Effect of dialysis on some Hematological and Electrolyte parameters in chronic kidney patients

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ABSTRACT

Objective: The purpose of the current study was to estimate some of the blood components and electrolytes on renal failure patients. The hematological parameters included measurement of Total WBC count, Lymphocyte count (%), MID cell (%), Granulocyte (%), RBC count, HGB, HCT (%) and platelet count while the electrolyte aspect involved serum levels of Calcium, Sodium, Potassium, and Chloride.

Methods: In this study, some hematological and serum electrolyte of 30 patients with end-stage renal disease were measured before and after hemodialysis. Blood elements were detected by using the auto-analyzer system. Fujifilm - Dri-Chem NX500i analyzer was used to detect the serum level of electrolytes.

Results: The current study showed that the dialysis had a clear effect on the blood elements, some hematological parameters increased including MID cell (%), RBC count, HGB, HCT (%) However, Total WBC count, Lymphocyte and Granulocytedefeated after dialysis. Some serum electrolytes were analyzed, calcium and sodiumlevels increased significantly (P <0.05); however, potassium level decreased significantly (P <0.05) and chloride level was not changed after dialysis.

Conclusions: This study provides additional support that the dialysis process has a direct impact on the blood components, physiological aspects and immune mechanisms of the human body.

Key words: Hemodialysis, Electrolytes, Erythrocytes, Leukocytes, Renal failure


INTRODUCTION

The main kidneys function is removal of toxic waste products, fluid overload as well as for maintaining the balance for acid–base (pH) and electrolytes (e.g. Na+, K+, Ca2+) [1]. Dialysis or hemodialysis (HD) is an lifesustaining treatment that reaches end stage-renal disease [2]. It is performed 4h 3days/week. There is a mortality rate for kidney failure patients, the main reseason is incomplete blood toxins removal during hemodilysisprocedure [1,2]. The principle of HD is that across a semi-permeable membrane (dialyzer), convection and diffusion can be performed between blood and dialysate [3]. The passage of fluid components across the dialyzer membrane is placed by diffusive solute transport down a concentration gradient. The diffusive transport remove of small solutes and is dependent of dialysate flow rate[3-4]. Through convection, Hydraulic and osmotic pressure removes water and sodium by differences across the membrane. The dialyzer in a HD machine, the solutes can be diffused between blood and dialysate for this reason, during the course of treatment, the main purpose is to rearrange plasma composition to normal value [5-7]. The fluid components which cross the dialyzer can be ditermined by molecular size and dialyzer membrane pore-size [7]. The fluid is used in dialysis named Dialysate, it plays a signifant role of waste material removal from blood and useful substances transportation, such as bicarbonate, into the blood (figure 1). In combination with the dialyzer membrane characteristics, the concentration gradient defines the diffusive flux between blood and dialysate. Such that, the diffusible substance (Na+, K+, Ca2+, and bicarbonates) plays a major consequence on diffusion flux [8]. Life-threatening cardiac arrhythmias can be prevented by avoiding both hyper- and hypokalaemia. The cardiovascular system might be protected by optimal calcium (Ca) and magnesium (Mg) dialysate concentrations they also prevents extraskeletal calcifications, severe secondary hyperparathyroidism and a dynamic bone disease [9].

Chronic kidney disease (CKD) changes hematological parameters, particularly red blood cell (RBC) indices and it contributes to the anemia.

Anaemia is a frequent complication in any stages of CKD, because failure of kidney is a reason to produce inadequate endogenous Erythropoietin (EPO), its’ severity is related to CKD progression. Moreover, the decrease of EPO leads to the development of circulating uremic-induced inhibitors of erythropoiesis, shortened red blood cell lifespan, and increased blood loss (10-11)

One of the main adverse consequences of renal kidney damage is immune system disorder, due to uremic toxins which leads to the increase the inflammatory state, the two factors are micro inflammatory state and haemodialysis itself. Biological incompatibility of dialysis membrane, bacterial contamination of dialysate and acetate dialysate are the main causes of inflammation. Immune deficiency and dialysis can lead to the development the state of chronic micro-inflammation in long-term dialysis patients. A series of complex immune responses are produced, in hemodialysis patients, such as complement activation, monocyte activation synthesis and release of cytokines, the increase of TNF alpha and the decrease of TGF beta oxidative stress, carbon oxygen radical generation [12-15]. The high incidence of bacterial infection in HD patients is related to immune function disorder, which mainly represents with low T lymphocytes and normal humoral immune function. T lymphocytes play as a balance of the immune system by the mutual restriction of T helper cells (Th/CD4) and T suppressor cells (Ts/CD8) and the cooperation with other immune cells. The main procedure of treatment of end stage renal disease (ESRD) is blood purification (17), including hemodialysis (HD), high flux hemodialysis (HFHD) and haemodiafiltration (HDF) [15-18].

