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Original Research Article

Haematological Alterations and Prevalence of Anemia among Hemodialysis Patients Infected with Hepatitis B and C Viruses in Western Libya

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Abstract: ***Background:*** Anemia is the most common haematological abnormalities in chronic renal failure. It has a public health importance in developing countries. In chronic renal failure patients, RBC count Hb concentration, hematocrit and platelet count were significantly reduced. There has been a strong association of hemodialysis (HD) and hepatitis viruses infection. Liver disease may be one of the factors, that affecting erythropiesis. ***Objectives*****:** The present study aimed to evaluate the haematological alterations and the prevalence of anemia in hemodialysis patients infected with hepatitis HBV and HCV in Western Libya. ***Subjects and Methods*****:** This study was conducted on 100 hemodialysis patients infected with hepatitis (50 HBV and 50 HCV) from October 2018 to October 2021 as case group and a group of 50 healthy individuals as a control group. Ethical approve and patients consent statement were taken from everyone and the study was performed in Surman Dialysis Clinic and Zawia Kidney Center in West Libya. 3 mL of blood from each participant was drawn by venipuncture into dipotassium ethylenediamine-tetraacetate containing Vacutainer tubes. All samples were processed for analysis immediately after collection. Peripheral blood baseline parameters were measured using Sysmex KX 21 analyzer. ***Results*****:** The results showed a significant ($P<0.01$) decreased in RBCs counts, hemoglobin content, Hematocrit value, lymphocytes %, and blood platelets count, and increased in neutrophils %, and mixed % in the HBV, and HCV infected hemodialysis patients compared with the healthy individuals. 78% of HBV infected hemodialysis patients and 74% of HCV infected hemodialysis patients were anemic. The degrees of anemia were 56%, and 48% mild anemia, 26% and 20% moderate anemia, and 18% and 6% severe anemia in anemic HBV and HCV infected hemodialysis patients, respectively. In severe, moderate, and mild anemic HBV and HCV infected hemodialysis patients, the RBCs counts, hemoglobin content, Hematocrit value, lymphocytes % and Platelets Count were showed a significant ($P<0.01$) decreases compared with the healthy individuals. In anemic HBV infected hemodialysis patients, a significant ($P<0.01$) increases were observed in MCV in mild anemic patients, neutrophils%, and mixed% in moderate anemic, and a significant ($P<0.05$) increases in MCV in moderate anemic patients, MCH in moderate and mild anemic, in neutrophils%, and mixed% in severe anemic. In anemic HCV infected hemodialysis patients, a significant ($P<0.01$) increases were observed in MCV, MCH, and mixed% in moderate and mild anemic patients. In a non-anemic HBV and HCV infected hemodialysis patients, a significant ($P<0.01$) decreases were observed in Hct, lymphocytes%, and platelets count and a significant increases were found in neutrophils%, and mixed%. ***Conclusion*****:** It can be concluded that the haematological parameters especially in anemic patients were showed a severe alterations and more than 70% were anemic in HBV and HCV infected hemodialysis patients. Therefore, HBV and HCV infected hemodialysis patients should be advised to a routinely monitor the haematological parameters for improvement in the control of anemia. Further clinical researches are needed to confirm these relations.

Keywords: Anemia, Haematological alterations, HBV infected hemodialysis patients, HCV infected hemodialysis patients, Western Libya.

1. INTRODUCTION

Chronic kidney disease (CKD) is a global public health problem, with greater burden and very high cost of care especially in developing countries. Haematological profiles are commonly affected in CKD and this becomes more apparent as the disease progresses (Shittu *et al.*, 2013). In chronic renal failure patients, RBC count Hb concentration, hematocrit and platelet count were significantly reduced (Suresh *et al.*, 2012). Chronic renal failure patients associated with

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anemia has a public health importance in developing countries (Hsu *et al.,* 2002, van der Putten *et al.,* 2008). The severity of anemia increases along with the severity of disease (van der Putten *et al.,* 2008, Suresh *et al.,* 2012). Patients with end-stage renal disease on maintenance hemodialysis are usually anemic due to lack of erythropoietin (EPO) secretion from the kidney (Fouad *et al.,* 2015). It is an independent risk factor for the development of cardiac dysfunction like increased cardiac output, cardiac enlargement, left ventricular hypertrophy and congestive cardiac failure (Kasiske *et al.,* 2001, Ayus *et al.,* 2005, and Khanam *et al.,* 2007).

Liver disease may be one of the factors affecting erythropiesis (Zumrutdal, and Sezgin, 2012). There has been a strong association of hemodialysis (HD) and HCV infection. It seems an important contributing factor for spread of hepatitis. A similar correlation was observed between HBV or HCV marker positivity and the number of patients treated per hemodialysis unit. Due to multiple practices of dialysis, these patients are more prone to HCV and HBsAg infection (Alashek *et al.,* 2012, Anwar *et al.,* 2016). Hepatitis C virus (HCV) infection is especially problematic in patients with end-stage renal disease who are undergoing hemodialysis. Rates of HCV infection are higher among hemodialysis patients than in the general population, and several routes of transmission are thought to stem from the dialysis unit (Berenguer, 2008). Sabry *et al.,* 2007 reported that the mean hemoglobin concentration was similar in HCV-positive compared to HCV negative group (10.32±2.03 versus 10.22±1.52 gm/dl, respectively). Mean HCT values were also similar in both groups being 30.94± 6.089% in HCV positive versus 30.77± 4.53% in HCV negative group, respectively. Fouad *et al.,* 2015 demonstrated that hemodialysis patients with HCV infection tended to have higher mean hemoglobin, hematocrit levels and levels of RBCs count and lower platelet counts than other groups.

The patients with hepatitis were found to have higher hemoglobin levels and were less anemic, which demanded lower EPO doses than in the hepatitis-free hemodialysis patients (Lin *et al.,* 2008, Alsaran *et al.,* 2009, Zumrutdal, and Sezgin, 2012).

2. OBJECTIVES

The present study aimed to evaluate the haematological alterations and the prevalence of anemia in hemodialysis patients infected with hepatitis HBV and HCV in Western Libya.

