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Evaluation of hematological parameters and hemodialysis outcomes in patients with chronic kidney disease from north Gujarat: A prospective study

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Background: As chronic kidney disease (CKD) progresses, changes in hematological parameters become more evident. Present study aimed to determine changes in hematological parameters and to evaluate effect of hemodialysis on levels of serum creatinine and urea in patients with CKD from north Gujarat. **Materials and methods:** A prospective cross-sectional study was conducted in patients with CKD who were on hemodialysis, aged between 30 to 70 years, serum creatinine level of more than 1.5 mg/dL. hematological tests were carried out in 50 patients with CKD, and were compared with same number of patients in control group which were matched (or comparable) in age and sex. All hematological parameters including Serum creatinine and urea were estimated before and after hemodialysis. **Results:** mean age and gender were comparable between groups. Hemoglobin, red blood cell count, packed cell volume, mean cell volume, mean cell hemoglobin, mean cell hemoglobin concentration and platelets were significantly lower in CKD group compared to control group ($P<0.05$). However, mean neutrophil, lymphocyte, monocyte, and eosinophil count were significantly higher in patients with CKD than controls ($P<0.05$). mean serum creatinine was more elevated in CKD group and reduced considerably after hemodialysis (11.61 mg/dL vs 5.53 mg/dL; $P<0.0001$). Similarly, mean urea concentration was higher in CKD group and significantly reduced after hemodialysis (143 mg/dL vs 38.47 mg/dL; $P<0.0001$). **Conclusion:** Hematological parameters can be used as markers in patients with CKD, and hemodialysis is an effective treatment in reducing serum creatinine and urea in patients with renal failure from north Gujarat.

Keywords: Hemoglobin, Renal failure, Post-hemodialysis, Hemoglobin

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Introduction

Diseases of the kidneys are the foremost public health issue and the leading cause of death worldwide. The incidence of chronic kidney disease (CKD) has increased worldwide in the past few decades. In India, the prevalence of CKD accounted for 13-15.04% [1].

In developing countries like India, renal failure is increasing. Due to lack of infrastructure and poor socioeconomic status these patients present late for the management [2].

The most common causes of renal failure are infections, autoimmune diseases, diabetes and other endocrine disorders, cancer, and toxic chemicals, which progressively deteriorate kidney function [3]. Hence, renal failure can be a result of complications associated with other severe medical conditions.

As CKD progresses, the changes in hematological parameters become more pronounced. The derangement of hematological parameters, including hemoglobin concentration, Red blood cell (RBC) count, leukocyte count, and platelet count, are associated with CKD. Other prognostic factors include elevated levels of creatinine and urea in the blood [4-6]. Hemodialysis helps in removing excessive toxic fluids and metabolic end products from the body and is also considered a cheaper therapeutic option than renal transplantation [7]. Many studies have evaluated the effect of hemodialysis on hematological and biochemical parameters [8-11]. However, the present study added value to the existing literature. This study aimed to determine the changes in hematological parameters and to evaluate the effect of hemodialysis on the levels of serum creatinine and urea in patients with CKD from north Gujarat.

Material and Methods

Study population: This prospective cross-sectional study was conducted at the Department of Pathology, Banas Medical College Research Centre, Gujarat, between April 2018 and March 2020. Institutional Ethics Committee approved the research and study procedure was following the principles of the Declaration of Helsinki. Written informed consent was obtained from all study patients before enrolment.

The inclusion criteria were patients with CKD who were on hemodialysis, aged between 30 to 70 years, serum creatinine level of more than 1.5 mg/dL. Patients suffering from preexisting blood disorders, stone disease and patients suffering from muscular atrophy were excluded from the study.

Fifty patients were included in the study group on hemodialysis for CKD and fifty patients were included in the control group. Both the groups were matched for age and sex.

Laboratory analysis: All hematological parameters including red Blood Cell count (RBC), hemoglobin concentration, total white blood cells (WBC), neutrophils, lymphocytes, packed cell volume (PCV), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC), platelet count and were estimated by using Beckman coulter automatic analyzer. A fully automated random-access chemistry analyzer (Humastar 300) was used to assess serum creatinine.

Study analysis: All statistical analyses were performed using SPSS software (version 23). The qualitative data were expressed as numbers and proportions, while the quantitative data were expressed as mean (SD). Categorical and continuous variables were compared with the Chi-square test and Mann-Whitney U test, respectively. Statistical significance was defined as $P < 0.05$.

Results

Overall, the age and gender were comparable between the groups. The hemoglobin was significantly lower in patients with CKD than in the control group (10.13 versus 14.72 g/dL; $P<0.0001$). Similarly, PCV, MCV, MCH, MCHC, platelets, and WBC were significantly lower in the CKD group ($P<0.05$); however, RDW-CV was considerably higher in CKD patients compared to the control (Table 1).

