Evaluation of renal function in leprosy: a study of 59 consecutive patients

Rodrigo A. Oliveira¹, Geraldo B. Silva Jr², Clodoaldo J. Souza¹, Eduardo F. Vieira¹, Rosa M. S. Mota³, Alice Maria Costa Martins⁴, Alexandre Braga Libório²,⁵ and Elizabeth F. Daher²

¹Department of Internal Medicine, School of Medicine, Federal University of Ceará, Barbalha, CE, ²Department of Internal Medicine, School of Medicine, Federal University of Ceará, Fortaleza, CE, ³Department of Statistics, Federal University of Ceará, Fortaleza, CE, ⁴Department of Pharmacy and Clinical Analysis, Federal University of Ceará, Fortaleza, CE and ⁵Department of Nephrology, University of São Paulo, Brazil

Abstract

Background. Renal abnormalities in leprosy have been largely described in medical literature, but there are few studies evaluating renal function in these patients.

Methods. This is a cross-sectional study in 59 consecutive paucibacillary (PB) and multibacillary (MB) leprosy patients. Glomerular filtration rate (GFR) was estimated by simplified-MDRD formula. Microalbuminuria was determined by 24 h urine collection. Urinary acidification capacity was measured after water deprivation and acid-loading with CaCl₂. Urinary concentration capacity was evaluated after desmopressin acetate administration, using the urinary to plasma osmolality (U/P osm) ratio. All parameters except microalbuminuria were measured in a control group of 18 healthy volunteers.

Results. Age and gender were similar between leprosy (MB or PB) and control groups. GFR ≤80 ml/min/1.73 m² was observed in 50% of the leprosy patients. GFR and U/P osm in leprosy patients were significantly lower than in controls (P < 0.001). Urinary acidification defect was found in 32% of PB and in 29% of MB patients and urinary concentrating ability was abnormal in 83% of PB and 85% of MB patients. Microalbuminuria was found in 4 patients (8.5%), leukocyturia was found in 13 (22%) and haematuria was present in 16 patients (27%). Plasma creatinine (P_c) >1.2 mg/dl was observed in 17.9% of MB patients and in none of the controls (P = 0.020). A negative correlation was observed between GFR and time of treatment (r = -0.339; P = 0.002). Age and time of treatment were independent risk factors for GFR ≤80 ml/min/1.73 m² in multivariate analysis.

Conclusions. Asymptomatic GFR changes and renal tubular dysfunction, including urine concentration defect and impaired acidifying mechanisms, can be caused by leprosy on specific treatment and without any reaction episodes.

Keywords: leprosy; renal function; renal tubular acidosis; tubular dysfunction; urinary osmolarity.

Introduction

Leprosy remains an important public health problem in Brazil, which ranks second in the world with the largest number of cases [1,2]. Renal abnormalities in leprosy have been largely described in medical literature [3–9]. Mitsuda and Ogawa [10] were the first to report renal lesions related to this disease, through autopsy findings. Kean and Childress [11] also described glomerulopathies, tubulopathies and nephrosclerosis in autopsied leprosy patients. Renal injury seems to be common in patients with erythema nodosum leprosum (ENL) [6]. In a review of 199 autopsies in Brazilian leprosy patients, renal lesions were present in 144 (72%) of those, who presented amyloidosis, glomerulonephritis, nephrosclerosis, tubulointerstitial nephritis, granulomas and other lesions [6].

Glomerular injuries have been described through histological findings. Proliferative mesangial glomerulonephritis is the most often described glomerular disease in leprosy [6,12]; however, many other histological features have been described [3–5,8,9,11–14]. The prevalence of glomerulonephritis has been reported as ranging from 6 to 50% in leprosy patients [15]. Amyloidosis, with an incidence ranging from 2 to 55% [15], is attributed to chronic granulomatous reactions caused by Mycobacterium leprae [14] and is manifested mainly by elevated proteinuria [16]. It may progress to chronic renal failure, which is one of the causes of death in leprosy [17].
The exact pathogenesis of renal lesions in leprosy is still uncertain [14]. *Mycobacterium leprae* does not seem to be directly involved in renal lesions [10], although it has been detected in the renal parenchyma of some patients, including the glomeruli [6,12]. The glomerular lesion is probably mediated by immunocomplexes, which develop during reaction episodes mainly in the erythema nodosum leprosum [14]. This mechanism is supported by clinical and laboratory findings, such as the visualization of immunocomplexes in histological material and decrease of serum complement in some cases [5,6,18–22]. Few studies have evaluated urinary acidification and concentration in patients with leprosy [23].

