The effect of hemodialysis on some physiological changes in patients with renal failure in Sirte city

Wafiyah M. Amhalhil
Department of Chemistry, Faculty of Science, Sirte University, Sirte, Libya
wafyamm@su.edu.ly

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Abstract

Dialysis is a supportive treatment for individuals with severe kidney dysfunction or chronic kidney failure. It does not address the underlying issue in a comprehensive manner; rather, it offers an alternative means of support. The study was conducted at Ibn Sina Teaching Hospital between 27 January and 3 July 2024. The study comprised the monitoring of 20 patients of both sexes, conducted prior to and following the administration of dialysis. The study encompassed an examination of various hematological variables, including an investigation of hemoglobin concentration, as well as an analysis of platelets, white and red blood cells, hematocrit, and biochemical variables in the blood serum, such as triglycerides and cholesterol. The results demonstrated a notable enhancement in haemoglobin levels among patients with kidney failure following dialysis. The haemoglobin level increased, and statistical tests confirmed that this difference was highly significant ($p < 0.001$), indicating the importance of dialysis in improving oxygenation in patients with kidney failure. The data demonstrated that metabolic alterations were heightened following dialysis. Statistical analyses substantiated that these elevations were markedly statistically significant ($p>0.001$).

Keywords: Chronic renal failure, hematological variables, physiological variables, biochemical variables

Introduction

Kidney failure represents a significant public health concern in Libya, with a complex etiology encompassing a range of underlying conditions. These include diabetes, chronic glomerulonephritis, hypertension, genetic disorders, and polycystic kidney disease (Meyer et al., 2007). Additionally, obesity and metabolic syndrome (Goleg et al., 2014) have emerged as prominent contributors to the prevalence of kidney failure in the country. The initial treatment plan is designed to address the underlying cause of the disease, while also regulating fluid and mineral balance. This is followed by one of three further treatment options: haemodialysis, peritoneal dialysis or kidney transplantation (Schnackenberg 2002 & Alghythan et al., 2012). Dialysis is a process whereby excess fluids and toxic metabolites, such as urea, are removed from the plasma and electrolytes are regulated by treating the patient's blood against a fluid that does not contain urea but contains minerals, such as potassium and calcium, at the same normal concentration in the blood of a healthy person (Ahmad et al., 2008). It can be used for those suffering from chronic kidney failure (Pendse et al., 2008). In Libya, the incidence rate of renal failure in 2003 was 200 patients per million population, and subsequently increased in 2007 to 350 patients per million population (Goleg et al., 2014). The quantity of patients going through dialysis in Libya expanded from 2116 out of 2007 to 2417 out of 2009. It is extended that the quantity of patients with renal disappointment in Libya will reach roughly 7667 by 2024 (Akkari, 2013). To keep up with the proportion of patients to dialysis machines at a pace of 3:4:1, it is important to expand the quantity of dialysis machines from 1,045 out of 2014 to 2,255 out of 2024. In 2014, the essential number of beds for patients with kidney illness is assessed to be around 468, notwithstanding 59 beds for those going through kidney transplantation. It is guessed that these figures will arrive at 547 and 69 beds, separately, by 2024 (Akkari, 2013). The global prevalence of kidney failure was 282 patients per million people in 2012, as reported by the World Health Organization (WHO). This figure increased to 624 patients per million people by 2014 (Goleg et al., 2014). Given the dearth of published data on the physiological changes associated with kidney failure in patients with chronic kidney failure in Libya, this study was undertaken to identify such changes in patients with chronic kidney failure at Ibn Sina Teaching Hospital, Sirte, Department of Kidney Diseases and Surgery in Libya.

Materials and methods

The present study was conducted on patients with renal failure undergoing haemodialysis at the kidney unit of Sirte Teaching Hospital between the dates of 27/01/2024 and 03/07/2024. The study encompassed a follow-up of 20 cases of both sexes with chronic renal failure, conducted before and after dialysis.

Blood sample collection

A total of 10ml of venous blood was collected from each subject in this study in two stages, prior to and following a period of washing in the morning before breakfast. The initial portion of the blood was transferred to specific test tubes containing the anticoagulant (EDTA) for the purpose of determining blood variables. The subsequent portion of the blood was transferred to test tubes devoid of any anticoagulant materials. Following a period of 10 to 30 minutes at the laboratory temperature, centrifugation was conducted for 20 minutes at a speed of 3000 rpm, with the objective of obtaining blood serum. Subsequently, the serum was transferred to a temperature-controlled environment (-20°C) for storage until the subsequent analyses and biochemical parameter measurements could be conducted. The physiological variables were measured before and after washing, following the acquisition of the patients' consent.

