Original Article

DOI: 10.7860/NJLM/2024/70168.2875

Unravelling the Histomorphological Features of Kidney: An Autopsy-based Study

Pathology Section

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ABSTRACT

Introduction: Renal failure and End-stage Renal Disease (ESRD) are one of the leading causes of mortality. The presence of co-morbidities like Diabetes Mellitus (DM), Hypertension (HT), pregnancy, liver diseases, and various infections accelerates renal failure. Understanding the pathophysiology of Acute Renal Failure (ARF) is necessary to interpret and correlate the spectrum of morphologic changes associated with it.

Aim: To study the aetiopathological causes of renal failure and evaluate the histopathological features associated with them.

Materials and Methods: A cross-sectional autopsy-based study was performed in the Department of Pathology, Topiwala National Medical College, Mumbai, Maharashtra, India over three consecutive years. A total of 650 adult autopsies were studied. Clinical and laboratory details were obtained from hospital records. Gross and histopathological examinations were performed with a special focus on the kidneys. Special stains were performed wherever required to highlight any characteristic features.

Results: It was found that males (n=460) were more affected than females (n=190). The age range was 13-90 years. The majority of autopsies were performed within 24 hours of hospital stay. Acute febrile illness was found to be the most common cause of ARF. Maximum number of cases were from medical units (n=520, 80%), followed by surgical (n=94, 14.5%) and gynaecological units (n=36, 5.5%). Features of Acute Kidney Injury (AKI) were seen in (n=374) 57.6% of cases, while Advanced Renal Disease (ARD) was noted in 10.9% of cases. Incidental findings at autopsy included two cases of renal cortical adenoma, one case each of renal cell carcinoma and medullary fibroma.

Conclusion: Acute febrile illness does not just a reflect ion of co-existent pathologies but also directly contributes to mortality, possibly due to the risk of non renal complications like bleeding and sepsis. In the present study, the majority of cases were from medical units, in a young age group with a male predominance. Maximum cases had a short hospital stay. Several characteristic histopathological features in the kidney were identified in different clinical settings, aiding in pinpointing the cause of death. Autopsy findings of the kidney are indeed a treasure untouched and needs to be explored and warrants meticulous investigation.

Keywords: Acute kidney injury, Acute renal failure, Acute tubular necrosis

INTRODUCTION

The relative incidence of renal pathology attributing to natural causes of death is 1.5%. In renal pathology, ESRD has a 40% incidence, and sepsis, one of the major causes of ARF, has an incidence of 37% [1]. Mortality associated with an episode of AKI is about 23.9% in adults and 13.8% in children [2]. ARF carries an extremely high mortality rate, and patients suffer from many complications like gastrointestinal haemorrhage and infection. Once renal failure develops, little can be done to alter the clinical course. Treatment usually consists of supportive therapy in the form of dialysis [3]. ARF includes a wide spectrum of renal lesions ranging from sublethal cellular swelling, loss of brush borders to Acute Tubular Necrosis (ATN). ARF is a broad term and encompasses all the clinical syndromes associated with both parenchymal and extrarenal factors that result in the loss of renal function [4]. Kidney biopsy is usually avoided in terminally-ill patients, and hence autopsy remains the ultimate tool to understand and learn renal pathology. Not only incidental findings, but the kidney reveals a host of other findings associated with DM, medical renal diseases (glomerulonephritis), tubulointerstitial diseases, HT, etc., [5]. Autopsy remains indispensable as it bridges the gap between histopathology and clinical correlation and at times can prevent unexpected catastrophes like maternal mortality. Gross examination of the specimen is not sufficient alone as the organ might not show visible changes. Microscopy thus helps in establishing the diagnosis and fills the lacuna in the pathogenesis [6]. For these reasons, this condition has a great deal of interest to physicians and pathologists as well.

Traditionally, AKI has been assessed using serum creatinine level and urine output. However, these parameters never highlight the actual site of injury. There is an increasing trend of using novel biomarkers for AKI, but this provision is not accessible to all healthcare systems [7]. Not to underestimate, the available resources like autopsy yield qualitative study material. So, learning can absolutely continue, even from the dead. The present study has the following objectives:

- To study the aetiopathological causes of renal failure.
- To study and evaluate the spectrum of histomorphological features of ARF in various conditions like acute febrile illnesses, liver diseases, systemic diseases (DM, HT), maternal mortality, etc.,
- To evaluate the presence of incidental tumours, if any.