The objective of the present study was to identify the renal function pattern in Brazilian leprosy patients on specific treatment using glomerular filtration rate (GFR) and tubular function tests. This study includes patients with multibacillary and paucibacillary leprosy, with variable disease and treatment time. All patients presenting an episode of erythema nodosum leprosum were excluded.

**Subjects and methods**

**Patients**

This is a cross-sectional study of 71 consecutive patients with clinical and laboratory diagnosis of leprosy, undergoing infectious disease consultation in public health centres in the Northeast of Brazil, from January to December 2004. Exclusion criteria were erythema nodosum leprosum reaction episode, arterial hypertension (systolic blood pressure \(\geq 140 \text{mmHg}\) and/or diastolic blood pressure \(\geq 90 \text{mmHg}\), diabetes mellitus, recurrent urinary tract infection or history of previous renal disease. All patients were undergoing specific leprosy treatment (dapsone, rifampicin and clofazimine). The multibacillary (MB) and paucibacillary (PB) groups were compared to a control group that consisted of 18 healthy volunteers.

The study protocol was reviewed and approved by Committees of Ethics from Hospital Universitário Walter Cantídio, Federal University of Ceará, in Fortaleza, Brazil. Patients were included in the study only after signing the informed consent form.

**Leprosy diagnosis**

Leprosy diagnosis was suspected from epidemiologic and clinical data and confirmed by skin smear microcopy and histology of skin lesions. The World Health Organization (WHO) classification system is based on the number of skin lesions present and whether and how many bacilli are detected on skin smear. PB leprosy is defined as five or fewer skin lesions without detectable bacilli on skin smears. Patients with a single skin lesion are classified separately, as single-lesion PB. MB leprosy is defined as six or more lesions present and whether and how many bacilli are detected on skin smear. PB leprosy is defined as five or fewer skin lesions without detectable bacilli on skin smears.

**Clinical and laboratorial parameters**

At the medical consultation, signs and symptoms were evaluated and the following aspects were recorded: age, gender, previous chronic diseases (heart failure, arterial hypertension or diabetes mellitus), time of disease, time of treatment, use of other concomitant drugs, number of skin lesions, skin smear microcopy, systolic and diastolic blood pressure, leprosy classification (multibacillary or paucibacillary). The following laboratory parameters were evaluated: plasma creatinine \((C_{\text{cr}})\), urea \((U_{\text{rea}})\), arterial \(pH\), bicarbonate \((Bic)\), sodium \((P_{\text{Na+}})\), potassium \((P_{\text{K+}})\), C-reactive protein (CRP), serum albumin and globulin, complement (laboratory C3 and C4), erythrocyte sedimentation rate (ESR), 24 h urinary creatinine, sodium, potassium, proteinuria \((U_{\text{prot}})\), urinalysis and microalbuminuria.

**Renal function evaluation**

GFR was estimated by simplified-MDRD formula with four variables [24] and was considered abnormal when \(\leq 80 \text{ml/min/1.73 m}^2\). All patients were submitted to a 12 h water and food deprivation. Fractional excretion of sodium \((\text{FE}_{\text{Na+}})\) and potassium \((\text{FE}_{\text{K+}})\) were calculated by standard formulae. Microalbuminuria was determined by 24 h urine collection and abnormal values were \(>30 \text{mg/day}\).

