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Original Article

Pathology Section

A Retrospective Cross-sectional Analysis of Renal Complications in Association with Cancer: Insights from 120 Autopsies

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ABSTRACT

Introduction: Kidney diseases frequently complicate cancer and its treatment, contributing to both morbidity and mortality. Malignancies can give rise to various kidney issues, such as glomerulonephritis and Chronic Kidney Disease (CKD). This association operates bidirectionally, with patients experiencing the development of renal diseases due to cancer, and CKD predisposing to cancer. Furthermore, nephrotoxicity induced by chemotherapy can result in Acute Tubular Injury (ATI) and necrosis, imposing limitations on its application.

Aim: To evaluate the spectrum of renal pathology in autopsies of malignancies.

Materials and Methods: This was a retrospective cross-sectional study of complete autopsies of all cases of malignancies performed in the Department of Pathology, Seth GS Medical College and KEM Hospital, Mumbai, Maharashtra, India. The study was carried out over a 5-year period from January 2015 to December 2019. Analysis of cases with respect to demographics, type of primary malignancy, gross and microscopic features, and the final cause of death was conducted. These findings were meticulously tabulated, with frequencies and percentages calculated for each category.

Results: A total of 4392 autopsies were conducted throughout the study period, with 120 of them revealing the presence of malignancies. A total of 38 (31.6%) malignancies were diagnosed for the first time at autopsy. The commonest renal findings on gross were scars (superficial and deep) seen in 40 (33.33%), followed by cortical cysts in 25 (20.83%), granular contracted kidney in 15 (12.50%), mass lesions in 7 (5.83%), abscesses in 7 (5.83%), and swollen, oedematous kidneys in 6 (5%) autopsies. The most frequent renal pathology on microscopy were infective lesions seen in 43 (35.83%), Acute Tubular Necrosis (ATN) in 32 (26.66%), ATI in 30 (25%), followed by malignancies- primary and secondary in 11 (9.16%), tubular casts in 6 (5%), etc. Rare findings included membranous glomerulonephritis and Tumour Lysis Syndrome (TLS) (Acute urate nephropathy) in 1 (0.83%) each. The TLS case had classic histomorphological features of TLS, apart from laboratory parameters. Extensive deposits of uric acid crystals were seen obstructing the tubules as well as some of the glomeruli on microscopy.

Conclusion: In one-third of the cases, the malignancy was exclusively discovered during the autopsy. The study revealed a diverse array of lesions, encompassing pyelonephritis, ATN, primary and metastatic renal tumours, cast nephropathy, membranous glomerulonephritis, and TLS. One-fifth of the cases had end-stage renal disease (advanced renal disease). A significant number of the cases exhibited tumour masses within the kidneys. One-fifth of the cases had renal pathology contributing to the final cause of death, further highlighting the association between malignancies and renal pathology.

Keywords: Autopsy, Chemotherapy, Kidney disease, Malignancies, Postmortem

INTRODUCTION

Kidney disease is known to occur in patients with malignancies and significantly contributes to both morbidity and mortality. Malignancies can give rise to various kidney issues and can impact the kidney in various ways. These include paraneoplastic nephropathies, nephrotoxic effects of chemotherapy and other medications, radiation, nephrectomies for renal cell carcinoma, obstruction or compression, tumour infiltration of the renal parenchyma, and underlying conditions like diabetes and hypertension [1]. Patients with malignancies exhibit a broad spectrum of renal pathology, encompassing conditions from ATI to CKD and even TLS. Therefore, renal pathology in cancer patients may arise from both the malignancy itself and the administration of various chemotherapy and immunosuppressive drugs during treatment. This association operates bidirectionally, as patients with cancer can develop renal diseases, while CKD can also predispose individuals to cancer.

Different malignancies have been found to occur in different stages of CKD. The prevalence of estimated Glomerular Filtration Rate (eGFR) of <60 mL/min per 1.73 m^2 in cancer patients is estimated to be 12-25% [2]. CKD stage 5 is associated with a higher risk of developing cancers of the kidney and urinary bladder, as well as infection-associated malignancies such as carcinoma of the cervix, carcinoma of the lung, and liver malignancies due to immunosuppression. CKD stage 3 in men is known to cause an elevated risk of cancers of the urinary tract [2].

