INTRODUCTION

Histological examination of the renal biopsies represents the gold standard for the diagnosis of different diseases affecting the kidney. Nowadays, most medical centres employ the use of percutaneous renal biopsy using real-time ultrasonography as well as automated percutaneous devices. Renal pathologies manifest in different ways and in the form of a spectrum from asymptomatic patients to those with life-threatening conditions. Although nephrologist do implement an armamentarium of diagnostic utilities including biochemical and serological in addition to urine-based investigations, the implementation of biopsies and histopathological examination is still considered as the gold standard in reaching a diagnosis in various types of renal disorders. Further, the percutaneous renal biopsy is considered as the most essential for the correct characterization of different types of diseases.
affecting the kidney and the renal system as a whole. It has a critical role in diagnosing different types of tubulo-interstitial and vascular diseases. Hence, an adequate histological specimen is mandatory for an accurate interpretation as well as early detection of the specific ailment affecting the renal tissues.

The histopathological analysis plays a vital role in the evaluation of proteinuric patients not only for diagnosis but also to assess the response to specific therapeutic modalities. It also gives significant information which provides an insight to estimate the progression of the medical condition and the prognosis of the existing renal disease. However, a needle biopsy is not risk-free which must be weighed against the benefits and the advantages of the yield of data via histopathological analysis obtained from the procedure. Our study aims to report the frequency of different pathological lesions among patients with renal diseases admitted to our medical centre. We shall also contrast our original data with the local (regional) and international data, based on the systematic review of the relevant body of literature, to see any concordance or discordance and we shall attempt to provide and postulate a reasonable explanation for any discrepancies from our results.

MATERIALS AND METHODS

Our study is retrospective in design, and it includes all the native kidney biopsies performed at the Renal Transplant Centre and the Renal Unit at Erbil Teaching Hospital for the period 2010-2017. The study has been ethically permitted by the institute review board and the related ethical committee of the Kurdistan Board for Medical Specialization. A total of 893 cases of different age groups were biopsied and included in this study. The indications for renal biopsy included patients with nephrotic syndrome, nephritic syndrome, renal insufficiency (failure) due to an unknown aetiology, and asymptomatic urinary abnormality. The biopsy procedure followed an established operative protocol. Prior to carrying out the procedure, laboratory technicians biochemically estimated the bleeding time, the clotting time, the prothrombin time, and the partial thromboplastin time. Abdominal ultrasonography was also a prerequisite in order to assess the renal or the lesional morphometric parameters including the dimensions, volume, the cortical thickness, and the status of the pelvicalyceal system. On the day of the procedure, a blood pressure more than 140/100 mmHg was an absolute indication to postpone the biopsy. The patients had to lay in a supine posture during the procedure. Following the acquisition of a successful biopsy, the patients were instructed to remain in bed, while their blood pressure is monitored regularly to prevent a catastrophic hypotensive episode or a hypovolemic shock. Besides, the urine output and its colour were checked for the occurrence of macroscopic hematuria.

The patients then were discharged home 6-8 hours after taking the biopsy given that they were hemodynamically stable and with no macroscopic hematuria. The patients were instructed to stay in the bed and avoid physical activities for the next twenty-four hours. All biopsies were obtained using a percutaneous trucut 14 gauge disposable needle. Two tissue samples were retrieved, one for the light microscopy and the other for immunofluorescence. Tissue sectioning and paraffin-embedding were prepared and stained with hematoxylin and eosin stain (H&E), Periodic acid–Schiffstain (PAS), and Masson’s trichrome stain. All the renal biopsies were examined by an experienced pathologist and evaluated via light and immunofluorescence microscopy to reach a definite diagnosis. The authors conducted a comprehensive and systematic review of the literature via the relevant databases including PubMed, Embase, the Cochrane Library, CINAHL Plus, and Elsevier, as well as interactive social research websites including ResearchGate and Academia. The graphical presentation and statistical analysis were conducted via Microsoft Excel 2016 and the Statistical Package for the Social Sciences (IBM SPSS version 24).