The study encompassed the measurement of the following criteria:

Blood variables: The following criteria were included in the measurement process:

A. Total Leucocyte Count: The total white blood cell count was calculated using the blood cell counter method and dilution solution (Turk's Fluid), as described by Brown (1993).

B- Estimation of haemoglobin concentration (Hb): The haemoglobin concentration meter (Hemeyibbin) and Drabkin's solution were employed as a dilution solution to estimate the haemoglobin concentration in the blood sample (Sood, 1985).

C- Total platelet count (Total Platelets Count): The blood cell count method and ammonium oxalate solution were employed as a dilution solution to calculate the total platelet count (Sood, 1985).

D - The haematocrit test (HCT) was conducted using capillary tubes containing heparin (Wong, 1928).

Biochemical variables: The following parameters were subjected to measurement:

A: Estimation of total cholesterol in the blood serum: The enzymatic method, as described by Siedel and his research group (Siedel, 1981), was employed for the estimation of total cholesterol in serum.

B - Estimation of triglycerides in the blood serum: The enzymatic method described by Fassati and Prenci was employed (Fossati et al., 1982).

Table 1: Devices used:

Device Name	Made	Serial number	Model
Centrifuge	Germany	SN0043720	2020-7-29
CBC HUWAN	Germany	SN825767	2015-A
Mindray BS-200 (Sysmex)	Germany	SNB9816	2020-5 XP-300

The haematological alterations that are associated with patients who are afflicted with renal failure, both before and after the commencement of dialysis.

The complete blood count (CBC) data were analysed using the SPSS program, with the objective of making statistical comparisons. The data pertaining to the complete blood count (CBC) analysis results for 15 patients diagnosed with renal failure, both prior to and following dialysis, were duly entered.

To demonstrate the modifications in blood constituents:

- **The arithmetic mean was calculated** for each component of the CBC analysis, including the number of red blood cells, the hematocrit percentage, the number of white blood cells of all types, and the number of platelets, both before and after dialysis. This was done using the arithmetic mean equation.
- **The mean difference between the means for** each component of the CBC analysis before and after dialysis was calculated, as was the standard deviation of the differences using the standard deviation equation.
- **A paired t-test was conducted** to ascertain whether there were statistically significant differences in the mean values of each component of the CBC examination during dialysis. The subsequent P-value was employed to ascertain the actual significance of the observed differences between the pre- and post-dialysis measurements.

These analyses will facilitate a more comprehensive understanding of the effects of dialysis on blood components in patients with renal failure. As illustrated in Table 1 and Figures 1, 2, 3, 4, and 5, and Table 3 and Figure 6, the comprehensive discrepancies between the developments in the CBC examination are presented.

Table 2: Hematological alterations in patients With renal failure (n=20)

Statement	Arithmetic mean beforewashing	Arithmetic mean after washing	Difference of means	Standard deviation ofdifferences	Statistics T-value(Paired t-test)	P-value
(RBC)count(million cells/microliter)	3.5	3.8	+0.3	0.15	4.0	< 0.001*
(HGB) (g/dL)	10.2	11.0	+0.8	0.20	8.0	< 0.001*
t (HCT) (%)	31.5	34.0	+2.5	0.8	6.25	< 0.001*
(WBC) (thousand cells/microliter)	8.5	7.8	-0.7	0.5	-2.8	0.012*
(PLT) (thousand cells/microliter)	210	225	+15	10	3.0	0.008*

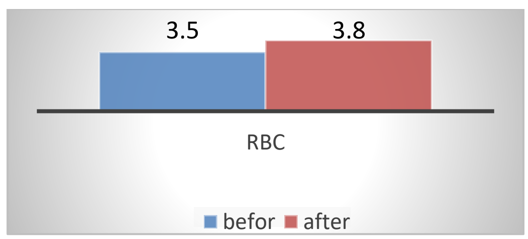
(*) indicates statistically significant differences (P < 0.05)

Table (3) Changes in CBC analysis for patients with renal failure (n=20) (total)

Statement	Arithmetic mean before washing	Arithmetic mean after washing	Difference of means	Statistics T-value (Paired t-test)	P-value
CBC	10.5	8.2	-2.3	6.8	< 0.001*

(*) indicates statistically significant differences.