The aim of this study is to investigate serum electrolytes (Na, K, Ca, Cl) and elements of blood before and after kidney dialysis for kidney failure, to see the impact of dialysis on these measurements in kidney failure patients.

SUBJECTS AND METHODS

Subjects
In this study, thirty patients were shared at age at (57.63±16.10). All the participants who have been diagnosed by a specialist physician at General Ranya Hospital in Sulymanya governorate, the patients were tested in Ranya city during the period (April 2020).

Methods
The study was conducted in General Rania Hospital, a dialysis unit at Rania city. 3ml of blood were collected from 30 patients directly before and after hemodialysis, 1ml to EDTA anticoagulant container for testing CBC and 2ml in the gel tube for testing electrolytes. For all patients, we used the polyflux with synthetic low-flux membrane size 17, three hours hemodialysis duration, blood flow rates arranged from 220ml/min to 300ml/min according to the health states of the patients. Fujifilm - Dri-Chem NX500i analyzer was used to detect the serum level of electrolytes. Blood elements are measured by using the auto-analyzer system. Two tests (pre and post- hemodialysis) have been done.

Statistical analysis
Statistical analysis was performed by using a Paired-Sample T-Test. For all analyses, a value of \( P<0.05 \) was considered significant. All statistical analyses were performed statistical Package for Social Science (SPSS) V20.

http://doi.org/10.36295/ASRO.2020.231115
RESULTS

The means of age and gender for participants in the present study are given in (Table-1). The changes in blood elements (Lymphocyte count (%), MID cell (%), Granulocyte (%), RBC count, HGB g/dl, HCT (%), and platelets count) at pre and post-examination are shown in (Table-2) respectively. The variations in the serum level for electrolytes (Calcium mg/dl, Sodium mEq/L, Potassium mEq/L, and Chloride mEq/L) are given in (Table-3).

Table (1) shows mean of age for the participants according to gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>N (%)</th>
<th>Mean of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15(50)</td>
<td>60.93±15.81</td>
</tr>
<tr>
<td>Female</td>
<td>15(50)</td>
<td>54.33±16.24</td>
</tr>
<tr>
<td>Total</td>
<td>30(100)</td>
<td>57.63±16.10</td>
</tr>
</tbody>
</table>

Male and female patients were 15 (50%), males were with high mean age (60.93±15.81) while, the overall mean age was 57.63±16.10.

Table (2) blood elements before and after hemodialysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pre dialysis M±SD</th>
<th>Post dialysis M±SD</th>
<th>The mean difference</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total WBC count</td>
<td>7.00±1.76</td>
<td>6.86±1.69</td>
<td>.14±1.39</td>
<td>0.591</td>
</tr>
<tr>
<td>Lymphocyte count (%)</td>
<td>26.0±12.00</td>
<td>23.56±8.48</td>
<td>2.51±7.11</td>
<td>0.063</td>
</tr>
<tr>
<td>MID cell (%)</td>
<td>7.82±4.44</td>
<td>12.73±5.80</td>
<td>-4.91±5.46</td>
<td>0.000</td>
</tr>
<tr>
<td>Granulocyte (%)</td>
<td>66.15±12.88</td>
<td>63.77±10.87</td>
<td>2.37±9.45</td>
<td>0.179</td>
</tr>
<tr>
<td>RBC count</td>
<td>3.88±0.94</td>
<td>4.34±1.27</td>
<td>-0.46±0.48</td>
<td>0.000</td>
</tr>
<tr>
<td>HGB g/dl</td>
<td>10.25±1.45</td>
<td>11.41±1.90</td>
<td>-1.16±1.00</td>
<td>0.000</td>
</tr>
<tr>
<td>HCT (%)</td>
<td>31.3±4.53</td>
<td>35.10±5.46</td>
<td>-3.79±3.02</td>
<td>0.000</td>
</tr>
<tr>
<td>platelet count</td>
<td>176.37±48.92</td>
<td>191.30±54.10</td>
<td>-14.93±32.02</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Granulation and lymphocytes were not significant differences. They were a significantly higher of MID cell count, RBC count, HGC, HCT (p-value <0.001), and platelet count (p-value <0.05).