RESULTS

The study involved biopsies taken from 893 patients including 472 males (52.86%) and 421 females (47.15%) with an age in the range of 6 months to 79 years and an average of 30.9 years. The number of biopsies executed for eight consecutive years (2010-2017) increased progressively but not consistently (Figure 1). The histopathology and immunofluorescence analysis of the biopsies revealed a heterogeneity of renal pathologies including focal segmental glomerulosclerosis (FSGS), minimal change disease (MCD), membranous glomerulonephritis (MGN), lupus nephritis (LN), diabetic nephropathy (DN), chronic glomerulonephritis (CGN), rapidly progressive glomerulonephritis (RPGN), acute tubular necrosis (ATN), tubulo-interstitial nephritis (TIN), membranoproliferative glomerulonephritis (MPGN), mesangio-proliferative glomerulonephritis (MPSG), post-infectious glomerulonephritis (PIGN), IgA nephropathy (IgAN), and thrombotic micro-angiopathy (TMA). In relation to the pre-operative indications of renal biopsy, the most common clinical indication was nephrotic syndrome (415, 46.47%), followed by acute renal failure (170, 19.04%), chronic renal failure (137, 15.34%), nephritic syndrome (66, 7.39%), proteinuria alone (65, 7.28%) and hematuria alone (40, 4.48%) (Table 1). The frequency distribution
for the major glomerular diseases in descending order of frequency was FSGS (245, 27.44%), MCD (143, 16.01%), MGN (103, 11.53%), arteriosclerosis (61, 6.83%), LN (46, 5.15%), IgAN (39, 4.37%), CGN (39, 4.37%), amyloidosis (30, 3.36%), RPGN (28, 3.14%), ATN (27, 3.02%), Chronic TIN (20, 2.24%), MPGN (20, 2.24%), chronic pyelonephritis (15, 1.68%), acute TIN (13, 1.46%), MPGN (13, 1.46%), PIGN (13, 1.46%), DN (11, 1.23%), acute pyelonephritis (10, 1.12%), TMA (9, 1.01%), and myeloma (8, 0.90%) (Table 2).

The distribution of different types of glomerular diseases was variable based on age and sex of the patients. The typology is broadly categorized into primary glomerular diseases, secondary glomerular diseases, and tubulointerstitial diseases (Table 3). In relation to primary glomerular diseases, it is evident that FSGS, MCD, MGN, MesPGN, and PIGN were more common in males while RPGN and CGN were more common in females while MPGN was equal in distribution amongst males and females. In relation to secondary glomerular diseases, it is noticeable that DN, amyloidosis, and arteriosclerosis were more common in males while LN, myeloma and TMA were more common in females. In relation to tubulointerstitial diseases, it is observable that chronic TIN, acute TIN, and ATN were more common in males while acute pyelonephritis and chronic pyelonephritis were more common in females (Table 3). To validate our results, we compared our data with the reported prevalence of glomerular and tubulointerstitial diseases in different countries based on data extrapolated from the published literature on the same topic (Table 4). Regarding primary glomerular diseases, MCD is more prevalent in India while FSGS is predominant in Pakistan and Oman. On the other hand, MGN is predominant in Iran. Regarding secondary glomerular diseases, it was found that LN is the most prevalent with an exception for Japan where DN is more predominant.

**DISCUSSION**

This study provides a comprehensive evaluation in relation to the demographic parameters, clinical presentation, and...
the prevalence of kidney diseases. Patients had an average age of 30.9 years and they were younger in comparison with patients from other studies conducted in Pakistan, India, and Oman.\textsuperscript{13,15} There was a slight male predominance in our study which is comparable to the other studies in contrast to the published work of Dawood and coworkers (Oman) and Sugiyama and colleagues (Japan) where the male-to-female ratio was different.\textsuperscript{15,16} There are large differences in reporting the underlying causes of nephrotic syndrome in different regions of the world and among different ethnicities, for instance in the United States, where FSGS is the commonest underlying pathology with an increasing incidence among all ethnic groups.\textsuperscript{17} IgA nephropathy was more frequent in European patients while FSGS is infrequent with no increment in the incidence.\textsuperscript{18} On the other hand, in Asian countries including Korea and Japan

