Original Article

A Comparative Study on Haematological Changes before and One hour after Haemodialysis in Patients with End Stage Renal Disease

Rahman MM[1], Giti S[2], Khan AA[3], Rahman MM[4], Tarek M[5], Bhuiyan MN[6]

DOI: https://doi.org/10.3329/jafmc.v18i1.61256

Abstract

***Introduction*:** Normal kidney function is very important for maintaining homeostasis. Any deviation of normal renal function leads to deviation of normal homeostasis. End-stage renal disease (ESRD) is the last stage of chronic kidney disease (CKD) resulting from different aetiologies. Different haematological abnormalities in patients with ESRD result from multiple pathogenesis. Treatment of this condition requires multidisciplinary approach. Among all the treatment options haemodialysis (HD) is the most common, widely accepted and available treatment option.

Objective: To find out the effectiveness of haemodialysis in the improvement of different haematological deviations developed during the course of ESRD.

Materials and Methods: A total of 72 patients with ESRD of both sexes with the age ranging from 25 years to 70 years were included in this comparative cross sectional study and carried out in Combined Military Hospital and Armed Forces Institute of Pathology, Dhaka Cantonment from November 2014 to October 2015.

Results: The pre dialysis haematological parameters found in this study were TRBC: 3.4 ± 0.5 X 10^{12}/L, haemoglobin (Hb) level : 9.5 ± 1.4 gm/dL, Haematocrit (HCT): 29.1 ± 4.4%, Mean corpuscular volume (MCV): 83.5 ± 7 fl, Mean corpuscular Hb (MCH): 28 ± 1.8 pg, Mean corpuscular Hb concentration (MCHC): 31.0 ± 2.9 gm/dl, Total leucocyte count (TLC): 6.6 ± 1.9 X10^9/L, Neutrophil: 66.3 ± 7.8 %, Lymphocyte: 24.5 ± 6.9 %, Monocyte: 5.0 ± 1.8%, Eosinophil: 4.1 ± 2.4 %, Platelet: 184.3 ± 66.5 X 10^9/L. One hour post HD values are: TRBC: 3.6 ± 0.6 X10^{12}/L, Hb level:10.1 ± 1.6 gm/dl, Hct: 30.9 ± 5 %, MCV:82.6 ± 6.9 fl, MCH: 29.1 ± 2.3 pg, MCHC: 32.2 ± 3.4 gm/dl,TLC: 7.3 ± 2.3 X 10^9/L, Neutrophil: 69.2 ± 7 %, Lymphocyte: 21.6 ± 5.5 %, Monocyte: 5.3 ± 2 %, Eosinophil: 3.9 ± 2.3%. Platelet: 206.1 ± 63.6 X10^9/L. Among these values TRBC, Hb level, Hct, MCH, MCHC, TLC, Neutrophil, Lymphocyte and Platelet count significantly improved after HD (p value < .05).

Conclusion: Haemodialysis in the management of patients with CKD/ESRD played a pivotal role in improving haematological parameters deranged by these conditions.

Key-words: End stage renal disease (ESRD), haemodialysis (HD), chronic kidney disease (CKD).

Introduction

End-Stage Renal Disease (ESRD) is the final stage of Chronic Kidney Disease (CKD) characterized by progressive, irreversible deterioration in renal function causing inability to maintain fluid and electrolyte balance and ultimately, resulting in azotaemia and uraemia. ESRD is defined by a decrease in glomerular filtration rate (GFR) and histologic evidence of less than 10% nephron function remaining[1]. In another definition, CKD is now defined according to the presence or absence of kidney damage and level of kidney function—regardless of the patient's underlying diagnosis. Kidney Disease Outcomes Quality Initiative (KDOQI) designates 5 stages, with stage 5 being ESRD, when loss of kidney function (GFR < 15 mL per minute per 1.73 m^2) precipitates a need for dialysis or kidney transplant. Patients in stages 1 and 2 may have robust, normal, or slightly lowered GFR with evidence of underlying kidney damage, including proteinuria; large or small kidneys on an ultrasound; or other evidence of compromised function. Patients with GFR < 60 mL per minute per 1.73 m^2 for more than 3 months are classified as having CKD. This classification represents a loss of 50% or more of the adult level of normal kidney function. Additionally, all people with kidney damage are classified as having CKD regardless of their GFR[2].

The ESRD patients require a regular course of dialysis or kidney transplantation to maintain life. Although dialysis is life-saving and prolongs survival, it is only temporary and does not replace all of the renal functions. Allogeneic renal transplantation is the only current means to restore the whole renal functions, but its application is severely limited by donor shortage and immune-related problems. Kidneys play a vital role in haemopoiesis and any insults to the kidneys are reflected by changes in the haematological parameters of the affected patient.

