Patterns of renal disease in Cape Town South Africa: a 10-year review of a single-centre renal biopsy database

Ikechi Okpechi¹, Charles Swanepoel¹, Maureen Duffield², Bonginkosi Mahala¹, Nicola Wearne¹, Stella Alagbe¹, Zunaid Barday¹, Craig Arendse¹ and Brian Rayner¹

¹Division of Nephrology and Hypertension, Groote Schuur Hospital and University of Cape Town and ²Department of Anatomical Pathology, University of Cape Town, Observatory, 7925, Cape Town, South Africa

Correspondence and offprint requests to: Ikechi Okpechi; E-mail: Ikechi.Okpechi@uct.ac.za

Abstract

Background. The patterns of glomerular diseases have been widely reported from different regional and national biopsy registries worldwide. However, there are scant studies on the epidemiology of biopsy-proven renal disease, particularly glomerular diseases in sub-Saharan Africa.

Methods. We retrospectively analysed the reports of 1284 native renal biopsies, reviewed by the same pathologist and performed at the Groote Schuur Hospital in Cape Town from 1 January 2000 to 31 December 2009.

Results. The mean age of all the patients biopsied was 36.8 ± 14.0 years with 61.8% of the patients being under 40 years of age. There was a preponderance of females (54.8%). There were more coloured patients (53.7%) than blacks (42.2%) or whites (3.9%). The frequencies of clinical indications for a renal biopsy were nephrotic range proteinuria (52.5%), acute renal failure (21.3%), asymptomatic urinary abnormalities (13.6%), chronic renal failure (6.4%), acute nephritic syndrome (5.8%) and haematuria (0.3%). The frequencies of the primary glomerulonephritis (GN) include mesangiocapillary GN (20.4%), mesangial proliferative GN (19.2%), membranous GN (18.5%), crescentic and necrotizing GN (11.4%), focal and segmental glomerulosclerosis (10.5%), post-infectious GN (8.2%), minimal change disease (6.0%) and IgA nephropathy (5.8%). Lupus nephritis was the most frequent secondary glomerular disease (39.0%) and was also the most frequent cause of the nephrotic range proteinuria (17.2%). HIV-associated nephropathy increased from 6.6% in 2000 to 25.7% in 2009 (P < 0.0001).

Conclusion. Our data are an important contribution to the epidemiology of renal disease in Africa. We hope that this will form the basis for developing a renal biopsy registry in South Africa and across the continent.

Keywords: Africans; glomerulonephritis; kidney biopsy

Introduction

Renal biopsy has become one of the cornerstones of nephrology practice, being an important means of diagnosing, prognosticating and guiding the treatment of many renal diseases, especially glomerular diseases [1]. The patterns of glomerular disease in many European [2–8], Asian [9–11] and American [12,13] countries are well known and have been published. For instance, IgA nephropathy (IgAN) is the prevalent form of glomerulonephritis (GN) seen in Western Europe, Australia and in some Asian countries, while in South America, focal and segmental glomerulosclerosis (FSGS) appears to be the frequent GN [14]. Several reports of glomerular diseases from Africa have been in the form of small case reports or reports of studies of specific forms of renal disease [15–17]. Although GN is reportedly the main cause of end-stage renal disease in Africa [18], little is known of the patterns of renal disease from African countries, mainly due to the non-existence of renal biopsy registries in many countries or because renal biopsy as a tool for diagnosing renal disease is entirely unavailable. The purpose of this study was to provide a comprehensive report of the relative frequencies of kidney diseases according to clinical presentation and histological diagnoses from the audit of a single-centre renal biopsy registry in Cape Town South Africa.

Materials and methods

This retrospective study was conducted in a single-centre in the Western Cape province of South Africa to evaluate the epidemiology of the histological types of renal diseases in native kidneys from renal biopsies taken from 1 January 2000 to 31 December 2009. All the biopsy materials were exclusively analysed at the Department of Anatomical Pathology of the University of Cape Town. We obtained ethical approval from the University of Cape Town research ethics committee to conduct the study. For each patient, we documented the demographics (name, age and gender), the in-
dication for renal biopsy and the renal histological diagnosis. Percutaneous renal biopsy specimens were stained and analysed by light microscopy and immunohistochemistry (IgG, IgM, IgA and C3). Electron microscopy (EM) was generally performed to confirm the light microscopic changes. For light microscopy (LM), paraffin sections were routinely stained with periodic-acid Schiff, haematoxylin-eosin, silver-methenamine and Congo red.

