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High-grade eosinophilic renal tumor/eosinophilic vacuolar renal tumor: a case report and literature review

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Abstract

Introduction Renal oncocytoma (RO) is an uncommon benign neoplasm of the kidney, while eosinophilic vacuolated tumor (EVT) represents a distinct subtype of renal oncocytoma characterized by specific morphological features. EVT is a rare eosinophilic renal neoplasm distinguished by its unique morphological, immunophenotypic, and molecular genetic attributes. Its biological behavior is generally indolent, and it is associated with a favorable prognosis.

Case report This case report provides a comprehensive account of a 52-year-old female patient who presented to the hospital for a medical evaluation, revealing that her left kidney had been occupying space for over one month. Following an abdominal enhanced CT scan, a diagnosis of renal clear cell carcinoma was suspected, leading to the decision to perform a "robot-assisted laparoscopic partial left nephrectomy." During the surgical procedure, a mass measuring approximately 3.8 × 3.5 cm was identified adjacent to the renal hilum in the midsection of the left kidney. Subsequent pathological analysis classified the excised tumor as an eosinophilic vacuolar tumor of the kidney.

Conclusion This case illustrates that EVT represents a novel solid neoplasm of the kidney, with occurrences being exceedingly uncommon. It is imperative for clinicians and pathologists to enhance their comprehension of these tumors and distinguish them effectively, thereby facilitating more precise classification of renal tumors and informing clinical management and prognostic assessment.

Keywords Eosinophilic vacuolated tumor, Renal oncocytoma, Case

Introduction

Renal tumors represent one of the most prevalent neoplasm categories within the genitourinary system, with benign renal tumors being less frequent than their malignant counterparts. The primary benign renal tumors include angiomyolipoma, eosinophiloma, and rarer entities such as retrorenal adenoma. Renal cell carcinoma constitutes approximately 90% of adult renal malignancies and is recognized as one of the most lethal urinary tumors [1]. The predominant histological subtypes of renal tumors are clear cell renal carcinoma, papillary renal cell carcinoma, and chromophobe renal cell

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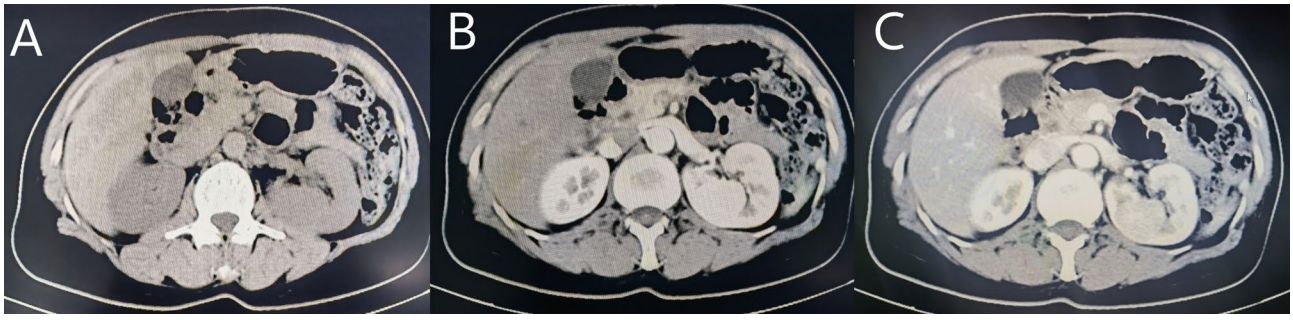

Fig. 1 Abdominal enhanced CT. (**A**) Abdominal plain CT. (**B**) arterial phase of enhanced CT. (**C**) venous phase of enhanced CT

carcinoma. Renal oncocytoma (RO) is an infrequent benign renal neoplasm, while eosinophilic vacuolated tumor (EVT) represents a distinct variant of renal oncocytoma characterized by unique morphological features. In 2018, He et al. [2] described this tumor type, which is primarily composed of eosinophils exhibiting high-grade nuclei and vacuolated cytoplasm, and demonstrated a relatively consistent immunophenotype, subsequently termed High-grade eosinophilic tumor of kidney (HOT). In 2019, Chen et al. [3] reviewed a cohort of renal tumors previously classified as unclassified, noting a histological morphology characterized by a nested pattern, eosinophilic cytoplasm, and prominent vacuoles, which was identified as a unique sporadic renal cell carcinoma. In 2021, the International Association of Urogenital Pathology (GUPS) reached a consensus to designate this tumor as "EVT." [4] The recent WHO classification of renal tumors (2022) has categorized these tumors under "other eosinophilic renal tumors." [5] EVT is a rare eosinophilic renal tumor distinguished by its unique morphological, immunophenotypic, and molecular genetic features. Its biological behavior is relatively indolent, and it is associated with a favorable prognosis. This case contributes to the understanding of EVT and enriches the existing case inventory.