MATERIALS AND METHODS

A cross-sectional autopsy study was carried out in the Department of Pathology a tertiary care municipal hospital, Topiwala National Medical College, Mumbai, Maharashtra, India for three consecutive years after obtaining ethical approval from the Institutional Ethics Committee (PG-14907). A total of 650 adult autopsy cases (both males and females) were studied in which the patients had died secondary to some disease (medical, surgical, obstetric, and gynaecological causes) under non suspicious circumstances.

Inclusion and exclusion criteria: Healthy patients aged less than or equal to 12 years were considered paediatric and were not included in the study. Paediatric patients, immunocompromised patients

{Human Immunodeficiency Virus (HIV) positive}, and medicolegal cases were excluded.

Study Procedure

Details like demographic profile, complete history, laboratory data, Final Cause of Death (FCOD), etc., were procured from the hospital records. The clinical data was recorded under the following headings: autopsy number and year, age, gender, total hospital stay, history with chief complaints, laboratory investigations including post-mortem investigations {like blood culture, peripheral blood smear for malarial parasites, rapid card test for leptospirosis/dengue, Liver Function Test (LFT), and Renal Function Test (RFT)}, and time since death when the autopsy was performed.

A complete or partial autopsy was performed. Gross examination of each organ was done meticulously with a special emphasis on the kidney. A minimum of two representative sections of the kidney were studied for histopathology. The sections were fixed in formalin, paraffin-embedded, and blocks were made. Sections were cut on a microtome (three microns), and routine Haematoxylin and Eosin (H&E) stains were done. Only light microscopy was done.

Special stains were performed, like Periodic Acid Schiff (PAS) to highlight basement membrane hyaline casts, Gomori Methanamine Silver (GMS) to evaluate glomerular and tubular basement membrane, and Masson's Trichrome was helpful to identify fibrous connective tissue, fibrin, and fibrinoid deposits. Other stains, like Congo red for amyloid, Von Kossa for Calcium, and Phosphotungstic Acid Haematoxylin (PTAH) for fibrin thrombi in glomeruli and blood vessels, were performed. Immunohistochemistry (IHC) CD34 was performed to confirm the presence of immature Haematopoietic Stem Cells (HSC) in the vasa recta of AKI in two cases and was graded as strong (3+), intermediate (2+), weak (1+), and negative (0).

Autopsy samples were classified purely on clinical grounds into 14 categories [Table/Fig-1]. The first four categories were clubbed together (a+b+c+d) because of the common presentation (acute febrile illness). In the other categories (e to n), individual organ pathology and generalised pathological diseases were mentioned. The final remark and diagnosis of AKI were done by considering the clinical and biochemical parameters along with microscopic features of the kidney and classified into eight groups: normal histology of the kidney, pre-renal causes of ARF, renal causes of ARF, cholemic nephrosis, pyelonephritis, ARDs, autolytic kidney features, Disseminated Intravascular Coagulation (DIC)/Haemolytic Uremic Syndrome (HUS) features of the kidney [Table/Fig-2].

FCOD		n	%
a	Malaria	95	14.6
b	Leptospirosis	21	3.2
c	Intrapulmonary haemorrhage	46	7.1
d	Acute febrile illness	49	7.7
e	Renal causes	32	4.9
f	Lung causes	68	10.5
g	Liver causes	71	10.9
h	Septicaemia	61	9.3
i	Maternal mortality	44	6.7
j	Diabetes/hypertension (HT)	46	7.1
k	Malignancy	39	6
l	Tuberculosis (TB)	51	7.8
m	Acute blood loss/Circulatory Collapse	18	2.8
n	Miscellaneous	9	1.4
	Total	650	100.0

[Table/Fig-1]: Showing Final Cause of Death (FCOD).

