



Research Article

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Comprehensive Study of Postmortem Renal Histopathological Findings: A Retrospective Study in Baghdad (2020-2024)

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Abstract

Background: Autopsy represents a comprehensive method for direct macroscopic and microscopic assessment of organs following death. Despite progress in imaging and molecular studies, autopsy-based renal histopathological examination continues to serve as an important adjunct method for precise identification of renal diseases. **Objective:** Determine the frequency and spectrum of renal histopathological findings in autopsy cases as the primary outcome and their associations with age and sex as secondary outcomes. **Methods:** A retrospective study was conducted between January and December 2025. The study was based on reviewing 1,834 archived renal autopsy cases performed between January 2020 and December 2024 at the Directorate of Forensic Medicine, Baghdad, Iraq. 102 cases were excluded due to autolysis, and the 1,732 renal cases that remained were classified as tumor, glomerular, tubular, interstitial, and vascular. **Results:** Out of the 1,732 renal autopsy cases, 73% were male cases, with an average age of 52.8 ± 18.4 years. Tubulointerstitial lesions were the most common histological pattern (64.1%). Pyelonephritis was the most common microscopic diagnosis (40.8%). Uncommon renal lesions included findings suggestive of renal tuberculosis (1.0%) and vascular lesions (0.7%). Renal diagnoses were significantly associated with age and sex ($p < 0.001$). **Conclusions:** Tubulointerstitial lesions were the predominant histopathological pattern, with pyelonephritis being the most common microscopic diagnosis. Renal diagnoses differed significantly according to age and sex. The finding of renal TB and vascular lesions reflects the value of autopsy renal histopathology investigation in identifying previously clinically unsuspected or incidental lesions.

Keywords: Autopsy; Kidney; Pyelonephritis; Postmortem; Renal pathology.

دراسة شاملة لنتائج الأمراض النسيجية الكلوية بعد الوفاة: دراسة استيعادية في بغداد (2020-2024)

الخلاصة

الخلفية: يمثل التشريح طريقة شاملة للتقييم المباشر الماكروسكوبي والمجهري للأعضاء بعد الوفاة. على الرغم من التقدم في التصوير والدراسات الجزيئية، لا يزال الفحص النسيجي المعتمد على التشريح يستخدم كطريقة ملحق مهمة للتعرف الدقيق على أمراض الكلى. **الهدف:** تحديد تكرار وطيف نتائج التشريح النسيجية الكلوية كنتيجة أولية وارتباطها بالعمر والجنس كنتائج ثانوية. **الطرائق:** أجريت دراسة استيعادية بين يناير وديسمبر 2025. استندت الدراسة إلى مراجعة 1,834 حالة تشريح كلوي مؤرشفة أجريت بين يناير 2020 وديسمبر 2024 في مديرية الطب الشرعي في بغداد، العراق. تم استبعاد 102 حالة بسبب التحلل الذاتي، وتم تصنيف 1,732 حالة كلوية باقية إلى أورام، كبيبي، أنيوبي، خلالي، وعائي وعائي. **النتائج:** من بين 1,732 حالة تشريح كلوي، كان 73٪ من الحالات الذكورية، بمتوسط عمر 52.8 ± 18.4 سنة. كانت الآفات الحبيبية البينية هي النمط النسيجي الأكثر شيوعاً (64.1٪). كان التهاب الحفرية هو التشخيص المجهري الأكثر شيوعاً (40.8٪). شملت الآفات الكلوية غير الشائعة نتائج تشير إلى السل الكلوي (1.0٪) والآفات الوعائية (0.7٪). ارتبطت التشخيصات الكلوية بشكل ملحوظ بالعمر والجنس ($p < 0.001$). **الاستنتاجات:** كانت الآفات tubulointerstitial هي النمط النسيجي السائد، وكان التهاب الحوضاء الكلوي هو التشخيص المجهري الأكثر شيوعاً. اختلفت تشخيصات الكلى بشكل كبير حسب العمر والجنس. يعكس اكتشاف مرض السل الكلوي والآفات الوعائية قيمة التحقيق في علم الأمراض النسيجية الكلوية في التشريح في تحديد الآفات التي لم تكن متوقعة أو عرضية سابقاً سريريا.