Table (3) electrolyte serum levels before and after hemodialysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pre dialysis M±SD</th>
<th>Post dialysis M±SD</th>
<th>The mean difference</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium mg/dl</td>
<td>10.12±1.97</td>
<td>10.82±1.28</td>
<td>-0.70±1.52</td>
<td>0.017</td>
</tr>
<tr>
<td>Sodium mEq/L</td>
<td>132.30±5.12</td>
<td>136.47±3.73</td>
<td>-4.16±4.90</td>
<td>0.000</td>
</tr>
<tr>
<td>Potassium mEq/L</td>
<td>4.78±0.75</td>
<td>3.37±0.44</td>
<td>1.41±0.66</td>
<td>0.000</td>
</tr>
<tr>
<td>Chloride mEq/L</td>
<td>100.73±5.41</td>
<td>101.20±4.49</td>
<td>-0.46±5.21</td>
<td>0.628</td>
</tr>
</tbody>
</table>

Electrolyte serum such as calcium and sodium have significantly increased after dialysis, the statistical values were (p. value < 0.05) and (p. value<0.001) respectively. While potassium significantly decreased after dialysis (p. value<0.001).

DISCUSSION
This study aimed to assess the blood cell components and electrolytes pre and post hemodialysis. The duration of dialysis and technic used to dialysis may conduct disturbance in blood composition. Dialysis is contributing to the diffusing of blood through the semipermeable membrane. The kind of membranes and the method of which dialysis has carried out would induce changes in blood hemostasis after hemodialysis. However, chronic hemodialysis treatment is associated with low RBC, hematocrit and low serum electrolytes as well as mortality. And spontaneous complications may occur as the result of direct physiological and electrolyte changes after hemodialysis [19]. In this study, polyflux with synthetic low-flux membrane size 17, three hours hemodialysis duration, blood flow rates arranged from 220ml/min to 300ml/min. Half participants were male 15 (50%) with a high mean age (60.93±15.81) than females (54.33±16.24). This study illustrated that most blood cell components increased after hemodialysis. They were a significant increase of MID cell count, RBC count, HGC, HCT, and platelet count. These findings are inconsistent with some other studies [20-22]. The increase of RBC, HCT, and platelets immediately after hemodialysis is mainly related to the decrease in plasma volume. Regarding platelets, some studies have illustrated that the hemodialysis circuit or extracorporeal circuit leads to the activation of platelets and that contributing to the formation of venous thrombosis at different vessel sites [23-24]. In our study, white blood cells, lymphocytes, and granulocytes have a tendency to be lower after hemodialysis. The associating of lymphocytes with hemodialysis has not been consistent. A study has shown that hemodialysis is a contributing factor in immune deficiency condition of ESRD patients, some lymphocytes such CD3+CD8+ cells significantly decreased after HD, however; other lymphocytes significantly decreased [25]. The findings from the current study are controversial with another study Saudi Arabia that has shown the WBCs and lymphocytes count increased in post-HD, WBCs lymphocytes [25]. Regarding the electrolyte serum, there were a significant increase in both calcium and sodium after dialysis (p. value < 0.05) and (p. value<0.001) respectively. Another study has revealed the same findings [26]. Hemodialysis enhances serum calcium and metabolic acidosis [27]. While there wasa significant decrease of potassium level after dialysis (p. value<0.001. Potassium level decreased significantly post-dialysis when compared with pre- dialysis [28].

CONCLUSION:

Most blood cell components increased after hemodialysis. While, white blood cells, lymphocytes, and granulocytes have a tendency to be lower after hemodialysis but the differences were not significant. Regarding the electrolyte serum, both calcium and sodium have significantly increased after dialysis but potassium have significantly decreased. These findings improve that poly flux with synthetic low-flux membrane size 17 have a required biocompatibility for hemodialysis.

REFERENCES