The results demonstrated the impact of the dialysis procedure on the outcomes of the complete blood count (CBC) analysis for a cohort of 20 patients diagnosed with kidney failure. The combined value of the CBC analysis indicates a significant improvement in the blood condition subsequent to undergoing the dialysis process, as evidenced by a decrease in the arithmetic mean of the combined value from 10.5 prior to dialysis to 8.2 following dialysis. This decrease is statistically significant with a P-value of less than 0.001, indicating that the observed improvement is not a mere coincidence but is primarily attributable to the effect of the dialysis process. The results demonstrated that the dialysis process exerts a beneficial influence on the overall condition of the blood and its components in patients with kidney failure. These findings indicate that the dialysis process is essential for maintaining the health and quality of life of patients with kidney failure. By improving blood components, it positively impacts the functions of vital organs and reduces complications associated with kidney failure.



Fifure (1) shows the variation in (RBC) counts before and after dialysis.

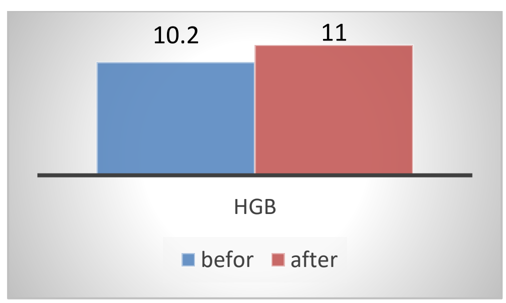


Figure (2) shows the difference between the (HGB) rates before and after dialysis

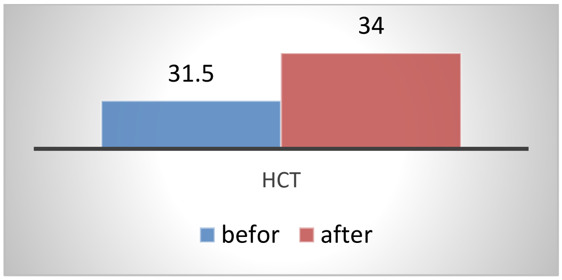


Figure (3)shows the difference between the (HCT) rates before and after dialysis

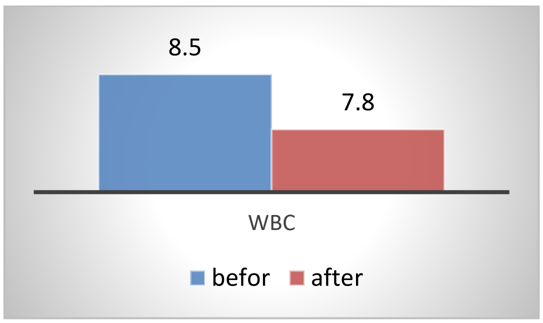


Figure (4) shows the difference between the (WBC) counts before and after dialysis

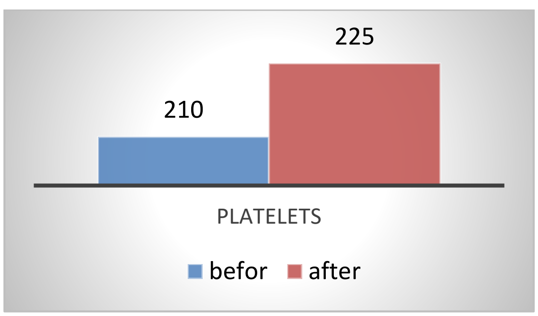


Figure (5)shows the difference between the (PLT) rates before and after dialysis

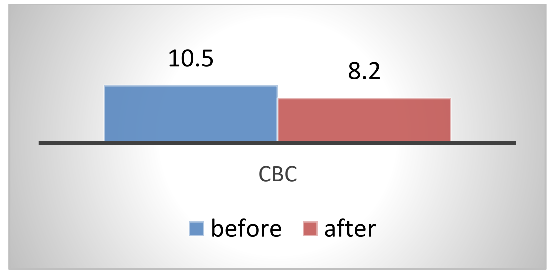


Figure (6)shows the difference between the (CBC) rates before and after dialysis

Metabolic changes associated with renal failure patients before and after dialysis:

The data pertaining to the levels of cholesterol and triglycerides before and after dialysis were entered for the same cohort of patients with renal failure. The arithmetic mean of cholesterol and triglycerides before and after dialysis was calculated using the appropriate equation for the mean. Additionally, the difference between the means and the standard deviation of the differences was calculated using the standard deviation equation. A paired t-test was conducted to ascertain whether there were any statistically significant differences between the means of cholesterol and triglycerides before and after dialysis. The resulting P-value was subsequently calculated.

Table 4: shows the metabolic changes associated with kidney failure patients before and after dialysis.