3. SUBJECTS AND METHODS

This study was conducted on 100 hemodialysis patients infected with hepatitis (50 HBV and 50 HCV) (age from 20 to 60 years) from October 2018 to October 2021 as case group and a group of 50 healthy individuals as a control group. Ethical approve and patients consent statement were taken from everyone and the study was performed in Surman Dialysis Clinic and Zawia Kidney Center in West Libya. Patients with especial established disorders such as endocrinopathies, and patients with use of certain drugs were excluded from study. During the study, no patient had blood or blood components such as fresh frozen plasma and platelet transfusion. In order to eliminate effects of sex and age on comparison between cases and control groups, age and sex were selected in each pair of groups as similar as possible. 3 mL of blood from each participant was drawn by venipuncture into dipotassium ethylenediamine-tetraacetate containing Vacutainer tubes. All samples were processed for analysis immediately after collection. Peripheral blood baseline parameters were measured using Sysmex KX 21 analyzer.

According to the World Health Organization (WHO, 2001) criteria for anemia in men is Hb<13 gm/dL and women is Hb<12 gm/dL. The degrees of anemia were mild, moderate, and severe in male>14 years, when haemoglobin concentrations were (11–12.9), (8–10.9), and <8g/dL and in female>14 years, when haemoglobin concentrations were (11–11.9), (8–10.9), and <8 g/dL, respectively (Qureshi *et al.,* 2015).

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences (SPSS 25) software**.** The statistical significance of differences between groups was evaluated with the one-way analysis of variance **(**ANOVA**),** and percentages were estimated by Chi-square. The results were considered statistically significant when $p<0.05$.

4. RESULTS

4.1. Haematological parameters in healthy individuals, HCV, and HBV infected hemodialysis patients

The data shown in Table (1) and figure (1) indicated a significant (*P<0.01*) decrease in RBCs counts (3.26 ± 0.06) $x10^6$ cell/µl, and (3.46 ± 0.07) x 10^6 cell/µl), respectively in the HBV, and HCV infected hemodialysis patients compared with the healthy individuals (4.48 ± 0.09) $x10^6$ cell/µl.

A significant (*P<0.01*) decreased in hemoglobin concentrations were found (8.40 ± 0.15) g/dl, and (10.40 ± 0.08) g/dl, respectively in the HBV, and HCV infected hemodialysis patients as compared with the healthy individuals (13.12 ± 0.18) g/dl (Table 1 & Figure 2).

Hematocrit values were a significantly (*P<0.01*) decreased (28.61 ± 0.50%, and 30.61 ± 0.45%) in the HBV, and HCV infected hemodialysis patients when compared to the healthy individuals (42.62 ± 1.04%) (Table 1 & Figure 3).

A non-significant (*P>0.05*) changes were observed in MCV, MCH, and MCHC [(86.11 ± 0.17fl)& (92.11 ± 0.61fl)], [(32.20 ± 0.32pg)& (31.40 ± 0.30 pg)], and [(33.24 ± 0.20g/dl)& (34.24 ± 0.23g/dl)] respectively in the HBV, and HCV infected hemodialysis patients compared to the healthy individuals (88.54 ± 0.74fl), (29.94 ± 0.32pg), and (34.29 ± 0.24/dl) (Table 1 & Figures 4-6).

Also, WBCs count was showed a non significant (*P>0.05*) changes in the HBV, and HCV infected hemodialysis patients when compared with the healthy individuals (Table 1 & Figure 7).

The data recorded in table (1) and figure (8, &10) indicated a significant (*P<0.01*) increase in neutrophils %, and mixed %, [(63.98 ± 0.62) & (64 ± 0.6)], and [(12.93 ± 0.32) & (10.99 ± 0.24)]], respectively in the HBV, and HCV infected hemodialysis patients as compared with the healthy individuals (59.69 ± 1.34), and (6.80 ± 0.33)

On the other hand, lymphocytes % and blood platelets count were significantly (*P<0.01*) decreased [(23.09 ± 0.42) and (25.01 ± 0.53), and (200 ± 7.3x10^3) cell/µl & (191 ± 8.6x10^3) cell/µl] in the HBV, and HCV infected hemodialysis patients as compared to the healthy individuals (35.25 ± 1.21) and (264.1 ± 12x10^3) cell/µl) (Table. 1& Figure 9 & 11).

Table 1: Haematological parameters in healthy individuals, HCV, and HBV infected hemodialysis patients

Groups Parameters	Control Mean ± SE	HBV infected patients Mean ± SE	HCV infected patients Mean ± SE	F	P Value
BCs Count (x10^6)	4.48 ± 0.09	3.26 ± 0.06**	3.46 ± 0.07**	22.57	0.000
Hb (g/dl)	13.12 ± 0.18	8.40 ± 0.15**	10.40 ± 0.08**	27.43	0.000
Hct (%)	42.62 ± 1.04	28.61 ± 0.50**	30.61 ± 0.45**	53.93	0.000
MCV (fl)	88.54 ± 0.74	86.11 ± 0.17*	92.11 ± 0.61*	3.02	0.051
MCH (Pg)	29.94 ± 0.32	32.20 ± 0.32*	31.40 ± 0.30*	2.43	0.060
MCHC (g/dl)	34.29 ± 0.24	33.24 ± 0.20	34.24 ± 0.23	0.01	0.992
WBCs Count (x10^3)	6.28 ± 0.21	6.09 ± 0.07	6.10 ± 0.19	0.11	0.898
Neutrophils %	59.69 ± 1.34	63.98 ± 0.62**	64 ± 0.6**	5.22	0.006
Lymphocytes %	35.25 ± 1.21	23.09 ± 0.42**	25.01 ± 0.53**	56.26	0.000
Mixed %	6.80 ± 0.33	12.93 ± 0.32**	10.99 ± 0.24**	17.38	0.000
Platelets Count (x10^3)	264.1 ± 12	200 ± 7.3**	191 ± 8.6**	58.23	0.000

*: Significant at *P<0.05* compared with the healthy individuals (Controls). **: Significant at *P<0.01* compared with the healthy individuals (Controls).