This study was undertaken to find out the changes in the common haematological parameters among patients with ESRD undergoing haemodialysis just before and one hour after dialysis and to observe the extent of effectiveness of haemolysis.

Materials and Methods

It was a comparative cross sectional study conducted at the Department of Nephrology, High Dependency Unit (HDU), Coronary care centre (CCC) of Combined Military Hospital (CMH)

1**. Lt Col Md Moshiur Rahman**, MBBS, DCP, MCPS, FCPS, Classified Specialist in Pathology, Armed Forces Institute of Pathology (AFIP), Dhaka (*E-mail*: sohel141st@gmail.com) 2. **Maj Gen Susane Giti**, MBBS, MMEd, MCPS, FCPS, Commandant, AFIP, Dhaka 3. **Brig Gen Arif Ahmed Khan**, MBBS, MCPS, FCPS, Classified Specialist in Pathology, Chief Instructor & Deputy Commandant, AFIP, Dhaka 4. **Brig Gen Md Mizanur Rahman**, MBBS, DCP, MCPS, FCPS, FRCP (Glasgo), MACP (USA), Adviser Specialist in Pathology (Haematologist), CMH, Chattogram & Principal, Army Medical College, Chattogram 5. **Lt Col Monwar Tarek**, MBBS, DCP, MCPS, FCPS, Classified Specialist in Pathology, AFIP, Dhaka 6. **Lt Col Mohammed Nuruzzaman Bhuiyan**, MBBS, DCP, MCPS, FCPS, Classified Specialist in Pathology, AFIP, Dhaka.

Dhaka and Department of Haematology, Armed Forces Institute of Pathology, Dhaka Cantonment, Bangladesh. The study was carried out over a periodof 12 months, from November 2014 to October 2015. A total of 72 patients admitted into CMH Dhaka with ESRD for Haemodialysis (HD) were selected as study population. Diagnosed cases of ESRD/CKD and between the ages of 25-70 of both sexes were included in this study. Patients with CKD/ESRD with other co-morbid conditions that may affect the haematological parameters were excluded from the study. Two millilitre blood samples from all patients were collected under aseptic conditions into EDTA containing vacutainer for Complete blood count (CBC) and into ESR tube for the estimation of ESR before HD and one hour after HD. CBC and ESR were measured by automated haematology and ESR analyzer adopting manufacture's instruction and the analyzer were standardized by running control samples daily morning. The collected data was compiled and then analyzed using Microsoft excel and SPSS version 25. *p* value < .05 is considered as significant.

Results

Among 72 patients 43 (60%) were male and 29 (40%) were female. Age distribution of the patients revealed that most of the patients (76.4%) were in the age group of 41 to 60 years and mean±SD of age of the patients was 47.2±15.0 years.

The common haematological parameters included in this study were total red cell count (TRBC)t, haemoglobin (Hb) level, haematocrit (Hct), mean cell haemoglobin (MCH), mean cell volume (MCV), mean cell haemoglobin concentration (MCHC), total leucocyte count (TLC), differential leucocyte count (DLC) and platelet (PLT) count. Table-I shows the comparison of the common haematological parameters just before and one hour after maintenance HD.

Table-I: Comparison of haematological parameters included in this study before and one hour before HD session

Variables	Just before HD (Mean ± SD)	One hour after HD (Mean ± SD)	p-value
RBC ($X10^{12}$/L)	3.4 ± 0.5	3.6 ± 0.6	.02
Hb (g/dL)	9.5 ± 1.4	10.1 ± 1.6	.04
Hct (%)	29.1 ± 4.4	30.9± 5	.02
MCV (fl)	83.5 ± 7	82.6 ± 6.9	.45
MCH (pg)	28 ± 1.8	29.1 ± 2.3	.001
MCHC (g/dL)	31.0 ± 2.9	32.2 ± 3.4	.03
TLC ($x10^9$/L)	6.6 ± 1.9	7.3 ± 2.3	.04
Neutrophil (%)	66.3 ± 7.8	69.2 ± 7	.02
Lymphocyte (%)	24.5 ± 6.9	21.6 ± 5.5	.006
Eosinophil (%)	4.1 ± 2.4	3.9 ± 2.3	.45
Monocyte	5.0 ± 1.8	5.3 ± 2	.51
PLT ($X10^9$/L)	184.3 ± 66.5	206.1 ± 63.6	.04

Discussion

Chronic Kidney Disease (CKD) is a major health problem and it greatly affects the economic and social status of affected patients. Its prevalence among adult Bangladeshi population is 17.3%[3]. Dialysis treatment (HD and peritoneal dialysis) remains the principal method of treatment for correcting the renal dysfunction. HD increases longevity of patients with ESRD by removing the metabolic end products and excess of water. The results of this present study showed that the patients with ESRD on regular HD displayed extent of improvement in various haematological parameters.

