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Study of Renal Functions in People Living with Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (PLHA): An Observational Study of Tertiary Care Hospital in North India

Takhe Takung[1*], Pawan Kumar Kare[2], Om Prakash Kalra[1], Sunil Agarwal[1], Kuldeep Kumar[3], Sonal Sharma[4] and Ashok Kumar Tripathi[2]

[1]Department of Medicine, University College of Medical Sciences and G.T.B. Hospital, Dilshad Garden, Delhi -110095, India.
[2]Department of Biochemistry, Biochemistry and Immunology Laboratory, University College of Medical Sciences and G.T.B. Hospital, Dilshad Garden, Delhi -110095, India.
[3]Department of Medicine, ART Clinic, University College of Medical Sciences and G.T.B. Hospital, Dilshad Garden, Delhi -110095, India.
[4]Department of Pathology, University College of Medical Sciences and G.T.B. Hospital, Dilshad Garden, Delhi -110095, India.

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The aim of this study was to find out the involvement of renal dysfunction in people living with human immunodeficiency virus/acquired immune deficiency syndrome (PLHA) in India.
Study Design: Observational study.
Place and Duration of Study: Total (n=150) consecutive HIV positive patients between November

**Corresponding author: E-mail: dr.takung@gmail.com;*

2012 - April 2014, who were attending the ART Clinic or were admitted in Department of Medicine at University College of Medical Sciences and Guru TegBahadur Hospital, Delhi, India were recruited for the study.

Methodology: Estimated glomerular filtration rate (eGFR) was calculated by using Modification of Diet in Renal Disease (MDRD) and Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation. Morning spot urine samples were collected for urine albumin and urine creatinine test. Albumin/creatinine ratio (ACR) was calculated by using urine albumin and urine creatinine and were expressed in mg/g creatinine.

Results: The mean eGFR (MDRD) of the study subjects was found 106.8±20.72 mL/min/1.73 m^2 and a statistically significant difference was observed between male and female subjects ($p = 0.039$). The mean eGFR (CKD-EPI) of the study subjects was found 107.53±18.50 mL/min/1.73 m^2, however, no significant difference was observed between male and female subjects ($p = 0.745$). The micro/macro-albuminuria (urinary ACR ≥ 30 mg/g creatinine) was found in 18 (12%) patients and leucocyturia and hematuria was found in 12.7% and 5% patients respectively. The median CD4 counts of the study subjects was 341 (222-467) cells/ mm^3 and 141 (94%) were taking highly active anti-retroviral therapy (HAART). The most common HAART regimens were zidovudin/ lamivudine/nevirapine (ZLN) and tenofovir/ lamivudine/ nevirapine (TLN); 60.7% & 26.0% respectively. Hepatitis B and C co-infection rate found among subjects was 4% and 3.3% respectively.

Conclusions: In conclusion, the prevalence of deranged renal functions as indicated by eGFR and urinary ACR is common in PLHA in North India. All HIV infected patients must undergo renal function tests including urinary ACR to detect the renal involvement at early stage.

Keywords: Human immunodeficiency virus; acquired immune deficiency virus; albumin/creatinine ratio.

ABBREVIATIONS

HIV : Human immunodeficiency virus.
AIDS : Acquired immune deficiency virus.
HAART : Highly active antiretroviral therapy.
PLHA : People living with HIV/AIDS.
ACR : Albumin/creatinine ratio.

1. INTRODUCTION

Human immunodeficiency virus (HIV) infection/ acquired immune deficiency syndrome (AIDS) is a global health problem affecting almost all countries worldwide [1]. HIV/AIDS is prevalent in both developed and developing countries including India. Infact, India is the third largest country having approximately 2.39 million peoples, affected by HIV/AIDS. It is one of the important causes for both morbidity and mortality in our country causing huge financial loss every year [2].