Acute Kidney Injury (AKI), proteinuria, and electrolyte disturbances are the most frequent renal diseases following chemotherapy and targeted therapies. Almost 50% of patients with multiple myeloma have AKI at presentation, and 10% required dialysis [3]. Cancer-associated AKI is common and associated with CKD, diabetes, and the concomitant use of diuretics with angiotensin-converting enzyme inhibitors/angiotensin receptor blockers [4]. Hence, the aim of the study was to evaluate the spectrum of renal pathology in autopsies of malignancies, as well as to assess the number of autopsies where renal pathology contributed significantly to the final cause of death. And the objective was to investigate the prevalence and types of renal pathology associated with different types of malignancies.

MATERIALS AND METHODS

This is a retrospective cross-sectional study of complete autopsies of all cases of malignancies performed in the Department of Pathology at Seth GS Medical College and KEM Hospital, Mumbai, Maharashtra, India. The study was carried out over a 5-year period from January 2015 to December 2019. During this period, 4392 autopsies were performed.

Inclusion and Exclusion criteria: Complete autopsies, encompassing both pathological and medicolegal cases of all age groups with an Antemortem diagnosis or postmortem diagnosis of malignancy, were included in the study. Partial autopsies and those without a diagnosis of malignancy were excluded.

Study Procedure

The clinical details of these autopsies were extracted from the deceased case files, which are routinely transmitted along with the body for postmortem examination. To gain insight into the ante-mortem kidney function of the cases, serum creatinine (Cr) and Blood Urea Nitrogen (BUN) levels were recorded from the case files. The normal range utilised as the reference was 0.7-1.2 mg/dL for Cr and 7-30 mg/dL for BUN. Every case was analysed with respect to demographics, the type of primary malignancy, gross, microscopy, Immunohistochemistry (IHC), and the final cause of death. IHC markers were done wherever required to make the diagnosis. The IHC markers used included epithelial markers such as Epithelial Membrane Antigen (EMA), Pan CK (Pan Cytokeratin), CK7, and CK20 aiding in the identification of epithelial cell characteristics. Hormonal markers crucial in assessing hormone receptor status comprised Oestrogen Receptor (ER), Progesterone Receptor (PR), and HER2Neu for breast carcinoma and Prostate Specific Antigen (PSA) for prostate carcinoma. Lymphoid markers encompassed Leukocyte Common Antigen (LCA), CD10, CD3, CD20, MPO (Myeloperoxidase), and CD38. Markers for neuroendocrine differentiation included Synaptophysin and Chromogranin. Additionally, markers such as Kappa and Lambda were utilised for the diagnosis of Myeloma and other light chain deposition diseases. MIB-1 labelling was done to assess the proliferative activity of the tumour cells. As this study was conducted in a government institute, IHC on every autopsy could not be done due to economic constraints and was done only in autopsies where it is essential for the diagnosis.

STATISTICAL ANALYSIS

Descriptive statistics were utilised in the form of mean, median, frequency, and percentages as needed.

RESULTS

A total of 120 autopsies of malignancies were conducted over a 5-year period from 2015 to 2019. Of these, 51 (42.5%) patients belonged to the 4th to the 6th decade, while 39 (32.5%) patients were in their 6th to 8th decade. A total of 8 (6.67%) patients were under 20 years of age. A total of 66 (55%) were male and 44 (45%) were female, and the mean age was 52.48 years.

Among the 120 autopsies, 59 (49.15%) had completed chemotherapy or were in the process of chemotherapy at the time of death. A total of 35 (29%) did not receive chemotherapy, and it was not known whether 26 (22.03%) received any chemotherapy.

Serum creatinine levels were <1.3 mg/dL in 48 (40.18%) cases and >1.3 mg/dL in 52 (43.33%) cases. BUN levels were <20 mg/dL in 40 (33.89%) cases and >20 mg/dL in 54 (45.77%) cases. Of the diagnosed malignancies, 33 (29.66%) cases were from the gastrointestinal tract, 25 (18.6%) cases were from the hepatobiliary tract, and 11 (6.77%) cases were haematolymphoid malignancies [Table/Fig-1].

On gross examination, contracted granular kidneys (indicative of advanced renal disease) were observed in 15 (12.50%) cases. Scars, both superficial and deep, were present in 40 (33.33%) cases. Tumour deposits/mass lesions were identified in 7 (5.83%) cases [Table/Fig-2,3].