| Renal Pathology | Patients n (%) | Age (Mean±SD) | Male n (%) | Female n (%) |
|----------------|---------------|--------------|------------|--------------|
| FSGS           | 245 (27.44)   | 27.7±16.42   | 136 (55.51)| 109 (44.49)  |
| MCD            | 143 (16.01)   | 18.6±13.47   | 80 (55.94) | 63 (44.06)   |
| MGN            | 103 (11.53)   | 38.9±13.69   | 65 (63.11) | 38 (36.89)   |
| MPGN           | 20 (2.24)     | 33.6±17.98   | 10 (50.00) | 10 (50.00)   |
| MesPGN         | 13 (1.46)     | 31.58±6.60   | 8 (61.54)  | 5 (38.46)    |
| IGAN           | 39 (4.37)     | 28.03±11.55  | 26 (66.67) | 13 (33.33)   |
| RPGN           | 28 (3.14)     | 39.43±16.35  | 13 (46.43) | 15 (53.57)   |
| CGN            | 39 (4.37)     | 31.67±15.49  | 19 (48.72) | 20 (51.28)   |
| **Secondary glomerulonephritis** |
| DN             | 11 (1.23)     | 41.64±12.09  | 7 (63.64)  | 4 (36.36)    |
| LN             | 46 (5.15)     | 28.43±9.77   | 6 (13.04)  | 40 (86.96)   |
| Myeloma        | 8 (0.90)      | 54.8±7.87    | 2 (25.00)  | 6 (75.00)    |
| Amyloidosis    | 30 (3.36)     | 42.83±14.94  | 22 (73.33) | 8 (26.67)    |
| TMA            | 9 (1.01)      | 23.81±17.35  | 3 (33.33)  | 6 (66.67)    |
| Arteriosclerosis| 61 (6.83)    | 44.15±13.46  | 37 (60.66) | 24 (39.34)   |
| **Tubulointerstitial disease** |
| Chronic TIN    | 20 (2.24)     | 35.32±17.14  | 13 (65.00) | 7 (35.00)    |
| Acute TIN      | 13 (1.46)     | 40.08±16.81  | 7 (53.85)  | 6 (46.15)    |
| ATN            | 27 (3.02)     | 33.89±14.26  | 19 (70.37) | 8 (29.63)    |
| Chronic PN     | 15 (1.68)     | 29.58±7.31   | 1 (6.67)   | 14 (93.33)   |
| Acute PN       | 10 (1.12)     | 35.00±17.13  | 4 (40.00)  | 6 (60.00)    |

| Renal biopsy lesion | Current study Pakistan, (Mubarak et al., 2011) | India, (Das et al., 2011) | Oman, (Al-Riyami et al., 2013) | Iran, (Ossareh et al., 2010) | Korea, (Chang et al., 2009) | Japan, (Sugiyama et al., 2013) |
|---------------------|-----------------------------------------------|--------------------------|--------------------------------|-------------------------------|-----------------------------|-------------------------------|
| Duration (year)     | 2010-2017                                     | 1995-2008                | 1999-2010                       | 1992-2010                     | 1998-2007                    | 1987-2008                     | 2009-2010                     |
| Sample (n)          | 893                                           | 1793                     | 1849                           | 133                           | 1407                        | 1818                          | 7034                          |
| Male: Female        | 1.12:1                                        | 1.6:1                    | 1.5:1                          | 0.56:1                        | 1.2:1                       | 1.02:1                        | -                             |
| Average age         | 30.9                                          | 1.61                     | 1.51                           | 0.56:1                        | 1.2:1                       | 1.02:1                        | -                             |
| FSGS                | 27.44                                         | 21.2                     | 10.5                           | 19.5                          | 10.0                        | 5.6                           | 5.3                           |
| MGN                 | 11.53                                         | 17.2                     | 7.3                            | 9.8                           | 26.8                        | 12.3                          | 10.7                          |
| RPGN                | 3.14                                          | 5.2                      | 4.5                            | 4.5                           | 1.5                         | 5.8                           | -                             |
| MCD                 | 16.01                                         | 5.8                      | 15.1                           | -                             | 8.3                         | 15.5                          | 12.1                          |
| MPGN                | 2.24                                          | 1.1                      | 3.9                            | 2.3                           | 5.5                         | 4.0                           | 2.6                           |
| IGAN                | 4.37                                          | 1.5                      | 4.4                            | 3.0                           | 11.0                        | 28.3                          | 29.3                          |
| MesPGN              | 1.46                                          | 1.9                      | 5.2                            | 4.5                           | 0.9                         | -                             | 38.8                          |
| DN                  | 1.23                                          | 0.9                      | 1.2                            | 3.8                           | 2.2                         | 2.0                           | 5.1                           |
| LN                  | 5.15                                          | 4.9                      | 14.2                           | 36.1                          | 11.0                        | 8.7                           | 4.8                           |
| Amyloidosis         | 3.36                                          | 4.6                      | 1.5                            | 2.3                           | 3.3                         | -                             | 1.4                           |
| Chronic TIN         | 2.24                                          | 2.8                      | 3.7                            | -                             | 0.3                         | 0.3                           | 1.8                           |
| Acute TIN           | 1.46                                          | 1.1                      | 1.1                            | 1.5                           | 2.0                         | 2.0                           | 1.5                           |
| PIGN                | 1.46                                          | 3.9                      | 5.6                            | -                             | -                           | -                             | 1.8                           |
| TMA                 | 1.01                                          | 0.6                      | 0.3                            | 1.5                           | 0.8                         | -                             | -                             |