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INTRODUCTION

Autopsy refers to the direct visual and histological inspection of organs after death; it is derived from the Ancient Greek autopsy [1]. It continues to be the gold standard in modern practice for determining cause of death, verifying premortem diagnosis, and fulfilling medicolegal requirements [2]. Globally, chronic kidney disease (CKD) affects more than 650 million people in 2021, while acute kidney injury (AKI) accounts for about 13 million cases, with the greatest impact in low- and middle-income countries (LMICs) [3]. Renal pathologies, which include CKD, AKI, glomerulonephritis, diabetic nephropathy, infectious illnesses, and renal neoplasms, are a wide range of conditions affecting glomeruli, tubules, interstitium, and renal vasculature [4]. Regional or national renal

disease registries may improve understanding of the diseases most common in the region. Systematic postmortem histopathological studies can complement these registries by identifying clinically silent renal lesions and supporting medical education and health-service planning [5]. However, data on the frequency and spectrum of renal histopathological findings in Iraqi postmortem material remain limited, particularly in large autopsy series [6]. Hence, an Iraqi autopsy-based study may provide complementary data on renal lesions beyond those identified in biopsy studies and clinical registries. Therefore, this study aimed to determine the frequency and spectrum of renal histopathological findings in autopsy cases as the primary outcome and to assess their associations with age and sex as secondary outcomes.

METHODS

Study design and setting

A retrospective study was conducted at the Histopathology Department, Directorate of Forensic Medicine, Baghdad, Iraq, between January 2025 and December 2025.

Study sample and case selection

The study was based on reviewing forensic autopsy cases performed previously between January 2020 and December 2024. The cases originated from Baghdad as well as referrals from other Iraqi provinces. There were 2000 autopsy cases in all. Due to an incomplete pathology record/paraffin block, 166 of these cases were discarded. Out of the remaining 1,834 cases, 102 were also excluded due to severe autolysis. The primary histopathology analysis included the remaining 1,732 cases, of which 1,597 had age information and 1,699 had sex information (Figure 1).

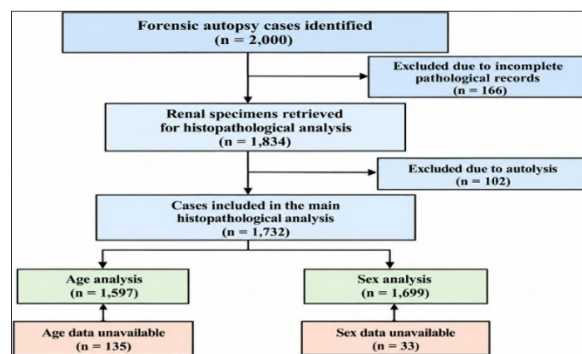


Figure 1: Flow diagram of case selection.

Inclusion and exclusion criteria

The study included autopsy renal cases with available paraffin blocks, slides, and pathological records. Cases with poorly preserved renal tissue and missing or incomplete pathological information were excluded from the study. Cases with missing age or sex data were excluded only from demographic analysis and retained for other analyses.

Sample preparation and histopathological examination

The forensic physicians examined both kidneys, but only the suspected diseased one was removed and delivered as a specimen. Each renal specimen was fixed by 10% buffered formalin for 6-24 hours, followed by gross examination (measurements were taken from every renal specimen received, despite being bilateral, and all dimensions were manually measured). In pediatrics, children and adolescents, the dimensions were correlated with age and sex [7], but in adults, a normal kidney size is about 10 to 12 cm in length and 5 to 6 cm in width [8]; anything over those measurements was considered as kidney enlargement. After that the renal specimens were sectioned and

processed (dehydrated, cleared, embedded into paraffin block, sectioned 3-5 micrometers, mounted, stained, then produced as a slide and tissue block). Each case contained both paraffin blocks and hematoxylin and eosin (H&E) slides. Those blocks and slides were retrieved from the archive section and reviewed by a single pathologist who was blinded to demographic information, using a light microscope (LEICA DM500) at magnifications of 4×, 10×, and 40×; thus, the possibility of observer bias could not be excluded. With regard to case diagnoses, the diagnoses of AKI and CKD were based on documented medical records and correlated with the corresponding histopathological findings. Renal neoplasms were evaluated based on their morphological features in H&E-stained sections in correlation with available clinical records. Renal tuberculosis (TB) and vascular lesions were detected incidentally during histopathological examination of H&E-stained renal sections. The diagnosis was based on suggestive morphological features, as ancillary confirmatory tests were unavailable.