Initially, it was reported that the main causes for morbidity and mortality among HIV/AIDS patients were opportunistic infections (OI) and neoplasms. However, with the advent of highly active antiretroviral therapy (HAART) and consequent increase in survival rates among these patients, chronic conditions like; diabetes, hypertension, cardiovascular disease (CVD) and chronic kidney disease (CKD) etc. are increasing and becoming more prevalent causes for both morbidity and mortality [3].

HIV/AIDS is a multi-systemic disorder affecting almost all organ systems in the human body. Kidney is one of the most commonly affected organ by HIV [4]. Renal involvement may be due to HIV infection or due to associated co-morbidities such as opportunistic infections, septicemia, neoplasms, hypovolemia and variety of drugs to which these patients are exposed. Renal abnormalities in people living with HIV/AIDS (PLHA) can manifest in many ways. These include electrolyte abnormalities, proteinuria (nephrotic and sub-nephrotic range), leucocyturia and acute kidney injury etc [5,6].

The HIV associated nephropathy (HIVAN) represents a distinctive form of renal involvement associated with HIV infection. It is a chronic complication of HIV infection and is characterized by frank proteinuria, hyperechoic and enlarged kidneys on ultrasonography [7]. The renal complications of HIV infection are a great challenge for clinician. Early assessment of renal status using micro-albuminuria could help to detect early renal complications of HIV.

There are many western studies reporting HIV infection and its relation to kidney diseases

especially HIVAN, however, very few studies have been published in India despite a large burden of disease due to HIV/AIDS. Hence the present study was carried out to know the various renal abnormalities and extent of renal problem in people living with HIV/AIDS in North India.

2. MATERIALS AND METHODS

This observational study was undertaken in the Anti-Retroviral Treatment (ART) Clinic, Department of Medicine, Department of Pathology and Department of Biochemistry at University College of Medical Sciences and Guru TegBahadur Hospital, Delhi, India. Total (n = 150) consecutive HIV positive patients, ≥ 18 years of age, who were attending the ART Clinic or were admitted in the medicine wards between November 2012 - April 2014 were recruited for the study. The subjects having diabetes mellitus, hypertension, pregnancy and any previous kidney disease were excluded from the study. A detailed medical, socio-economic and treatment history was taken and physical examination was done. Various factors which may affect the development of renal function abnormalities like; duration of the disease, drugs (HAART and others), opportunistic infections, CD4 count and co-infections like hepatitis B and C viruses were taken into consideration. Ethical approval was obtained by Institutional Ethics Committee for Human Research (IEC-HR), UCMS and patients gave written informed consent.

2.1 Biochemical Investigations

5 mL fasting peripheral venous blood was collected from subjects for various biochemical investigations. Routine biochemical tests included blood urea, serum creatinine, sodium, potassium, calcium and uric acid were carried out in the hospital laboratory. Estimated glomerular filtration rate (eGFR) was calculated by using Modification of Diet in Renal Disease (MDRD) [8] and Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [9]. Morning spot urine samples were collected for urine albumin and urine creatinine test. Serum creatinine and urine creatinine were measured by alkaline picrate jaffee´s kinetic method [10]. Urine micro-albumin was estimated by nephelometer (nephstar®, Goldsite Diagnostics). Albumin/creatinine ratio (ACR) was calculated by using urine micro-albumin and urine creatinine and were expressed in mg/g creatinine.

2.2 Statistical Analysis

The statistical analysis was performed by using the SPSS version 20.0. Data were expressed as mean ± SD, median, IQR or percentage (%) as applicable. Urine albumin, urine creatinine and urinary albumin/creatinine ratio were expressed in median, IQR and analysed by Mann-Whitney test. Comparison of various variables between male and female subjects were done by using Student's unpaired t- test. $p<0.05$ was considered as significant.