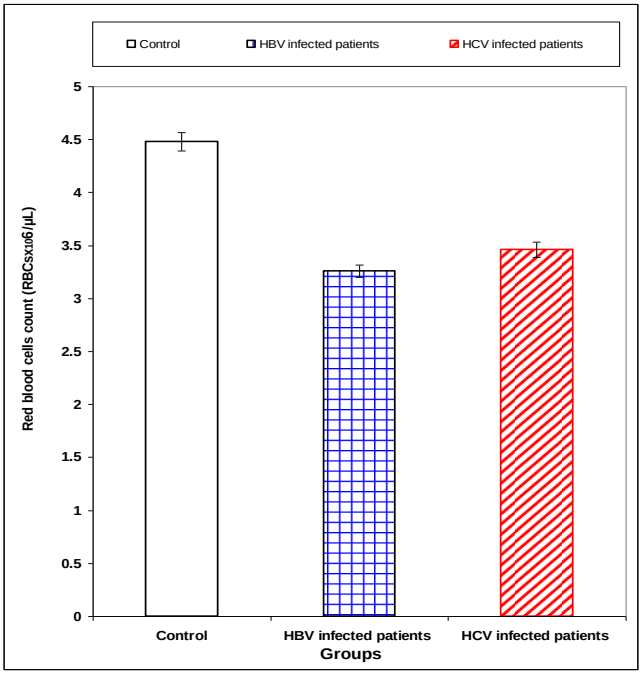

Figure 1: RBCs count in healthy individuals, HCV, and HBV infected hemodialysis patients

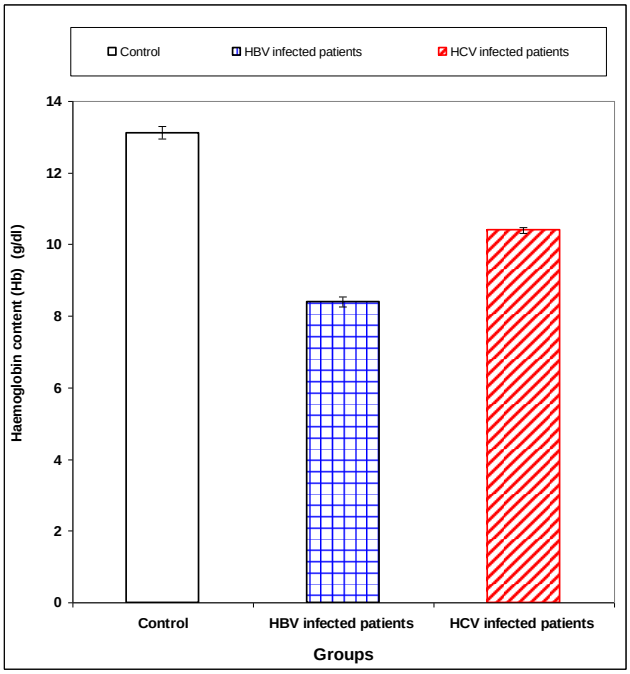

Figure 2: Hemoglobin content in healthy individuals, HCV, and HBV infected hemodialysis patients

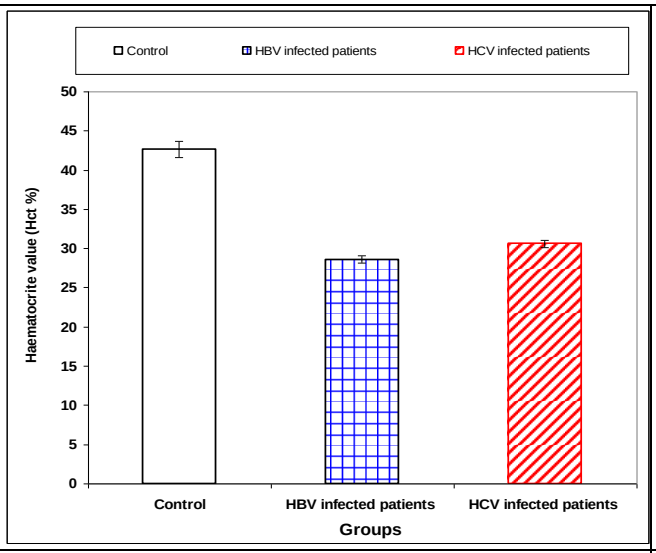

Figure 3: Hematocrit value in healthy individuals, HCV, and HBV infected hemodialysis patients

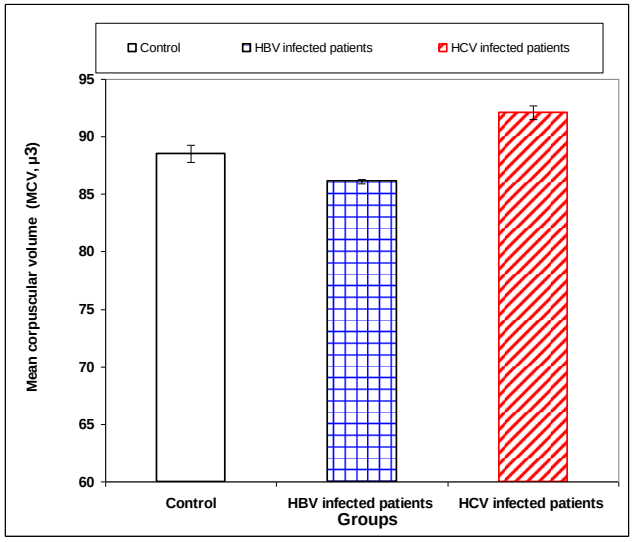

Figure 4: Mean corpuscular volume in healthy individuals, HCV, and HBV infected hemodialysis patients

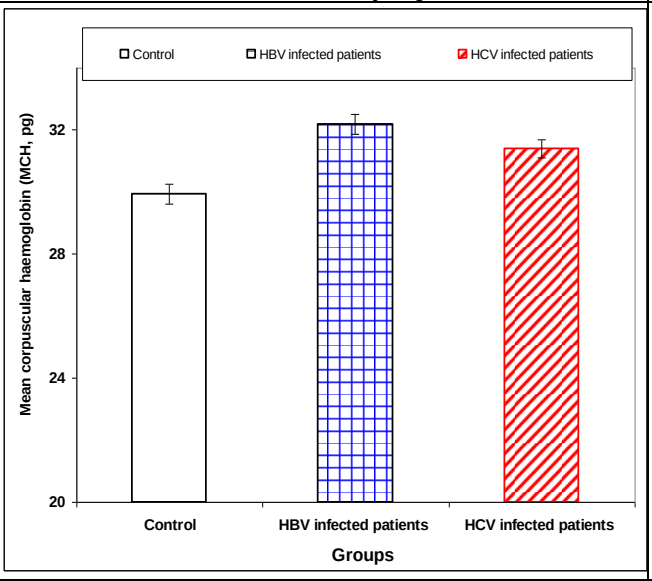

Figure 5: Mean corpuscular hemoglobin in healthy individuals, HCV, and HBV infected hemodialysis patients