Ethical considerations

The protocol was approved on 9 February 2025 (certificate No. Path/120) by the Institutional Scientific Committee of the Iraqi Board of Medical Specialties. The informed consent was waived because the study used retrospective records and material obtained from deceased individuals.

Statistical analysis

Microsoft Excel was used for data entry. The data were analyzed using SPSS-27 (statistical packages for social sciences version 27). Categorical data were presented as frequencies and percentages, while continuous variables were summarized as mean $\pm$ standard deviation (SD) and range. Age was categorized into six groups to facilitate comparison of renal pathological findings across different age ranges and to provide an adequate distribution of cases. The chi-square test was used to evaluate the association between the study variables, and Cramér's V was calculated as a measure of effect size for associations between categorical variables. A *p-value* < 0.05 was considered statistically significant.

RESULTS

A total of 1,834 cases were identified. Autolysis was present in 102 cases, which were excluded from histopathological analysis. Therefore, the remaining 1,732 cases were included in the histopathological analysis. Age was available for 1,597 cases, and sex was available for 1,699 cases. The mean age of the cases was 52.8 ± 18.4 years, with a range of 1 month to 105 years. The most frequent age group was 46-60 years (521/1597, 32.6%) (Figure 2). Regarding sex, 1232/1699 (73%) in the studied sample were male, with a male-to-female ratio as approximately 2.6:1 (Figure 3).

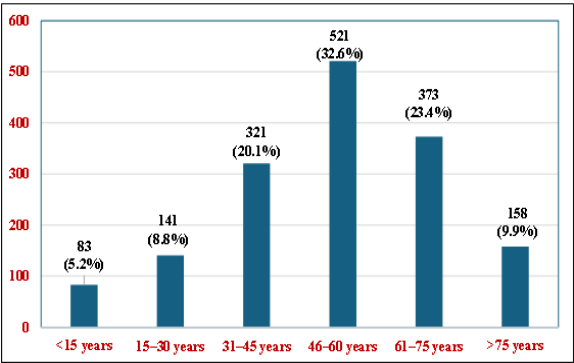


Figure 2: Age distribution of the cases (n=1597).

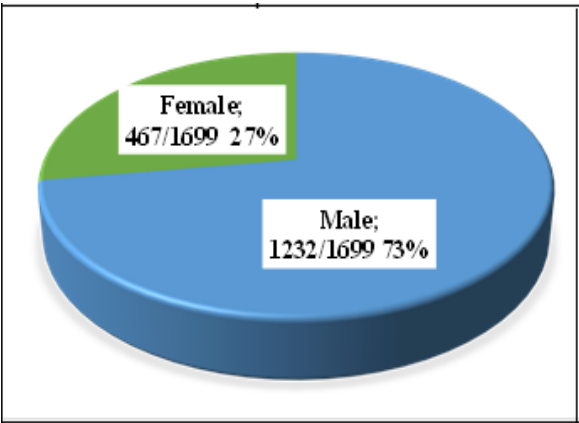


Figure 3: Sex distribution of the cases (n=1699).

Renal enlargement was reported in 1,051/1,732 cases (60.7%). Out of 1732 cases, the mean length was 10.7 ± 1.7 cm with a range of 7.1 to 14.5 cm, and for the width, the mean was 5.3 ± 1.06 cm with a range of 1.5 to 9 cm. The main macroscopic finding was hemorrhagic foci in the majority of cases (1264/1732, 72.9%) (Table 1).