Remark	Frequency (n)	Percentage (%)
Normal kidney	174	26.8
Pre-renal ARF	229	35.2
Renal ARF	145	22.4
Cholemic nephrosis	10	1.5
Pyelonephritis	51	7.8
Advanced Renal Disease (ARD)	20	3.1
Autolytic changes	4	0.6
DIC/HUS-like features	17	2.6
Total	650	100

[Table/Fig-2]: Showing remark of renal pathology.

STATISTICAL ANALYSIS

Statistical analysis was done as age distribution, sex ratio, as well as the incidence of AKI with an analysis of different microscopic features of the kidney in relation to FCOD and the final remark. All the analyses were done by using Statistical Package for Social Sciences (SPSS) 10 software, and the results were accepted as significant when the p-value was less than or equal to 0.05 in the Chi-square test.

RESULTS

A total of 650 cases were studied, out of which 153 cases (23.5%) were of the first year, 239 cases (36.8%) were of the second year, and 258 cases (39.7%) were of the third year. The study comprised predominantly male patients 460 (70.8%) and females 190 (29.2%). The male-to-female ratio was 2.4:1. The youngest patient was 13 years old, and the eldest was a 90-year-old female, so the age range was 13 to 90 years. The maximum autopsies were performed in the age group of 31 to 40 years 167 (25.7%) followed by 21 to 30 years 159 (24.5%), while the 81 to 90 years group comprised the least number of cases 5 (0.8%). Features of AKI were seen in 57.6% of cases, while ARD was noted in 10.9% of cases.

The majority of autopsies 396 (61%) were done in cases with less than 24 hours of hospital stay, of which 367 autopsies (56.4%) were performed within 12 hours of death. An autopsy was mandatory in cases with a hospital stay of less than 24 hours and in postoperative cases as per the rule. The majority of the patients were from medical units 520 (80%), followed by surgical units 94 (14.5%) and gynaecology 36 (5.5%). Out of 650 patients, 211 (32.5%) patients had acute febrile illness (a+b+c+d), of which malaria was predominant with 95 cases (14.6%). Also, there were 61 cases (9.4%) of septicaemia with significant renal involvement. Out of 374 cases of ARF, 229 cases (35.2%) showed pre-renal azotemia, while 145 cases (22.4%) were reported as primary renal azotemia. Swollen kidney was found in 302 cases (46.4%), and small granular contracted kidney was seen in 84 cases (12.9%). A total of 50 percent of the contracted kidneys were seen in pyelonephritis and ARD. Out of 650, 18 cases (2.8%) had hypovolemic shock with features of ARF mainly due to acute blood loss and Acute Gastroenteritis (AGE).

Grossly, congestion and prominent striations were seen in 363 cases (55.8%). There were four cases of papillary necrosis seen as a complication of sepsis and sickle cell crisis and 14 cases of cortical infarction. A total of 246 cases (37.8%) showed apparent flattening and dilatation with necrosis of the epithelium of Proximal Convoluted Tubules (PCT).

Hyaline casts and pigmented casts were seen in 271 cases (41.5%) as a features of AKI. Calcification in the Distal Convoluted Tubule (DCT) and collecting ducts (3.1%), along with atrophy of tubules (4.8%), were mainly associated with ARD. Non specific oedema and mild lymphocytic infiltration were seen in 437 cases (67.2%), while 154 cases showed features of acute tubulointerstitial nephritis.

Out of 374 cases of AKI, PCT changes were noted in 210 cases (56.1%), while in 256 cases (68.4%), DCT showed AKI features. Large nucleated HSCs were seen in the vasa recta in 359 cases (55.2%) with AKI [Table/Fig-3]. The Chi-square test showed a significant association between PCT, DCT, and Vasa Recta findings with ARF (p-value <0.001) [Table/Fig-3].