The indications for renal biopsy were categorized into six groups: (i) nephrotic range proteinuria (NS), (ii) acute nephritic syndrome (ANS), (iii) asymptomatic urinary abnormalities (AUA), (iv) haematuria, (v) acute renal failure (ARF) and (vi) chronic renal failure (CRF). We defined the NS as urine protein excretion >3.5 g/24 h, the ANS as presence of haematuria and oedema, hypertension and reduced estimated glomerular filtration rate and AUA as non-nephrotic range proteinuria (with or without microscopic haematuria). Haematuria was defined as the presence of red blood cells in the urine without any other symptoms or signs of renal disease. Due to the often late presentation of patients with renal disease in our population, it was occasionally difficult to differentiate ARF from CRF. Disease at the time of renal biopsy.

We adopted the classification method used by Polito et al. [13]. Renal histopathological diagnosis was divided into four main classes: (i) primary glomerular diseases, (ii) secondary glomerular diseases, (iii) tubulo-interstitial nephropathies (TIN) and (iv) miscellaneous nephropathies. Primary glomerular diseases were classified into eight pathologies: minimal change disease (MCD—characterized by normal glomeruli on LM and foot process fusion on EM), mesangial proliferative GN (MesPGN—characterized by variable increase of mesangial cells and matrix), negative immunohistochemistry stains for IgA but variable mesangial deposition of C3, IgG and IgM, variable foot process fusion, absence of tuft adhesion and absence of interpositioning on EM), mesangiocapillaril GN (MCGN—characterized by thickening of the peripheral basement membrane of the glomeruli, demonstration of double contours on silver stain, variable degrees of deposits on immunohistochemistry, sub-epithelial deposits and interpositioning on EM and presence of spikes in type III MCGN), membranous GN (MGN—characterized by thickening of the peripheral glomerular basement membrane, presence of ‘spikes’ on silver stain, variable immune deposits and presence of sub-epithelial and intramembranous deposits on EM), FSGS (characterized by focal and segmental pattern of sclerosis, presence of tuft adhesion, variable degree of interstitial fibrosis and foot process fusion on EM), IgAN (characterized by variable increase in mesangial matrix, mesangial hypercellularity and IgA deposits), crescentic and necrotizing GN (not fulfilling the criteria for systemic disease) and post-infectious GN (PGN—characterized by enlarged and hypercellular glomeruli due to swelling and proliferation of glomerular cells, granular deposits of IgG and complement in the mesangium and a ‘hump’ appearance on EM). The biopsy diagnosis of primary glomerular disease was only given if the patient’s serology was negative for human immunodeficiency virus (HIV), hepatitis B and C, syphilis, anti-neutrophil cytoplasmic antibodies, anti-nuclear antibodies and if there was no known associated systemic disease at the time of renal biopsy.

Secondary glomerular diseases included (i) those involving systemic diseases such as lupus nephritis (LN) and cryoglobulinaemic GN, (ii) those related to infections (all HIV-related pathologies, endocarditis, hepatitis B and C, tuberculosis and others), (iii) diseases involving metabolic, hereditary and renal glomerular diseases (MHRGD) and these included diabetic nephropathy (DN), amyloidosis, light chain deposition disease, Goodpasture’s disease, hereditary renal diseases such as Alport’s nephritis, Fabry’s disease, thin basement membrane disease and other renal diseases and (iv) diseases that affected the vessels included benign and malignant nephroangiiosclerosis [HNAS—characterized by the presence of atheroma of peripheral basement membranes of the glomeruli (with silver stains of the glomerular basement membranes showing absence of spikes or reduplication), variable hyaline thickening of the vessels and fibro-intimal proliferation].