3. RESULTS

3.1 Demographic and Biochemical Characteristics of Study Subjects

The demographic and biochemical characteristics of among HIV infected patients are listed in Table 1. A total of (n = 150) patients were recruited in the study, out of which 103 were males and 47 were females. The age range of the study population was 18 to 60 years, with mean age of 37.63±9.61. The mean age for HIV infected male participants was 38.86±9.53 and 34.91±8.29 for HIV infected female participants. These ages were stratified into 3 groups with 102 (68%) participants between 18 to 40 years, 33 (22%) aged between 40 to 50 years and 15 (10%) > 50 years. However, the difference in age was found statistically significant (p = 0.019) between male and female. The mean BMI (kg/m^2) of among male and female participants were 21.63±8.22 and 22.51±11.72 respectively and no significant difference was found between the BMI of male and female subjects. The mean haemoglobin (gram%) of among male and female patients were 12.67±2.22 and 10.60±1.67 g/dL respectively and it was found statistically significant. However, no statistically significant difference was found for total leucocyte count (TLC), erythrocyte sedimentation rate (ESR), total protein, serum albumin, serum sodium and potassium levels between male and female patients.

3.2 Renal Function Investigations in Study Subjects

Renal function tests in HIV infected patients are shown in Table 2. There was no statistically significant difference between blood urea and serum creatinine of male and female patients. Of the among patients 3 (2%) had eGFR (MDRD) < 60 mL/minute, while 26 (17%) had eGFR

(MDRD) values between 60 to 90 mL/minute. 121 (81%) of the HIV infected participants had eGFR (MDRD) values above 90 mL/minute. A statistically significant difference was found between the eGFR (MDRD) of male and female patients, and females having lower eGFR than males. 2 (1%) had eGFR (CKD EPI) < 60 mL/minute, while 28 (19%) had eGFR (CKD EPI) values between 60 to 90 mL/minute. 120 (80%) of the HIV infected participants had eGFR (CKD EPI) values above 90 mL/minute. However, there was no statistically significant difference between mean eGFR (CKD EPI) of male and female participants. 132 patients (88%) had UACR values below 30 mg/g creatinine, while 16 (11%) had micro-albuminuria and UACR values > 30 to 300 mg/g creatinine. Of the 2 (1%) patients who had macro-albuminuria, UACR values greater than or equal to 300 mg/g creatinine. Also no statistically significant difference was found between urinary ACR of male and female participants. In the present study, leukocyturia and hematuria were found in 12.7% and 5% of study subjects. Analysis showed more number of male subjects having, leukocyturia and hematuria compared to female subjects.

3.3 Clinical Features of Study Subjects

Various clinical parameters of HIV infected patients are represented in Table 3. There was statistically significant difference between male and female participants for smoking habits and alcohol use habits. The median CD4 counts of the HIV positive participants in the study population was 341(222.00–467.00). CD4 counts grouped as < 200 (n = 29, 19%), 200 to 400 (n = 70, 47%), >400 (n = 51, 34%).

3.4 Treatment Regimens in Study Subjects

The number of various treatment regimens that were being followed by the patients at the time of recruitment are listed Table 4. The number of patients taking HAART were 141 (94%). Most of patients were using ZLN and TLN regimen.

3.5 Biochemical Parameters and Clinical Status of HIV Infected Patients with and Without Albuminuria

Various parameters among HIV infected patients with and without albuminuria are shown in Table 5. The mean of age in patients with and without albuminuria was 40.17±13.03 and 37.28±9.06 years respectively. However, difference was not statistically significant (p = 0.347). The male to female ratio among the patients with and without albuminuria was 2.6 and 2.1 respectively. BMI was higher in patients with micro/macro-albuminuria as compared to patients without albuminuria (22.33±4.13 versus 21.31±3.55 kg/m^2) but it was not statistically significant (p = 0.266). The mean blood urea in patients with and without albuminuria was 25.33±7.44 mg/dL and 23.94±9.88 mg/dL respectively. The meanserum creatinine of the patients with or without

Table 1. Demographic and biochemical characteristics at baseline in among HIV infected patients