Microscopic examination revealed a spectrum of glomerular lesions, with membranous glomerulopathy observed in a case of colonic adenocarcinoma and segmental sclerotic lesions seen in a single case [Table/Fig-4a-f]. Glomerular hypercellularity was noted in 2

Organ system	No. of cases with %	Most common tumour	%
Gastrointestinal tract	33 (27.5%)	Moderately-differentiated adenocarcinoma	36.36
		Signet ring cell adenocarcinoma	12
Hepatobiliary system	25 (20.83%)	Moderately-differentiated adenocarcinoma	28
Haematolymphoid system	11 (9.16%)	Non-Hodgkin's lymphoma, plasma cell myeloma, Acute myeloid leukaemia	63.63
Central nervous system	8 (6.67%)	Glioma	75
Lung and mediastinum	13 (10.83%)	Adenocarcinoma	53.84
Female genital tract	7 (5.83%)	Moderately-differentiated squamous cell carcinoma	42.85
Male genital tract	5 (4.16%)	Prostatic adenocarcinoma	100
Urinary system	5 (4.16%)	Clear cell renal cell carcinoma	80
Breast	5 (4.16%)	Infiltrating duct carcinoma, Not Otherwise Specified (NOS)	80
Oral cavity	4 (3.33%)	Moderately-differentiated squamous cell carcinoma	100
Skin and soft-tissue	1 (0.83%)	Basal cell carcinoma	100
Salivary gland	1 (0.83%)	High-grade duct carcinoma	100
Unknown primary	2 (1.66%)	Poorly-differentiated adenocarcinoma	50

[Table/Fig-1]: Distribution of organ system and most common tumour diagnosis.

Organ system	Gross features	Frequency	%
Gastrointestinal tract	Contracted granular kidney	4	3.33
	Cortical cysts	11	9.16
	Scars (Superficial and deep)	12	10
	Calculi	3	2.5
	Hydronephrosis	1	0.83
	Oedematous kidney	2	1.66
	Flea-bitten kidney (Petechiae)	1	0.83
	Horse shoe kidney	1	0.83
	Infarct	1	0.83
	Abscess, exudates	2	1.66
	No significant pathology	8	6.66
Hepatobiliary system	Contracted granular kidney	2	1.66
	Cortical cysts	2	1.66
	Scars (Superficial and deep)	12	10
	Calculi	2	1.66
	Mass lesions/tumour deposits	1	0.83
	Oedematous kidney	1	0.83
	Flea-bitten kidney (Petechiae)	1	0.83
	Greenish yellow colour z (bile-stained)	1	0.83
	Abscess, exudates	1	0.83
	Infarct	1	0.83
	No significant pathology	7	5.83
Haematolymphoid system	Mass lesions/tumour deposits	2	1.66
	Oedematous kidney	1	0.83
	Contracted granular kidney	1	0.83
	Cortical cysts	1	0.83
	Scars (Superficial and deep)	2	1.66
	No significant pathology	2	1.66
CNS	Cortical cysts	1	0.83
	Scars (Superficial and deep)	1	0.83
	Calculi	1	0.83
	No significant pathology	7	5.83