Table 1: Macroscopic findings

Macroscopic findings		n (%)
Size of the kidney (n=1732)	Normal	625 (36.1)
	Enlarged	1051 (60.7)
Macroscopic finding (n=1732)	Atrophic	56 (3.2)
	Hemorrhagic foci	1264 (72.9)
	Cystic changes	199 (11.5)
	Loss of corticomedullary differentiation	162 (9.4)
	Unremarkable pathology	72 (4.2)
	Cavitary lesion	18 (1.0)
	Solid lesion	17 (1.0)

Note: Kidney size and macroscopic findings were recorded separately, with one macroscopic finding assigned to each case.

Regarding renal compartment involvement (defined according to the predominant histopathological compartment affected), tubulointerstitial lesions (involving the renal tubules and/or interstitium) were identified in 1,111/1,732 (64.1%) cases, while glomerular lesions (involving the glomeruli) were identified in 310/1,732 (17.9%) cases (Figure 4). Representative histopathological findings from the study cases (Figure 5).

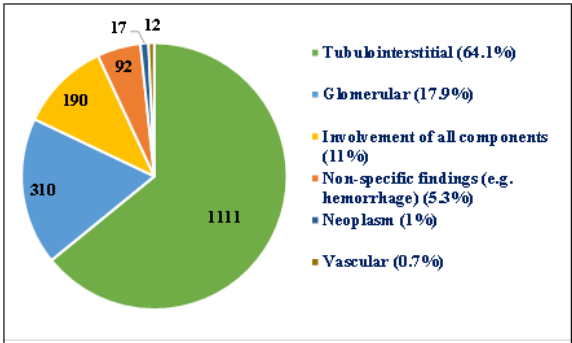


Figure 4: Case distribution according to the renal compartment involved (n=1732). Categories were mutually exclusive, with each case assigned to one predominant category.

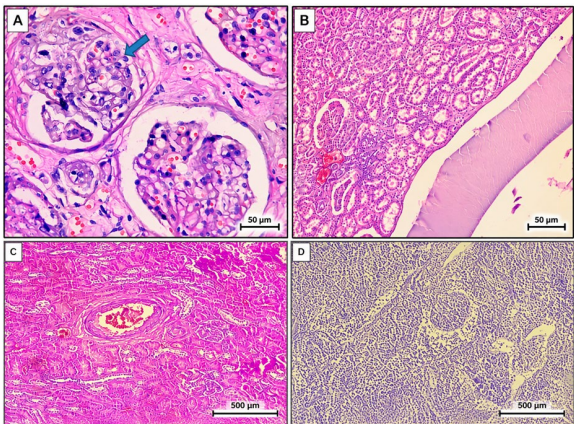


Figure 5: (A) A 55-year-old man's renal sections exhibit microscopic signs of chronic glomerulonephritis, such as increased mesangial matrix (arrow) associated with interstitial fibrosis (hematoxylin and eosin [H&E] stain, high-power, 40 x; scale bars = 50 μ m). (B) Renal sections from a 55-year-old female diabetic patient exhibit microscopic signs of diabetic nephropathy, including mesangial expansion, thickened glomerular capillary walls, and tubular atrophy (Hematoxylin and eosin [H&E] stain, high-power, 40 x; scale bars = 50 μ m). (C) Renal sections from a 25-year-old man with a known case of pulmonary tuberculosis exhibit microscopic characteristics of renal tuberculosis, such as granulomatous inflammation made up of epithelioid histiocytes with surrounding lymphocytic infiltration and giant cell formation (Hematoxylin and eosin [H&E] stain, medium-power, 10 x; scale bars = 500 μ m). (D) A 50-year-old man's renal sections exhibit characteristics of clear renal cell carcinoma, including sheets and nests of tumor cells divided by thin septa (Hematoxylin and eosin [H&E] stain, medium-power, 10 x; scale bars = 500 μ m).

