESRD patients on maintenance HD were enrolled. Data were collected via a structured questionnaire and CBC tests performed immediately before and after a dialysis session. Statistical analysis was performed using paired-sample T-tests.

Results: Among the 105 patients, statistically significant difference were observed in most CBC parameters when compared pre-dialysis and post-dialysis (total WBC, Eosinophil, MCV, MCH were statistically significant (P≤0.05) while RBC, Hb, HCT, MCHC and PLT count were highly significant (P≤0.001). Majority of study populations were hypertensive 75.2% (79/105), while Diabetes mellitus (DM) accounted for 16.2% of cases and both conditions together for 15.2%.

Conclusion: A single session of HD induces significant changes in most CBC parameters (WBC, Eosinophil, MCV, MCH, P≤0.05).

Keywords: Renal failure disease, Hemodialysis, Blood Cell Count, Hemodialysis Center in Mukalla, Mukalla, Yemen.

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تأثير الغسيل الكلوي على مؤشرات تعداد خلايا الدم لدى مرضى الفشل الكلوي المراجعين لمركز الغسيل الكلوي في مديرية المكلا، اليمن

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الملخص:

الخلفية: يعتبر غسيل الكلى أحد أكثر العلاجات شيوعًا التي تستخدم لعلاج مرض الفشل الكلوي والذي يعتبر سببًا خطيرًا للوفيات في اليمن.

الأهداف: تهدف الدراسة إلى تقييم التغيرات في غسيل الكلى على عدد خلايا الدم بين مرضى الفشل الكلوي الذين يحضرون إلى مركز غسيل الكلى في منطقة المكلا.

الطريقة: دراسة مقطعية أجريت بين 105 مريض في مركز غسيل الكلى والتي توفر الرعاية الصحية لمرضى الفشل الكلوي في منطقة المكلا ، اليمن خلال الفترة من بداية يناير إلى نهاية أبريل 2019. تم جمع البيانات عن طريق المقابلة (وجهاً لوجه) باستخدام استبيان والتحقيقات المخبرية بما في ذلك تعداد الدم الكامل (فحص دم شامل).

النتائج: في دراستنا وجدنا أن 105 من مرضى غسيل الكلى تظهر أن هناك تغييرات غير ذات دلالة إحصائية في اختبار تعداد الدم الكامل (فحص دم شامل) بالمقارنة مع مرحلة ما قبل غسيل الكلى ومرحلة ما بعد غسيل الكلى.

الأسباب الرئيسية التي تؤدي إلى الفشل الكلوي في دراستنا هي داء السكري و / أو ارتفاع ضغط الدم. المرضى الذين يعانون من مرض السكري يمثلون (16.2٪) (105/17) مريض، في حين أن الذين يعانون من ارتفاع ضغط الدم وحده يمثلون (75.2٪) (105/97) مريض وكلاهما مرض السكري وارتفاع ضغط الدم يؤدي إلى فشل كلوي في (15.2٪) (105 / 16) مريض

الاستنتاج: هذه الدراسة تعطي تغييرات ملحوظة في بعض مؤشرات الدم في مرضى الفشل الكلوي الذين يخضعون الصيانة لغسيل الكلى.

الكلمات المفتاحية: مرض الفشل الكلوي، غسيل الكلى، عدد خلايا الدم، مركز المكلا للكلية الصناعية ، المكلا، اليمن.

Introduction:

Renal disease is a pathophysiological condition with multiple etiologies that progressively reduce nephron number and function, often leading to end-stage renal disease (ESRD). ESRD is defined as an irreversible loss of endogenous renal function sufficient to render the patient permanently dependent on renal replacement therapy, either dialysis or transplantation (1).