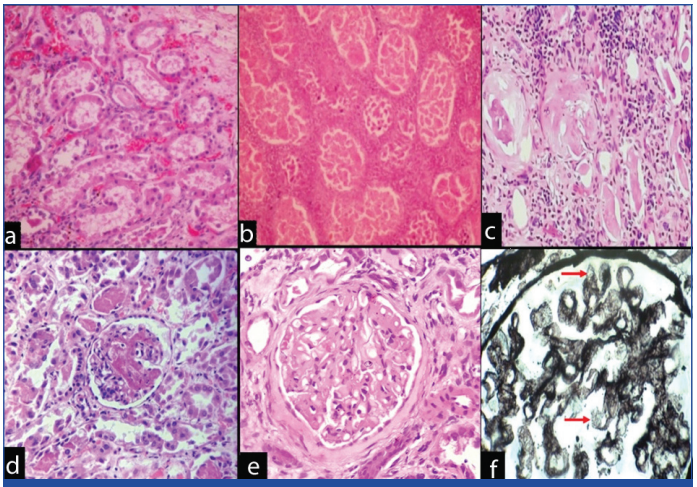
Lung and mediastinum	Scars (Superficial and deep)	2	1.66
	Contracted granular kidney	2	1.66
	Abscess, exudates	1	0.83
	No significant pathology	7	5.83
Female genital tract	Scars (Superficial and deep)	2	1.66
	Contracted granular kidney	1	0.83
	Abscess, exudates	1	0.83
	Hydronephrosis	1	0.83
	Oedematous kidney	1	0.83
	Mass lesions/tumour deposits	1	0.83
	Calculi	3	2.5
	No significant pathology	3	2.5
Male genital tract	Scars (Superficial and deep)	2	1.66
	Contracted granular kidney	1	0.83
	Abscess, exudates	2	1.66
	Hydronephrosis	3	2.5
	Cortical cysts	3	2.5
	Mass lesions/tumour deposits	2	1.66
	Oedematous kidney	1	0.83
Urinary system	Scars (Superficial and deep)	3	2.5
	Contracted granular kidney	2	1.66
	Hydronephrosis	1	0.83
	Cortical cysts	3	2.5
	No significant pathology	4	3.33
Oral cavity	Cortical cysts	2	1.66
	Scars (Superficial and deep)	1	0.83
	Contracted granular kidney	1	0.83
Salivary gland	Cortical cysts	1	0.83
	Scars (Superficial and deep)	1	0.83
	Contracted granular kidney	1	0.83
	Calculi	1	0.83
Skin and soft-tissue	Scars (Superficial and deep)	1	0.83
	Cortical cysts	1	0.83
Unknown primary	Scars (Superficial and deep)	1	0.83
	Mass lesions/tumour deposits	1	0.83

[Table/Fig-2]: Organ systems and gross pathology observed.

Gross pathology of the kidneys	Frequency	%
No significant pathology	38	31.66
Cortical cysts	25	20.83
Scars (Superficial and deep)	40	33.33
Contracted granular kidney/End stage kidneys	15	12.50
Calculi	10	8.33
Hydronephrosis	6	5.00
Mass lesions/tumour deposits	7	5.83
Abscess, exudates	7	5.83
Oedematous kidney (Large, white kidneys)	6	5.00
Infarcts	2	1.66
Flea-bitten kidney (Petechiae)	2	1.66
Horse shoe kidney	1	0.83
Greenish yellow colour (bile-stained)	1	0.83

[Table/Fig-3]: Gross pathology of the kidney.

(1.66%) cases, but further evaluation through Immunofluorescence (IF) and Electron Microscopy (EM) could not be conducted in 3 cases due to economic constraints. A significant number (>75%) of globally sclerosed glomeruli (indicative of advanced renal disease) were seen in 25 (20.83%) cases, and thrombotic microangiopathy was identified in 3 (2.5%) of the autopsies [Table/Fig-5].



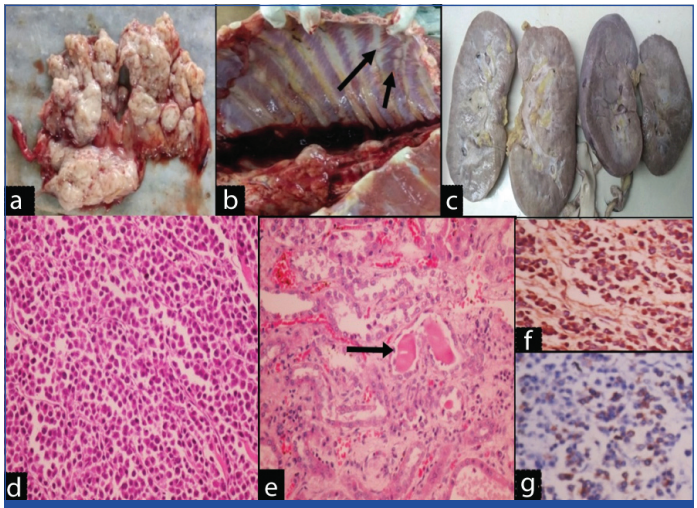
[Table/Fig-4]: Microscopic Image: a) Acute Tubular Injury (ATI) (H&E, 100x); b) Acute Tubular Necrosis (ATN) (H&E, 100x); c) Chronic Pyelonephritis (CPN) (H&E x 100); d) Fibrin thrombi in a case of DIC (H&E, 100x); e) Membranous glomerulopathy (H&E, 400x); f) Moth-eaten appearance on Jones Methanamine Silver stain (400x).