Table 3: Descriptive statistics: The clinicopathological diagnosis of renal pathologies based on age, sex, and the number of the patients

Table 4: The prevalence of renal and glomerular pathologies in other countries based on the systematic review of the literature
as well as India, MCD and IgAN were the most frequent aetiology of nephrotic syndrome.\textsuperscript{14,16,19}

The primary glomerular disease was the most frequent type encountered in our patients while nephrotic syndrome was the most common clinical indication for a renal biopsy which is similar to the results reported in numerous other published research throughout the world.\textsuperscript{13,14,20} Among primary glomerular diseases, FSGS was the most frequent pathological lesion (27.44\%) encountered in our study which is similar to data from regional Asian studies.\textsuperscript{13‑15} However, these results depart from those reported in other published papers which show a relatively low incidence of FSGS.\textsuperscript{18,21} MCD was found to be more common in the younger age group (18.61±13.47 years) and it was the second most frequent pathology encountered in our study (16.01\%) which is identical to other studies from India, Korea, and Japan.\textsuperscript{14,16,19} However, it differs from the results reported in other studies carried out in Pakistan and Iran.\textsuperscript{13,20} In Oman, MCD was not detected among the diagnosed renal and glomerular pathologies which can be due to the higher age group of participants (patient) involved in that study.\textsuperscript{15} MGN was more common in the older age group of our patients (38.94±13.69 years), and it represents the third most frequent diagnosis among patients with primary glomerular diseases which is identical data to other studies.\textsuperscript{14,16,20} In Iran, MGN was the most frequent renal pathology encountered among patients with primary glomerular diseases.\textsuperscript{20} On the other hand, the incidence of MGN is declining in Europe and North America over time.\textsuperscript{17,22} IgAN is the most frequent glomerular disease in Japan and Korea and it was less encountered in our study which is compatible with data from other regional Asian studies.\textsuperscript{14,15,16,19,25}

Secondary glomerular disease ranked 2\textsuperscript{nd} following the most common primary glomerular disease. In our patients, Lupus nephritis was the most common secondary glomerular disease followed by amyloidosis and diabetic nephropathy which was identical to all other studies.\textsuperscript{13‑15,23} However, diabetic nephropathy was more frequent than lupus nephritis in Japan while diabetic nephropathy was more common than amyloidosis in Omani patients.\textsuperscript{13,16} In tubulointerstitial diseases, the most common aetiology of acute and chronic TIN were drugs especially NSAID, and in our study, most of the patients in this category were relatively older. Chronic TIN was more common than acute TIN which is identical to other studies conducted in Pakistan, India and Japan.\textsuperscript{13,14,16} The epitome of our study signifies that the spectrum of glomerular diseases varies based on age, sex, as well as the geographical mapping and the ethnic grouping. In primary glomerular diseases, we found that FSGS represented the most common incriminated pathology among the younger age group followed by MCD. Lupus nephritis was the most common pathology detected for secondary glomerular diseases especially in the young females group followed by amyloidosis and DN in higher age group. Minimal change disease and lupus nephritis were more frequent in the younger age group while MGN and Amyloidosis were more clustered in the middle age group.

