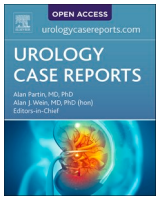
Urology Case Reports 59 (2025) 102944

Contents lists available at ScienceDirect

Urology Case Reports

journal homepage: www.elsevier.com/locate/eucr



Oncology

Renal pelvic urothelial carcinoma with imaging features presenting as renal infarction 1 case report and literature review

Haidong Yang [a], Wenli Yang [a], Nanjun Duan [a], Jing Luo [a], Zhengyan Yang [a], Weiran Zhang [a], Wei Feng [b,*], Haifeng Wang [b,**]

[a] Department of Urology, Baoshan People's Hospital, Baoshan, Yunnan province, 678000, PR China
[b] Hospital of Kunming Medical University, 374 Dianmian Road, Kunming, Yunnan, 650101, PR China

A B S T R A C T

Renal pelvic cancer is relatively rare in clinical practice, and renal pelvic cancer characterized by renal infarction is even rarer. We here report a case of renal pelvic urothelial carcinoma with squamous metaplasia with renal infarction as the main imaging feature, and summarize the imaging manifestations of some rare renal pelvic carcinomas.

Conclusion: The imaging features of renal pelvis cancer are diverse and often confused with some benign and malignant diseases, suggesting that extra caution should be exercised in the diagnosis and treatment of renal pelvis cancer.

1. Introduction

Urothelial carcinoma is the fourth most common tumour in Western countries, and upper tract urothelial carcinoma (UTUC) accounts for 5–10 % of all urothelial carcinomas,[1] approximately two-thirds of UTUC occur in the renal pelvis.[2] Renal pelvis cancer is similar in type and morphology to bladder cancer. However, renal pelvis cancer is more aggressive than bladder urothelial cancer, and approximately two-thirds of UTUC are invasive at the time of diagnosis.[3] Therefore, early and accurate diagnosis is of great significance for guiding treatment and improving prognosis.

The symptoms of renal pelvic cancer are variable and non-specific, and diagnosis mainly relies on imaging evaluation.[4] A variety of imaging tests are available for renal pelvis cancer. MRU has high soft tissue resolution, which helps to understand whether the tumour invades surrounding soft tissue organs. It is currently one of the commonly used examinations for the diagnosis of renal pelvis cancer.[5] However, computed tomography urography (CTU) shows high sensitivity (92 %–96 %) and specificity (95 %–99 %),[6] can provide more accurate diagnostic information and is therefore considered the preferred imaging modality for the current diagnosis and staging of UTUC.[7]

Renal infarction (RI) refers to an emergency in which the main or branches of the renal artery interrupt the blood flow of the corresponding blood vessels in the kidney due to embolism or thrombosis, resulting in ischemic necrosis of the kidneys corresponding to the corresponding blood vessels; the incidence of this disease is relatively high Low, clinical symptoms are not specific, and it is easy to be misdiagnosed or missed, leading to irreversible damage to the kidneys.[8] It usually presents as one or more wedge-shaped necrotic lesions, with occluded blood vessels at the top and perirenal bottom. Its histological characteristics are coagulative necrosis with an outline of necrotic tissue. Enhanced CT has certain advantages in distinguishing renal pelvic cancer and renal infarction.

The imaging manifestations of renal pelvis cancer are mostly filling defects of the collecting system. However, the imaging manifestations of some patients with UTUC are also atypical, and the imaging manifestations of many benign and malignant diseases may be very similar to UTUC,[9] so it is easy to be misdiagnosed. Our study reports a case in which imaging features were renal infarction, but postoperative pathological examination revealed invasive renal pelvic urothelial carcinoma with squamous metaplasia. This study focused on exploring the imaging characteristics of renal pelvis cancer under CTU.