Microscopic features		Frequency		%
No significant findings on light microscopy		24		20.00
Simple cortical cysts		03		2.50
Glomerular lesions				
Significant global sclerosis /advanced renal disease		20		16.66
Thrombotic microangiopathy		03		2.50
Glomerular hypercellularity		02		1.66
Membranous glomerulopathy		01		0.83
Segmental sclerotic lesions		01		0.83
Tubulointerstitial lesions				
Infective lesions		43		35.83
Acute Tubular Injury (ATI)		30		25.00
Acute Tubular Necrosis (ATN)		32		26.66
Tubular Atrophy- Interstitial fibrosis (IFTA)		12		10
Tubular casts	White Blood Cell (WBC) casts	02	06	5.00
	Bile casts	03		
	Myeloma casts	01		
Vascular lesions				
Medial hypertrophy		20		16.66
Hyaline arteriosclerosis		14		11.66
Infarcts		02		1.66
Malignancies				
Primary		04		3.33
Metastatic		07		5.83
Miscellaneous				
Acute Urate Nephropathy {Tumour Lysis Syndrome (TLS)}		01		0.83

[Table/Fig-5]: Microscopic features of the kidneys.

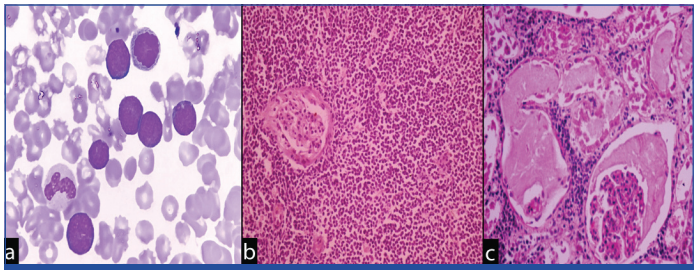
In tubulointerstitial lesions, acute pyelonephritis was observed in two cases. Chronic Pyelonephritis (CPN) was subcategorised into mild CPN in 23 cases, moderate CPN in seven cases, and severe CPN in six cases [Table/Fig-5]. Extensive tuberculous pyelonephritis was seen in a single case, and abscesses were found in four cases. The presence of tuberculous pyelonephritis in this context may be linked to the immunosuppressed state commonly seen in cancer patients. A total of 43 (35.83%) cases were of infective aetiology [Table/Fig-5]. A significant number of cases presented ATN in 32

(26.66%) cases, Acute Tubulointerstitial Nephritis (ATI) in 30 (25%) cases, and Tubular Atrophy-Interstitial Fibrosis (IFTA) in 12 (10%) cases [Table/Fig-5]. A variety of tubular casts were observed in 6 (5%) cases, among which bile casts were seen in three cases, White Blood Cells (WBC) casts in two cases, and myeloma casts in a single case [Table/Fig-5,6a-f]. Vascular lesions were also common, with medial hypertrophy in 20 (16.66%) cases, hyaline arteriosclerosis in 14 (11.66%) cases, and infarcts observed in 2 (1.66%) cases. An unusual case of acute urate nephropathy (TLS) was noted in a case of T-cell acute lymphoblastic leukaemia. On gross examination, the kidneys appeared enlarged with map-like areas of tumour deposits [Table/Fig-7a,b]. Microscopic examination revealed more than 95% lymphoblasts on the peripheral blood smear. Additionally, the kidneys exhibited extensive infiltrates of lymphoblasts, with the renal tubules and glomeruli impacted by urate crystals [Table/Fig-8a-c]. Renal pathology significantly contributed to the cause of death in 23 (19.16%) cases, while the pathology of other organ systems led to the cause of death in 97 (80.83%) cases [Table/Fig-9]. Renal pathology played a significant role in contributing directly or indirectly to the cause of death. Some indirect causes included severe CPN and renal abscess, which precipitated septicemia ultimately leading to death. Meanwhile, direct causes encompassed ATN and cast nephropathy, resulting in acute renal failure and subsequent death.