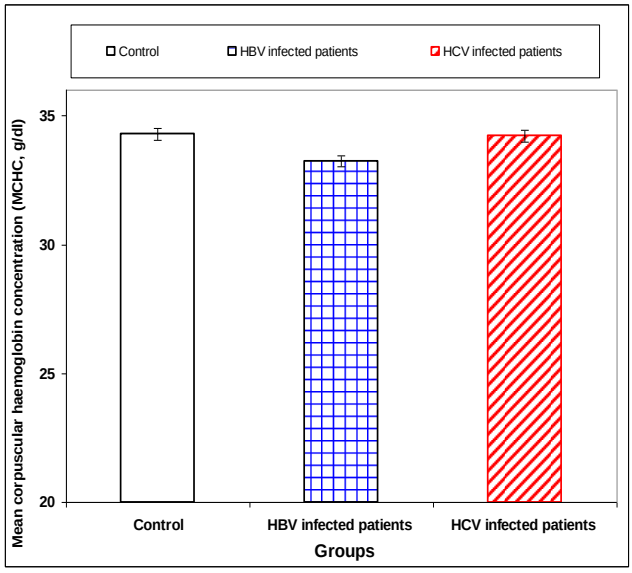

Figure 6: Mean corpuscular hemoglobin concentration in healthy individuals, HCV, and HBV infected hemodialysis patients

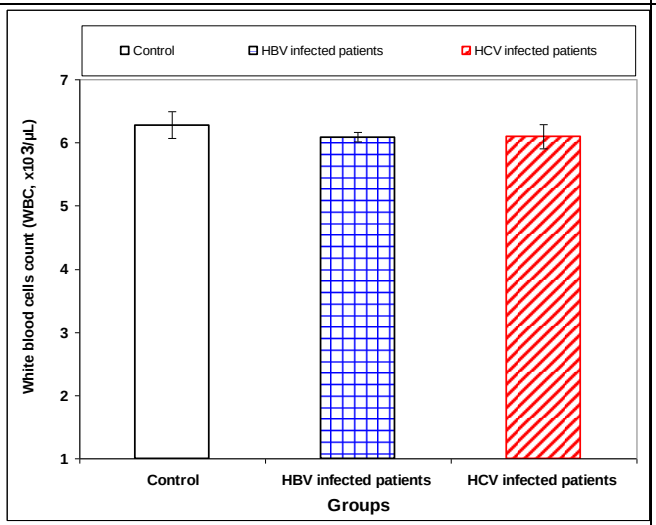

Figure 7: White leukocytes count in healthy individuals, HCV, and HBV infected hemodialysis patients

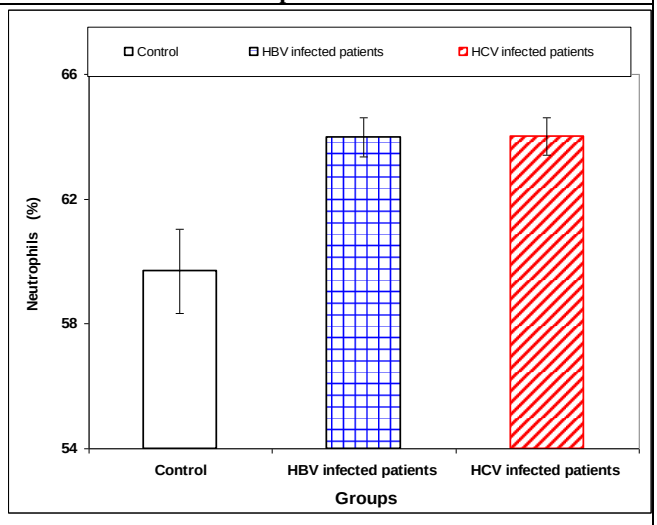

Figure 8: Neutrophils % in healthy individuals, HCV, and HBV infected hemodialysis patients

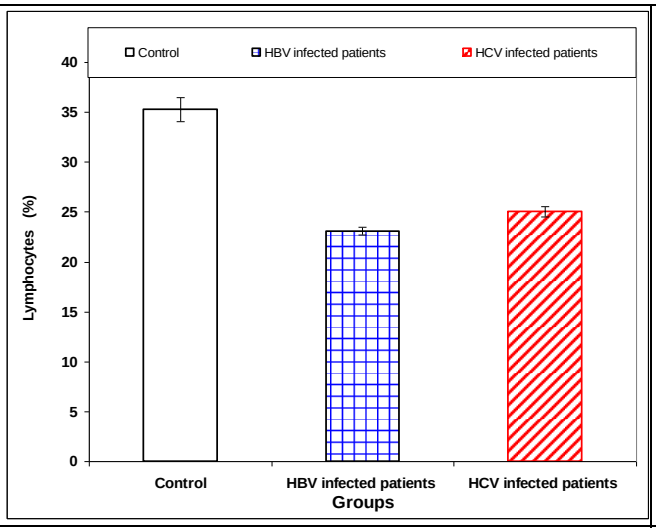

Figure 9: Lymphocytes % in healthy individuals, HCV, and HBV infected hemodialysis patients

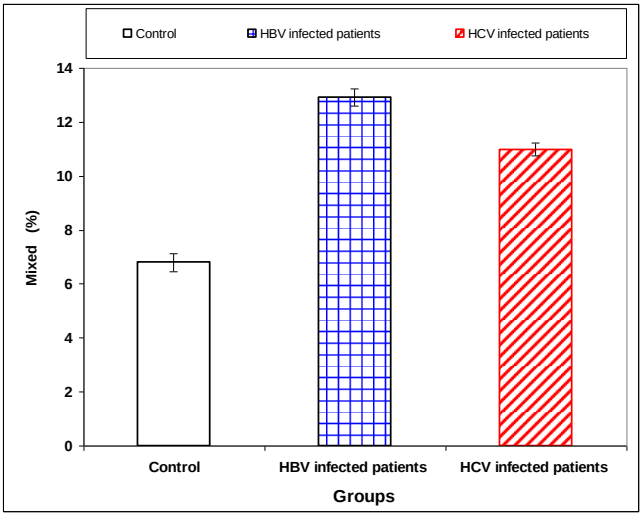

Figure 10: Mixed % in healthy individuals, HCV, and HBV infected hemodialysis patients