The most common clinical indication for biopsy (0.3% overall). Between 1 January 2000 and 31 December 2009, we performed 1753 renal biopsies in our unit. After excluding 327 transplant biopsies, 41 biopsies with inadequate samples and 101 cases with incomplete data, we present results on analysis obtained from 1284 histological diagnoses on native kidney biopsies alone. There were more females biopsied in each year, as well as in the entire 10-year period (n = 704; 54.8%) than males. The mean age of all the patients at the time of renal biopsy was 36.8 ± 14.0 years. There was a higher frequency of coloured patients (53.7%) compared to patients whose ethnicity was described as black (42.4%) or white (3.9%). The rate of renal biopsy rose from 39.1 biopsies p.m.p./year (2000–2005) to 43.4 biopsies p.m.p./year (2006–2009). This is similar to biopsy rates reported from other registries in European countries [2].

There was a significant variation in the occurrence of all primary glomerular diseases in the 10-year period (P = 0.049), and secondary glomerular diseases became the prominent form of kidney diseases seen from the year 2002 to 2009 (Table 1). Table 2 shows the distribution of the different types of renal diseases by age and ethnicity and also shows that secondary glomerular diseases were more frequent in the young (<40 years) and middle aged (40–60 years) in all the ethnic groups while primary glomerular diseases were more frequent in the elderly.

The frequencies of the clinical indications for renal biopsy were 52.5%, 21.3%, 13.6%, 6.4%, 5.8% and 0.3% for nephrotic range proteinuria, ARF, AUA, CRF, ANS and haematuria, respectively (Table 3). Nephrotic range proteinuria was also the most common clinical indication for a renal biopsy in all the ethnic groups. Biopsies for AUA and CRF were significantly higher in coloureds (P < 0.0001) and in whites (P = 0.040), respectively. Haematuria was the least common clinical indication for biopsy (0.3% overall).

Overall, MCGN was the most common type of primary glomerular disease (20.4%) followed by MesPGN (19.2%) and MGN (18.5%). IgA nephropathy was the least common of all the primary glomerulopathies, with a frequency of 5.8% (Table 4). In blacks and coloureds, MCGN was also the dominant form of primary glomerular disease seen...
(20.6 and 20.7%, respectively) while MesPGN was more common in whites (27.8%). Overall, and in all the ethnic groups, MesPGN occurred more frequently with no immune deposits than with IgM deposition alone or with the combination of deposits of C3, IgG and IgM. The frequency of FSGS was found to be higher among blacks (13.1%) than coloureds (9.0%) or whites (5.1%) although this was not statistically significant. Table 5 shows the fre-
quency of the subtypes of MCGN. Type I MCGN was the most frequent (90.4 vs 9.6% for type III MCGN). The frequencies of types I and III MCGN were also observed to be higher in males than in females. Type II MCGN was not observed during the period of the study. Figure 1 shows the distribution of primary glomerular diseases by age and gender; MCGN, MGN and PIGN were more frequently seen in males (P < 0.0001, P = 0.040 and P = 0.015, respectively), and MGN was observed to occur in significant higher frequency in the elderly (P = 0.003).

Overall, LN was the most common type of secondary glomerular disease observed (39%) and also occurred at a significantly higher frequency in coloureds (59.1%, P < 0.0001) and in the young (P < 0.0001) (Table 6 and Table 5.

<table>
<thead>
<tr>
<th></th>
<th>All n = 94</th>
<th>Blacks n = 36</th>
<th>Coloureds n = 55</th>
<th>Whites n = 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 26</td>
<td>n = 10</td>
<td>Males (n = 34)</td>
<td>Males (n = 1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Females (n = 21)</td>
<td>Females (n = 2)</td>
</tr>
<tr>
<td>Type I (%)</td>
<td>90.4</td>
<td>72.7</td>
<td>60.0</td>
<td>–</td>
</tr>
<tr>
<td>Type II (%)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Type III (%)</td>
<td>9.6</td>
<td>66.7</td>
<td>80.0</td>
<td>–</td>
</tr>
</tbody>
</table>

MCGN, mesangiocapillary GN.