Statement	Arithmetic mean before washing	Arithmetic mean after washing	Difference of means	Standard deviation of differences	Statistics T-value (Paired t-test)	P-value
Cholesterol	**128.3**	**142.61**	**14.31**	**1.88**	**7.612**	**< 0.001**
Triglycerides	**28.6**	**39.62**	**11.02**	**0.952**	**11.576**	**< 0.001**

The data presented in the table demonstrates a notable impact of dialysis on cholesterol and triglyceride levels in patients with renal failure. The mean increase in cholesterol levels was 14.31 units, while the mean increase in triglyceride levels was 11.02 units following dialysis. The results of the statistical tests confirmed that these increases were highly significant ($P < 0.001$), thereby ruling out the possibility of them being a mere coincidence. These findings highlight the necessity for periodic monitoring of metabolic indicators in patients with renal failure, particularly following dialysis, to facilitate the implementation of appropriate medical interventions aimed at rectifying any aberrant levels that may emerge. The researcher posits that this considerable elevation in cholesterol and triglyceride levels subsequent to dialysis merits further investigation to ascertain its underlying causes and long-term consequences. Such changes may be related to alterations in protein and fat metabolism resulting from renal failure or to adverse effects of the treatment itself. The researcher emphasises the necessity for further research to facilitate the development of novel treatment protocols that will enhance lipid profiles and mitigate the risk of cardiovascular disease in patients with kidney failure.

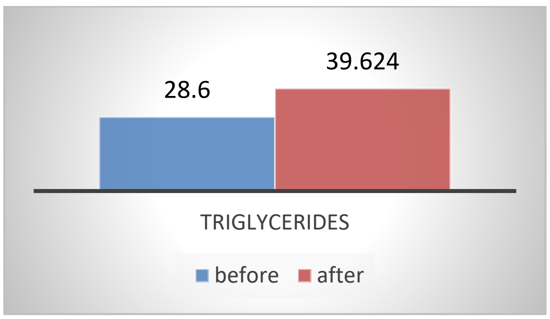


Figure (7)shows the difference between the arithmetic means of triglyceride rates before and after dialysis

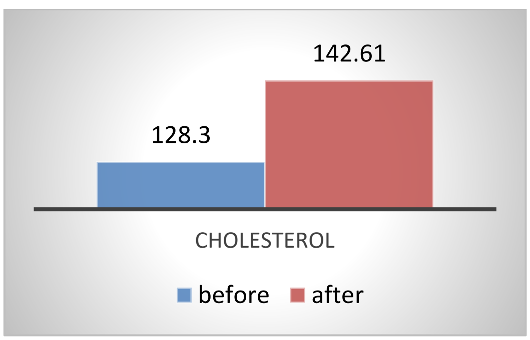


Figure (8)shows the difference between cholesterol levels before and after dialysis

Discussion of the results

The present study demonstrated notable alterations in numerous blood and metabolic parameters among patients with renal failure. The results demonstrated that kidney failure has a detrimental impact on the production of red blood cells. This was evidenced by a notable decline in the average number of red blood cells, haemoglobin levels and haematocrit in patients, which is a clear indicator of anaemia, a prominent complication of kidney failure. These results corroborate the findings of numerous previous studies that have confirmed the role of kidney failure in causing anaemia. This is due to a decline in the production of the hormone erythropoietin, which stimulates the production of red blood cells in the bone marrow. Additionally, the accumulation of toxins in the blood affects the breakdown of these cells. The findings indicated that the dialysis procedure exerts a beneficial influence on the overall condition of the blood and its constituent elements in patients with kidney failure. These findings indicate that the dialysis process is essential for maintaining the health of patients with kidney failure and improving their quality of life. The improvement of blood components has a positive impact on the functions of vital organs and reduces the complications associated with kidney failure. Additionally, the study indicated a notable elevation in cholesterol and triglyceride levels following dialysis, which prompts inquiries into the impact of this procedure on fat metabolism in these patients. The researchers recommend further studies to gain a deeper understanding of these changes and to identify ways to mitigate their adverse effects on the health of patients with kidney failure.

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Conclusions

1. Patients with renal failure exhibit a notable reduction in red blood cell count, haemoglobin, and haematocrit, which suggests that anaemia is a prevalent complication.
2. The low cholesterol and triglyceride levels observed in patients with renal failure may reflect a defect in lipid metabolism, which requires further investigation.
3. The results demonstrated that hemodialysis is an effective intervention for improving blood profiles in patients with renal failure. There were statistically significant improvements in blood levels of patients both before and after dialysis.
4. Further investigation is required to ascertain wh ether there is a causal relationship between the use of haemodialysis and an increase in cholesterol and triglyceride levels.
5. It is imperative that effective therapeutic strategies be sought to improve haematologic and metabolic profiles and prevent complications in patients with renal failure.

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