S. No.	Remark	PCT	DCT	Vasa recta
1	Normal (n=174)	n=4, 2.3%	n=1 0.6%	n=0
2	Acute Renal Failure (ARF) (n=374)	N=210 56.1%	N=256 68.4%	N=346 92.5%
3	Other diseases (DM/HT=46, MM=44, Miscellaneous=12) (n=102)	N=32 31.3%	N=14 13.7%	N=13 12.7%

[Table/Fig-3]: Showing PCT, DCT and vasa recta with features of acute kidney injury. Chi-square test showed significant association between PCT; DCT and Vasa Recta findings with ARF; highlighted in bold numbers (p-value <0.05)

Mesangiolysis was seen in 176 cases (27.1%). A total of 35 cases (5.4%) of malaria and sepsis showed proliferative glomerulonephritis with AKI. Glomerulosclerosis seen in 73 cases (11.2%) was the predominant finding in all scarred contracted kidneys. There were 22 cases (3.4%) with autolytic changes like swollen epithelium and loss of nuclei. Neutrophilic tubulitis was seen in all 21 cases of leptospirosis. Evaluation of blood vessels showed that in the majority of cases 377 (58%), blood vessels were normal, and in 198 cases (30.5%), blood vessels showed medial thickening along with other ARD findings. In cases of DIC and HUS, 15 out of 17 cases (88.2%) showed fibrin thrombi and fibrinoid necrosis of the vessel wall.

Miscellaneous cases included glomerulopathy associated with chickenpox (n=2) and measles (n=2). Amyloidosis of the kidney was reported in two patients who presented with ARF. Malignancy was seen in four cases and reported as renal cortical adenoma (n=2), renal cell carcinoma (n=1), and renomedullary interstitial cell tumour (n=1). Autolysis was a prominent feature when performed 24 hours after death (n=35). Out of these 35 cases, four showed complete autolysis.

DISCUSSION

Out of 650 autopsies, ARF was mentioned in FCOD in only 96 cases (14.7%). After reviewing all 650 kidney sections and considering the clinical history and spectrum of ARF, 374 cases (57.6%) showed ARF [8]. Aggarwal HK et al., reported ARF in only 1.9% of all the patients in their study [9]. This contrast was seen as their study was Outpatient Department (OPD) based, while most patients develop ARF during the course of the primary disease or as a surgical complication. On the other hand, Nash K et al., mentioned ARF in 38.2% of cases [3].

In our study, maximum patients were from medical units (80%), followed by surgical cases (14.5%) and gynaecological cases (5.5%). Aggarwal HK et al., reported similar findings where medical renal failure was the most common cause (64.6%), followed by surgical (23.8%) and obstetrical causes (12.6%) in their study of 232 patients [9]. Sakhuja V et al., and Chugh KS et al., also reported similar findings [10,11]. Devrajan P mentioned renal vasculature shutdown and associated ischaemic injury with pale cortex and congested medulla [12]. These findings are consistent with this study, where 138 out of 374 cases showed congestion and prominent cortical striations.

In the present study, males were affected more than females, with a sex ratio of 2.4:1, which is similar to the studies by Yadav and Dr. SNS, Mulay PS and Khosla A, Kaur A et al., and Sahoo SK et al., [13-16]. The most common age group involved was 31-40 years, which is similar to the studies by Yadav SNS et al., Mulay PS et al., and Kaur A, while the study by Sahoo SK et al., shows involvement of an older age group [Table/Fig-4] [13-16].

S. No.	Studies	Male: Female ratio	Most common age group affected (years)
1	Yadav SNS and Bhattacharya AB, Uttar Pradesh, 2019, [13]	1.8:1	31 -50
2	Mulay PS and Khosla A Maharashtra, 2020 [14]	2.1: 1	20-40
3	Kaur A et al., Punjab 2018 [15]	4:1	21-40
4	Sahoo SK et al., Odisha, 2023 [16]	3:1	51-70
5	Present study	2.4:1	31-40

[Table/Fig-4]: Comparison of different studies according to sex ratio and most common age group [13-16].

Out of 650 cases, 29 cases (4.5%) showed small abscesses on the renal cortex, and out of these 29 cases, 11 cases (2.9%) showed features of ARF. Mittal BV, in her study of renal lesions in infective endocarditis, reported similar findings where renal involvement in sepsis shows subtle features of ARF [17]. Tuberculosis (TB) was seen in 51 out of 650 cases, of which 24 cases (47%) showed miliary tubercles on the kidney. Out of 24 cases, 10 cases (41.6%) had features of ARF. Pulmonary TB spreads via the haematogenous route to distant organs like the kidney, and it is the most common site of extrapulmonary TB [18,19]. A variety of lesions are seen in the kidney, beginning from granulomas, ulcers, abscesses (putty kidney), necrosis, calcification (cement kidney), and amyloidosis [19]. In the later stages, the kidney becomes non functional. TB affects the glomerular filtration rate and leads to chronic granulomatous interstitial nephritis [19]. Shribman JH et al., mentioned a case of miliary TB with focal proliferative glomerulonephritis [20].