Fig. 1. Frequencies of the primary glomerular diseases by different age groups (top panel) and by gender (bottom panel).
Figure 2A and B). HIV-associated nephropathy (HIVAN) was the main cause of secondary glomerular disease in blacks and was also more frequently seen in younger patients (P < 0.0001) (Figure 2C and D). Although the frequency of benign and malignant hypertensive nephrosclerosis was higher in the young and in blacks, it did not reach statistical

<table>
<thead>
<tr>
<th>Type of secondary glomerular disease</th>
<th>All (%) n = 629</th>
<th>Blacks (%) n = 283</th>
<th>Coloureds (%) n = 325</th>
<th>Whites (%) n = 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lupus nephritis*</td>
<td>39.0</td>
<td>15.9</td>
<td>59.1</td>
<td>38.1</td>
</tr>
<tr>
<td>IRGN*</td>
<td>30.1</td>
<td>57.6</td>
<td>7.4</td>
<td>14.3</td>
</tr>
<tr>
<td>Vascular diseases</td>
<td>18.0</td>
<td>15.5</td>
<td>19.4</td>
<td>28.6</td>
</tr>
<tr>
<td>MHRGD</td>
<td>12.9</td>
<td>11.0</td>
<td>14.1</td>
<td>19.0</td>
</tr>
</tbody>
</table>

IRGN, infection-related GN; MHRGD, metabolic, hereditary and rare GN. *P < 0.0001 (ANOVA for ethnicity).

Fig. 2. Frequencies of lupus nephritis (panels A and B), HIV-associated nephropathy (C and D) and hypertensive nephrosclerosis (E and F) by age group and ethnicity.
significance (Figure 2E and F). The causes of nephrotic range proteinuria are shown in Figure 3, and the main causes were by LN (17.2%), HIVAN (12.2%), MGN (11.6%), CGN/ESK (9.8%) and MesPGN (7.6%). The annual frequency of HIVAN was observed to have been on the increase, rising from a frequency of 6.6% of all biopsies performed in 2000 to 25.7% in 2009 (P < 0.0001) (Figure 4). Acute tubular necrosis was the most common type of TIN observed overall (61.1%) and in blacks (66.2%) and coloureds (59.5%). However, CIN and other forms of TIN were significantly and more frequently seen in whites (Table 7).

Discussion

Renal biopsy is sorely lacking in the practice of nephrology in many developing countries around the world and especially in Africa. One of the major strengths of the present study is in providing a broad account of biopsy-proven renal diseases from a sub-Saharan African (SSA) country over a
period of time in which the full impact of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) on renal diseases in the region is yet to be fully assessed. The study population in Cape Town, being in many respects similar to the population across the entire SSA, may therefore be representative of the types of kidney disease encountered in this part of Africa. This study may also be useful in providing a stimulus for comparing the clinico-histological patterns of renal diseases between South Africa and other parts of the world.

We found that the most common indication for a renal biopsy was the nephrotic range proteinuria, with an overall frequency of 52.5% (55.7% in blacks, 49.6% in coloureds and 58.0% in whites). These frequencies are similar to the reported frequencies of nephrotic syndrome as indication for biopsy from registries in other parts of the world [2,8,11,13,19]. Nephrotic range proteinuria has also been shown to be the most common indication for renal biopsy in a recent study that reviewed the profiles of adults admitted to a nephrology unit in the Free State province of South Africa [20] and consequently represents the most common clinical presentation of renal diseases worldwide. ARF was the next common indication for a renal biopsy in our series and ATN was usually responsible for this (Table 8). Although some registries report AUA as the next common indication for biopsy after the nephrotic syndrome, we noted that patients with no known background medical history were referred late or presented for the first time with moderate to severe renal dysfunction. This pattern of late presentation or late referral was also confirmed in the study of van Rensburg et al. [20] and might be prevalent in many settings of SSA. Additionally, the frequent use of native herbal medications prescribed by a traditional diviner (the 'sangoma') [21], the use of non-steroidal anti-inflammatory drugs or drugs used in the treatment of HIV and tuberculosis in our population may have caused the ARF which needed confirmation by a renal biopsy.