[Table/Fig-6]: Image: Cast nephropathy in plasma cell myeloma: a&b) Paravertebral mass with nodules in the ribs; c) Enlarged pale kidneys; d) Paravertebral mass-atypical plasma cells in sheets; e) Tubules showing fractured myeloma casts; f) Immunohistochemistry (IHC) staining showing diffuse strong kappa positivity (x400). Lambda negative; g) IHC staining showing focal positivity of EMA (x400).

[Table/Fig-7]: Image: Acute urate nephropathy and extensive tumour infiltrates in T-cell ALL: a) Bilateral enlarged kidneys with cream-coloured map-like areas of tumour deposits; b) Cut surface kidneys- Irregular whitish tumour deposits.



[Table/Fig-8]: Image: Acute urate nephropathy and extensive tumour infiltrates in T-cell ALL: a) ALL- Peripheral smear showing >95% lymphoblasts (Leishman stain 1000x); b) Kidneys- extensive infiltrates of lymphoblasts; c) Renal tubules and glomeruli impacted with urate crystals.

Serial no.	Type of primary malignancy	Renal pathology contributing to the cause of death
1	Poorly-differentiated cholangiocarcinoma of the hepatic duct	Septicaemia, moderate CPN and ATN, renal infarct with local invasion into the liver and metastatic lymph nodes.
2	Von Hippel Lindau syndrome (Pancreatic neuroendocrine tumour, grade 1 with lymph node metastasis)	Disseminated intravascular coagulation with ATI, thrombotic microangiopathy
3	Clear cell renal cell carcinoma. Furhman Grade 4	Disseminated clear cell renal cell carcinoma. Furhman Grade 4
4	Clear cell renal cell carcinoma ISUP/WHO grade 3	Acute necrotising pancreatitis, ATN, pulmonary oedema and shock
5	Poorly-differentiated periampullary adenocarcinoma	Septicaemia and acute renal failure following bile cast nephropathy due to obstructive jaundice
6	Basal cell carcinoma of the skin	Marked CPN
7	Moderately-differentiated adenocarcinoma of pancreas	Disseminated malignancy with liver metastasis in a previously operated case of carcinoma of pancreas with ATN, moderate CPN, bronchopneumonia and focal ischemic bowel changes
8	Acute lymphoblastic leukaemia following severe myelodysplastic syndrome	Multiorgan involvement with acute lymphoblastic leukaemia following severe myelodysplastic syndrome and moderate pyelonephritis
9	Renal cell carcinoma (operated)	Renal failure due to ATN, moderate CPN in an operated case of clear cell renal cell carcinoma
10	Moderately-differentiated sqamous cell carcinoma of cervix	Septicaemia and acute renal failure following acute on CPN
11	Prostatic adenocarcinoma Gleason score 7 (4,3), Grade group 3	Septicaemia, moderate CPN and acute renal failure due to ATN
12	Pulmonary adenocarcinoma	Acute pyelonephritis with renal microabscesses in a case of disseminated pulmonary adenocarcinoma
13	Moderately-differentiated squamous cell carcinoma of oesophagus	Marked CPN and bronchopneumonia
14	Clear cell renal cell carcinoma, International Society of Urological Pathology (ISUP)/World Health Organisation (WHO) grade 1	Septicaemia, severe CPN and acute tubular with benign duodenal perforation
15	Well-differentiated mucinous adenocarcinoma of ascending colon	Septicaemia, shock following perforative peritonitis in a colo-colic intussusception with moderate CPN
16	Poorly-differentiated adenocarcinoma of pancreatic duct	Septicaemia, severe CPN, acute ascending cholangitis with liver pyemic abscesses, ATN and bile cast nephropathy with metastasis to regional lymph nodes and liver
17	Poorly differentated squamous cell carcinoma of cervix	Acute on chronic renal failure/acute on CPN with hydronephrosis with poorly-differentated squamous cell carcinoma of cervix
18	Moderately-differentiated cholangiocarcinoma of extrahepatic bile duct	Intraabdominal bleed and bile cast nephropathy
19	Well-differentiated adenocarcinoma of rectum	Septicaemia in an operated case of adenocarcinoma of rectum with acute CPN and renal micro abscesses and infarct
20	Endometrial stromal sarcoma	Acute renal failure, ATN in a case of recurrent endometrial stromal sarcoma
21	Prostatic adenocarcinoma Gleason score 6(3,3), Grade group 1	Acute pancreatitis with acute on chronic renal failure/advanced renal disease

21	T-cell acute lymphoblastic leukaemia/lymphoma	Acute urate nephropathy (Tumour lysis syndrome) with multi-organ dissemination and AKI (multifactorial)
23	Multiple myeloma	Multiple myeloma with predominantly extramedullary involvement and cast nephropathy

[Table/Fig-9]: Cases where the renal pathology significantly contributed to the cause of death.