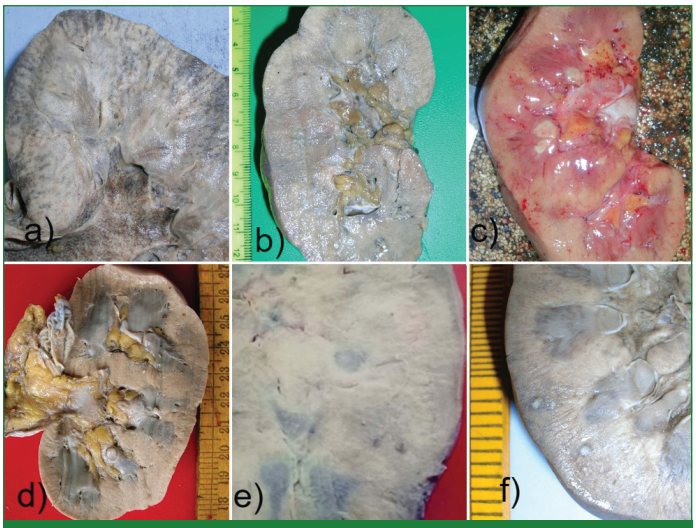
Out of 650 cases, cortical infarction was seen in a total of 14 cases, of which ten cases were seen in sepsis, one case each of fungal infection and acute pyelonephritis with DM, and two cases of cortical infarction in maternal mortality. These findings are similar to the study by Matlin RA and Gary NE [21].

Out of 650 cases, there were 17 cases (2.5%) of DIC associated with obstetrical complications or sepsis. Fibrin thrombi in the kidney and ARF were seen in 16 out of 17 cases (94.1%). Michelle H has reported the involvement of the kidney in DIC with fibrin in 67% of cases [22]. Sheehan HL has mentioned 87% of cases of DIC with fibrin thrombi in the kidney [23]. Out of 650 cases, 44 cases (6.8%) of maternal mortality were studied, which were associated with complications like postsurgical bleeding, postpartum haemorrhage, preeclampsia, and DIC. Fibrin thrombi were seen in 15 cases (34%) which had DIC and ARF. Michelle H mentioned that preeclampsia was the most common glomerular disease worldwide and a leading cause of maternal morbidity and mortality, affecting 7-10% of pregnancies [22]. These features were also explained by Heaton JM and Turner DR using renal biopsy, which showed characteristic endotheliosis [24].

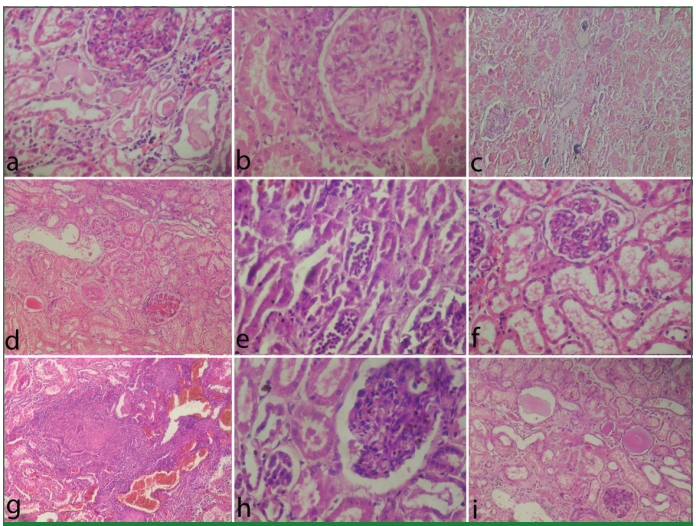
Neutrophilic tubulitis is the accumulation of neutrophils within the lumen of the PCT without the presence of granular casts. Neutrophilic tubulitis with ARF, one of the specific findings, was seen in all 21 cases (100%) of leptospirosis. Interstitial nephritis with tubular necrosis as a feature of Leptospirosis was also mentioned by Salkade HP et al., [25]. The gross and microscopic features of renal involvement in different clinical conditions, has been shown in [Table/Fig-5,6].