The most frequent microscopic diagnosis in the present study was pyelonephritis, accounting for (706/1732, 40.8%) of cases, indicating predominant tubulointerstitial renal involvement, followed by glomerulonephritis, which represented (276/1732, 15.9%) of cases and constituted the most common glomerular lesion. Uncommon lesions, including TB, neoplasms, and vascular lesions, were identified in 47 of 1,732 cases (2.7%). Of the total 1,732 cases, TB accounted for 18 (1.0%), neoplasms for 17 (1.0%), and vascular lesions for 12 (0.7%) (Table 2). TB was the most frequent uncommon lesion, accounting for 18/47 cases (38.3%), followed by neoplasm, accounting for 17/47 (36.2%). Among the neoplasms, renal cell carcinoma (RCC) was identified in 9/17 (52.9%) and about 0.5% of all examined cases, with all nine RCC cases occurring in males (100%). Among the vascular lesions, renal infarction was the most common lesion, accounting for 4/12 (33.3%) of cases (Table 3).

Table 2: Microscopic findings and diagnosis (n=1732)

Microscopic findings and diagnosis	n (%)
Chronic kidney disease	190 (11.0)
Glomerulonephritis	276 (15.9)
Diabetic nephropathy	34 (2.0)
Pyelonephritis	706 (40.8)
Acute kidney injury	160 (9.2)
Interstitial nephritis	189 (10.9)
Cystic lesion	38 (2.2)
Nonspecific findings	92 (5.3)
Uncommon lesions	47 (2.7)
Total	1732 (100)

Note: Diagnostic categories were mutually exclusive; each case was classified according to its principal histopathological diagnosis.

There was a statistically significant association between age group and renal diagnosis among 1,597

cases. There was a statistically significant association between sex and renal diagnosis among 1,699 cases (Tables 4 and 5).

DISCUSSION

Autolysis was found in 102 cases; it can resemble acute tubular injury (ATI). According to Castelino *et al.* (2023), postmortem autolysis causes homogeneous nuclear pyknosis in all tube segments, which helps in differentiating it from actual clinical damage. Therefore, to prevent overdiagnosing ATI, it is crucial to identify autolysis [9].

Table 3: Types and subtypes of uncommon renal lesions

Category	Subtype	n (%)
Tuberculosis, 18 (38.3%)	Tuberculosis	18 (100.0)
Neoplasms, 17 (36.2%)	Renal cell carcinoma	9 (52.9)
	Lymphoma	2 (11.8)
	Metastasis	2 (11.8)
	Spindle cell tumor	1 (5.9)
	Benign adenoma	1 (5.9)
	Nephroblastoma	1 (5.9)
	Medullary fibroma	1 (5.9)
Vascular lesions, 12 (25.5%)	Renal infarction	4 (33.3)
	Arterionephrosclerosis	3 (25.0)
	Degenerative vascular disease	2 (16.7)
	Ischemic nephropathy	2 (16.7)
	Vasculitis	1 (8.3)
Total, 47 (100%)		

Note: Category percentages were calculated among all uncommon lesions (n = 47), while subtype percentages were calculated within their respective categories.

Table 4: Association between age and diagnosis

Diagnosis	Age						n	p-value
	<15	15-30	31-45	46-60	61-75	>75		
Cystic lesion	2(2.6)	0(0.0)	2(0.6)	12(2.3)	13(3.2)	4(2.6)	33	< 0.001
Chronic kidney disease	0(0.0)	5(4.1)	30(9.5)	62(11.9)	59(14.5)	19(12.2%)	175	
Pyelonephritis	28(36.8)	52(42.6)	112(35.3)	198(38.1)	177(43.6)	79(50.6%)	646	
Tuberculosis	2(2.6)	5(4.1)	2(0.6)	5(1.0)	1(0.2)	1(0.6%)	16	
Neoplasm	1(1.3)	7(5.7)	5(1.6)	3(0.6)	0(0.0)	0(0.0%)	16	
Glomerulonephritis	4(5.3)	10(8.2)	43(13.6)	90(17.3)	81(20)	24(15.4%)	252	
Diabetic nephropathy	1(1.3)	1(0.8)	4(1.3)	18(3.5)	6(1.5)	1(0.6%)	31	
Acute kidney injury	12(15.8)	11(9.0)	52(16.4)	45(8.7)	28(6.9)	7(4.5%)	155	
Interstitial nephritis	15(19.7)	21(17.2)	39(12.3)	56(10.8)	34(8.4)	17(10.9%)	182	
Vascular disorder	0(0.0)	0(0.0)	2(0.6)	4(0.8)	2(0.5)	2(1.3%)	10	
Nonspecific findings	11(14.5)	10(8.2)	26(8.2)	27(5.2)	5(1.2)	2(1.3%)	81	
Total (n= 1597)	76(100)	12(100)	317(100)	520(100)	406(100)	156(100)	1597	