Urinary concentrating ability was evaluated by the ratio between urinary and plasma osmolality \((U/P_{\text{osm}})\) after a 12 h water and food deprivation. A baseline sample \((T_0)\) was collected before the administration of an intranasal spray of DDAVP [25] (desmopressin acetate, 20 mcg) and a second sample was collected 4 h \((T_4)\) later.

Urinary acidification was evaluated by measuring urinary \(pH\) \((U_{\text{ph}})\) at baseline \((T_0)\) and 4 h \((T_4)\) after ingestion of \(\text{CaCl}_2, 2 \text{mEq/kg of body weight}\) [26]. Metabolic acidosis induced by \(\text{CaCl}_2\) load was documented by a decrease in serum \(\text{HCO}_3^-\) concentrations \(>3 \text{mmol/l}\) and a \(pH < 7.35\). Failure to decrease urinary \(pH\) to \(< 5.5\) after \(\text{CaCl}_2\) load was considered consistent with some form of distal renal tubular acidosis (RTA). All tubular function tests were also performed in the control group.

**Analytical methods**

Plasma creatinine was measured by Bonsness and Taussky method. Sodium and potassium were measured by flame photometry. Urinalysis was determined by qualitative proteinuria, glycosuria and ketonuria, using reagent strips (Labtest, Lab. Ames, Miles do Brasil). Urinary sediment was analysed by phase microscopy. Proteinuria was measured in 24 h urine samples by the turbidimetric method after precipitation with \(1\%\) sulfosalicylic acid (upper normal value 0.15 g/day). Microalbuminuria was measured by immunoturbidimetric methods (Tinaquant®, Roche). Osmolality was assessed by freezing-point depression. Blood \(pH\) and bicarbonate were determined in a \(pH\) blood gas system (AVL compact-1, Medical Instruments). Urinary \(pH\) was measured with a \(pH\)-meter (Quims, LTDA). Complement was measured by haemolytic assay (CH50) and nephelometry (C3 and C4). Serum CRP was measured by nephelometry (Dade Behring Inc., Newark, DE, USA). Total serum albumin and globulin were measured by protein electrophoresis.
Statistical methods

Leprosy patients were analysed as a general group and were later allocated into two groups according to the leprosy classification, multibacillary (MB) or paucibacillary (PB) and compared with the control group. Fisher’s exact test and chi-square test were used to analyse allele frequencies in the patients’ groups. Differences between two independent variables were evaluated using student’s t-test or Mann–Whitney test as appropriate. Comparison between the three groups were performed using one-way ANOVA followed by Bonferroni post-test or Kruskal–Wallis test with multiple comparison adjustments for non-parametric analysis. Pearson or Spearman’s correlation coefficients, when appropriate, were used to test the relationship between continuous variables.

Risk factors for GFR decrease were determined by multivariate analysis with logistic regression. The initial model included significant variables at the univariate analysis and clinically significant variables. Data were expressed as mean ± SD. P < 0.05 was considered statistically significant. The Epi info 2002 (Centers for Disease Control and Prevention, Atlanta, USA) and SPSS software for Windows, release 10.0 (SPSS Inc. Chicago, USA) were used in all the analyses.

Results

Of the 71 patients followed in the outpatient clinics with a diagnosis of multibacillary or paucibacillary leprosy from January to December 2004, 10 were excluded due to previous arterial hypertension and 2 due to diabetes mellitus type 2. Fifty-nine patients who agreed to participate in the study were included. The mean age of the patients was 43 ± 15 years (range 17–58), 51% of them were males. Leprosy classification was paucibacillary in 31 (52%) and multibacillary in 28 (48%) of them. Mean time of treatment was 15 ± 17 (1–98) weeks and mean time of disease was 22 ± 30 (1–132) months. The control group consisted of 18 normal individuals, 13 (72%) being males and the mean age was 35 ± 8 (18–48) years.