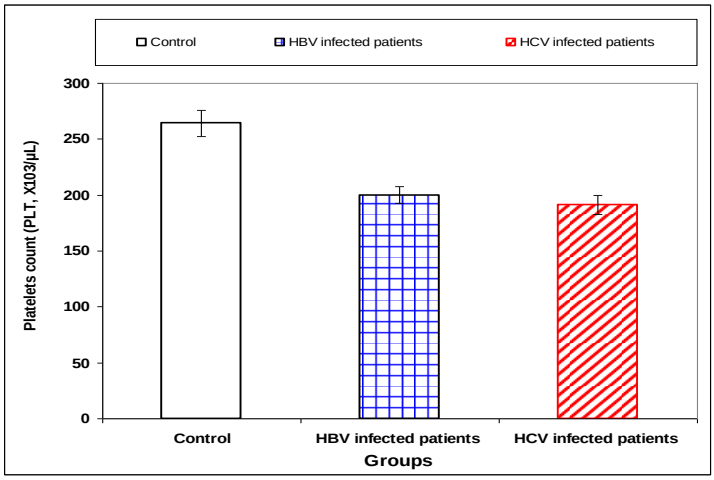

Figure 11: Platelets count in healthy individuals, HCV, and HBV infected hemodialysis patients

4.2. Distribution of anemia among HBV and HCV infected hemodialysis patients

Statistical analysis of the results showed that 78% of HBV infected hemodialysis patients and 74% of HCV infected hemodialysis patients were anemic (Table 2 & Figure 12).

Table 2: Distribution of anemia among HBV and HCV infected hemodialysis patients

Groups Distribution of anemia	HBV infected hemodialysis patients		HCV infected hemodialysis patients	
	Frequency	Percent (%)	Frequency	Percent (%)
Anemic Patients	39	78	37	74
None anemic Patients	11	22	13	26

Data in Table (3) and Figure (13) shown that the distribution of anemic HBV and HCV infected hemodialysis patients according to the degrees of anemia. Mild anemia was 56%, 48%, and moderate anemia was 26% and 20%, and severe anemia was 18% and 6% in anemic HBV and HCV infected hemodialysis patients, respectively.

Table 3: Distribution of anemic HBV and HCV infected hemodialysis patients according to the degrees of anemia

Groups	HBV infected hemodialysis patients		HBV infected hemodialysispatients	
Degrees of anemia	Frequency	Percent (%)	Frequency	Percent (%)
Severe	7	18	3	6
Moderate	10	26	10	20
Mild	22	56	24	48

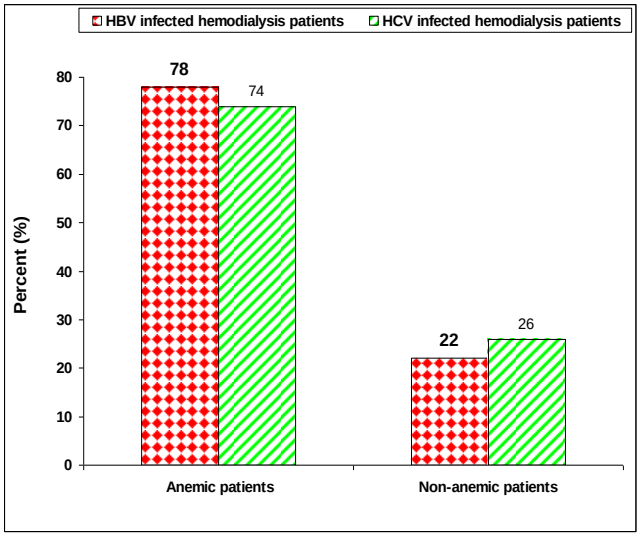

Figure 12: Distribution of anemia among HBV and HCV infected hemodialysis patients

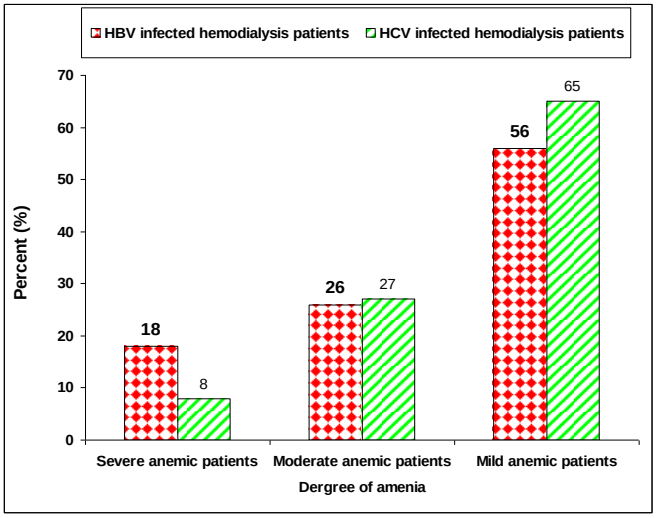

Figure 13: Distribution of anemic HBV and HCV infected hemodialysis patients according to the degrees of anemia

4.3. Haematological parameters in the healthy individuals and HBV infected hemodialysis anemic and non-anemic patients

The data in table (4) show the haematological parameters in the healthy individuals, anemic, and non-anemic HBV infected hemodialysis patients. RBCs counts, hemoglobin content, Hematocrit value, Lymphocytes % and Platelets Count were showed a significant (*P<0.01*) decrease in severe, moderate, and mild anemic HBV infected hemodialysis patients compared with the healthy individuals.

In anemic HBV infected hemodialysis patients, a significant (*P<0.01*) increases were observed in MCV in mild anemic patients, neutrophils%, and mixed% in moderate anemic, and a significant (*P<0.05*) increases in MCV in moderate anemic patients, MCH in moderate and mild anemic, in neutrophils %, and mixed % in severe anemic.

In a non-anemic HBV infected hemodialysis patients, a significant (*P<0.01*) decreases were observed in Hct, lymphocytes%, and platelets count and a significant (*P<0.05*) increases were found in neutrophils%, and mixed%.