Significant association was observed using Pearson's chi-square test ($\chi^2 = 192.19$, degrees of freedom = 50). 95% CI: 0.110–0.157, Cramer's V = 0.155

Values are presented as frequency and percentage. Cramér's V is small (≥ 0.10), medium (≥ 0.30), and large (≥ 0.50). Note: Totals for diagnostic groups differ across the table due to missing age data for 135 cases.

Table 5: Association between the sex and diagnosis

Diagnosis	Male	Female	Total	p-value
Cystic lesion	30(2.4)	8(1.7)	38	<0.001
Chronic kidney disease	128(10.4)	54(11.6)	182	
Pyelonephritis	570(46.3)	126(27)	696	
Tuberculosis	15(1.2)	3(0.6)	18	
Neoplasm	15(1.2)	2(0.4)	17	
glomerulonephritis	192(15.6)	76(16.3)	268	
Diabetic nephropathy	26(2.1)	8(1.7)	34	
Acute kidney injury	76(6.2)	79(16.9)	155	
Interstitial nephritis	123(10)	64(13.7)	187	
Vascular	5(0.4)	7(1.5)	12	
Nonspecific findings	52(4.2)	40(8.6)	92	
Total (n=1699)	1,232(100)	467(100)	1699	

Significant association was observed using Pearson's chi-square test ($\chi^2 = 100.17$, degrees of freedom = 10).

95% CI: 0.183–0.280, Cramer's V = 0.243

Values are presented as frequency and percentage. Cramér's V is small (≥ 0.10), medium (≥ 0.30), and large (≥ 0.50). Note: Totals for diagnostic groups differ across the table due to missing sex data of 33 cases.

The mean age of the studied cases was 52.8 ± 18.4 years, with the most affected age group being 46–60 years, followed by 61–75 years, indicating that most cases occurred among middle- and older individuals. This age distribution is consistent with a study reported by Desai *et al.* (2020) [10]. Males made up about 73% of the autopsy cases, with an M:F ratio of approximately 2.6:1, consistent with research by Omenai *et al.* (2021) [11]. However, the sex distribution reported by Perrone *et al.* (2018) differed from that observed in the present study, which may be attributed to variations in study populations [12]. Macroscopic examination demonstrated that the kidneys were enlarged, with hemorrhagic foci being the most common finding (72.9%); our finding agreed with those of Basra *et al.* (2025) [13]. In contrast, Padmanabhan *et al.* (2017) found contracted kidneys to be the predominant gross finding, mainly due to chronic glomerulonephritis [14]. The variation in gross findings between studies may be related to differences in the underlying renal pathologies. Tubulointerstitial lesions accounted for the majority of renal involvement (64.1%), significantly outnumbering glomerular (17.9%) and vascular (0.7%) lesions. According to a prior retrospective autopsy study by Khare *et al.* (2021), tubulointerstitial pathology was the most common pattern of renal involvement in autopsy cases (58.49%) [15]. In the microscopic findings, the most common diagnosis was pyelonephritis (40.8%), followed by interstitial nephritis (10.9%) and AKI (9.2%). The high frequency of pyelonephritis may be a reflection of poor sanitation and poverty in developing nations [16]. Our results, however, contradict those of Sandhu *et al.* (2017) in India, who found that AKI was the most common finding, primarily as a result of poisoning, drug abuse, and deaths from snakebite [17]. Interstitial nephritis accounted for 10.9% (189 cases), comparable to the 12.72% reported by Saniha *et al.* (2025), reflecting chronic inflammatory injury caused by infections and systemic diseases, and may indicate previously unrecognized or poorly controlled CKD [18]. 11.0% of cases had CKD, which is consistent with the 10% found by Sahoo *et al.* (2023), despite the fact that their analysis was based on a smaller autopsy series of 80 cases [19]. However, our results are less than the 37.5% reported by Mondal *et al.* (2023) [20]. These results can be due to variations in the research populations, healthcare access, and delayed diagnosis, which continue to be significant obstacles, especially in areas with limited resources [21]. The most common glomerular lesion was glomerulonephritis, which was seen in 276 cases (15.9%), in line with retrospective research by Omenai *et al.* (2021), which found that 12.9% of glomerular lesions were caused by chronic glomerulonephritis [11]. On the other hand, diabetic nephropathy was shown to be the most common glomerular lesion (16%) in 140 adult autopsies evaluated by Perrone *et al.* (2018). The variation illustrates how different autopsy-based studies have different glomerular lesion distributions [12]. Diabetic nephropathy was identified in 34 cases (2.0%). In contrast, Klessens *et al.* (2016) reported histologically