2. Case statement

A 63-year-old male was admitted to the hospital with a 1-week history of gross hematuria. There is no history of smoking, no family history of malignant tumours, no history of occupational exposure to

* Corresponding author.
** Corresponding author.
E-mail addresses: doctoryanghaidong@163.com (H. Yang), 18288573946@qq.com (W. Yang), duannanjun@126.com (N. Duan), 77028611@qq.com (J. Luo), 609708271@qq.com (Z. Yang), 13769040666@163.com (W. Zhang), 1369912025@qq.com (W. Feng), wanghaifeng@kmmu.edu.cn (H. Wang).

https://doi.org/10.1016/j.eucr.2025.102944
Received 2 December 2024; Received in revised form 5 January 2025; Accepted 13 January 2025
Available online 25 January 2025

carcinogens and no history of chronic diseases. His general condition was good on admission, with no fever, weight loss, or dyspnea. No abnormalities were found on physical examination. The results of laboratory tests such as blood cell analysis, liver and kidney function, and tumour markers were all normal. CTU (Fig. 1) and MRI (Fig. 2) revealed a lesion approximately 8.0 cm in size, with a filling defect in the upper segment of the ureter, showing no significant enhancement. A thrombus is suspected, although tumour involvement cannot be excluded. To rule out thrombotic disorders, further tests for hypercoagulability should be performed, all of which returned negative results. Preoperative diagnosis: renal pelvic tumour with renal infarction (cT3aN0M0), with upper urothelial carcinoma being considered in the differential diagnosis. Taking into account the patient's overall condition, the tumour's location, potential vascular invasion, and other factors, the decision was made to proceed with a laparoscopic nephroureterectomy. Postoperative pathological examination showed (Fig. 3): High-grade infiltrating urothelial carcinoma of the renal pelvis with squamous metaplasia, renal capsule invasion, vascular invasion, and nerve infiltration (pT3N0).

After the operation, the patient was started on warfarin anticoagulant therapy, with regular monitoring of the INR. The patient was successfully discharged without any thrombosis-related events and is scheduled to return to the hospital on an elective date for postoperative adjuvant treatment.

3. Discussion

The typical radiological features of renal pelvis cancer include the presence of fixed masses within the renal pelvis and calyces, with single or multiple irregular or lobulated soft tissue density masses exhibiting exophytic growth. However, certain radiological characteristics of renal pelvis cancer can be atypical, often leading to confusion with both benign and malignant diseases, which may result in misdiagnosis.[9] Previous studies have shown that tumour cells in certain types of renal cell carcinoma (RCC) can invade blood vessels, leading to extensive coagulative necrosis, which is frequently misdiagnosed as renal infarction.[10]

In the past, there have been cases where renal infarctions were misdiagnosed as renal tumours.[11] However, cases of renal pelvis cancer primarily presenting with renal infarction as the main radiological feature are exceedingly rare. In the case reported here, the imaging features of renal pelvis cancer predominantly manifested as renal infarction. Patients with malignant tumours are at a higher risk of developing a hypercoagulable state and forming thrombi, although the precise mechanisms behind this are still unclear. Research indicates that tumour cells interact with the coagulation system in various ways, and the hypercoagulable state in renal pelvis cancer patients may be related to procoagulant substances released by tumour cells, tumour-induced stimulation of vascular endothelial cells, and platelet activation mediated by tumour cells.[12] It may also be associated with factors such as the patient's age, obesity, lifestyle, and genetic predisposition. Preoperative coagulation function monitoring, antiphospholipid antibodies, Factor V Leiden mutation, protein C/S deficiency, venous Doppler ultrasound of the lower limbs, and cardiac echocardiography for thrombosis risk were all negative, with no signs or symptoms suggesting a patent foramen ovale (PFO), thereby excluding primary thrombotic diseases. Therefore, it is likely that both tumour-related factors and the patient's individual condition contributed to renal vascular ischaemia, leading to thrombosis and the formation of renal infarction.Additionally, imaging revealed that the affected renal artery had a rough and elongated lumen, and pathological examination showed tumour vascular invasion, which may also be related to the infarction features. The specific combination of arterial thrombosis and renal infarction in the same kidney, within the context of upper tract urothelial carcinoma (UTUC), is an unusual phenomenon. In patients presenting with such imaging features, it is crucial to comprehensively assess and exclude primary thrombotic diseases. It is also essential to perform thorough laboratory tests, such as thromboelastography (TEG), viscoelastic haemostasis testing, rotational thromboelastometry, and coagulation function indicators, to clarify the coagulation status. Based on the results, appropriate anticoagulation therapy may be beneficial in reducing thrombotic events and assisting in tumour control.[13]