Table 4: Haematological parameters in healthy individuals and HBV infected hemodialysis anemic and non-anemic patients

Groups	Control (n=50)	Severe anemic Patients (n=7)	Moderate anemic Patients (n=10)	Mild anemic Patients (n=22)	Non-anemic Patients (n=11)
Parameters	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**
RBCs Count ($x10^6$)	**4.48 ± 0.09**	**2.57 ± 0.08****	**3.31 ± 0.10****	**3.42 ± 0.13****	**4.22 ± 0.11**
Hb (g/dl)	**13.12 ± 0.18**	**6.97 ± 0.19****	**9.55 ± 0.12****	**11.49 ± 0.07****	**12.90 ± 0.13**
Hct (%)	**42.62 ± 1.04**	**22.13 ± 0.98****	**28.08 ± 0.40****	**32.54 ± 0.85****	**38.09 ± 0.57****
MCV (fl)	**88.54 ± 0.74**	**91.79 ± 0.87**	**91.83 ± 1.35***	**94.67 ± 1.17****	**91.20 ± 0.95**
MCH (Pg)	**29.94 ± 0.32**	**29.46 ± 1.30**	**31.59 ± 0.36***	**31.85 ± 0.73***	**31.57 ± 0.82**
MCHC (g/dl)	**34.29 ± 0.24**	**33.72 ± 0.66**	**34.45 ± 0.26**	**33.58 ± 0.49**	**34.62 ± 0.48**
WBCs Count ($x10^3$)	**6.28 ± 0.21**	**6.26 ± 0.56**	**6.05 ± 0.25**	**5.86 ± 0.48**	**6.36 ± 0.44**
Neutrophils %	**59.69 ± 1.34**	**65.01 ± 0.85***	**64.36 ± 1.00****	**62.92 ± 1.14**	**63.38 ± 1.48***
Lymphocytes %	**35.25 ± 1.21**	**21.91 ± 1.36****	**22.91 ± 0.84****	**24.38 ± 1.36****	**23.01 ± 0.93****
Mixed %	**6.80 ± 0.33**	**10.10 ± 0.56***	**11.54 ± 0.62****	**12.94 ± 1.10**	**13.22 ± 1.03***
Platelets Count ($x10^3$)	**264.1 ± 12**	**210 ± 26****	**188 ± 9****	**181 ± 18****	**189.89 ± 18****

***: Significant at *P<0.05* compared with the healthy individuals (Controls). **: Significant at *P<0.01* compared with the healthy individuals (Controls).**

4.4. Haematological parameters in healthy individuals and HCV infected hemodialysis anemic and non-anemic patients

The data in table (5) show the haematological parameters in the healthy individuals, anemic, and non-anemic HCV infected hemodialysis patients. RBCs counts, hemoglobin content, Hematocrit value, Lymphocytes % and Platelets Count were showed a significant (*P<0.01*) decrease in severe, moderate, and mild anemic HBV infected hemodialysis patients compared with the healthy individuals.

In anemic HCV infected hemodialysis patients, a significant (*P<0.01*) increases were observed in MCV, MCH, and mixed% in moderate and mild anemic patients.

In a non-anemic HBV infected hemodialysis patients, a significant (*P<0.01*) decreases were observed in Hct, lymphocytes %, and platelets count and a significant (*P<0.01*) increases were found in neutrophils%, and mixed%.

Table 5: Haematological parameters in healthy individuals and HCV infected hemodialysis anemic and non-anemic patients

Groups	Control (n=50)	Severe anemic Patients (n=3)	Moderate anemic Patients (n=24)	Mild anemic Patients (n=10)	Non-anemic Patients (n=13)
Parameters	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**	**Mean ± SE**
RBCs Count ($x10^6$)	**4.48 ± 0.09**	**2.37 ± 0.12****	**3.12 ± 0.07****	**3.33 ± 0.19****	**4.19 ± 0.09**
Hb (g/dl)	**13.12 ± 0.18**	**6.85 ± 0.29****	**9.58 ± 0.11****	**11.49 ± 0.07****	**12.98 ± 0.13**
Hct (%)	**42.62 ± 1.04**	**22.57 ± 1.82****	**27.95 ± 0.39****	**33.32 ± 0.73****	**38.22 ± 0.49****
MCV (fl)	**88.54 ± 0.74**	**92.24 ± 1.48**	**93.28 ± 0.71****	**94.59 ± 1.33****	**89.41 ± 2.13**
MCH (Pg)	**29.94 ± 0.32**	**31.67 ± 1.11**	**32.43 ± 0.48****	**32.78 ± 0.95****	**30.80 ± 0.61**
MCHC (g/dl)	**34.29 ± 0.24**	**33.91 ± 0.71**	**34.69 ± 0.27**	**34.63 ± 0.56**	**34.01 ± 0.42**
WBCs Count ($x10^3$)	**6.28 ± 0.21**	**7.40 ± 0.83**	**6.06 ± 0.25**	**5.68 ± 0.41**	**6.27 ± 0.4**
Neutrophils %	**59.69 ± 1.34**	**65.93 ± 1.18**	**62.31 ± 1.19**	**64.03 ± 1.20**	**65.67 ± 1.98****
Lymphocytes %	**35.25 ± 1.21**	**23.14 ± 2.39****	**23.74 ± 0.75****	**24.06 ± 1.10****	**20.65 ± 1.27****
Mixed %	**6.80 ± 0.33**	**10.19 ± 0.61**	**13.13 ± 0.74****	**10.70 ± 0.48****	**12.74 ± 0.99****
Platelets Count ($x10^3$)	**264.1 ± 12**	**196 ± 13****	**206 ± 10****	**184 ± 15****	**197 ± 17****

****: Significant at P<0.001 compared with the healthy individuals (Controls).**

5. DISCUSSION

Haematological parameters are commonly affected in CKD. Red cell indices are the ones commonly and severely affected. This is because as high as 90% of erythropoietin is produced in the juxta glomerular apparatus of the kidney while 10% are produced in the liver and other organs. The severity of affectation depends on the stage of renal failure (Shittu *et al.*, 2013). It is known that the fetal liver is the primary site of production of the relevant haemopoietic hormones. These are the glycoproteins thrombopoietin and erythropoietin as well as and the somatomedins. After birth, the kidneys take over as the main site of EPO synthesis which is the primary regulator of erythropoiesis (Jelkmann, 2001, Sabry *et al.*, 2007). In patients with end-stage renal failure, serum EPO may increase after hepatitis B or C infection, resulting in an improvement of red cell status (Radovic *et al.*,1999, Sabry *et al.*, 2007).