The mean neutrophil, lymphocyte, monocyte and eosinophil was significantly higher in patients with CKD patients compared to controls ($P<0.05$) (Figure 1). The mean (SD) serum creatinine was more elevated in the CKD group compared to the control (11.10 [2.57] versus 0.89 [0.14]; $P<0.0001$). Urea levels were also found to be significantly higher in the CKD group compared to the control (137.88 [41.34] versus 14.19 [2.01]; $P<0.0001$).

There was significant reduction in mean serum creatinine level from pre-hemodialysis (11.61 mg/dL) to post-hemodialysis (11.61 mg/dL versus 5.53 mg/dL; P<0.0001) (Figure 2A). Similarly, mean urea was significantly reduced post-hemodialysis in patients with renal failure (pre-hemodialysis, 143.00 mg/dL versus post-hemodialysis, 38.47 mg/dL; P<0.0001) (Figure 2B).

The mean levels of serum creatinine and urea before and after hemodialysis were compared across three age groups in patients with renal failure and are summarized in Table 2 and Table 3, respectively. A significant decrease in mean serum creatinine level after hemodialysis was observed in all the three age groups (18-40 years, P<0.0001; 41-60 years, P<0.0001; 61-80 years, P=0.0002). The levels of mean urea were significantly reduced post-hemodialysis compared to pre-hemodialysis in patients with renal failure across all age groups (18-40 years, P<0.0001; 41-60 years, P<0.0001; 61-80 years, P<0.0001).

Table 1: Comparison of demographic and hematological parameters between patients with chronic kidney disease and healthy controls

Parameter	CKD (N=55)	Control (N=55)	P value
Age (years)	45.91 (14.86)	42.23 (13.56)	0.1777
Age group (years) 18-40 41 to 60 61 to 80	20 (36.36) 26 (47.27) 9 (16.36)	22 (40.00) 30 (54.55) 3 (5.45)	0.6957 0.4471 0.0677
Sex, n (%) Male Female	38 (69.09) 17 (30.90)	33 (60.00) 22 (40.00)	0.3312 0.3207
Hemoglobin (g/dL)	10.13 (1.74)	14.72 (2.10)	<0.0001
RBC (X1012/L)	3.55 (0.58)	5.12 (0.94)	<0.0001
PCV (%)	31.71 (5.17)	34.77 (4.52)	0.0013
MCV (fl)	89.61 (6.26)	92.11 (6.12)	0.0365
MCH (pg)	28.56 (2.24)	30.86 (2.45)	<0.0001
MCHC (g/L)	31.83 (1.03)	32.62 (1.89)	0.0076
RDW-CV	15.11 (1.30)	13.05 (1.24)	<0.0001
Platelet count (U/µL)	182,420 (83,449.87)	221,745 (67,264.51)	0.0076
WBC (X109/L)	7,026.80 (2,616.06)	5,238.2 (2,178.47)	0.0002
Serum creatinine (mg/dL)	11.61 (3.31)	0.89 (0.14)	<0.0001
Urea (mg/dL)	143.00 (40.49)	14.19 (2.01)	<0.0001

Data shown as mean (SD), unless otherwise specified.

Table 2: Incidence of serum creatinine in renal failure patient's during pre and post hemodialysis

Age Group (Years)	N	Pre-hemodialysis	Post-hemodialysis	T-value	P value
		Mean (SD)	Mean (SD)		
18 to 40	20	11.89 (3.55)	5.67 (1.69)	-7.075	<0.0001
41 to 60	26	11.31 (3.17)	5.37 (1.82)	-8.286	<0.0001
61 to 80	9	11.76 (3.35)	5.60 (1.77)	-4.877	0.0002

Table 3: Incidence of urea in renal failure patient's during pre and post hemodialysis

Age Group (Years)	N	Pre-hemodialysis	Post-hemodialysis	T-value	P value
		Mean (SD)	Mean (SD)		
18 to 40	20	151.1 (35.24)	33.65 (19.75)	-13.002	<0.0001
41 to 60	26	134.23 (40.77)	40.35 (22.66)	-10.263	<0.0001
61 to 80	9	156.56 (47.90)	40.78 (19.21)	-6.730	<0.0001

