ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 9, Issue – 1, February - 2026, Page No.: 174 – 181

Histopathological Patterns of Renal Lesions in Autopsy Specimens: A Descriptive Study from Northern India

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How to citation this article: Dr. Seetaram Gurjar, Dr. Kamlesh Yadav, Dr. Nidhipriya, "Histopathological Patterns of Renal Lesions in Autopsy Specimens: A Descriptive Study from Northern India", IJMACR- February - 2026, Volume – 9, Issue - 1, P. No. 174 – 181.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Autopsy-based renal histopathology provides a unique opportunity to determine the true burden and spectrum of clinically silent kidney diseases, particularly in resource-limited settings where advanced diagnostic facilities may be scarce. This study aimed to evaluate the histopathological patterns of renal lesions in autopsy specimens from a tertiary care centre in Rajasthan, India. A descriptive cross-sectional study was conducted on 180 consecutive autopsy kidney specimens received in the Department of Pathology over one year. Properly fixed specimens were examined grossly and microscopically using haematoxylin and eosin staining, with special stains when required. Lesions were categorised as glomerular, non-glomerular, or normal. Demographic variables were correlated with histopathological findings using descriptive statistics and significance testing ($p < 0.05$). Of the 180 specimens, 25% were microscopically normal, while 75% showed pathological changes. Non-glomerular lesions predominated (52.8%), followed by glomerular lesions (22.2%). Acute tubular necrosis (31.6%) and chronic pyelonephritis (26.3%) were the most frequent non-glomerular findings. Among glomerular lesions, focal segmental glomerulosclerosis was most common (30%), followed by diffuse glomerulosclerosis (20%) and membranous glomerulonephritis (15%). The majority of cases occurred in the 50–70-year age group, with male predominance (65.6%). No statistically significant association was observed between age or sex and lesion type. A substantial proportion of autopsy kidneys harbour occult pathological changes, emphasising the importance of routine histopathological examination for accurate disease burden estimation, clinicopathological correlation, and public health planning.

Keywords: Kidney Diseases; Autopsy; Histopathology; Glomerulosclerosis; Acute Tubular Necrosis.

Introduction

The kidneys are vital excretory organs responsible for maintaining internal homeostasis by regulating fluid balance, electrolyte composition, acid–base equilibrium, and blood pressure, in addition to eliminating metabolic waste products and toxins. They also perform essential endocrine functions, including erythropoietin production, renin secretion, and vitamin D activation, underscoring their central role in systemic physiology.[1] Owing to their complex structural and functional organisation, kidneys are vulnerable to a wide spectrum of pathological insults that may be acute or chronic, congenital or acquired, and localised or systemic. Many renal diseases remain clinically silent or underdiagnosed during life, particularly in populations with limited access to advanced diagnostic facilities, and may only be detected incidentally at advanced stages or during post-mortem examination. Autopsy-based histopathological evaluation, therefore, provides a unique and comprehensive opportunity to assess the true burden, distribution, and morphological spectrum of renal lesions in a given population.[2] Such evaluations not only enhance understanding of disease prevalence and natural history but also serve as a valuable audit of clinical diagnostic accuracy by identifying discrepancies between antemortem diagnoses and postmortem findings.

The concept of autopsy audit has gained increasing importance, as several studies have demonstrated that a significant proportion of renal pathologies, including chronic kidney disease, glomerulonephritis, acute tubular injury, vascular nephropathies, interstitial nephritis, and congenital anomalies of the kidney and urinary tract, often remain undetected or underestimated during life.[3] Histopathologically, renal lesions involve multiple compartments, including glomeruli, tubules, interstitial tissue, and vasculature, each contributing uniquely to functional impairment and disease progression. Glomerular diseases like diabetic nephropathy, amyloidosis, and various forms of glomerulonephritis constitute a major cause of chronic renal failure and end-stage renal disease, while tubulointerstitial disorders commonly arise from ischemia, toxins, infections, or drug reactions and represent a significant cause of acute and chronic renal dysfunction. Vascular lesions, including hypertensive nephrosclerosis and thrombotic microangiopathy, are frequently encountered in elderly and hypertensive populations and may coexist with other renal pathologies, further complicating clinical presentation and management. Congenital and developmental anomalies also contribute substantially to renal morbidity and mortality, especially in pediatric and perinatal populations.[4]

In developing countries, where renal biopsy and advanced nephropathology services may be limited, autopsy studies play a critical role in generating epidemiological data and raising awareness of the silent burden of renal disease.[5] Systematic histological evaluation of autopsy kidneys, even when gross findings appear normal, can uncover subclinical pathology, guide preventive strategies, and contribute to public health planning by establishing regional disease registries.[6] Thus, autopsy-based renal histopathology remains an indispensable tool for understanding disease patterns, improving diagnostic accuracy, and strengthening preventive and therapeutic approaches in nephrology. The present study was therefore conducted to examine

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the spectrum of histopathological findings in kidney specimens received at the autopsy section of a tertiary care hospital in Rajasthan, India.