The current results showed a significant (*P<0.01*) decreased in RBCs counts, hemoglobin content, and Hematocrit value, (that tend to have higher in HCV than HBV patients), in the HBV, and HCV infected hemodialysis patients compared with the healthy individuals. Similarly, previous studies reported that hemodialysis patients with HCV infection tended to have higher mean Hb, Hct, and RBCs count than other groups (Sahin *et al.*, 2003, Chen *et al.*, 2008, Khurana *et al.*, 2008, Lin *et al.*, 2008, Fouad *et al.*, 2015). Shittu *et al.*, 2013 reported that RBCs count, hemoglobin concentration, Hct, WBCs count, and platelet count for the patients with chronic kidney disease were significantly different from that of the control except MCV, MCH, and MCHC. The concentration of serum creatinine shows negative correlation with all the hematological parameters, and the degree of changes depends on the severity of renal failure (Suresh *et al.*, 2012, and George *et al.*, 2015).

In chronic renal failure, impaired production of erythropoietin is the main reason for the decrease in red blood cell count, hemoglobin concentration, hematocrit, and platelet count (Suresh *et al.*, 2012 and Dorgalaleh *et al.*, 2013). Other associated factors like increase haemolysis, suppression of bone marrow erythropoiesis, hematuria and gastrointestinal blood loss may play a role in decrease red blood cell count, Hb, and Hct (Suresh *et al.*, 2012). Inflammation has a key role in erythropoietin resistance. Renal failure is a low-grade inflammatory condition in which proinflammatory cytokines antagonize the action of EPO by directly inhibiting erythroid progenitor cells and by disrupting

iron metabolism, in which hepcidin has a central role. EPO resistance could also be caused by inflammation-induced changes in erythropoietin -receptor properties, assembly and recycling, and by interference with post-receptor signaling routes. Neocytolysis might also have a role in erythropoietin resistance (van der Putten *et al.*, 2008). Neocytolysis is a physiological process initiated by a drop in EPO levels, which leads to selective hemolysis of young circulating red blood cells and subsequent down regulation of red cell mass when it is excessive (Rice *et al.,* 2001).

Altintepe *et al.,* 2004 reported lesser EPO and iron requirements in HCV-positive HD compared to HCV-negative ones as a result of higher endogenous serum EPO concentrations and changes in iron metabolism in liver disease. They further concluded that the mechanism by which infection and inflammatory disease impair responsiveness to erythropoiesis is still poorly understood (Özdemir *et al.,* 2005). Iron deficiency is frequent in patients with renal failure and iron need is further increased by EPO therapy; therefore, iron replacement is very important in the treatment of renal anemia (Tarng *et al.*, 1999, Kaufman *et al.,* 2001). Sabry *et al*., 2007 reported that the assumption that even if endogenous EPO concentration is increased in them, resistance to EPO action could have occurred secondary to chronic infection which impairs iron availability or perhaps suppresses erythropoiesis by humoral factors, other cytokines or growth factors (Mecans and Krantz, 1992, Sabry *et al*., 2007). Also, Sahin *et al*., 2003 concluded that higher Hb and Hct levels in HCV-positive was attributed most probably to increased production of EPO from HCV-infected patient's liver. These may reflect increased endogenous erythropoietin production by regenerating hepatocytes (Simon *et al.*,1980, Fouad *et al.,* 2015) during hepatitis and be proportional to increased interleukin-6 (IL-6) level (Radovic *et al.,* 1999, Fouad *et al.,* 2015), however previous study observed IL-6 levels were higher in HCV infected patients than in HBV patients (Falasca *et al*., 2006, Fouad *et al.,* 2015). Chen *et al.,* 2008 observed that HCV infections were, associated with higher levels of iron, and Ferritin than HBV patients. Fouad *et al.,* 2015 demonstrated that hemodialysis patients with HCV infection tended to have higher levels of iron, ferritin, TSAT, and TIBC than other groups. Relatively low levels of hepatic hepcidin expression of the degree of iron burden may be involved in the pathophysiologic mechanism of increased iron overload in patients with chronic hepatitis C (Fujita *et al.,* 2007, Usama *et al.*, 2012, Fouad *et al.,* 2015). These observations may be explained the higher level Hb and Hct among HCV patients than HBV patients in the present study.

Hematological disturbance such as anemia is considered as a frequent complication occurs in chronic kidney disease and is associated with morbidity and mortality and a decline in quality of life (Weiss *et al.,* 2005, Wasti *et al.,* 2013). The severity of anemia is directly proportional to the degree of renal function (Wasti *et al.,* 2013). Rathod *et al.,* 2014 reported that normochromic normocytic anemia is the most common hematological abnormality in chronic renal failure. Anemia can be correlated with severity of renal failure. Mild to moderate anaemia was found in up to 69% and 100% (Arogundade *et al.,* 2006) of subjects and severe anaemia in about 18% (Oluboyede, and Williams, 1995) of subjects. Normochromic normocytic blood picture is commonly seen in CKD as in other chronic disorders. It is seen virtually in all patients in Nigeria (Arogundade *et al.,* 2006, Akinsola *et al.,* 2009, and Shittu *et al.,* 2013), but a figure as low as 30% was reported in India (Abdu *et al.,* 2009). Microcytic hypochromic blood picture is also common, seen in up to 65% of subjects while macrocytic blood picture is seen only in 5% of subjects (Abdu *et al.,* 2009).

