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The Value of Biopsy in Histopathological Diagnosis

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Abstract: *In this prospective study, 78 renal biopsies were performed: 46 men and 32 women. The average age of men was 37 ± 18.3 years, and that of women was 24.6 ± 13.8 years. Most often, biopsy was performed in the age group from 19 to 48 years among both men (58.6%) and women (66.7), respectively. The most common age group undergoing biopsy was between 19 and 48 years of age for both men (76.1%) and women (78.1%). There were 18 patients over 45 years of age (23.1%): 11 men and 7 women. The primary reason for renal biopsy was the presence of proteinuria with hematuria and subnephrotic proteinuria in 26 patients, followed by nephrotic syndrome in 12 patients. IgA nephropathy emerged as the most frequently identified histopathological diagnosis, accounting for 17.7% of cases. Conversely, minimal change disease, the second most prevalent histopathological finding at 10.4%, was identified in patients with nephrotic syndrome; their renal biopsies appeared normal under histological examination due to the absence of electron microscopy analysis. Nephrosclerosis ranked as the third most common histopathological diagnosis among patients at 6.7%. Additional findings included focal segmental glomerulosclerosis (7.3%), membranous glomerulonephritis (7%), mesangiocapillary glomerulonephritis (7%), and chronic graft rejection (2.6%) in two patients with accompanying fasting and transplant azotemia. Acute tubular necrosis and chronic interstitial nephritis were each present in 1.3% of patients, while 9.0% of cases yielded inconclusive results, indicating either a blood clot or brain tissue in the biopsy samples.*

Keywords: *percutaneous renal biopsy, nephropthy, histological investigation, minimal change disease*

Introduction

A kidney biopsy involves extracting a small piece of kidney tissue for detailed microscopic analysis. This procedure has significantly enhanced the categorization of intrinsic renal conditions, leading to improved insights into their underlying causes. Despite the numerous research studies on kidney biopsies, there is a notable scarcity of literature on the connection between biopsy indications and histopathological findings, particularly in Uzbekistan. Individuals showing clinical or laboratory signs of kidney issues, lacking a definitive diagnosis through non-invasive assessments, and meeting the criteria for a renal biopsy, underwent the procedure.

Material and Methodology

This prospective study was conducted at the Samarkand Multidisciplinary Medical Center, Department of Angiosurgery and Transplantation. 78 patients underwent kidney biopsy over three and a half years between 2021 and 2024. The average hospitalization rate during this period was 25 patients per year. Patients with kidney disease were admitted and underwent kidney biopsy in the nephrology department. Information that was collected before biopsy included: age, sex, medical history, blood pressure, Kidney Function Test (KFT), bleeding time, clotting time, activated partial thromboplastin time, partial thromboplastin time, hemoglobin concentration. Patients who had clinical and/or laboratory evidence of renal disease, whose diagnosis was uncertain using noninvasive techniques, and who were eligible for renal biopsy underwent renal biopsy. The indications for biopsy were as follows:

1. Protinuria and hematuria
2. Subnephrotic protinuria
3. Nephrotic syndrome
4. ATN is not restored within 4 weeks
5. Systemic disease (for example, vasculitis)
6. Subnephrotic protinuria with azotemia
7. Post-transplant azotemia.

Eligible patients were given a detailed medical history and examined according to the prescribed form. Routine studies such as hemogram, ESR, kidney function test, liver function test, blood glucose level, ECG, coagulogram, chest x-ray, microscopic examination of urine, ultrasound of the abdominal cavity, determination of protein in 24-hour urine were performed before kidney biopsy. All patients underwent percutaneous renal biopsy after exclusion of the cause of renal disease by other noninvasive methods.

Procedure

The percutaneous renal biopsy procedure utilized an automatic spring device with a range of sizes (from 15 to 22G). Lidocaine was administered to anesthetize the skin and subcutaneous tissue, followed by deeper anesthesia using a spinal needle. In certain cases, ultrasound was employed to determine the depth, which was then confirmed with a spinal needle. The biopsy needle was inserted to the appropriate depth, and if renal tissue retrieval was insufficient, deeper biopsies were conducted. Biopsy repetition occurred until an adequate tissue sample was obtained, typically comprising three samples. Post-procedure instructions advised patients to maintain a supine position for six hours and undergo 24-hour monitoring for potential complications. Blood pressure was monitored at 30-minute intervals for the initial 3 hours, followed by hourly monitoring for 5 hours, and subsequently every 4 hours for 16 hours. Patients were monitored for post-biopsy complications such as hematuria, pain, fever, and others. Hemoglobin levels were assessed 24 hours post-biopsy to evaluate any drop. Biopsy tissues were sent for histopathological and immunohistochemical analysis, with only light microscopy conducted.