DISCUSSION

A diverse array of renal pathologies is clinically observed and evident in patients with malignancies. These pathologies encompass a wide range, affecting all components of the kidney. They include renal parenchymal invasion, ATI, ATN, CKD, thrombotic microangiopathy, glomerular diseases, malignant obstructive uropathy, chronic tubulointerstitial nephritis, electrolyte disturbances, and nephrotoxic effects induced by anticancer drugs, including chemotherapy and immunotherapy [5,6].

Out of the 120 autopsies of malignancy in the present study, 59 (49.15%) cases had received chemotherapy. Chemotherapy-induced kidney injury is becoming more prevalent with newer anticancer drugs that are being added to chemotherapy regimens. Gemcitabine, Mitomycin C, and antiangiogenesis drugs are known to cause TMA [7]. Renal complications like focal segmental glomerulosclerosis have been associated with therapy by Interferons (IFN), pamidronate, and zoledronate, while minimal change disease has been linked to IFN. BRAF inhibitors, ALK inhibitors, and PD-1 inhibitors can cause acute interstitial nephritis [2,8].

The most prevalent renal diseases in patients with malignancies are AKI and electrolyte disturbances [3]. AKI and ATN were significant findings in the present study, with ATI observed in 30 (25%) cases and ATN in 32 (26.6%) cases, collectively accounting for more than 50% of our autopsy cases. Distinguishing ATI from postmortem degenerative changes becomes challenging, especially when the autopsy is delayed and conducted long after death. Therefore, the present study may reflect a higher incidence of ATI. Sepsis emerges as the leading cause of AKI in cancer patients. The use of anti-infectives in treating sepsis in critically-ill cancer patients can lead to nephrotoxicity and AKI. Co-morbidities such as CKD, congestive cardiac failure, hypertension, diabetes mellitus, and liver disease also contribute to the occurrence of AKI [4]. Glomerular diseases can arise either as a paraneoplastic process or as a consequence of chemotherapy [9]. Among glomerular lesions, a significant number of globally sclerosed glomeruli (indicative of advanced renal disease) were observed in 25 cases (20.83%). Glomerular hypercellularity was noted in a single case related to adenocarcinoma of the gastrointestinal tract. Additionally, a case of membranous glomerulopathy was identified in association with adenocarcinoma of the colon. Glomerular pathology manifests across various malignant diseases, with membranous glomerulonephritis being the most common, often linked to solid cancers. The precise incidence of malignancy with membranous nephropathy remains unknown, though several studies report a prevalence ranging from 1% to 22%. Minimal change disease is predominantly associated with Hodgkin disease, while membranoproliferative glomerulonephritis is linked to chronic lymphocytic leukaemia [8,10].

Three of the autopsies had TMA as a terminal event that led to death. TMA is a complication that can develop directly from the underlying malignancy or more often from anticancer therapy [11]. In the present study, authors encountered three noteworthy autopsies, one of which involved a young male diagnosed with plasma cell myeloma during the autopsy. The 33-year-old patient presented with lower back pain and progressive weakness in the lower limbs over the past two months. An Magnetic Resonance Imaging (MRI) of the spine revealed a collapse of the D7 and D10 vertebral bodies, along with a large paravertebral soft-tissue mass. Positron Emission Tomography-computed Tomography scan (PET CT) scans indicated multiple osteolytic lesions throughout the entire skeleton. Autopsy findings in the kidneys revealed classic fracture casts and extensive malignant plasma cell infiltrates, confirmed as CD 68, Kappa, and EMA positive through IHC. The final diagnosis at autopsy was Multiple Myeloma with predominantly extraosseous involvement and cast nephropathy [Table/Fig-6].