Renal failure remains a major cause of mortality in Yemen. It includes both acute renal failure (ARF) and chronic renal failure (CRF), with a higher prevalence among males (2). Blood consists of cells, cell fragments, and plasma, making up approximately 8% of total body weight. It contains erythrocytes (red blood cells, RBCs), leukocytes (white blood cells, WBCs), thrombocytes (platelets, PLTs), and plasma. In adults, blood cells constitute about 45% of total blood volume (hematocrit), while the remaining 55% is plasma, composed of water, proteins, and electrolytes (3).

ESRD develops when both kidneys fail to maintain normal physiological functions, including waste elimination and fluid-electrolyte balance. Without intervention, ESRD leads to severe illness and eventual death (4). Treatment options include dialysis or kidney transplantation (5).

Common causes of ESRD include DM (type 1 or 2), hypertension, atherosclerosis, genetic disorders such as polycystic kidney disease, and exposure to nephrotoxic drugs including certain antibiotics, chemotherapeutic agents, and analgesics (6). Dialysis is categorized into two types: peritoneal dialysis and HD(6). HD involves removing blood from the patient via a surgically created access site, filtering it to remove toxins, and returning it to the body (7).

Anemia is a common complication in renal disease and is defined as Hb) levels Patients with ESRD often experience platelet dysfunction due to uremic toxins, leading to bleeding tendencies. Although dialysis improves platelet function, it does not eliminate hemorrhagic risk (8). Additionally, these patients are at increased risk for both thrombotic and bleeding events, often requiring anticoagulation therapy, which must be carefully managed to avoid complications (9).

Coagulation disorders in CKD involve complex interactions among platelets, vascular endothelium, coagulation and anticoagulant systems, and fibrinolysis. Most laboratory tests assess only specific steps in the coagulation cascade, making comprehensive evaluation challenging (10).

The development and progression of CKD significantly reduce quality of life and increase premature mortality. Standard care involves close monitoring for disease progression and timely referral for dialysis or transplantation (11).

Up to our knowledge, no such study has been conducted in Mukalla region of Yemen. Therefore, this study aimed to evaluate the immediate effects of HD on CBC among renal failure patients and its relation with duration and frequency of HD sessions before and after hemodialysis, at the MKC.

Patients and Methods:

Study Design:

Our study was a cross-sectional study that was carried out in first January to end June 2019 aimed to evaluate the immediate effects of a single HD session on CBC parameters among renal failure patients attending to HD center in Mukalla District, Yemen.

Study Area:

The study was conducted in MKC, the only center in Mukalla city and contains seventeen dialysis machines.

Study Population:

The study population was with ESRD who attending MKC in Mukalla District.

Inclusion criteria:

Patients with ESRD aged ≥15 years included after taking verbal consent from them.

Exclusion criteria:

Patients with previous hematologic diseases.

Sample Size Estimation:

The sample size was calculated by using the following formula:

$N=\frac{(Z)^2\,pq}{d^2}$

N = sample size required.

Z=confidence level (for 95%=1.96).

P = proportional of characteristic in the population (14.1%). [13]

q = 1-p (1- 14.1) = (100 -14.1=85.9)

d = precision or error allowable (7).

$N=\frac{(1.96)\ 2\times(14.1\times85.9)}{(7)^2}=\frac{3.8416\times1211.19}{(7)^2}=\frac{4652.9}{(7)^2}=95$

The sample size requires was 95 patients.

We added 10 % to increase the sample size, so the sample size was 105 patients.

Sampling Method:

The sample was collected daily comprehensively from ESRD patients in MKC.

Data Collection and Tools:

The data was collected by using two tools:

1- Face-to-face interviews by using pre-test taken by questionnaire including ages, sex, causes of renal failure, start dialysis and number of times of dialysis.

2- Laboratory investigations.

Laboratory Investigations:

Complete Blood Count (CBC) test was used to determine RBC, WBC, PLT, Hb and HCT And absolute neutrophil count. CBC is a window into the functional status of the bone marrow, the factory producing all blood elements. It is easily obtained, easily performed, relatively cheap and serial measurements can evaluate response to therapy.