Parameters	Total (n = 150)	Male (n = 103)	Female (n = 47)	Significance (unpaired t- test)
Age (years)	37.63±9.61	38.86±9.53	34.91±8.29	**0.019**
18 – 40	102 (68%)	64 (62%)	38 (81%)	
40 – 50	33 (22%)	25 (24%)	8 (17%)	
>50	15 (10%)	14 (14%)	1 (2%)	
BMI (kg/m^2)	21.87±7.09	21.63±8.22	21.02±4.16	0.481
Haemoglobin (gram %)	12.02±2.27	12.67±2.22	10.60±1.67	**0.000**
TLC ($cells/mm^3$)	6,064±2,052	6,003±2,039	6,198±2,096	0.591
ESR (mm in 1^{st} hour)	22.24±13.83	21.33±14.10	24.23±13.14	0.234
Total protein (g/dL)	7.8±1.01	7.74±1.05	7.94±0.93	0.263
Serum albumin (g/dL)	4.07±0.94	4.07±0.81	4.07±0.78	0.987
Serum sodium (mEq/L)	140.95±5.95	140.99±5.97	140.87±5.97	0.911
Serum potassium (mEq/L)	4.23±0.56	4.26±0.59	4.17±0.47	0.359

Data expressed in mean ± SD and number (%), value significant at p < 0.05 and highly significant at p < 0.001

albuminuria was 0.88±0.14 mg/dL and 0.81±0.14 mg/dL respectively. The mean eGFR (CKD-EPI) for the patients with and without albuminuria were 99.95±19.21 and 108.56±20.53 mL/min/1.73 m^2 respectively. However, the differences were not statistically significant for blood urea, serum creatinine and eGFR (CKD-EPI). The mean eGFR (MDRD) for the patients with and without albuminuria were 96.60±19.80 and 108.19±20.53 mL/min/1.73 m^2 respectively and the difference was found statistically significant.

Table 2. Renal function tests in among HIV infected patients

Parameters	Total (n = 150)	Male (n = 107)	Female (n = 43)	Significance p value
Blood urea (mg/dL)	24.11±9.6	24.88±10.33	22.40±7.57	0.143
Serum creatinine (mg/dL)	0.82±0.14	0.86±0.13	0.74±0.15	0.453
eGFR (MDRD) (mL/min/1.73 m^2)	106.8±20.72	109.16±20.29	101.63±20.93	**0.039***
<60	3 (2%)	3 (3%)	0 (0%)	
60 – 90	26 (17%)	17 (16%)	9 (21%)	
>90	121 (81%)	87 (81%)	34 (79%)	
eGFR (CKD EPI) (mL/min/1.73 m^2)	107.53±18.50	107.86±18.27	106.79±18.99	0.745
<60	2 (1%)	2 (2%)	0 (0%)	
60–90	28 (19%)	19 (18%)	9 (21%)	
>90	120 (80%)	86 (80%)	34 (79%)	
Urinary albumin (mg/L)	5.75 (4.96-15.94)	5.71 (4.96-16.37)	5.84 (4.96-13.80	0.875
Urinary creatinine (gm/L)	1.13 (0.612-1.74)	1.12 (0.61-1.74)	1.13 (0.64-1.72)	0.832
Urinary ACR (mg/g creatinine)	8.14 (4.77-14.62)	8.26 (5.03-17.76)	7.75 (4.66-14.23)	0.290
<30	132 (88%)	90 (87%)	42 (89%)	
30–300	16 (11%)	11 (11%)	5 (11%)	
>300	2 (1%)	2(2%)	0 (0%)	
Leukocyturia (%)	19 (12.7%)	15 (14%)	4 (9.3%)	
Hematuria (%)	8 (5%)	6 (5.6%)	2 (4.6%)	

*Data were expressed as mean ± SD, number (%), median and (IQR). *p value significant at <0.05*