Materials and Methods

This study was a descriptive, cross-sectional, observational analysis of the histopathological spectrum of renal lesions in autopsy specimens. The study was conducted at the Department of Pathology, SMS Medical College and Attached Hospitals, Jaipur, Rajasthan. The study ran from October 2023 onward for 1 year, or until the required sample size was achieved, followed by an additional 2 months dedicated to data compilation and statistical analysis. The study population comprised all preserved kidney specimens received in the Department of Pathology from autopsy cases during the study period. Ethical approval was obtained from the Institutional Review Board and Ethical Committee prior to commencement of the study, and informed written consent was obtained from the appropriate authorities for the use of autopsy material. The sample size was calculated at a 95% confidence interval based on a presumed prevalence of 69% non-glomerular renal lesions derived from the seed article, with a relative error of 10%, resulting in a minimum required sample size of 180 kidney specimens.[7] All properly fixed kidney specimens were included in the study, while autolysed or poorly fixed specimens were excluded to ensure optimal histological assessment. Consecutive sampling was employed, wherein all eligible cases meeting the inclusion and exclusion criteria were selected until the desired sample size was achieved. Detailed clinical information, including age, gender, clinical history, and personal habits such as smoking, tobacco chewing, and alcohol consumption, was retrieved from post-mortem records. Each kidney specimen underwent thorough gross examination, assessing parameters such as colour, size, weight, dimensions, external surface, cut surface appearance, corticomedullary differentiation, and pelvicalyceal system. The tissues were fixed in 10% neutral buffered formalin, and representative sections, including the corticomedullary junction, were sampled and processed using an automatic tissue processor. Paraffin-embedded tissue blocks were sectioned at 3 micrometres and routinely stained with Haematoxylin and Eosin for microscopic evaluation. Special stains, including Periodic Acid–Schiff (PAS) and Silver Methenamine, were applied wherever necessary to enhance visualisation of basement membranes and structural details. Microscopic examination focused on identifying and documenting glomerular lesions, tubular and interstitial changes, vascular abnormalities, and any neoplastic features. All slides were independently reviewed by two histopathologists to minimise observer bias and ensure diagnostic accuracy. Renal artery stenosis was graded based on the percentage of luminal narrowing as Grade 0 (normal), Grade I (1–25%), Grade II (26–50%), Grade III (51–75%), and Grade IV (76–100%). Histopathological findings and clinical data were systematically recorded and tabulated, and simple correlations were derived to analyse clinico-pathological patterns of renal lesions. Statistical analysis was performed to assess the distribution and frequency of various renal pathologies in relation to demographic variables and histological categories, thereby enabling a comprehensive evaluation of the spectrum of renal lesions encountered in autopsy specimens. Data analysis was done using SPSS v.22. Quantitative data were expressed as percentages and proportions. Qualitative data were summarised using mean and standard

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deviation. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 180 autopsy kidney specimens were evaluated in the present study. The age distribution showed that the majority of cases belonged to the older age groups, with the highest proportion observed in the 60–70 years age group (25%), followed by the 50–60 years age group (22.2%). Individuals aged 30–40 years constituted 16.7%, while those below 30 years and between 40–50 years each accounted for 13.9% of cases. The lowest representation was observed in patients aged 70 years or older (8.3%). There was a clear male predominance, with 118 males (65.6%) and 62 females (34.4%). On gross examination, most kidneys appeared normal in size and morphology (67.8%), whereas 12.2% showed increased kidney size and 20% showed decreased kidney size, suggesting underlying chronic or pathological processes in a significant proportion of cases (Table 1).

Histopathological examination revealed that only one-quarter of specimens (25%) were microscopically normal. A substantial proportion exhibited pathological changes, with non-glomerular lesions being the most frequent, observed in 95 cases (52.8%), followed by glomerular lesions in 40 cases (22.2%) (Table 2). Among the glomerular lesions, focal segmental glomerulosclerosis (FSGS) was the most common entity, accounting for 30% of cases, followed by diffuse glomerulosclerosis (20%). Membranous glomerulonephritis constituted 15%, while mesangial proliferative glomerulonephritis and diabetic nephropathy each accounted for 12.5% of cases. Amyloidosis was identified in 10% of glomerular lesions. Among non-glomerular lesions, acute tubular necrosis was the predominant finding (31.6%), followed by chronic pyelonephritis (26.3%). Renal arteriosclerosis accounted for 15.8% of cases, renal tuberculosis for 10.5%, simple renal cysts for 8.4%, and renal cell carcinoma for 7.4%, highlighting the wide pathological spectrum encountered in autopsy kidneys (Table 2).