Collective and specimen processing:

One milliliter of venous blood pre and post dialysis was collection and mixed with 50 µl of (EDTA) Ethylene Diamine Tetra Acetate Acid in the test tube. Sysmex automatically with draws part of the blood sample from the tube and determine CBC indexes (RBC, WBC, PLT, Hb and HCT). Equipment was used to collect and sample processing including syringes, tourniquet, tubes and Sysmex (model kx-21N type of CBC use five differential).

Data Analysis:

The data was entered and analyzed by using statistical package for social science (SPSS v24) software program. Descriptive statistics using descriptive statistical table (Frequencies and percentage). And data was presented in tables and paragraph by using paired-samples T test.

Ethical Consideration:

An approval of this study obtained from Hadhramout University, College of Medicine and Health Sciences, Department of Medical Laboratory Science and Department of Community Medicine. A letter to the manager of MKC was taken to facilitate our study. Objectives of our study clarifying to renal failure patients and verbal consent obtained from each renal failure patients before enrollment in the study.

We ensure that those who agree to participate in our study, their information kept in strict confidence and privacy to use for the benefits of the community.

Results:

The total number of study participants was 105, aged between 15–76 years, with a mean ± SD of 45.51 ± 9.23 years.

Table (1) showed the distribution demographics among ESRD patients attending MKC in Mukalla District. The majority (54.3%), were in the age group (36-55). 65.7% of them were males.

Table 2 demonstrates that hypertension, DM and both diseases account for 75.2%, 16.2% and 15.2% respectively. The majority of study participants had been on HD for three years or more i.e. 64 (60.9%), 98 (93.3%) of them underwent dialysis twice weekly**.** The CBC parameters of HD patients showed an increase in mean of WBC's, neutrophils, lymphocyte, RBC's count, Hb%, HCT, MCHC an PLT while a decrease in the mean of Moncocyte, Eosinophils and MCV with a statistically significant difference in total WBC, Eosinophil, MCV, MCH (P≤0. 05), while Neutrophil, Lymphocyte, Monocyte, RBC, Hb, HCT, MCHC and PLT count were highly statistically significant (P≤0.001) when compared pre- and post-dialysis (Table 3).

Table 1: The distribution of demographics among study participants (n=105)

Demographic Categories	Subcategories	n (%)
Gender	Male	69 (65.7)
	Female	36 (34.3)
Age Group (Years)	15 - 35	25 (23.8)
	36 - 55	57 (54.3)
	56 - 75	23 (21.9)

Table 2: Description of co-morbidities, duration of HD and frequency of sessions among study participants (n=105)

Item	n (%)
Diabetes mellitus	
Yes	17 (16.2)
No	88 (83.8)
Hypertension	
Yes	79 (75.2)
No	26 (24.8)
Diabetes mellitus & Hypertension	
Yes	16 (15.2)
No	89 (84.8)
Duration of Dialysis	
≤ 1 year	32 (30.5)
1–2 years	9 (8.6)
≥ 3 years	64 (60.9)
Frequency of dialysis sessions	
Once a month	0 (0.0)
Twice a month	1 (1.0)
Once a week	6 (5.7)
Twice a week	98 (93.3)

Table 3: the Difference in Hematological Parameters Pre- and Post-Hemodialysis among study participants (n=105)