Table 3. Clinical status of HIV infected patients

	Total	Male	Female	Significance
*Duration of HIV infection (months)	26.00 (12.00-45.00)	27 (13-49)	26 (6-39)	0.555+
*Duration of HAART therapy (months)	21.50 (4.75-35.25)	22 (6-36)	19 (3 - 29)	0.117+
**Smokers	55 (36.67%)	54 (52.4%)	1 (2.1%)	0.000++
**Alcohol users	37 (24.67%)	36 (35.00%)	1 (2.10%)	0.000++
**Co-infection with Hep. B	6 (4%)	4 (3.88%)	2 (4.26%)	1.00++
**Co-infection with Hep. C	5 (3.33%)	4 (2.67%)	1 (0.67%)	1.00++
*CD4 counts (cells/mm^3)	341.00 (222.0-467.00)	438 (321.0-580.6)	532 (350.0-625.8)	0.150+
<200	29 (19%)	23 (22%)	6 (13%)	
200 – 400	70 (47%)	45 (44%)	25 (53%)	
>400	51 (34%)	35 (34%)	16 (36%)	

**Median (IQR), **Number (%),+ Mann-Whitney Test,++ Fisher's Exact Test*

Table 4. Treatment regimen being followed by the patients at the time of enrolment

	Total n (%)	Male n (%)	Female n (%)
ZLN (zidovudine, lamivudine and nevirapine)	91 (60.7)	66 (64.1)	25 (53.2)
TLN (tenofovir, lamivudine and nevirapine)	39 (26.0)	22 (21.4)	17 (36.2)
SLN (stavudine, lamivudine and nevirapine)	5 (3.3)	4 (3.9)	1 (2.1)
ZLE (zidovudine, lamivudine and efavirenz)	3 (2.0)	3 (2.9)	0 (0.0)
TLE (tenofovir, lamivudine and efavirenz)	3 (2.0)	2 (1.9)	1 (2.1)
Not on HAART therapy	9 (6.0)	6 (5.8)	3 (6.4)

Data was expressed in number and percentage (%)

Table 5. Biochemical and clinical status of HIV infected patients based on with and without albuminuria

	Patients without albuminuria (n = 132)	Patients with micro/ macro-albuminuria (n = 18)	p value and significance
*Age (years)	37.28±9.06	40.17±13.03	0.347^{+}
Male: Female ratio	90/42	13/5	
BMI (Kg/m^2)	21.31±3.55	22.33±4.13	0.266^{+}
*Blood urea (mg/dL)	23.94±9.88	25.33±7.41	0.565^{+}
*Serum creatinine (mg/dL)	0.81±0.14	0.88±0.14	0.056^{+}
*eGFR CKD EPI (mL/min/1.73m^2)	108.56 ±20.53	99.95±19.21	0.063^{+}
*eGFR MDRD (mL/min/1.73m^2)	108.19±20.53	96.60±19.80	0.026^{+}
***Smokers (n)	47	8	0.465^{+++}
**Duration of HIV infection (months)	26.00 (9.00-47.00)	29.50 (13.00-41.25)	0.759^{++}
**Duration of HAART therapy (months)	21.00 (4.00-35.00)	22.50 (10.50-39.00)	0.688^{++}
***Hepatitis B co-infection (n)	5	1	0.542^{+++}
***Hepatitis C co-infection(n)	5	0	1.00^{+++}
**CD4 count (cells/mm^3)	332.50 (217.75-466.50)	347.50 (270.5-478.25)	0.548^{++}

**Mean ± SD, ** Median (IQR), ***Number, $^{+}$Unpaired t-test, $^{++}$Mann-Whitney Test, $^{+++}$Fisher's Exact Test*

The number of smokers among patients with and without albuminuria was 8 and 47 respectively. The median duration of HIV infection in patients with and without albuminuria was 29.50 months (13.00-41.26) and 26.00 months (9.00-47.00) respectively. The median duration of HARRT therapy in patients with and without albuminuria was 22.50 months (10.50-39.00) and 21.00 months (4.00-35.00) respectively. The median CD4 count of the patients with and without albuminuria was 347.50 cells/mm^3 (27.50-478.25) and 332.50 cells/mm^3 (270.75-466.50) respectively. There was no statistically significant difference for these parameters.