Result

In this prospective study, 78 renal biopsies were performed: 46 men and 32 women. The average age of men was 37 ± 18.3 years, and that of women was 24.6 ± 13.8 years. Most often, biopsy was performed in the age group from 19 to 48 years among both men (58.6%) and women (66.7), respectively. The most common age group undergoing biopsy was between 19 and 48 years of age for both men (76.1%) and women (78.1%). There were 18 patients over 45 years of age (23.1%): 11 men and 7 women (Table 1).

Table 1. Distribution of subjects by age and gender

Age (years)	Male		Female		General	
	n	%	n	%	n	
from 19 to 48	35	76,1	25	78,1	60	76,9
> 45	11	23,9	7	21,9	18	23,1
General	46	59,0	32	41,0	78	100,0
mean ± standard deviation	37 ± 18,3 (9, 70)		24,6±13,8 (13, 60)		33,5 + 14,0 (9, 70)	

n = No. patients of each gender and n = total number of patients.

Discussion

The present study was conducted to elucidate the relationship between indications and histopathological findings of renal biopsy, which would help to gain clinical knowledge about the possible cause of renal disease. Biopsy was performed after proper evaluation of the patient's clinical and laboratory parameters. Gross hematuria was identified in only one patient, since it is not an indication for biopsy unless the patient insists on making a diagnosis (Table 2).

Table 2. Indications for kidney biopsy in the examined patients

Indications	n	%
Protinuria and hematuria	19	24.4
Subnephrotic protinuria	19	24.4
Nephrotic syndrome	17	21.8
Acute renal failure	3	3.8
Systemic disease	1	1.3
Subnephrotic protinuria with azotemia	15	19.2
Azotemia after kidney transplantation	3	3.8
Gross hematuria	1	1.3
Signs of a kidney biopsy are shown. n = Number of patients.		

- Nephrotic syndrome 17 patients (21.8%)
- Isolated subnephrotic protinuria 19 patients (24.4%)
- The most common indication for kidney biopsy was protinuria and hematuria (nephritic syndrome) in 19 patients (24.4%)
- Several studies related to the present study are available on the Internet.

Zheng et al. (2011) conducted a retrospective analysis of renal biopsy indications and histopathological findings, covering a span of 31 years and involving 1419 biopsy procedures. The average age of patients was (8.08±3.46) years, ranging from 6 months to 18 years. The primary clinical presentations included hematuria (38.8%, 551/1419), primary nephrotic syndrome (30.9%, 439/1419), and renal manifestations secondary to systemic diseases (23.8%, 338/1419). Among these, primary glomerulonephritis (PGN) constituted 63.9% (907/1419) of cases, followed by secondary glomerulonephritis (SGN) at 23.2% (329/1419) and hereditary glomerulonephritis (HGN) at 12.1% (172/1419). The leading causes of PGN were IgA nephropathy (26.6%, 241/907) and minimal change disease (23.0%, 209/907). Focal segmental glomerulosclerosis (FSGS) accounted for only 3.0% (27/907) of PGN cases.

Among SGN cases, membranous nephropathy (MN) was most prevalent (47.1%, 155/329), followed by lupus nephritis (28.6%, 94/329). Thin basement membrane nephropathy (TBMN) and Alport syndrome constituted 80.8% (139/172) and 17.4% (30/172) of HGN cases, respectively. Over the study period, there was a decrease in PGN cases and an increase in HGN cases. Notably, the prevalence of mesangial proliferative glomerulonephritis (MsPGN) and hepatitis B virus-associated glomerulonephritis (HBV-GN) decreased over time, while that of IgA nephropathy (IgAN) and hereditary nephritis (HSN) increased. IgA nephropathy was the most common cause among patients presenting with hematuria and proteinuria, while thin basement membrane nephropathy (TBMN) predominated among those with isolated microscopic hematuria. The majority of patients with primary nephrotic syndrome, particularly those with steroid-dependent and frequently relapsing forms, exhibited minimal change disease (MCD). The study suggests the need for stricter indications for kidney biopsy in cases of isolated microscopic hematuria.

In our study, histopathological diagnoses and incidence rates were examined. The most prevalent diagnosis was IgA nephropathy, followed by idiopathic nephrotic syndrome. It's noteworthy that the diagnosis of idiopathic nephrotic syndrome was considered for patients exhibiting nephritic syndrome alongside normal renal biopsy histopathology. Specifically:

IgA nephropathy accounted for 15.4% (12 out of 78) of cases, with various clinical presentations such as proteinuria with hematuria, subnephrotic proteinuria, nephritic syndrome, systemic lupus erythematosus (SLE) with proteinuria, gross hematuria, and azotemia with subnephrotic proteinuria.