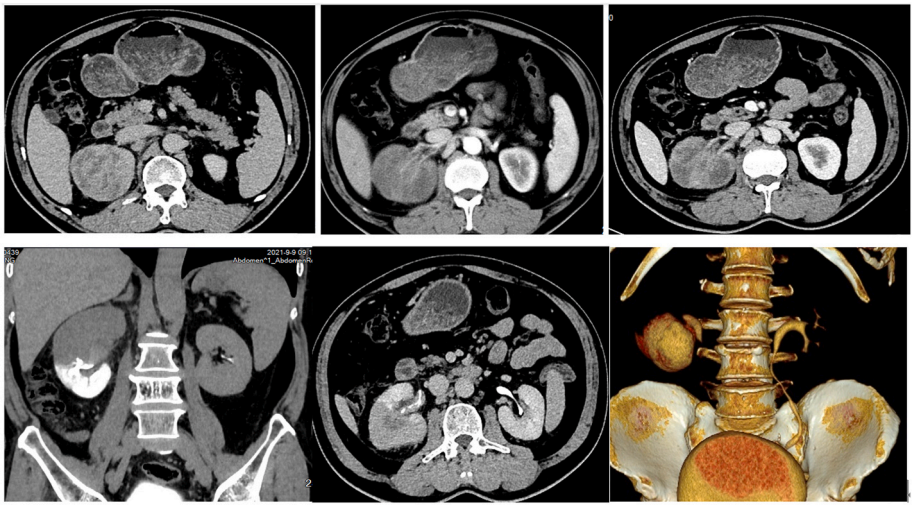


Fig. 1. (CTU)
a Plain scan shows a low-density mass with blurred borders of approximately 8.0 cm × 7.0 cm in the upper pole of the right kidney;
b In the enhanced arterial phase, the edges of the upper pole and middle renal artery branches of the right kidney are rough, the artery lumen is blurred, and the degree of enhancement of the mass is significantly lower than that of normal renal tissue.
c In the enhanced venous phase, the right renal vein is unclearly displayed, and the degree of enhancement of the mass is still significantly lower than that of normal renal tissue;
d During the enhanced excretion phase, no contrast agent was secreted in the upper pole and middle part of the right kidney;
e Enhanced delayed excretion phase (40 minutes) showed a strip-like low-density filling defect in the right renal pelvis and the upper ureteral cavity;
f Three-dimensional imaging of the urinary tract, imaging of the urinary tract during the excretory phase of the left kidney, delayed excretion of contrast agent in the lower part of the right kidney, and enhanced imaging of the renal parenchyma.