The current results showed that 78% of HBV infected hemodialysis patients and 74% of HCV infected hemodialysis patients were anemic. The degrees of anemia were 56%, and 48% mild anemia, 26% and 20% moderate anemia, and 18% and 6% severe anemia in anemic HBV and HCV infected hemodialysis patients, respectively. In severe, moderate, and mild anemic HBV and HCV infected hemodialysis patients, the RBCs counts, hemoglobin content, and Hematocrit value, were showed a significant ($P<0.01$) decreases compared with the healthy individuals. In anemic HBV infected hemodialysis patients, a significant ($P<0.01$) increases were observed in MCV in mild anemic patients, and a significant ($P<0.05$) increases in MCV in moderate anemic patients, MCH in moderate and mild anemic. In anemic HCV infected hemodialysis patients, a significant ($P<0.01$) increases were observed in MCV, and MCH in moderate and mild anemic patients. In a non-anemic HBV and HCV infected hemodialysis patients, a significant ($P<0.01$) decreases were observed in Hct. Zumrutdal, 2011 found that 8% of hemodialysis patients without hepatitis were able to maintain nearly normal hemoglobin levels (≥12 g/dL) without the administration of recombinant human EPO whereas the corresponding ratio in hemodialysis patients with chronic hepatitis was greater than 3-fold (25.3%). Takeda *et al*., 2002 reported that the hemoglobin levels were normal and/or better in hemodialysis patients might be due to a several factors such as male gender, higher body mass index, chronic hepatitis, and more years on hemodialysis therapy. Shittu *et al*., 2013 recorded that moderate anaemia was prevalent and the anaemias are predominantly normocytic normochromic. Degree of anaemia worsened with the progression of CKD, as reported in other studies (Arogundade *et al.,* 2006, and Akinsola *et al.,* 2009). The decline in haemoglobin concentration, Hct and RBCs count can be explained by a corresponding reduction in the synthesis and serum

levels of erythropoietin which is a major drive for erythropoiesis in the bone marrow (Shittu *et al*., 2013).

Rathod *et al.,* 2014 reported that uremic patients are nearly always anemic. Anemia of the chronic renal failure is multifactorial. The pathogenesis of this type of anemia has been attributed to decreased plasma erythropoietin due to renal damage, inhibitors of erythropoiesis in uremic plasma and decreased hemoglobin oxygen affinity (Mitchel, and Pegrum, 1971 and Rathod *et al.,* 2014). In addition to damage to renal site of erythropoietin production, plasma erythropoietin and erythropoisis is further suppressed in patients with renal disease. The stimulus to erythropoietin production is less intense than in patients with comparable severe anemia due to other causes. This is because the affinity of oxygen decreases which increases the availability of oxygen per unit of hemoglobin circulating through kidney (Mitchel, and Pegrum, 1971 and Rathod *et al.,* 2014). Other contributing factors include deficiencies of iron or folate and chronic disease with endogenous erythropoietin resistance (Dodds and Nicholls, 1983, Mojdehkar *et al.,*2004, van der Putten *et al.,*2008), heavy- metal toxicity, blood loss, and a reduction in red cell survival induced by toxic radicals (Mojdehkar *et al.,*2004).

The present study showed that WBCs count was showed a non significant (*P>0.05*) changes in the HBV, and HCV infected hemodialysis patients when compared with the healthy individuals. Similar results were obtained by Shittu *et al.,* 2013 who reported that the total WBC count remained normal at the mild and moderate stages but was elevated above normal at the severe stage. These is run parallel with other studies (Arogundade *et al.,* 2006, Akinsola *et al.,* 2009, and Talwar and Gupta, 2002). The normal WBC count may be due to the fact that uraemia affects the function of leukocytes rather than granulopoiesis and this is the reason why there is poor leukocytes response to infection in CKD patients (Colart *et al.,* 1990).

The current results showed a significant (*P<0.01*) decreased in lymphocytes %, (that tend to have higher in HCV than HBV patients) and increased in neutrophils %, and mixed % (that tend to have lower in HCV than HBV patients), in the HBV, and HCV infected hemodialysis patients compared with the healthy individuals. In severe, moderate, and mild anemic HBV and HCV infected hemodialysis patients, the lymphocytes % was showed a significant (*P<0.01*) decreases compared with the healthy individuals. In anemic HBV infected hemodialysis patients, a significant (*P<0.01*) increases were observed in neutrophils%, and mixed% in moderate anemic, and a significant (*P<0.05*) increases in neutrophils%, and mixed% in severe anemic. In anemic HCV infected hemodialysis patients, a significant (*P<0.01*) increases were observed in mixed% in moderate and mild anemic patients. In a non-anemic HBV and HCV infected hemodialysis patients, a significant (*P<0.01*) decreases were observed in lymphocytes %, and a significant increases were found in neutrophils %, and mixed%. Similarly, Wasti *et al.,* 2013 reported that the Lymphocytes count was decreased in CKD patients 16.3% and was also decreased in kidney transplant patients is 15.8%. The decreased in lymphocytes count may be due to chronic infections, severe stress (Hyperadrenocorticism), kidney failure, or prolonged use of glucocorticoid (Cortisone) injections. It was marked increased in kidney transplant patients 76.9%, this increase in Monocytes in kidney transplant patients showing that they are activated in these patients, which may be due to chronic infection of the stomach, tuberculosis or a chronic inflammation condition like inflammatory bowel disease and malignancy or an abscess and in chronic kidney disease decrease count usually non significant (Alghythan *et al.,* 2012).

The present study showed a significant (*P<0.01*) decreased in blood platelets count, that tend to have higher in HCV than HBV patients, in the HBV, and HCV infected hemodialysis patients compared with the healthy individuals. A similar results were obtained by Chen *et al.,* 2008 and Fouad *et al.,* 2015 who observed that hemodialysis patients with HCV infection tended to have lower platelet counts than other groups. Thrombocytopaenia in 52% of subjects is also common findings (Abdu *et al.,* 2009). Total platelet count also remained within normal range at the mild and moderate stages but mild thrombocytopenia was noticed at the severe stage (Shittu *et al*., 2013). Gafter *et al*., 1987, and Dorgalaleh *et al.,* 2013 reported that platelet count was statistically significant decreased and mild thrombocytopenia in chronic renal failure patients. Also, authors were found a mild thrombocytopenia among chronic renal failure patients. Also, similar study was revealed that the patients with renal failure are at high risk of bleeding due to thrombocytopenia and platelet dysfunction (Mohamed, 2010).

Thrombocytopenia is a possible hypothesis for the relation between HCV infection and increase red blood cell production as increased thrombopoietin secretion secondary to thrombocytopenia may increase the number of hematopoietic stem cells and progenitor cells (Simon *et al.,* 1980, Fouad *et al.,* 2015).

6. CONCLUSION

It can be concluded that the haematological parameters specially in anemic patients were showed a severe alterations and more than 70% were anemic in HBV and HCV infected hemodialysis patients. So, HBV and HCV infected hemodialysis patients should be advised to a routinely monitor the haematological parameters for improvement in the control of anemia. Further clinical researches are needed to confirm these relations.

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