The present study indicated that the mean value of TRBC, Hb level, Hct, MCH and MCHC showed a statistically significant increase after HD in patients with ESRD. This increase can be explained by the fact that before HD, patients are usually hypervolemic leading to low TRBC, Hb level, Hct, MCH and MCHC. As ultra-filtration takes place at HD, the value of these red cell parameters proportionally increase[4]. The post-HD increase in red cell parameters in this study correlates with the values observed by Costeat and Pereiret[5,6]. They also reported significant decrease in the MCV value. The authors hypothesized that the increase in MCHC and decrease in MCV could be related to the erythrocyte membrane protein loss during the HD procedure. Another study have also reported that the mean value of Hb and Hct show a statistically significant increase in renal failure patients after HD when compared to pre-HD results. However, the findings of the present study were inconsistent with those reported by Małyszko et al[7] who found that the Hb concentration and erythrocytes counts did not differ significantly post-HD. Vickers et al[8], also reported no significant difference between the pre- and post-HD with respect to RBCs count. Moreover, Inagaki et al[9], found a significant decrease in the Hct levels in patients undergoing HD. They attributed their results to the supine position of the HD patients and consequent haemodilution caused by redistribution of water from the extra- to intra- vascular space. Mohamed and his associates[10] also reported an insignificant increase of RBCs count, Hb level, Hct and MCV but a decrease of MCH and MCHC values in renal failure patients' post-HD.

The present study showed the mean value of TLC and the mean percentage of neutrophils and lymphocytes with the exception of monocyte and eosinophils, showed statistically significant increases in renal failure patient's post-HD when compared to pre-HD counts. The increases of leucocytes and differential counts post-HD were explained by the fact that at the beginning of HD, patients are usually hypervolemic and the values of the leucocytes and differential counts are lower. As ultrafiltration takes place, leucocytes and differential counts proportionally increase[4]. Our findings are in contradiction to those reported by Pereira et al[6] and Mohamed et al[10]. The former authors compared the pre- and post-dialysis TLC and differential counts in 34 ESRD patients under conventional HD. They reported that the mean value of monocytes and eosinophils counts significantly decrease, while there were no significant changes in the WBCs, such as neutrophils, lymphocytes, and basophils counts in renal failure patients post- HD when compared to pre-HD counts. The later researchers did not find any statistically significant increase of the mean leucocytes counts in renal failure patient's post-HD. In contrast Vickers et al[8] reported that there was a massive decrease in circulating polymorphonuclear neutrophils and monocytes, but there was no change in the number of circulating lymphocytes, post-HD when compared to pre-HD counts. Inagaki et al[9] similarly reported significant decreases in the leucocytes counts in patients undergoing HD. They explained that the reduction in leucocytes counts during the HD session may not be entirely attributable to the HD procedure, but rather due to the supine position and consequent haemodilution caused by redistribution of water from the extra- to intra-vascular space.

The present study revealed that there was statistically significant increase in the mean value of platelets count, though still within the normal range, in post- HD renal failure patients sample when compared to that of pre- HD sample. The decrease of platelets count in HD patients (if compared to normal individuals) may be due to either inadequate platelets production or over-consumption in HD patients[11] or to a diminished TPO production in the kidney[12]. This finding is congruent with the data obtained by Linthorst et al[13], which indicates that the platelets count in the HD group were significantly lower both before, and after HD when compared to the counts from normal healthy controls. Ulusoy et al[14] also reported that the platelets counts were significantly lower in ESRD patients on regular HD than in healthy controls. These findings were inconsistent with Erdem et al[15] who found that the platelet count were within normal limits before study and showed no statistically significant difference between patient and control groups (P>0.05). But the finding in this study is not consistent with Yeniçerioglu et al[16] who reported a significant decrease in circulating platelets post-HD when compared to the pre-HD counts. The decrease in platelets counts post-HD may be due to either the HD procedure itself, through the interaction of blood with membranes that may activate complement (Galbusera et al[14]) or to the heparin used during dialysis was one of the factors accounting for the increased platelet aggregation after dialysis as previously reported by Charvát et al[17]. In a previous study by Docci et al[18] stated that the dialysis membrane composition is a major factor influencing haemodialysis-associated platelet loss. They reported that the HD patients in their study suffered significant platelet loss during cuprophan dialysis, but not polyacrylonitrile dialysis. In contrast to the results of present study, Mohamed et al[10] found that there were no statistically significant differences between the mean platelets countpost-HD when compared to pre-HD counts. Likewise, other researchers[14,19,20] reported that there were no significant differences in platelets counts between the pre- and post-HD counts.