Figure 1

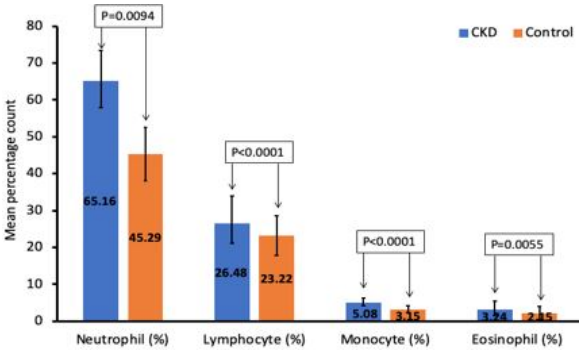
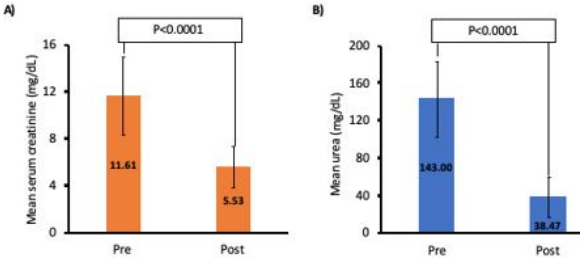


Figure 2



Discussion

Chronic kidney disease is considered as one of the progressive diseases causing loss of kidney function with a fall in the glomerular filtration

Rate, which further significantly increases the levels of serum creatinine and blood urea. Therefore, these biochemical parameters can also be used as a diagnostic tool to assess renal diseases. The present study determined the hematological changes in patients with renal failure. Also, it evaluated the pre-dialysis and post-dialysis mean levels of serum creatinine and blood urea in patients with renal failure from north Gujarat undergoing hemodialysis to elucidate the effect of hemodialysis on renal failure. The key finding was: (i) compared to the control group, mean hemoglobin was significantly lowered in the CKD group (ii) PCV, MCV, MCH, MCHC, platelets and WBC count were found to be reduced in the CKD group ($P<0.05$) (iii) The mean neutrophil, lymphocyte, monocyte and eosinophil was significantly higher in CKD group (iv) The incidence of serum creatinine and serum urea was significantly higher before hemodialysis and reduced significantly after hemodialysis.

In the present study, a significant decrease in RBCs and hemoglobin was associated with the CKD group compared to the control group. These findings were similar to the other studies conducted previously [8,12,13]. In addition, Aruna and Shabana [14] concluded that anemia has commonly occurred in patients with chronic renal failure as damaged kidneys could not produce erythropoietin (EPO) sufficiently. A decrease in RBC count may be due to impaired kidney function, which does not produce EPO, which helps make RBCs from the bone marrow. Similarly, platelet count was found to be lowered in patients with CKD mainly due to impaired erythropoietin secretion [15,16].

Moreover, the present study showed a significant reduction in PCV, MCV, MCH, MCHC in the CKD group compared to the control group. These findings of the present study were also well supported by the results of the previous studies [8,13]. However, hematological parameters including neutrophil, lymphocyte, monocyte and eosinophil count were significantly increased in patients with CKD. In another study reported by Yoshitomi et al. demonstrated similar observations [17]. At the same time, our results contrast the finding of the survey done by Hassen et al, where patients with CKD are associated with a decreased lymphocytic count, the elevated levels of neutrophil, lymphocytes, and monocytes can be used as markers that reflect the state of systemic inflammation. [8]. Other essential aspects affected are the changes in renal function tests.

The mean serum creatinine and urea are significantly increased in patients with CKD compared to the control group, which is inversely proportional to the number of nephrons present in the body [18]. Elevated levels of urea and serum creatinine were observed during a renal failure is mainly because kidneys lose their filtering ability and the ability to eliminate nitrogenous wastes from the blood resulting in the accumulation of such substances in the blood [19]. This result was consistent with [8,10,14].???They showed significantly increased urea and serum creatinine concentrations in patients with CKD. Elevated levels of serum creatinine may cause itching and damage to nerve endings. So, creatinine clearance is the best method to examine kidney function, and hemodialysis plays a vital role in lowering the serum values effectively. (reasoning ???)

In the present study, patients with CKD undergoing hemodialysis showed a significant reduction in serum creatinine and urea. These findings were consistent with the previous studies indicating the significant role of hemodialysis in the clearance of urea and creatinine in the blood [9]. It was found that people in the age group of 41 to 60 years are more prone to develop CKD. This is in agreement with the study done by Nisha et al, where patients with renal failure have been associated with comorbid conditions including hypertension, diabetes and some other age-related changes [10].

The small sample size limited the present study. This was a prospective case-control study from a single institution. Further cross-sectional trials with larger sample sizes and longer follow-up are needed to confirm these findings.

Conclusion

This study showed that hematological parameters like hemoglobin, red blood cell count, packed cell volume can be used as markers in patients with CKD, and hemodialysis is an effective treatment in reducing serum creatinine and urea in patients with renal failure Gujarat. To our knowledge, this is the first study of the north Gujarat region that showed a relationship between hematological parameters and CKD patients.

Contribution of each author

1. Study design, drafting the article and critical revision of the article. 2. Conception of the

Work, critical revision of the article and final approval of the published version. 3. Data collection and drafting of the article. 4. Data collection and data analysis.

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