Haematuria was the least common indication for a renal biopsy (0.3% of all biopsies) and possibly reflects the low incidence of IgAN in our population (5.8% of all primary glomerular disease) and our policy of not routinely performing renal biopsies for asymptomatic patients with only haematuria and normal renal function. In a similar study from Egypt [19], haematuria was also the least frequent indication for a renal biopsy (3.24%), and the prevalence of IgAN from previous reports in Africa was 2.4 and 3.8% in South Africa [22,23], 3.8% in Tunisia [24] and 9.8% in Egypt [19]. Hence, unlike what has been commonly reported from many European, North American and Asian countries, we have found that overall, MCGN (and not IgAN) is the dominant form of primary glomerular disease in our population especially in blacks and coloured patients while MesPGN is more frequently seen in whites (Table 4). We have also shown that MCGN, MGN and PIGN occur in significantly greater frequency in males, while MGN significantly affects the elderly. Mesangio-capillary GN has been described to frequently present as type I or III and to be commonly associated with cryoglobulinemia and HCV infection in adults [25]. Although secondary MCGN is typically associated with autoimmune diseases and chronic infections like HCV, malaria, schistosomiasis and HIV, genetic predisposition to idiopathic MCGN has previously been investigated [26]. In our patients with idiopathic MCGN, secondary causes were excluded following rigorous investigations; however, we cannot rule out the possibility of genetic predisposition. Registries from some non-European countries have shown FSGS to occur more frequently or to have a high frequency of occurrence in their population relative to other primary glomerular diseases [13]. Although FSGS is known to be common in black Africans [27], its incidence in our study both as a primary glomerular disease and as a cause of N/S was not very high in the different age groups. The reason for this is not clear. How-

### Table 7. Distribution of tubulo-interstitial nephropathies (TIN) by age and gender (n = 139)

<table>
<thead>
<tr>
<th>TIN type</th>
<th>All (%)</th>
<th>Blacks (%)</th>
<th>Coloureds (%)</th>
<th>Whites (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute interstitial nephritis</td>
<td>20.9</td>
<td>23.1</td>
<td>20.3</td>
<td>-</td>
</tr>
<tr>
<td>Acute tubular necrosis</td>
<td>61.1</td>
<td>66.2</td>
<td>59.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Chronic interstitial nephritis</td>
<td>8.6</td>
<td>4.6</td>
<td>10.1</td>
<td>40.0</td>
</tr>
<tr>
<td>Others**a</td>
<td>9.4</td>
<td>6.1</td>
<td>10.1</td>
<td>40.0</td>
</tr>
</tbody>
</table>

ANOVA for ethnicity: *P = 0.021, **P = 0.013.

*aIncludes cases of multiple myeloma-associated interstitial disease, interstitial granulomas, pyelonephritis and one case of microsporidiosis.

### Table 8. Frequencies of pathologies found for the biopsy indication: acute renal failure

<table>
<thead>
<tr>
<th>Histology</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute tubular necrosis</td>
<td>23.4</td>
</tr>
<tr>
<td>HIVAN</td>
<td>15.0</td>
</tr>
<tr>
<td>Lupus nephritis</td>
<td>14.2</td>
</tr>
<tr>
<td>Acute interstitial nephritis</td>
<td>6.6</td>
</tr>
<tr>
<td>Hypertensive nephrosclerosis</td>
<td>6.6</td>
</tr>
<tr>
<td>Crescentic GN</td>
<td>5.1</td>
</tr>
<tr>
<td>Post-infectious GN</td>
<td>4.4</td>
</tr>
<tr>
<td>Diabetic nephropathy</td>
<td>4.0</td>
</tr>
<tr>
<td>Mesangial proliferative GN</td>
<td>3.3</td>
</tr>
<tr>
<td>Mesangio-capillary GN</td>
<td>2.9</td>
</tr>
<tr>
<td>IgAN</td>
<td>1.8</td>
</tr>
<tr>
<td>Chronic interstitial nephritis</td>
<td>1.5</td>
</tr>
<tr>
<td>Others*</td>
<td>11.2</td>
</tr>
</tbody>
</table>

*aOthers include FSGS, MGN, myeloma kidney, amyloidosis and scleroderma.
ever, we think that the declining incidence of all primary glomerular diseases, including FSGS, may be related to the rising frequency of secondary glomerular diseases, especially HIVAN which occurs in significantly greater frequency in the young. The distribution of MGN, however, seems to have followed a recognized worldwide pattern, having a higher frequency in the elderly.