4. DISCUSSION

Human immunodeficiency virus infection and acquired immune deficiency syndrome is a global pandemic affecting all the nations. It is highly prevalent in India. In pre-HAART era, the main renal causes for mortality and morbidity were opportunistic infections, sepsis, hypovolemia, acute kidney injury or neoplasms, however, after the initiation of HAART, chronic conditions like CKD have become more prevalent due to increase in longetivity of these patients. Though renal involvement in these patients has been extensively documented in Western literature, there is a paucity of literature in Indian set up. Therefore, this study was carried out to know about the various renal manifestations in people living with HIV/AIDS in India.

In the present study total 150 patients were recruited. Most of patients were from ART clinic. The mean age of among study subjects was 37.63±9.61 years suggesting high prevalence of HIV infection was found in young population. Gupta et al. [11] in their study on HIV associated

renal disease had found the mean age of the study subjects to be 33.9±7.9 years, which is similar to our result. Most of study subjects had normal BMI (21.87±7.09 kg/m^2). Most of patients were having short duration of HIV infection and almost all of them were on HAART (94%). The CD4 count is an indirect reflection of viral load and activity. The median CD4 count of the study population was 341 (222-467) cells/mm^3. The most common HAART regimens being followed by patients were zidovudin/ lamivudine/ nevirapine (ZLN) and tenofovir/ lamivudine/ nevirapine (TLN), 60.7% and 26.0% respectively. Hepatitis B and C co-infection rate was also low 4% and 3.3% respectively in the study subjects. This results are similar to the study by Gupta et al, where the rate of hepatitis B and C co-infection was found to be 5.54% and 2.43% respectively [12].

In the present study, the kidney function tests showed normal levels of blood urea and serum creatinine; 24.11±9.6 mg/dL and 0.82±0.14 mg/dL, respectively. The mean eGFR calculated by MDRD and CKD EPI equation were found 106.8±20.72 and 107.53±18.50 mL/min/1.73m^2, respectively. Out of 150 patients, 26 (17%) had eGFR (MDRD) ≤ 90 mL/min/1.73m^2, 3 (2%) patients had eGFR (MDRD) < 60 mL/min/1.173 m^2. However, this is far less as compared to the prevalence rate found in study from Tanzania by Msango et al. [13]. This difference could be due to the study being conducted in HAART naive African population whereas in our study most of patients were taking HAART. However, in another study of Cailhol et al. [14] 15.5% patients shown eGFR (MDRD) between 60 to 90 mL/min/1.73 m^2 and 30 to 59 mL/min/1.73 m^2 was found in 2% patients. Even though mean eGFR of the patients was in normal range, but there were significant differences in eGFR (MDRD) between male and female study subjects. Female subjects had a lower eGFR as compared to the male subjects. These results are similar to study in Tanzania by Msango et al [13]. FolefackKaze et al. [15] have shown in their study that HIV positive patients who were not on HAART had mean serum creatinine value of 9.3±2.5 mg/dL and mean eGFR of 107.3±35.6 mL/min/1.73m^2 (MDRD) and no significant difference was found in eGFR between male and female patients. The urinalysis revealed the presence of proteinuria in 12% of patients by dipstick method. Malhotra et al. [16] have reported 43 (9.1%) out of 472 patients were positive for protein by dipstick in their study. Janakiraman et al. [17] have shown proteinuria in 29 (27%) out of 104 HIV patients. In the present study, leukocyturia and hematuria were found in 12.7% and 5% of study subjects. However, in study of Burundi et al, involving 300 HIV positive patients it was found 18.4% of patients had leucocyturia and 6.1% had proteinuria [14]. The leucocyturia is taken as a marker of interstitial nephritis which can be due to NSAIDs use or co-infections such as tuberculosis. FolefackKaze et al. [15] reported 43 out of 104 patients (41%) had urinary abnormalities including proteinuria (36%), leukocyturia (13%) and hematuria (12%).