Parameter	Pre dialysis	Post dialysis	*P*-value
	Mean ± SD	Mean ± SD	
WBC count ($\times 10^3/\mu l$)	6.4 ± 2.99	6.5 ± 2.76	≤0.05
Neutrophil (%)	60.9± 12.7	66.7± 12.8	0.001
Lymphocyte (%)	21.3± 12.6	21.8± 10.3	0.001
Monocyte (%)	8.3 ± 2.9	6.8 ± 2.4	0.001
Eosinophil (%)	3.3 ± 3.0	3.1 ± 2.8	≤0.05
Basophil (%)	1.1 ± 0.51	1.1 ± 0.54	>0.05
RBC count ($\times 10^6/\mu l$)	3.4 ± 0.88	3.7 ± 0.80	0.001
Hb Concentration (g/dl)	9.6 ± 2.20	10.4 ± 2.16	0.001
HCT (%)	30.0± 6.99	32.5 ± 6.84	0.001
MCV (fl)	89.0± 7.66	88.7 ± 7.69	≤0.05
MCH (pg)	28.4±2.82	28.44 ± 2.85	≤0.05
MCHC (g/dl)	31.9± 0.71	32.1 ± 0.74	0.001
PLT count ($\times 10^3/\mu l$)	207.8±69.9	224.9±65.98	0.001

Discussion:

In this cross-sectional study, the effect of HD on CBC parameters among renal failure patients attending to HD center in Mukalla District, Hadhramout.

This study found out that most of HD patients in Mukalla were within the age of 50-60 years which accounted for (28.5%). This is similar to what obtained in previous studies in Sudan (13) and Nigeria (14-15). However, studies in India (16), Democratic Republic of Congo demonstrated a younger age of patients (17.)

In HD patients enrolled in this study, males were found to be more than females and this is similar to what obtained in previous studies in Nigeria (14) and India (16).

Blood cell count derangements are common in CKD patients and these become most apparent as the disease progresses due to diminished erythropoietin (EPO) production, increased hemolysis, bone marrow suppression, hematuria and gastrointestinal blood loss (14). Maintenance HD is the most common renal replacement treatment modality in Mukalla District, Hadhramout where near normal kidney function is temporarily restored.

In this study, pre dialysis and post dialysis hematological parameters were analyzed. The CBC parameters of HD patients showed statistically significant difference in total WBC, Eosinophil, MCV, MCH (P≤0.0 5), while Neutrophil, Lymphocyte, Monocyte, RBC, Hb, HCT, MCHC and PLT count were highly statistically significant (P≤0.001) and this is in agreement with previous studies (14-16).

Pre-dialysis assessment revealed significantly lower mean ± SD values of WBC, RBC, and platelet counts, accompanied by reductions in leukocyte differentials and erythrocyte indices in patients with renal failure. In contrast, most hematological parameters improved following dialysis, with the exception of mean corpuscular volume (MCV) and eosinophil count, which were higher in the pre-dialysis state than post-dialysis. These post-dialysis increases in blood cell indices are consistent with findings from previous studies (13-17). However, our results differ from those reported by Dara et al., who observed no significant post-dialysis changes in hematological indices. (18)

Regarding to duration of dialysis (period dialysis) of 105 renal failure patients attending to MKC, those who were under dialysis for ≤ one year accounted for (30.5%) of studied patients and the majority of patients under dialysis for ≥ three years account for (60.9%) and the later was similar to what obtained in Benjamine *et al.* (11).

Greater mean ± SD changes in WBC, RBC, platelet counts, and hemoglobin levels were observed between pre- and post-dialysis measurements in patients with a dialysis duration of less than one year, whereas patients receiving dialysis for ≥3 years exhibited consistently lower values of these parameters (13).

The majority of the study population (93.3%) received twice-weekly hemodialysis, in agreement with findings reported by Bengamine *et al.* (11).

Conclusion:

This study gives remarkable changes in some hematological parameters ESRD patients undergoing maintenance hemodialysis. A single session of HD induces significant changes in most CBC parameters (WBC, Eosinophil, MCV, MCH ($P \leq 0.05$), while Neutrophil, Lymphocyte, Monocyte RBC, Hb, HCT, MCHC and PLT), while no statistically significant changes for basophil. The majority of study participants had been on HD for three years or more (64%), with (98 % of them) underwent dialysis twice weekly. Hypertension, DM and both accounts for 79%, 17% and 16% respectively among ESRD patients in Mukalla District, Yemen.

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