The second distinctive case involved a 26-year-old pregnant patient who presented with fever and chills persisting for three weeks, accompanied by a dry cough and dyspnoea for one week, along with AKI. Further investigations revealed hypophosphatemia and hyperuricemia. A peripheral smear indicated a total count of 96,000 cells/cumm with 67% lymphoblasts. Autopsy findings demonstrated extensive infiltrates of lymphoblasts in the kidneys, along with abundant urate crystals impacting the renal tubules and Bowman's space. A conclusive diagnosis of T-cell acute lymphoblastic leukaemia with multiorgan dissemination and acute urate nephropathy (TLS) was established [Table/Fig-7,8].

The third case involved a 23-year-old primigravida at 29 weeks gestation with a diagnosed bilateral large ovarian tumour, identified on ultrasonography. She presented at the tertiary care centre with severe abdominal pain, backache, and leaking per vagina. Physical examination revealed an oedematous abdominal wall, a gravid uterus of 34 weeks size, and tumours that could not be individually palpated. Despite these complications, she underwent a normal vaginal delivery, giving birth to a live female foetus weighing 1.6 kg. Unfortunately, she developed postpartum septicemia and pulmonary thromboembolism, leading to her demise. Postmortem examination revealed a large Krukenberg tumour in the right ovary measuring 40x26x14 cm and weighing 2 kg, along with a tumour in the left ovary measuring 20x10x6 cm and weighing 600 gm. Additionally, the sigmoid colon exhibited a 2x1 cm signet ring cell adenocarcinoma with peritoneal metastasis. IHC revealed positive CK and EMA results, while AFP and CD10 were negative. The bilateral kidneys were normal on gross and microscopy and probably remained so since the duration of the malignancy was only two months.

Two autopsies revealed an unknown primary source of malignancy; one of a 45-year-old female with disseminated poorly-differentiated adenocarcinoma and the other of a 65-year-old male with disseminated squamous cell carcinoma. Despite an extensive review of the literature, authors did not find any similar studies on renal pathology in autopsies of malignancy. In the current study, 38 (31.67%) malignancies were diagnosed for the first time only at autopsy. A study by Furia LD titled "The value of necropsy in oncology" reported major discordances between clinical and postmortem findings in 34 (33%) out of the 102 patients in their study [12].

The AKI and ATN were significant findings in the present study, with ATI observed in 30 (25%) and ATN in 32 (26.6%) of cases, collectively amounting to more than 50% of the autopsy cases. The incidence of AKI in cancer patients is reported to reach up to 12% by Salahudeen A et al., [13]. The rate of AKI among critically-ill cancer patients varies from 12% to 49%, with 9-32% of patients requiring renal replacement therapy [14].

In a Danish study involving 37,257 cancer patients, the incidence of AKI was reported as 17.5% according to the RIFLE criteria (Risk, Injury, Failure, Loss of kidney function, and End-stage kidney disease) [15-18]. This study, representing the largest cohort of Danish cancer patients, revealed varying rates of AKI in specific cancer types: 44% in kidney cancers, 33% in myeloma, 31.8% in liver cancer, and 27.5% in leukaemia [14]. In the present study, 20 autopsies (16.66%) revealed significant global sclerosis, indicating advanced renal disease. A study conducted by Ciorcan M et al., demonstrated a comparable prevalence of CKD, with 12.27% after the first year of follow-up and 13.42% after the second year, closely aligning with the present findings [19].

Limitation(s)

Limitations of the present study included economic constraints and resource limitations inherent in a government hospital setting. The unavailability of extensive immunohistochemical markers, IF, and EM posed additional challenges for detailed investigations. Furthermore, being an autopsy study, the absence of detailed clinical history, drug history, and antemortem laboratory details were a limitation. Postmortem changes also affected the pathological examination, introducing further complexity to the analysis.

CONCLUSION(S)

The present study provides valuable insights into the complex interplay between renal complications and cancer. Notably, a significant proportion of malignancies were diagnosed for the first time through this comprehensive autopsy investigation, highlighting the importance of thorough postmortem examinations. The study emphasises the importance of incorporating renal assessment and management into the holistic care of cancer patients. By recognising and addressing renal complications early in the course of cancer treatment, healthcare providers can potentially mitigate morbidity and improve patient outcomes. Moving forward, these findings advocate for a tailored approach to oncology management that prioritises the identification and management of renal pathologies, ultimately contributing to improved patient care and outcomes.

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