Liver disease was seen in 71 out of 650 cases (10.9%). Out of 71 cases, 41 cases (57.7%) showed intraepithelial yellow-brown pigment in the PCT, and 75% of these cases had acute hepatitis and features of AKI. Hepinstall explained the deposition of haemosiderin in the cytoplasm of the PCT in cases of haemolysis associated with febrile illnesses and sickle cell anaemia [26]. Out of 650 cases, bile casts and pigmented casts were seen in 42 cases (6.5%) of acute fulminant as well as non fulminant hepatitis due to either Hepatitis A or Hepatitis E viral infection and hyperbilirubinemia due

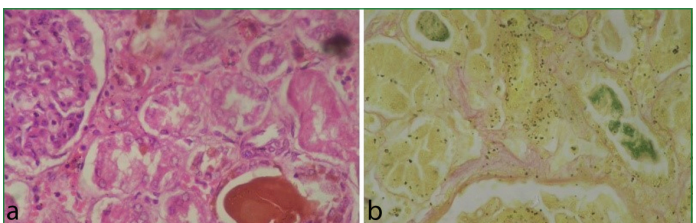
to haemolysis in malaria and leptospirosis. Out of these 42 cases, 37 (76%) showed features of AKI. Faust RL, Pimstone N, mentioned the presence of bile casts in DCT and Hepatitis A virus infection [27]. The bile casts in the kidney in a case of hepatitis along with the special stain (Fouchet stain) shown in [Table/Fig-7]. A study mentioned that renal involvement in hepatitis was either secondary to the direct cytopathic effect of the virus on the epithelium or immune complexes and cryoglobulins [28].



[Table/Fig-5]: Gross image. a) Kidney showing prominent cortical striations in acute kidney injury; b) Kidney showing cortical infarction; c) Kidney showing papillary necrosis; d) Swollen kidney with pale cortex and congested medulla; e) Enlarged kidney showing diffuse involvement in a case of lymphoma; f) Kidney cortex showing miliary tubercles.

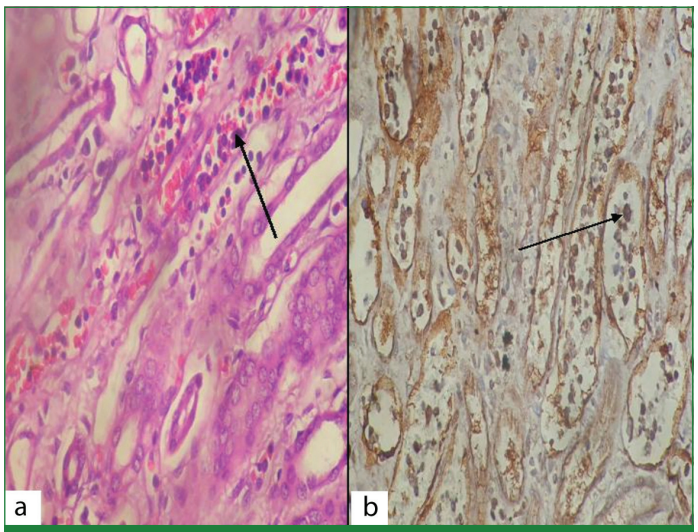


[Table/Fig-6]: Microphotographs of kidney. a) PCT with apparent dilatation and flattening of epithelium in AKI (H&E, 10x); b) Kidney showing marked mesangiolysis (H&E, 40 x); c) Kidney showing swollen epithelium, loss of nuclei suggestive of autolysis (H&E, 10x); d) Kidney showing fibrin thrombi in glomeruli, in DIC case (H&E, 40x); e) Kidney showing neutrophilic tubulitis in a case of Leptospirosis H&E, 40x); f) Kidney showing hyaline and pigmented casts in AKI (H&E 10x); g) Kidney showing tubercular granulomas (H&E, 10x); h) Kidney showing brown malarial pigment in mesangium (H&E, 40x); i) Kidney showing thyroidisation (H&E, 40x).