The inflammatory activity tests were abnormal in only two (3%) leprosy patients presenting high levels of C-reactive protein. All patients had protein electrophoresis (mean albumin 4.7 ± 0.38 g/dl, reference range 3.4–5.4 g/dl; globulin 2.45 ± 0.6 g/dl, reference range 2.0–3.5 g/dl), serum complement (mean CH50 162 ± 45 U/ml, reference range 142–279 U/ml; mean C3 level 116 ± 22 mg/dl, reference range 83–173 mg/dl; mean C4 level 21.8 ± 5.7, reference range 14–40 mg/dl) and erythrocyte sedimentation rate (mean ESR 12 ± 10 mm/h, reference range <20 mm/h) within normal values. Other demographic and clinical characteristics are shown in Table 1.

Leprosy patients with no erythema nodosum leprosum have lower GFR and altered tubular function in comparison with the controls

The comparison between the leprosy patients and the control group showed no differences in age, gender, systolic and diastolic blood pressure. As seen in Tables 1 and 2, leprosy patients presented lower GFR (86 ± 25 vs 112 ± 18 ml/min/1.73 m², P = 0.0007). When analysing leprosy patients according to their bacillary classification, MB patients had the lowest GFR in comparison with the controls and PB patients, but although a reduced GFR was observed between controls and PB patients (107 vs 92.9 ml/min) no significant difference was observed. Urinary concentration capacity defect, as demonstrated by a lower U_Osm after desmopressin administration (667 ± 169 vs 938 ± 103 mOsm/kg, P = 0.0002) and a lower U/P_Osm ratio (2.38 ± 0.48 vs 3.39 ± 0.33, P = 0.0002) was observed when comparing leprosy patients and controls, but no difference was observed

Table 1. Demographic and clinical characteristics of the study population

<table>
<thead>
<tr>
<th></th>
<th>General population (n = 59)</th>
<th>Paucibacillary (n = 31)</th>
<th>Multibacillary (n = 28)</th>
<th>Controls (n = 18)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years (mean ± SD)</td>
<td>37 ± 11</td>
<td>35 ± 11</td>
<td>38 ± 11</td>
<td>32 ± 8</td>
<td>0.357</td>
</tr>
<tr>
<td>Male, %</td>
<td>52</td>
<td>40</td>
<td>68</td>
<td>72</td>
<td>0.017*</td>
</tr>
<tr>
<td>Systolic blood pressure, mmHg</td>
<td>117 ± 19</td>
<td>115 ± 15</td>
<td>118 ± 14</td>
<td>114 ± 12</td>
<td>0.720</td>
</tr>
<tr>
<td>Diastolic blood pressure, mmHg</td>
<td>77 ± 10</td>
<td>75 ± 10</td>
<td>78 ± 8</td>
<td>76 ± 8</td>
<td>0.232</td>
</tr>
<tr>
<td>Time of disease, months</td>
<td>21 ± 28</td>
<td>22 ± 25</td>
<td>23 ± 34</td>
<td>–</td>
<td>0.910</td>
</tr>
<tr>
<td>Time of treatment, weeks</td>
<td>14 ± 16</td>
<td>8 ± 7</td>
<td>23 ± 34</td>
<td>–</td>
<td>0.001**</td>
</tr>
<tr>
<td>Positive skin smear microscopy, %</td>
<td>42</td>
<td>0</td>
<td>91</td>
<td>–</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Skin lesion, %</td>
<td>0</td>
<td>14</td>
<td>22</td>
<td>–</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

Data are shown as mean ± SD or percentages. Student’s t-test, ANOVA with Tukey post-test and chi-square. *P = 0.017 paucibacillary vs control group and **P < 0.001 multibacillary vs paucibacillary, by Student t-test. The P-value refers to ANOVA, except when indicated.
Renal function in leprosy

Table 2. Comparison of renal function in paucibacillary and multibacillary patients and controls