diabetic nephropathy in 106 of 168 (63%) autopsied cases. The markedly higher frequency is due to the fact that their study cases were restricted to patients with diabetes [22]. As described by Abusaib *et al.* (2020), for the past 30 years, diabetes has been steadily increasing worldwide, especially in LMICs [23]. Neoplastic lesions were detected in 17 cases (1%), with RCC being the predominant tumor, consistent with Rzepecka *et al.* (2014) [24]. Renal TB was identified in 18 cases (1.0%). In comparison, Dharshini and Jeyalakshmi (2024) reported 2 cases of tuberculosis in a smaller 30-case autopsy series (6.7% of all autopsies), with both studies relying on histopathological findings suggestive of tuberculosis [25]. Vascular lesions were identified in 12 cases (0.7%), predominantly renal infarction, which is often underdiagnosed clinically because of its nonspecific presentation in line with Saju and Leslie (2024) [26]. With all factors considered, these results demonstrate the importance of autopsy analysis in detecting concealed kidney disorders. A significant association was found between age and the distribution of renal disorders, with pyelonephritis and glomerulonephritis being more common in middle- and elderly age groups, which is similar to the findings of Sumnu *et al.* (2015), who found that these kidney disorders become more common with increasing age [27]. Similarly, a significant association was discovered between sex and renal disease distribution, with males having a higher frequency of renal pathology, consistent with Kattah and Garovic (2020) [28]. Oshima *et al.* (2023) also explained that males are at higher risk due to greater exposure to modifiable risk factors, which contributes to the faster progression of renal disease in males [29].

Study Limitations

Retrospective, single-center design; demographic variables were incomplete in some cases; kidney weight was unavailable. Diagnoses were also based primarily on archived H&E sections, without systematic immunofluorescence, immunohistochemistry, electron microscopy, microbiological, or molecular confirmation. Additionally, the study could not establish whether identified lesions contributed to death or represented incidental findings.

Study Strengths

The strengths of this study include the large autopsy sample size, the inclusion of cases spanning a five-year period, and the systematic review of archived histopathological material. The study also provides a general description of kidney disease findings, including rare kidney lesions.

Conclusion

The distribution of renal diagnoses differed significantly across age groups, and renal pathological diagnoses were more frequent among males in this autopsy series, demonstrating the importance of demographics in renal

disease patterns. Enlarged kidneys with hemorrhagic foci were the most common macroscopic findings. Tubulointerstitial lesions were the most common pattern of renal involvement, with pyelonephritis being the most common microscopic diagnosis. Diabetic nephropathy and CKD illness demonstrated the growing influence of metabolic and chronic systemic disorders on renal pathology. Despite their rarity in the study, notable findings included histological features suggesting renal TB and vascular renal lesions, demonstrating that autopsy examination can reveal previously unsuspected renal pathologies. These findings collectively emphasize the importance of clinicians and forensic pathologists recognizing the wide range of renal diseases, public health programs, multicenter studies using standardized diagnostic criteria with appropriate ancillary investigations, and increased awareness among healthcare providers, as renal tuberculosis can remain clinically silent and can often be identified only during autopsy examinations.

Conflict of interests

The authors declared no conflict of interest.

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The authors did not receive any source of funds.

Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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