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**REFERENCES**

1. Iversen P and Brun C. Aspiration biopsy of the kidney. The American Journal of Medicine 1951;11(3):324‑330.
2. Doyle AJ, Gregory MC and Terreros DA. Percutaneous native renal biopsy: comparison of a 1.2-mm spring-driven system with a traditional 2-mm hand-driven system. American Journal of kidney diseases 1994;23(4):498‑503.
3. Kim D, Kim H, Shin G, Ku S, Ma K, Shin S, et al. A randomized, prospective, comparative study of manual and automated renal biopsies. American Journal of kidney diseases 1998;32(3):426‑431.
4. Kumar V, Abbas AK, Fausto N.Kidney. Vinay K, Abbas AK, Fauston N (eds). Robbins and Cotran pathologic basis of disease, 7\textsuperscript{th} ed. Philadelphia: WB Saunders; 2007. pp. 977.
5. Mannan R, Bhasin TS, Singh PA, Misra V and Manjari M. The pattern of glomerulonephritis in the North Indian gangetic plain-A 13-year epidemiological study. Journal of Clinical and Diagnostic Research 2012;6(5):55‑58.
6. Korbet SM. Percutaneous renal biopsy. In Seminars in Nephrology 2002 May 1 (Vol. 22, No. 3, pp. 254‑267). Elsevier.
7. Tendel C, Vikse BE, Bostad L and Svarstad E. Safety and complications of percutaneous kidney biopsies in 715 children and 8573 adults in Norway 1988–2010. Clinical Journal of the American Society of Nephrology2012;7(10):1591‑1597.
8. Corwin HL, Schwartz MM and Lewis EJ. The importance of sample size in the interpretation of the renal biopsy. American Journal of Nephrology1988;8(2):85‑89.
9. Al‑Arrayed A, George SM, Mallaik AK, Al‑Arrayed S, Rajagopalan S, Sharqawi SE, et al. The spectrum of glomerular diseases in the Kingdom of Bahrain: An epidemiological study based on renal biopsy interpretation. In Transplantation proceedings 2004 Jul 1 (Vol. 36, No. 6, pp. 1792‑1795). Elsevier.
10. Rabbani MA, Memon GM, Ahmad B, Memon S, Tahir SA and Tahir S. Percutaneous renal biopsy results: a retrospective analysis of 511 consecutive cases. Saudi Journal of Kidney Diseases and Transplantation2012;23(3):614.
11. Nast CC and Cohen AH. Pathology of Kidney Transplantation. (ed). Handbook of Kidney Transplantation, 5\textsuperscript{th} ed. Philadelphia: Lippincott Williams & Wilkins; 2010. pp. 311‑29.
12. Shaker IK, Al‑Saedi AJ, Al‑Salam S, Saleem MS and Al‑Shamma IA. Spectrum of glomerular disease in Iraqi patients from a single center. Saudi Journal of Kidney Diseases and Transplantation2002;13(4):515‑519.
13. Mubarak M, Kazi JI, Naqui R, Ahmed E, Akhter F, Naqvi SA, et al. Pattern of renal diseases observed in native renal biopsies in adults in a single centre in Pakistan. Nephrology 2011;16(1):87‑92.
14. Das U, Dakshinamurty KV and Prayaga A. Pattern of biopsy-proven renal disease in a single center of South India: 19 years experience. Indian Journal of Nephrology 2011;21(4):250‑257.
15. Dawood Al Riyami AS, Al Bulushi Y, Al Dhahli A and Date A. The
spectrum of glomerular diseases on renal biopsy: data from a single tertiary center in Oman. Oman Medical Journal 2013;28(3):213-215.

16. Sugiyama H, Yokoyama H, Sato H, Saito T, Kohda Y, Nishi S, et al. Japan renal biopsy registry and Japan kidney disease registry: committee report for 2009 and 2010. Clinical and Experimental Nephrology 2013;17(2):155-173.

17. Swaminathan S, Leung N, Lager DJ, Melton LJ, Bergstralh EJ, Rohlinger A, et al. Changing incidence of glomerular disease in Olmsted County, Minnesota: a 30-year renal biopsy study. Clinical Journal of the American Society of Nephrology 2006;1(3):483-487.

18. Jamal Q, Jafarey NA and Naqvi AJ. A review of 1508 percutaneous renal biopsies. Journal of the Pakistan Medical Association 1988;38(10):272-275.

19. Chang JH, Kim DK, Kim HW, Park SY, Yoo TH, Kim BS, et al. Changing prevalence of glomerular diseases in Korean adults: a review of 20 years of experience. Nephrology Dialysis Transplantation 2009;24(8):2406-2410.

20. Ossareh S, Asgari M, Abdi E, Nejad-Gashli H, Ataipour Y, Aris S, et al. Renal biopsy findings in Iran: case series report from a referral kidney center. International Urology and Nephrology 2010;42(4):1031-1040.

21. Khan AZ, Anwar N, Munib M and Shah F. Histological pattern of glomerulopathies at Khyber teaching hospital, Peshawar. Pakistan Journal of Medical Research 2004;43(3):117-120.

22. Hanko JB, Mullan RN, O’rourke DM, McNamee PT, Maxwell AP and Courtney AE. The changing pattern of adult primary glomerular disease. Nephrology Dialysis Transplantation 2009;24(10):3050-3054.

23. Yahya TM, Pingle A, Boobes Y and Pingle S. Analysis of 490 kidney biopsies: data from the United Arab Emirates Renal Diseases Registry. Journal of Nephrology 1998;11(3):148-150.

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Mudhafar Abdullah Ali- contributed to the study design, the review of the literature, histology-related workup, statistical analysis, and preparation of the manuscript. Safa Ezzaddin Al-Mukhtar- contributed to the study design and the supervision of the study. Ahmed Al-Imam- was responsible for the manuscript submission and correspondence with the editorial office of the journal.

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