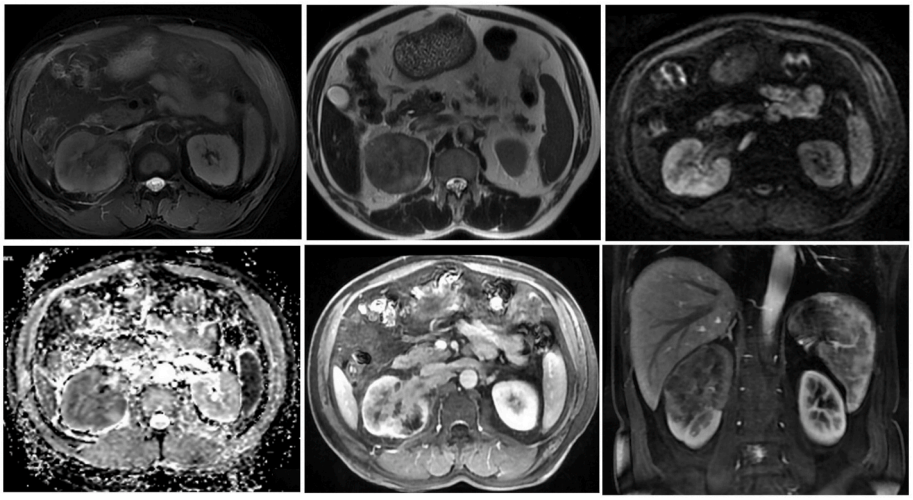


Fig. 2. (MRI)
The right kidney was enlarged, and there was an abnormal signal mass with blurred borders of approximately 7.9 cm × 7.0 cm in the upper pole and middle of the right kidney.
a: T1WI sequence shows slightly low signal; b: T2WI sequence shows slightly high signal; c: DWI sequence shows mild diffusion restriction of the lesion; d: ADC sequence shows reduced signal; e: Enhancement shows that the right renal artery is disordered and slender; f right kidney The upper and middle enhancements were significantly reduced.

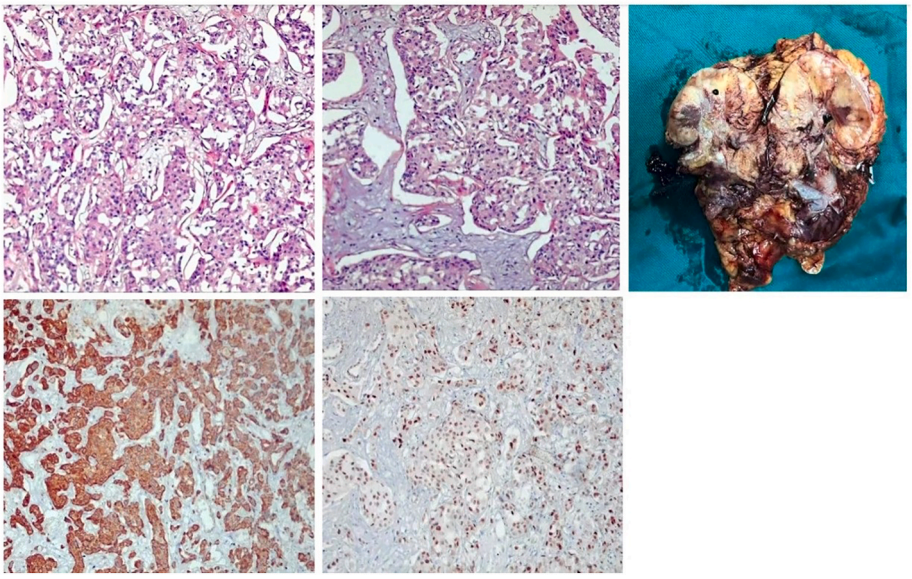


Fig. 3. (Pathological results)
Gross specimen: The left kidney was cut open and the cortex and medulla could not be identified. A mass with a length of 7.0cm was seen on the section. The section was grayish-yellow and the solid substance was hard.
Histological specimens: infiltrative urothelium with squamous differentiation, intravascular tumour thrombus, neural invasion (CK7+, *CK20*+, GATA-3+, CK5/6+, P40+, P53 60 %, ki-67 60 %).

Upper tract urothelial carcinoma (UTUC) of the renal pelvis is highly invasive, potentially due to the thinness of the renal pelvis and ureteral walls. When aggressive tumours affect the renal pelvis, they typically invade the renal parenchyma.[14] Consequently, due to the infiltration of renal tissue, advanced invasive renal pelvis cancer is often difficult to distinguish from renal cell carcinoma (RCC). Firstly, both RCC and renal pelvis cancer typically show early enhancement. Secondly, in some cases, renal pelvis cancer invades and grows into the deep regions of the renal pelvis and calyces, retrogradely entering the renal collecting ducts or renal tubules, or directly penetrating through the renal pelvis wall and the renal sinus fat. The lesion merges with the kidney, making the boundaries unclear. This feature is highly suggestive of confusion with renal collecting duct carcinoma. Although in most cases of renal pelvis cancer, the contours of the kidney are preserved, allowing differentiation from RCC,[7] late-stage eccentricity, focality, and infiltrative renal pelvis cancer can often lead to distortion of the renal profile, a feature also commonly seen in RCC.[15] Therefore, the potential for misdiagnosis remains high.In our case, most renal pelvis cancers show marked enhancement on imaging; however, in this instance, the enhancement of the renal pelvis tumour was not typical, with minimal tumour enhancement. In addition to the aforementioned factors, renal venous tumour thrombus may influence the enhancement pattern on imaging. Previous studies have shown that renal venous tumour thrombus is typically associated with RCC, but it is rarely observed in UTUC.[16] In this