The association between demographic variables and the type of renal lesion was also analysed. The distribution of both glomerular and non-glomerular lesions increased with advancing age, particularly in the 50–70 years age group; however, no statistically significant association was observed between age and lesion type ($p = 0.342$). Similarly, males showed a slightly higher frequency of both glomerular (57.5%) and non-glomerular (60%) lesions than females, but this difference was not statistically significant ($p = 0.661$), indicating that lesion distribution was relatively independent of sex as seen in Table 3.

Discussion

The present study highlights the substantial burden of silent renal pathology in autopsy specimens, emphasising the diagnostic and epidemiological value of systematic histopathological evaluation of kidneys. A majority of cases demonstrated microscopic abnormalities despite largely normal gross findings, pointing to the fact that renal disease often remains clinically occult until advanced stages or until discovered incidentally at autopsy. Non-glomerular lesions constituted the predominant category, followed by glomerular lesions, reflecting the vulnerability of renal tubules and interstitium to ischemic, infectious, toxic, and systemic insults. These findings support the concept that renal pathology in the general population is frequently underestimated in routine clinical practice and reinforce the role of autopsy audit in identifying

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undiagnosed disease burden and clinicopathological discrepancies.

The predominance of non-glomerular lesions in this study aligns with observations by Herrera et al. (2004), who evaluated renal lesions in patients with plasma cell dyscrasias and found interstitial and tubular injuries to be far more common than primary glomerular pathology, with cast nephropathy and acute tubular necrosis frequent findings.[8] Similarly, Paueksakon et al. (2014) emphasised that acute tubular injury, interstitial nephritis, and vascular lesions are among the most commonly encountered renal pathologies in autopsy practice, particularly in critically ill and elderly populations.[9] The high frequency of acute tubular necrosis and chronic pyelonephritis in the present series likely reflects the cumulative effects of systemic hypoperfusion, sepsis, drug toxicity, and chronic infections, which are common contributors to terminal illness and mortality in hospital settings.

Among glomerular lesions, focal segmental glomerulosclerosis was the most frequent, followed by diffuse glomerulosclerosis and membranous glomerulonephritis. This pattern is consistent with the findings of Ohasi et al. (2014), who reported a significant association between focal segmental glomerulosclerosis and endothelial injury in patients with disseminated intravascular coagulation, suggesting that microvascular damage and chronic hemodynamic stress may contribute to the development of glomerulosclerosis.[10] The presence of diabetic nephropathy and amyloidosis in a subset of cases further reflects the contribution of chronic systemic diseases to renal structural damage, many of which may remain clinically silent or poorly documented during life.

The age distribution in the present study demonstrated a higher prevalence of renal lesions in older age groups, which may be attributed to cumulative exposure to metabolic disorders, hypertension, infections, and vascular changes. However, no statistically significant association was observed between age or sex and lesion type, suggesting that renal pathology may occur across demographic groups and that multiple interacting risk factors influence disease manifestation. Comparable demographic trends have been noted in autopsy-based organ pathology studies such as those by Chauhan et al. (2015) and Kadam et al. (2017), where male predominance and incidental detection of silent organ pathology were frequently observed, reinforcing the hidden burden of chronic disease in the population.[11, 12]

Infective and inflammatory renal lesions identified in this study highlight the importance of recognising renal involvement in systemic infections. Paueksakon et al. (2014) stressed the need for careful histological evaluation of kidneys in autopsy cases to identify infectious etiologies and differentiate them from non-infectious inflammatory processes.[9] Chronic pyelonephritis and renal tuberculosis detected in the present series further demonstrate that chronic infections remain a significant cause of renal damage in developing regions, often progressing silently until irreversible parenchymal loss occurs.

The findings also echo those of Aslan et al. (2018), who demonstrated complex renal histopathological changes in sepsis-associated acute kidney injury, including inflammatory infiltration and fibrin deposition beyond the classical acute tubular necrosis.[13] Such studies support the concept that renal injury in critically ill patients is multifactorial and dynamic, and that autopsy evaluation provides valuable mechanistic insights that

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may not be apparent clinically. Furthermore, Kaur et al. (2018) emphasised the importance of autopsy renal examination in sudden or unexpected deaths, where renal lesions may contribute indirectly to morbidity or act as silent comorbidities.[14]

The identification of incidental neoplastic lesions, including renal cell carcinoma, further reinforces the diagnostic utility of routine renal sampling at autopsy. Kadam et al. (2017) similarly reported clinically unsuspected incidental malignancies detected at autopsy, highlighting the broader public health value of postmortem histopathology in detecting occult disease.[12]

Conclusion

The findings of the present study, therefore, strengthen the evidence that routine histopathological examination of the kidneys during autopsy is essential for accurately documenting the true burden and spectrum of renal disease. Establishing regional and national renal pathology registries based on autopsy data may improve epidemiological surveillance, guide preventive strategies, and enhance clinical awareness, ultimately contributing to better early detection and management of chronic kidney disease in the population.