<table>
<thead>
<tr>
<th></th>
<th>Leprosy patients</th>
<th>Paucibacillary</th>
<th>Multibacillary</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>((n = 59))</td>
<td>((n = 31))</td>
<td>((n = 28))</td>
<td>((n = 18))</td>
</tr>
<tr>
<td>GFR, ml/min/1.73 m²</td>
<td>86 ± 25⁺</td>
<td>92 ± 27</td>
<td>78 ± 19</td>
<td>107 ± 18</td>
</tr>
<tr>
<td>Pcr, mg/dl</td>
<td>0.93 ± 0.2</td>
<td>0.86 ± 0.16</td>
<td>1.03 ± 0.2</td>
<td>0.94 ± 0.14</td>
</tr>
<tr>
<td>FE(_{Na}) %</td>
<td>1.02 ± 0.80</td>
<td>1.04 ± 0.93</td>
<td>0.98 ± 0.51</td>
<td>1.1 ± 0.35</td>
</tr>
<tr>
<td>FE(_{K}) %</td>
<td>25 ± 14⁺</td>
<td>23 ± 12</td>
<td>28 ± 15</td>
<td>8 ± 3⁺</td>
</tr>
<tr>
<td>(U_{\text{osm}} T4) (mOsm/Kg.H₂O)⁺</td>
<td>667 ± 169⁺</td>
<td>663 ± 188</td>
<td>683 ± 155</td>
<td>938 ± 103⁺</td>
</tr>
<tr>
<td>(U/P_{\text{osm}} T4)</td>
<td>2.33 ± 0.48</td>
<td>2.32 ± 0.64</td>
<td>2.34 ± 0.48</td>
<td>3.39 ± 0.33⁺</td>
</tr>
<tr>
<td>(U/P_{\text{osm}} T4)</td>
<td>5.45 ± 0.51</td>
<td>5.51 ± 0.64</td>
<td>5.40 ± 0.31</td>
<td>5.25 ± 0.21</td>
</tr>
</tbody>
</table>

*⁺\(P<0.001\) vs controls by Student t test. \(P<0.001\) vs controls and <0.05 vs Paucibacillary. \(^⁺\(P<0.01\) vs Paucibacillary and multibacillary by ANOVA with Tukey post-test. Values are expressed as mean ± SD. \(^⁺\(n = 56, (n = 29\) for PB and \(n = 27\) for MB). GFR, glomerular filtration rate; Pcr, plasma creatinine; FE\(_{Na}\), fractional excretion of sodium; FE\(_{K}\), fractional excretion of potassium; \(U_{\text{osm}}\), urinary osmolality after DDAVP; \(U/P_{\text{osm}}\), urinary to plasma osmolality ratio; \(U/P_{\text{osm}}\), urinary pH after acidification test.

between PB and MB patients. GFR <80 ml/min/1.73 m² was observed in 30 (50%) patients and a lack to increase \(U_{\text{osm}}\) after DDAVP was observed in 47 (84%) patients (Figure 1).

Urinary pH did not decrease to 5.5 or less in response to acid-loading with CaCl₂ in 18/59 (30%) of patients. Of these patients with urinary acidification defect, five had hypokalemia and elevated FE\(_{K}\), characterizing a classic distal tubular acidosis.

Although no difference was observed in FE\(_{Na}\), a higher FE\(_{K}\) was observed in leprosy patients (Table 2), suggesting a tubular lesion causing a direct potassium handling defect, even in patients with normal urinary acidification, as discussed later.

Abnormalities in urinary sediment were present in 35% of the 59 patients (Table 3). Microalbuminuria >30 mg/day was observed in four patients (8.4%). Only two patients had proteinuria >150 mg/day. Nephrotic range proteinuria was not observed in any patient.

**GFR in leprosy patients is associated with age and time of treatment**

Table 4 shows the results of univariate and multivariate analyses. When clinical parameters and factors associated with leprosy and its treatment were considered as a function of GFR, age, positive skin smear microscopy, MB classification and time of treatment were significantly associated with a reduced GFR. At the multivariate regression analysis, only age and time of treatment were independent predictors of reduced GFR.

**Discussion**

The results of this cross-sectional analysis of renal function in leprosy clarify important aspects of glomerular and tubular dysfunction in multibacillary and paucibacillary patients. Several studies [5,14,27–30] have shown a low prevalence of the disease in men (1.5–2.1) with a mean age of 43 years, a fact not observed in our population.