patient, the tumour enhancement on contrast-enhanced imaging was not prominent. Apart from arterial factors, venous factors may also affect CTU imaging. Renal venous tumour thrombus could be one of the reasons for the lack of significant tumour enhancement.[17] For such patients, it is necessary to conduct further diagnostic investigations, including exfoliative cytology, urine methylation analysis, and even ureteroscopy, to assist in confirming the diagnosis and determining the optimal treatment plan.

Other, less common manifestations of renal pelvis cancer include hydronephrosis. Hydronephrosis or ureterohydronephrosis may be an early indication of cancer. The oedema often exhibits numerous lobulated protrusions, typically cystic-solid masses with thick, irregular septations. Tumour invasion of the renal vein and retroperitoneal lymph node metastases may also be present. In some cases, these signs may even be the only indicators of renal pelvis cancer.[14]In summary, radiologists should exercise particular caution when diagnosing and excluding renal pelvis cancer to avoid misdiagnosis or missed diagnosis.

4. Conclusion

Renal pelvis cancer is a rare malignant tumour. Its radiological features can primarily be classified into three types: renal pelvis mass, renal pelvis wall thickening, and tumour infiltration into the renal parenchyma. CT urography (CTU) is currently the preferred diagnostic method for renal pelvis cancer. However, the radiological manifestations of renal pelvis cancer are highly varied and often confuse both benign and malignant diseases, making definitive diagnosis difficult for radiologists.Our case is unique and intriguing, as it differs from the typical clinical characteristics of renal pelvis cancer. On the one hand, the affected renal artery is narrow and irregular, and imaging shows signs of infarction with wedge-shaped, low-density lesions.On the other hand, renal venous tumour thrombus and renal pelvic tumour obstruction further affect renal haemodynamics. Signs of infarction are often considered to be caused by the hypercoagulable state caused by the tumour, leading to microthrombosis. Appropriate anticoagulation during the perioperative period may be beneficial to the patient's prognosis. Therefore, in this context, renal pelvis cancer must be differentiated from simple renal infarction. Additionally, due to its growth characteristics, advanced renal pelvis cancer of this type can easily be confused with renal cell carcinoma. A comprehensive evaluation is required to devise a more rational treatment plan. Furthermore, radiologists should be alert to whether some benign radiological features of the renal pelvis might represent early signs of renal pelvis cancer.

CRediT authorship contribution statement

Haidong Yang: Writing – original draft. **Wenli Yang:** Writing – original draft, Data curation. **Nanjun Duan:** Formal analysis. **Jing Luo:** Formal analysis, Data curation. **Zhengyan Yang:** Formal analysis, Data curation. **Weiran Zhang:** Resources, Investigation. **Wei Feng:** Writing – review & editing. **Haifeng Wang:** Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