Conclusion

Patients with CRF or ESRD usually develop remarkable changes in the haematological parameters and effective management by HD significantly improve these parameters and should be undertaken such treatment in these patients to improve the quality of lifestyle.

CRF or ESRD causes definite changes in haematological parameters and HD causes marked improvement in most of the haematological parameters. The results of this study indicate that most of the Haematological parameters measured in post-HD patients were either elevated or lowered when compared to pre-HD values. Improvement of RBC parameters following HD causes patient's symptomatic improvement and better compliance. Changes in WBC parameters causes improved ability of the body to combat the infections as these patients are gradually becoming immunocompromized. This clinical implication was not investigated in this present study.

References

1. Michael IO, Gabreil OE. Chronic renal failure in children of Benin, Nigeria. Saudi J Kidney Dis Transpl. 2004; 15(1):79-83.

2. St Peter WL. Introduction: chronic kidney disease: A burgeoning health epidemic. J Manag Care Pharm. 2007; 13(9):2-5.

3. Hasan MJ, Kashem MA, Rahman MH et al. Prevalence of Chronic Kidney Disease (CKD) and identification of associated risk factors among rural population by mass screening. CBMJ. 2012; 1(1):20-6.

4. Rangel EB, Andreoli MC, Matos AC et al. Haemoglobin and haematocrit at the end of haemodialysis: A better way to adjust erythropoietin dose? J Artif Organs. 2010; 13(1):63-6.

5. Costa E, Rocha S, Rocha-Pereira P et al. Changes in red blood cells membrane protein composition during haemodialysis procedure. Ren Fail. 2008; 30(10):971-5.

6. Pereira R, Costa E, Gonçalves M et al. Neutrophil and monocyte activation in chronic kidney disease patients under haemodialysis and its relationship with resistance to recombinant human erythropoietin and to the haemodialysis procedure. Haemodial Int. 2010; 14(3):295-301.

7. Małyszko J, Zbroch E, Wołczyński S et al. Leptinaemia in patients dialysed with different buffers and dialysis membranes. Nephrol Dial Transplant. 1999; 14(10):2527-9.

8. Vickers J, Lösche W, Döpel E et al. Measurement of platelet activation and adhesion to leucocytes during haemodialysis. Platelets. 1998; 9(3-4):261-4.

9. Inagaki H, Kuroda M, Watanabe S et al. Changes in major blood components after adopting the supine position during haemodialysis. Nephrol Dial Transplant. 2001; 16(4):798-802.

10. Mohamed Ali MS, Babiker MA, Merghani LB et al. Haematological changes post-haemo and peritoneal dialysis among renal failure patients in Sudan. Saudi J Kidney Dis Transpl. 2008; 19(2):274-9.

11. Galbusera M, Remuzzi G, Boccardo P. Treatment of bleeding in dialysis patients. Semin Dial. 2009; 22(3):279-86.

12. Ando M, Iwamoto Y, Suda A et al. New insights into the thrombopoietic status of patients on dialysis through the evaluation of megakaryocytopoiesis in bone marrow and of endogenous thrombopoietin levels. Blood. 2001; 97(4):915-21.

13. Linthorst GE, Folman CC, van Olden RW et al. Plasma thrombopoietin levels in patients with chronic renal failure. Haematol J. 2002; 3(1):38-42.

14. Ulusoy S, Ovali E, Aydin F et al. Haemostatic and fibrinolytic response to nasal desmopressin in haemodialysis patients. Med Princ Pract. 2004; 13(6):340-5.

15. Erdem Y, Haznedaroglu IC, Celik I et al. Coagulation, fibrinolysis and fibrinolysis inhibitors in haemodialysis patients: contribution of arteriovenous fistula. Nephrol Dial Transplant. 1996; 11(7):1299-305.

16. Yeniçerioglu Y, SapakSahin S, Capa G et al. Effects of haemodialysis on pulmonary clearance of Tc-99m diethylene triamine penta acetate (DTPA). Scand J Urol Nephrol. 2000; 34(2):126-30.

17. Charvát J, König J, Bláha J. Is heparin responsible for enhanced platelet aggregation after haemodialysis? Nephron. 1986; 44(2):89-91.

18. Docci D, Turci F, Del Vecchio C et al. Haemodialysis-associated platelet loss: study of the relative contribution of dialyzer membrane composition and geometry. Int J Artif Organs. 1984; 7(6):337-40.

19. Sloand JA, Sloand EM. Studies on platelet membrane glycoproteins and platelet function during haemodialysis. J Am Soc Nephrol. 1997; 8(5):799-803.

20. Romão JE Jr, Fadil MA, Sabbaga E et al. Haemodialysis without anticoagulant: Haemostasis parameters, fibrinogen kinetic and dialysis efficiency. Nephrol Dial Transplant. 1997; 12(1):106-10.