The analysis of inflammatory tests showed no abnormality in the majority of our patients, suggesting that these patients had no episodes of erythema nodosum leprosum, which is classically associated with the deposition of immunocomplexes in the glomeruli, leading to proliferative glomerulonephritis and reduced GFR [20,29,31–33]. In our observational cohort of selected leprosy patients with no arterial hypertension, diabetes or previous reaction episodes, we observed a reduced GFR in comparison with the controls suggesting an independent mechanism for GFR decrease other than immunocomplex deposits. Moreover, this reduced GFR was independently associated with time of treatment, which was longer in MB patients, pointing to drug-induced nephrotoxicity or disease-associated time-dependent renal damage.

GFR decline (GFR <80 ml/min/1.73 m²) was observed in 50% of our patients, and serum creatinine >1.2 mg/dl was observed in 8.5% of the cases. Nigam et al. [7], studying 64 leprosy patients, detected GFR decrease in 62.9% of the patients with lepromatous leprosy (mean serum creatinine of 3.0 mg/dl) and in
significant proteinuria could be due to the absence of glomerular dysfunction, which is similar to that described by other studies [7,14,23,27,29,34–36].

Microalbuminuria is a known early predictor of glomerular lesion in patients with diabetes and cardiovascular diseases [37–42]. The first study to describe microalbuminuria in leprosy was performed in Brazil, by Kirsztajn et al. [14], who observed microalbuminuria higher than 20 mg/dl in 15.8% of their patients. In the present study, 8.5% of the patients presented microalbuminuria, with no difference between MB and PB patients. There was also no correlation between microalbuminuria and GFR. Microalbuminuria was not a predictor for GFR decrease and no association with low creatinine clearance was observed among our patients. Further studies are required to better establish the role of microalbuminuria as a marker for GFR dysfunction in leprosy.

Proteinuria has been frequently found in leprosy patients [21,43] and its frequency has shown to be extremely variable in different studies [7,13,44,45]. In our study only two patients presented proteinuria higher than 150 mg/day. None of our patients presented nephrotic range proteinuria. Kirsztajn et al. [14], analysing 96 patients, found proteinuria levels higher than 0.1 g/dl in 2.1% of cases, with none of them presenting nephrotic proteinuria. In a retrospective study, conducted by Silva Júnior and Daher, analysing 461 leprosy patients, proteinuria was found in 36 cases (7.8%). Nephrotic levels were observed in 3 of 138 lepromatous leprosy patients [28]. There have been many other studies showing proteinuria in leprosy [3,4,29,45,46]. In the present study, mild proteinuria was observed in six cases (11.9%). The absence of significant proteinuria could be due to the absence of reaction episodes, one of the criteria used for patients’ inclusion in our study. Haematuria was observed in 27% of our patients, with no difference between MB and PB patients, which is similar to that observed in other studies [7,14,27,28]. In other studies, haematuria has been more frequently associated to the lepromatous leprosy patients in the presence of reaction episodes [3,4,32]. Although we did not observe patients with reaction episodes in our study, there was a high percentage of haematuria among our patients. Leukocyturia was found in 13 (22%) of our patients, with this incidence being similar to that described in literature [7,14,28].

In the present study, the mean values of $U_{\text{pH}} T4$ in MB and PB was not different from those in the control group, but $U_{\text{pH}}$ T4 > 5.5 was abnormal in 30% of cases, suggesting distal tubular acidosis. Drutz and Gutman [50] studied 49 patients and found that urine pH did not decrease below 5.5 in response to NH₄Cl in 20% of their patients. Gutman et al. [23] studied the distal renal tubular function in 47 patients with leprosy after urinary acidifying test and found incapacity to decrease urinary pH in nine cases, of whom five were lepromatous, three borderline and one was a tuberculous patient. Other studies also found urinary acidifying impairment in leprosy patients, with variable incidences [27,47]. Correlations between the acidifying incapacity and age, time of disease or time of treatment were not observed in the present study.