References

1. Siegel RL, Miller KD, Wagle NS, et al. Cancer statistics, 2023. *CA A Cancer J Clin*. 2023 Jan;73(1):17–48. https://doi.org/10.3322/caac.21763.
2. Ali O, Fishman EK, Sheth S. Upper urinary tract urothelial carcinoma on multidetector CT: spectrum of disease. *Abdom radiol (New York)*. 2019 Dec;44(12): 3874–3885. https://doi.org/10.1007/s00261-019-02173-2.
3. Cheaib JG, Claus LE, Patel HD, et al. Site of metastatic recurrence impacts prognosis in patients with high-grade upper tract urothelial carcinoma. *Urol Oncol*. 2021 Jan; 39(1). https://doi.org/10.1016/j.urolonc.2020.09.029, 74.e9-.e16.
4. Guo L, Bai X, Tuoheti K, et al. Atypical presentations of UTUC: a case report of three patients. *Front Oncol*. 2023. https://doi.org/10.3389/fonc.2023.1294316, 131294316.
5. Abreu-Gomez J, Udare A, Shanbhogue KP, et al. Update on MR urography (MRU): technique and clinical applications. *Abdom radiol (New York)*. 2019 Dec;44(12): 3800–3810. https://doi.org/10.1007/s00261-019-02085-1.
6. Janisch F, Shariat SF, Baltzer P, et al. Diagnostic performance of multidetector computed tomographic (MDCTU) in upper tract urothelial carcinoma (UTUC): a systematic review and meta-analysis. *World J Urol*. 2020 May;38(5):1165–1175. https://doi.org/10.1007/s00345-019-02875-8.
7. Tsikitas LA, Hopstone MD, Raman A, et al. Imaging in upper tract urothelial carcinoma: a review. *Cancers (Basel)*. 2023 Oct 18;15(20). https://doi.org/10.3390/cancers15205040.
8. Antopolsky M, Simanovsky N, Stalnikowicz R, et al. Renal infarction in the ED: 10-year experience and review of the literature. *Am J Emerg Med*. 2012 Sep;30(7): 1055–1060. https://doi.org/10.1016/j.ajem.2011.06.041.
9. Jena R, Sureka SK, Singh UP. Upper tract transitional cell carcinoma clinically mimicking inflammatory renal pathology: a report of three cases. *Indian J Urol : IJU : j Urol Soc India*. 2021 Apr-Jun;37(2):169–172. https://doi.org/10.4103/iju.IJU_173_20.
10. Xu Q, Cao Q, Liu N, et al. Renal collecting duct carcinoma with extensive coagulative necrosis mimicking anemic infarct: report of a case and the literature review. *Diagn Pathol*. 2013 Jul 16:8119. https://doi.org/10.1186/1746-1596-8-119.
11. Suzer O, Shirkhoda A, Jafri SZ, et al. CT features of renal infarction. *Eur J Radiol*. 2002 Oct;44(1):59–64. https://doi.org/10.1016/s0720-048x(01)00476-4.
12. Yazaki S, Salgado R, Shimoi T, et al. Impact of adjuvant chemotherapy and radiotherapy on tumour-infiltrating lymphocytes and PD-L1 expression in metastatic breast cancer. *Br J Cancer*. 2023 Feb;128(4):568–575. https://doi.org/10.1038/s41416-022-02072-2.
13. Mackman N, Bergmeier W, Stouffer GA, et al. Therapeutic strategies for thrombosis: new targets and approaches. *Nat Rev Drug Discov*. 2020 May;19(5):333–352. https://doi.org/10.1038/s41573-020-0061-0.
14. Nakai H, Takahashi H, Wellnitz CV, et al. Imaging of upper tract urothelial carcinoma. *Radiographics*. 2024 Nov;44(11), e240056. https://doi.org/10.1148/rg.240056.
15. Prando A, Prando P, Prando D. Urothelial cancer of the renal pelvicaliceal system: unusual imaging manifestations. *Radiographics*. 2010 Oct;30(6):1553–1566. https://doi.org/10.1148/rg.306105501.
16. Browne RF, Meehan CP, Colville J, et al. Transitional cell carcinoma of the upper urinary tract: spectrum of imaging findings. *Radiographics*. 2005 Nov-Dec;25(6): 1609–1627. https://doi.org/10.1148/rg.256045517.
17. Matteo M, Elena B, Cristina BM, et al. Rare case of an upper urinary tract carcinoma (UTUC) in renal pelvis and ureter associated to renal vein thrombosis: diagnostic imaging with CECT, MRI and CEUS. *J ultrasound*. 2019 Sep;22(3):373–379. https://doi.org/10.1007/s40477-019-00396-z.