Again, unlike many other registries where primary glomerular diseases dominate, secondary glomerular diseases accounted for a higher percentage (49.0%) of all our biopsies. This has largely been due to the higher prevalence of biopsies related to infections (mainly HIV) and those performed to characterize the renal lesions of systemic lupus erythematosus (SLE). Overall, LN was the most frequent cause of the nephrotic range proteinuria (17.2%) followed by HIVAN (12.2%). The HIV situation in South Africa and SSA is well known and would explain the high prevalence of HIV-associated renal disease from our study. On the other hand, the high prevalence of LN can be explained by the large population of the Cape coloureds (mainly Cape Malays and Indians) in Cape Town. Renal disease in SLE is known to occur more commonly in Asians (especially Malaysians, Chinese and Indians) than in other populations [28] and therefore may explain the high prevalence of LN seen in Cape Town. Other secondary glomerular diseases such as amyloidosis, myeloma and vascular nephropathies were more commonly seen in the elderly, in keeping with findings from other registries.

We noticed a significant variation in the incidences of primary glomerular diseases (P = 0.049) in the 10-year period (Table 1). This pattern may have reflected the rising rate of renal biopsies and the high annual incidence of HIVAN (Figure 4). In a recent review, HIV/AIDS was the major communicable disease identified to account for a high death rate in adults aged 15–64 years in Cape Town and its surrounding districts between 2001 and 2006 [29]. During this same period, deaths attributed to nephritis/nephrosis were reported to have risen sharply by an astounding 67% [30]. Hence, HIV/MD may be contributing significantly to the morbidity and mortality associated with kidney disease in SSA and this will need to be further researched.

Hypertensive renal disease (benign and malignant hypertensive nephroangiosclerosis) occurred in higher frequency in the young and in black South Africans (Figure 2E and F) without any other identifiable secondary causes. Malignant hypertension has also been reported in young male African Americans, but in recent years some of these cases may be due to abuse of methamphetamine (locally called ‘tik’ because of a clicking sound when heated) in Cape Town [21,31]. Such patients may present with malignant hypertension, neuropsychiatric disturbances and renal failure. The lesions of HNAS seen in the elderly were often of the benign type or of patients presenting with ESKD due to hypertension. We observed that the frequencies and distribution of other diseases classified under the category of vascular diseases were similar to reports from other series.

Diseases we classified as TIN and MHRGD followed the same pattern as those published from other registries. ATN and AIN were less common in the elderly than in the young while CIN was more commonly observed in the elderly. We observed that the use of nephrotoxic drugs for the treatment of HIV or tuberculosis contributed substantially to patients diagnosed with ATN or AIN. Most of the cases under the category of MHRGD were due to DN and there were higher frequencies of MHRGD-related pathologies in the elderly than in the young or middle aged. However, we do not routinely perform renal biopsies in patients with DN, except when there is doubt about the diagnosis or if we suspected other pathologies, the low frequency of DN may have resulted from this policy.

One limitation of this study may be in our policy of not offering to biopsy patients who are asymptomatic and present only with haematuria. This might have contributed to the low prevalence of IgAN. This policy is, however, not unique to our centre as it is generally observed across the entire country. Another limitation may be the high percentage of coloured patients in Cape Town which will not be representative of the demographic distribution in other provinces.

Conclusion

The results presented in this study are useful in showing the patterns of renal disease commonly encountered in SSA. Although we do not think that the pattern of secondary glomerular diseases we have observed is completely representative of the whole of South Africa or even SSA given that SLE may be less prevalent in other regions as it is in Cape Town, we however consider that the picture of renal disease caused by HIV may be similar or even worse in other areas with poorer health care facilities. Whether the declining frequency of primary glomerular disease during the period of our study is due to the rising incidence of infection-related GNs will still need to be confirmed. Our results should provide further proof of the epidemic of HIV renal disease in SSA and should therefore provide motive for prevention, early detection and aggressive treatment. Finally, we hope that our result will provide the necessary stimulus for starting a more comprehensive renal biopsy registry within South Africa.

Acknowledgements. We wish to express our thanks to Mr Daniel Rademeyer for handling and processing most of the pathology specimens over the past many years and to Ms Alison Oosthuizen for regularly updating our site’s renal biopsy registry.

Conflict of interest statement. None declared.

References

Patterns of renal disease in Cape Town South Africa


Received for publication: 29.4.10; Accepted in revised form: 1.10.10