In our cohort, we identified five patients with an impairment in distal H⁺ secretion with impaired urinary acidification, hypokalemia and a high FEK, a fact that was observed by Drutz et al. [50] and that can also be attributed to immunologic reaction and deposits. In this selected cohort, we demonstrate that leprosy patients are at risk for renal lesions (glomerular or tubular) directly mediated by the bacillus and/or by the drugs used in treatment.

In the present study no correlation was observed between FEKNa and GFR. The MB, PB and control group patients presented similar FEKNa. Gutman et al. [23] did not find abnormalities in the excretion of phosphates, amino acids, uric acid and calcium in their leprosy patients, as well as proteinuria or glycosuria. Peters et al. [44] studied the proximal tubular function in leprosy through the analysis of phosphates, uric acid and amino acid clearance and compared the results to a control group, but found no significant abnormalities. Sathiranan et al. [47] found increased sodium renal excretion in 13 of 35 leprosy patients (37%), all presenting reaction episode. We can conclude that the proximal tubular dysfunction in leprosy is not common, except in patients with lepromatous leprosy in reaction episodes [47].

The mean FEK values in MB and PB patients were significantly higher than in the control group, even in patients without impaired urinary acidification, suggesting that other tubular lesions can be present leading to potassium wasting without affecting sodium reabsorption.

**Table 3. Urinary sediment abnormalities in leprosy patients**

<table>
<thead>
<tr>
<th>Urinary abnormality</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukocyturia</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Haematuria</td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td>Proteinuria</td>
<td>7</td>
<td>11.9</td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td>4</td>
<td>8.4</td>
</tr>
</tbody>
</table>

**Table 4. Risk factors for GFR dysfunction**

<table>
<thead>
<tr>
<th>Univariate/ Multivariate</th>
<th>OR (95%CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>1.08 (1.03–1.13)</td>
<td>0.001</td>
</tr>
<tr>
<td>Positive skin smear microscopy</td>
<td>3.45 (1.15–10.19)</td>
<td>0.035</td>
</tr>
<tr>
<td>Multibacillary classification</td>
<td>3.83 (1.30–11.32)</td>
<td>0.019</td>
</tr>
<tr>
<td>Time of treatment (weeks)</td>
<td>1.07(1.01–1.13)</td>
<td>0.017</td>
</tr>
<tr>
<td>Multivariate</td>
<td>1.09(1.04–1.14)</td>
<td>0.001</td>
</tr>
<tr>
<td>Age (years)</td>
<td>1.09(1.02–1.16)</td>
<td>0.012</td>
</tr>
</tbody>
</table>


Renal function in leprosy

Urinary concentrating defect was observed in 84% of our patients, a higher percentage than that described by other authors [3,4,23,27]. Gutman et al. [23], studying urinary concentrating capacity in 47 patients with leprosy, found urine concentrating defect in 15% of these patients after nocturne deprivation and administration of intramuscular vasopressin. Chugh et al. [3] found urine concentrating defect and an impaired acidifying mechanism in 9 of 36 patients (25%), after an 18 h water deprivation. Ponce et al. [27] found urine concentrating defect in 6 of 9 patients (66%). Our data suggest that this inability to concentrate urine is frequent in MB and PB patients, even in the absence of hypergammaglobulinemia and reaction episodes [23]. This concentration defect presented no association with treatment type or duration and is probably related to prolonged exposure to the infectious agent [21,31,48,49].

Our work has some limitations, one is that the control group is not exactly matched for age and gender. One major outcome of this study is that age is an independent risk factor for renal damage, so the difference between leprosy and control groups, although not statically different, is a potential source of bias. Another limitation is that patients were already receiving anti-leprosy treatment and they were not incident leprosy patients.

In conclusion, the frequency of mild glomerular dysfunction as well as tubular dysfunction was considerably high in our cohort of leprosy patients, even without clinical manifestations. Age and time of treatment were independent causes of GFR dysfunction mainly in the multibacillary forms, even in the absence of reaction episodes. It is important to evaluate renal function in all patients with leprosy for early detection and treatment of complications, even in those without any reaction episode.

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Conflict of interest statement. None declared.

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