[Table/Fig-7]: Microphotographs of kidney. a) Kidney showing bile casts in a case of acute hepatitis (H&E, 40x); b) Fouchet stain highlighting green coloured (bile) casts in kidney (H&E, 40x).

In the present study, the authors found the accumulation of large nucleated CD34 positive (3+) erythroblasts, immature myeloid cells, and megakaryocytes in the vasa recta in cases of ARF. This positivity is due to the presence of the CD34 protein, which is easily picked up by IHC [29,30]. The kidney showing immature haematopoeitic cells which are highlighted by IHC for CD34 shown in [Table/Fig-8]. This association was statistically significant ($p<0.05$). Scheburt GE mentioned the accumulation of immature blood cells in medullary vessels mainly associated with renal failure [31]. Hepinstall suggested that the presence of nucleated cells is a common finding in cases of ARF, and in many cases, it is the only histologic clue for the diagnosis of ARF [32]. Bonventre JV reported that hypoxic injury to the tubules and blood vessels releases growth factors which stimulate local erythropoiesis [33]. Benedetta B has suggested that the origin of these nucleated cells may be organ-specific stem cells [34]. Oliver JA et al., applied IHC to vasa recta findings associated with cases of ATN [35]. All these findings are applicable and consistent with this study.



[Table/Fig-8]: Immunohistochemistry (IHC). a) Kidney showing immature haematopoietic cells (H&E, 40x); b) Immunohistochemistry (IHC) for CD34 highlighting the immature haematopoietic cells at 40x.

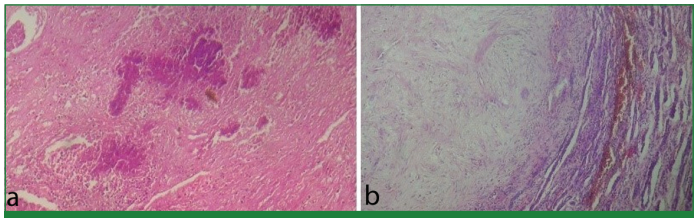
In this study, 61 cases out of 650 showed features of septicaemia secondary to surgical complications, intestinal perforation, pneumonia, and skin abscesses. Out of these 61 cases, 50 cases (81.9%) had ARF with prominent tubular necrosis. A study mentioned that 78% of cases of sepsis died due to ARF [36]. Similar findings were noted by Langenberg C et al., [37].

Renal involvement in malaria should be suspected in any febrile patient with symptoms like altered sensorium, ARF, anaemia, and jaundice. Out of 650, 95 cases (14.6%) were of malaria (*P. falciparum* n=54, *P. vivax* n=21, mixed infection n=20). Parasitised Red Blood Cells (RBCs), malarial pigment in the mesangium, and mesangial hyperplasia were seen in 41 cases (43.1%) of malaria. Renal involvement in malaria is indicated clinically by microalbuminuria, proteinuria, and the formation of urinary casts, which are seen in 20-50% of cases [38]. Nitya N et al., reported a 20-31% incidence of hepatitis associated with malaria [39]. In this study, 14.7% of patients had jaundice with malaria. Similar findings of hepatic involvement in malaria were noted by Naik BS [40].

There were 3 cases (0.4%) of diagnosed dengue fever, where ARF was seen with tubular necrosis, RBC casts, and pigmented casts in DCT related to myoglobinuria. These cases presented with oliguria and myositis. Guzmán MG and Kourí G found that 1.6% of cases of dengue had kidney involvement [41]. Gunasekera HH et al., mentioned rhabdomyolysis and myoglobinuric ARF to be associated with dengue [42].

Direct involvement of the kidney in typhoid is rare and is mostly secondary to hypovolemic shock or sepsis. In the 6 cases (0.9%) of typhoid that were studied, 2 cases (33.3%) showed features of ARF secondary to sepsis. Ata F et al., reported a case of resistant typhoid infection leading to AKI and rhabdomyolysis [43]. The possible mechanism is sepsis-induced tissue hypoxia, dehydration, acidosis, and electrolyte imbalance.