In the present study urinary ACR was used to quantify the proteinuria. The median ACR was 8.14 (4.77-14.62) mg/g creatinine. Micro-/macro-albuminuria was found in 18 (12%) out of 150 patients. Our results are in accordance to study of Malhotra et al. [16] where, 12.3% patients were found to have micro-albuminuria. A study of Varma et al. [18] showed proteinuria in 17.6% of HIV positive subjects; however, they used 24 hour urinary protein estimation for quantifying proteinuria and all the subjects were males. A study of Gupta et al. [11] have found proteinuria in 13.8% of HIV infected cases. The mean age of patients with micro/macro-albuminuria was 40.17±13.03 years which was higher as compared to that of patients without albuminuria (37.28±9.06 years), however, this difference could not reach statistical significance (p = 0.347). A prospective study on 429 HIV positive patients from Japan by Ando et al. [19] showed that HIV infected patients with micro-albuminuria have higher age (50.7±10.3 years) as compared to patients without micro-albuminuria (45.8±10.9 years) and the difference was statistically significant (p = 0.0058). Our results are similar to this study but statistical significance could not be reached due to small study sample size. In the present study, BMI was higher in patients with micro/macro-albuminuria as compared to patients without albuminuria (22.33±4.13 versus 21.31±3.55 kg/m^2) but it was not statistically significant (p = 0.266). This is in accordance with the result of Ando et al. [19]. However, Msango et al. [13] shown micro-albuminuria was more common in patients with BMI > 18.5 kg/m^2 (73.3% versus 67.1%, p = 0.30). Serum creatinine was higher among patients with micro/macro-albuminuria (0.88±0.14 versus 0.81±0.14 mg/dL) but did not reach statistical significance (p = 0.056). Szczech et al. [20] in their study found that there was no difference in serum creatinine levels among patients with or without micro-albuminuria (0.9±0.2 versus 0.9±0.2 mg/dL, p = 0.80). eGFR (MDRD) was

significantly lower among patients with micro/macro-albuminuria (96.60±19.80 versus 108.19±20.53 mL/min/1.73 m^2, p = 0.026) even though it was in the normal range. In patients with micro/macro-albuminuria the percentage of patients with eGFR ≤ 90 mL/min/1.73 m^2 was 33.33% (6 out of 18) and in patients without albuminuria the percentage of patients with eGFR < 90 mL/min/1.73 m^2 was 17.42% (23 out of 132). The percentage of patients with eGFR ≤ 90 mL/min/1.73 m^2 was higher among the patients with micro/macro-albuminuria as compared to the patients without albuminuria; however, it did not reach a statistical significance (p = 0.119). These results are similar to the result of a study from USA by Baekken et al. [21]. Median CD4 counts in patients with micro/macro-albuminuria was higher than that of patients without albuminuria (347.50 versus 332.50 cells/mm^3) but it did not reach the statistical significance (p = 0.55). This is in contrast to the results of previous studies. Ando et al. [19] have shown $\log_{10}$ CD4 cell count (cells/µL) to be lower in HIV infected patients with micro-albuminuria (2.55±0.287 versus 2.60±0.215) but it did not achieve the statistical significance (p = 0.41). Szczech et al. [20] have found that CD4 count was lower in the patients with micro-albuminuria (159±157 cells/mL) as compared to those without micro-albuminuria (207±195 cells/mL) (p = 0.04).

The difference in our result could be due to large sample size, racial differences, higher age and BMI, higher prevalence of smoking and hepatitis C co-infection, inclusion of diabetic and hypertensive patients and detection of proteinuria by different methods in various studies.

5. LIMITATION OF STUDY

As the study had a cross-sectional design, cause and effect relationship between HIV infection and renal dysfunction could not be carried out. The number of subjects in the study was small.

6. CONCLUSION

In conclusion, the prevalence of deranged renal functions as indicated by eGFR, serum creatinine, urinary ACR and urinary abnormalities like hematuria and leucocyturia are common in PLHA in North India. All HIV infected patients must undergo renal function tests including urinary ACR to detect renal involvement in early stage. Further studies involving large number of patients are needed to know the extent and pattern of renal involvement in PLHA.

CONSENT

All authors declare that written informed consent was obtained from the patient.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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