Minimal change disease was present in 10.3% (8 out of 78) of patients, with a majority exhibiting non-proteinuric or proteinuric with hematuric symptoms.

Nephrosclerosis was identified in 7.7% (6 out of 78) of cases, with presentations including subnephrotic proteinuria, azotemia with subnephrotic proteinuria, and hematuria with proteinuria.

Lupus nephritis affected 7.7% (6 out of 78) of patients, with various stages of SLE noted.

Focal segmental glomerulosclerosis was observed in 8.9% (7 out of 78) of cases, with presentations ranging from subnephrotic proteinuria to nephritic syndrome.

Membranous glomerulonephritis, mesangiocapillary glomerulonephritis, chronic interstitial nephritis, membranoproliferative glomerulonephritis, rapidly progressive glomerulonephritis, acute tubular necrosis, myeloma nephropathy, chronic graft rejection, vascular spider proliferation, and amyloidosis were among the diagnoses recorded, each with varying clinical presentations.

Inconclusive results were obtained in 6.4% (5 out of 78) of cases, with presentations including subnephrotic proteinuria, nephrotic syndrome, vasculitis with active urinary sediment, and post-transplant azotemia.

Conclusion

A kidney biopsy involves extracting a small piece of kidney tissue for detailed microscopic analysis (Ahuja, 1998). The microscopic analysis of renal tissue samples is pivotal for the diagnosis, management, and treatment of renal ailments. The integration of renal biopsy into medical practice marks a significant milestone in clinical nephrology. It has been instrumental in categorizing kidney diseases and enhancing our comprehension of their origins. Even with the emergence of novel, minimally invasive diagnostic methods, the role of kidney biopsy in evaluating the diagnosis and prognosis, and guiding the therapeutic approach for numerous renal conditions, remains unparalleled. Its usage continues to grow, particularly due to the introduction of advanced biopsy devices and the application of real-time ultrasonography for guidance.

The inaugural open kidney biopsy took place in 1899 (Alwall, 1952), while the first percutaneous renal biopsy was conducted by Alwall in 1944 (Burstein et al., 1993). Iversen and Brun (1951) affirmed that percutaneous renal biopsy stands as a paramount tool in identifying kidney ailments that lead to acute renal failure. Following their study, this diagnostic procedure gained substantial global traction, unveiling insights into diseases previously only discernible post-mortem through kidney specimens. Over time, advancements like immunofluorescence and electron microscopy have bolstered the diagnostic capabilities of renal biopsy, offering crucial insights into the histopathology, pathogenesis, and classification of renal conditions (Choufani, 2001). Presently, the utilization of real-time ultrasound and automated needles ensures over 99% diagnostic accuracy in biopsies (Cozens et al., 1992).

Undoubtedly, percutaneous renal biopsy substantially aids clinical nephrology by providing precise diagnoses, prognostic insights, and facilitating tailored treatment for patients with kidney issues (Greenbaum et al., 2000). Nonetheless, the procedure's associated risks of morbidity and occasional mortality necessitate tailored risk-benefit

evaluations for each patient, a process prone to subjectivity (Iversen & Brun, 1951; Kuller et al., 2001). Consequently, the broad array of indications for kidney biopsy reveals notable discrepancies among nephrologists (Madaio, 1990; Mak, 2001).

The purpose of this study was to elucidate the relationship between indications and histopathology of renal biopsies. Renal biopsy stands as a critical tool for diagnosis in the realm of kidney transplant medicine. Our research involved 78 subjects who underwent renal biopsy due to various indications such as proteinuria and hematuria, isolated subnephrotic proteinuria, nephrotic syndrome, systemic illnesses, subnephrotic proteinuria accompanied by azotemia, and post-transplant azotemia. The predominant histopathological finding was IgA nephropathy, succeeded by Minimal Change Disease (MCD), Focal Segmental Glomerulosclerosis (FSGS), Membranous Glomerulonephritis (MGN), and Rapidly Progressive Glomerulonephritis (RPGN). In 5.1% of the instances, the biopsy either failed to yield tissue or the sample was inadequate. The findings underscore the irreplaceable nature of renal biopsy, as it is evident that identical pathologies can manifest with varying urinary and renal anomalies. Morphological examination of renal tissue remains an essential practice for transplant surgeons to resolve patient issues conclusively.

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