Table 1: Sociodemographic and clinical characteristics of patients (N=180)

Category	Parameters	Frequency	Percentage (%)
Age Group (years)	Below 30	25	13.9
	30-40	30	16.7
	40-50	25	13.9
	50-60	40	22.2
	60-70	45	25
	Above 70	15	8.3
Sex	Male	118	65.6
	Female	62	34.4
Gross Examination	Normal	122	67.8
	Increased Kidney size	22	12.2
	Decreased Kidney size	36	20

Table 2: Histopathological findings in the patients (N=180)

Parameters	Category	Frequency	Percentage (%)
Histopathology	Normal	45	25
	Glomerular lesions	40	22.2
	Non-Glomerular lesion	95	52.8
Histopathological Classification of Glomerular Lesion (n=40)	Focal Segmental Glomerulosclerosis	12	30
	Diffuse Glomerulosclerosis	8	20
	Membranous Glomerulonephritis	6	15
	Mesangial Proliferative Glomerulonephritis	5	12.5
	Diabetic nephropathy	5	12.5
	Amyloidosis	4	10
Histopathological Classification of Non-Glomerular Lesion (n=95)	Acute Tubular Necrosis (ATN)	30	31.6
	Chronic pyelonephritis	25	26.3
	Renal tuberculosis	10	10.5
	Renal arteriosclerosis	15	15.8
	Simple renal cyst	8	8.4
	Renal cell carcinoma	7	7.4

Table 3: Association between predictors and type of lesion in patients (N=180)

Parameters	Category	Glomerular lesion		Non-Glomerular lesion		p-value
		Frequency	Percentage	Frequency	Percentage	
Age (years)	Below 30	5	12.5	13	13.7	0.342
	30-40	6	15	15	15.8	
	40-50	8	20	13	13.7	
	50-60	8	20	21	22.1	
	60-70	10	25	23	24.2	
	Above 70	3	7.5	10	10.5	
Sex	Male	23	57.5	57	60	0.661
	Female	17	42.5	38	40	

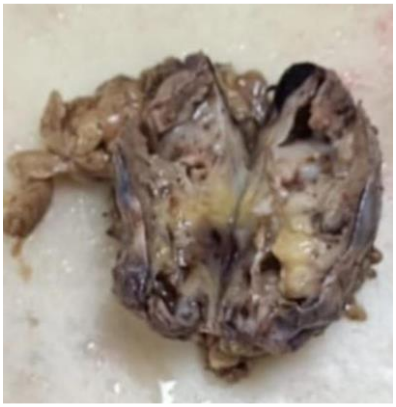

Figure 1: (a) Gross – small size Kidney and

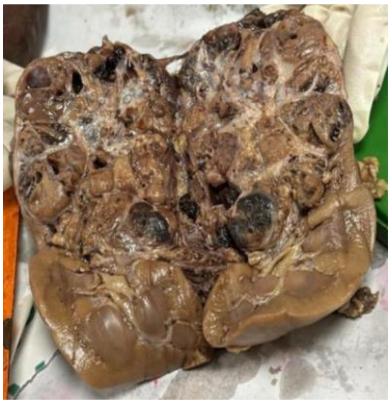

Figure 1: (b) Gross – polycystic Kidney

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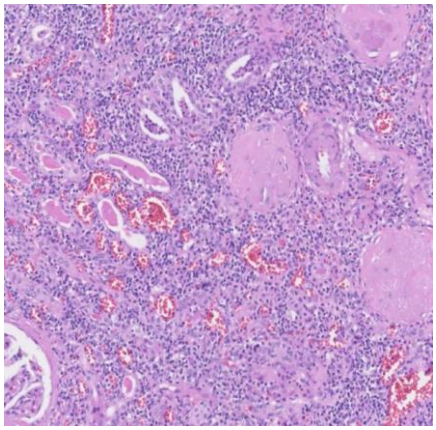

Figure 2: Microscopic View (a) Chronic Pyelonephritis and

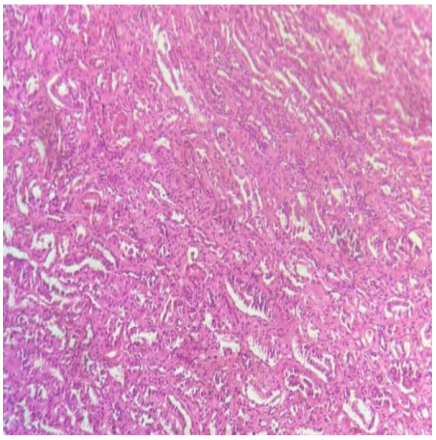

Figure 2: Microscopic View (b) Interstitial Nephritis

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