There were 3 cases (0.6%) of disseminated fungal infection (mucormycosis) with involvement of the kidney and frank tubular necrosis. Gupta KL reported that mucormycosis was the commonest fungus associated with dissemination, kidney involvement, and high mortality [44]. Levy E and Bia MJ mentioned isolated renal mucormycosis with ARF in a case report [45] [Table/Fig-9].



[Table/Fig-9]: Microphtographs of kidney. a) Mucormycosis involving kidney- large areas of necrosis seen (H&E, 10x); b) Renomedullary interstitial tumour, note the well circumscription of tumour (H&E, 10x).

The authors studied 39 cases (6%) of different systemic malignancies, most of which presented with advanced malignancy. Out of these, 16 cases (41%) presented with renal failure and showed tubular necrosis as the main finding. Banday K et al., mentioned renal involvement in advanced malignancy and late presentation as a primary or secondary to chemotherapy and drug toxicity [46] [Table/Fig-9]. Involvement of the kidney with lymphoma usually presents late as it causes whole organ infiltration without compromising the organ function until significant involvement. Multiple myeloma was seen in two cases, in which one case showed characteristic obstructive glomerulopathy and fractured casts in DCT.

Renal failure and ESRD account for death in more than 10% of all diabetic and hypertensive patients [9]. In cases of DM and HT, most patients had a history of both diseases. Out of 650, 46 cases (7.1%) of DM and 27 cases (58.6%) of HT died due to metabolic causes, ischaemic heart disease, and intracranial bleed in which most of the kidneys showed ARD. Sakhuja V et al., mentioned that DM and HT were the commonest causes of Chronic Renal Failure (CRF) [10]. Diabetes-related renal lesions and associated morbidity and mortality were reported by Gibson T and Char G, where they found that sepsis was the main cause of death [47].

In this study, three drug-addict males showed renal dysfunction associated with lung abscess, Acute Gastroenteritis (AGE) acute-on-chronic gastroenteritis. Opioids and related drugs are known to cause renal damage through ischaemic-reperfusion injury, free radical generation, urinary retention, alteration in sympathetic, parasympathetic, and renin-angiotensin systems [48]. Features of post-mortem autolysis like swollen, eosinophilic, and granular epithelium with indistinct nuclei were found in 35 cases where an autopsy was performed after 24 hours. Similar findings were noted in the study conducted by Paueksakon P and Fogo AB [49]. Comparison of different studies based on renal pathology is described using [Table/Fig-10] [15,16,50].

S. No.	Renal pathology incidence in %	Kaur A et al., Punjab, 2018, [15]	Sahoo SK et al., Odisha, 2023, [16]	Sandhu V et al, Punjab, 2017, [50]	Present study
1	Glomerular lesion	17	8.66	20	27.1
2	Tubulointerstitial lesion	32	32.28	41	23.7
3	Normal histology	25	7.09	27	27
4	Vascular lesions	26	38.58	-	55.2
5	Infections	-	4.72	-	3.4
6	Autolysis	-	7.87	-	5.3

[Table/Fig-10]: Showing comparison of different studies according to the renal pathology [15,16,50].

Limitation(s)

In the majority of cases in the present autopsy study, renal work-up was unavailable (as the renal cause of death might not have been anticipated, cases were referred, or dead body received only for autopsy), rendering clinicopathological correlation impossible.

CONCLUSION(S)

Autopsy is an economical method that helps resolve discrepancies between gross appearance and microscopy. It is a modality that helps ascertain the cause of death. Knowing the cause of death gives us insight into the aetiopathogenesis, which, in turn, helps guide treatment and prevent complications. Some diseases affecting the kidneys, like DM and HT, can be controlled through lifestyle modifications. In the present study, identification of haematopoietic stem cells was possible with the help of IHC, which is impossible in biopsy specimens. The role of histopathology cannot be overemphasised. Collection of specimens of rare entities is indeed an academic feast and a constant source of knowledge. Autopsy is surely an unopened treasure.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Feb 17, 2024
- Manual Googling: Apr 23, 2024
- iThenticate Software: May 30, 2024 (5%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Feb 16, 2024**
Date of Peer Review: **Mar 19, 2024**
Date of Acceptance: **May 31, 2024**
Date of Publishing: **Jul 01, 2024**