Case report

The patient is a 52-year-old female who was admitted to the hospital following a routine health assessment that identified a left renal mass persisting for one month. An abdominal CT scan conducted during the evaluation revealed a space-occupying lesion in the left kidney, primarily suspected to be of neoplastic origin, with clear cell carcinoma as a differential diagnosis. The patient denied experiencing abdominal pain, hematuria, abdominal masses, hypertension, anemia, erythrocytosis, liver function abnormalities, cough, hemoptysis, bone pain, or fractures, and her medical history was otherwise unremarkable. Upon admission, a contrast-enhanced abdominal CT scan illustrated a nodular lesion located in the posterior aspect of the left kidney, measuring approximately 31 × 30 × 29 cm, characterized by well-defined

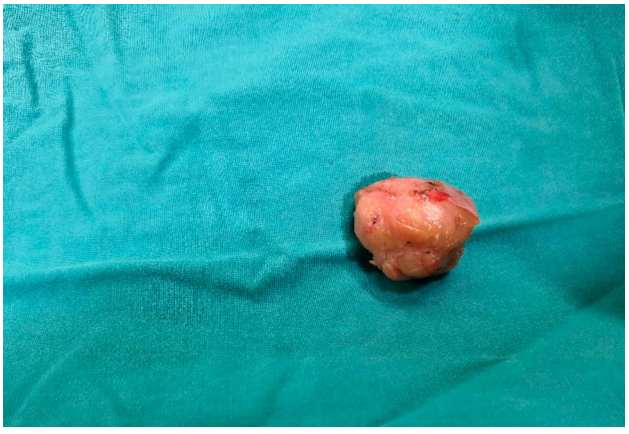

Fig. 2 Surgical resection of tumor

margins and slight encroachment into the renal sinus, leading to mild deformation of the renal sinus. Dynamic contrast enhancement exhibited a "fast in, fast out" enhancement pattern, heightening the suspicion for clear cell carcinoma (initial staging: T1N0M0) or alternative pathologies (Fig. 1A-C).

Upon admission, no definitive surgical contraindications were identified during the preoperative auxiliary assessment. The patient and their family expressed a strong desire for surgical intervention. Following a comprehensive preoperative evaluation, a robot-assisted laparoscopic partial left nephrectomy was conducted under general anesthesia. Intraoperatively, a mass measuring approximately 3.8 × 3.5 cm was observed on the dorsal aspect of the left kidney, exhibiting endogenous growth, without invasion of the collecting system, and characterized by a firm texture and well-defined margins. The tumor was excised in its entirety (Fig. 2). The patient demonstrated a favorable recovery postoperatively.

The postoperative pathological findings indicate that a robotic-assisted partial nephrectomy was performed, resulting in the resection of a 35 mm solid, tan-brown neoplasm. At low magnification, the tumor appeared well-circumscribed yet non-encapsulated, with thick-walled vessels and small non-neoplastic tubules entrapped at the periphery (Fig. 3A). At higher

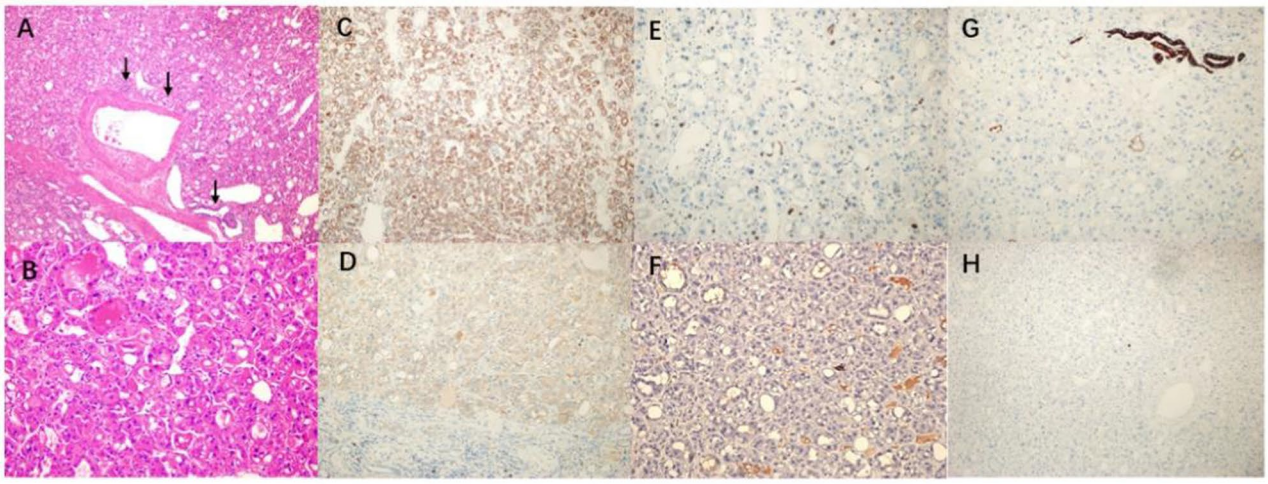

Fig. 3 Histopathology and Immunohistochemistry characters of this case of Eosinophilic vacuolated tumor. **A**. The tumor was well-circumscribed, but non-encapsulated, with thick-walled vessels present at the periphery and entrapped renal tubules can be seen (black arrow), HE, 100x; **B**. Tumor cells showed nested and focal tubulocystic architecture, oncocytic cytoplasm with intracytoplasmic vacuoles, round to oval nuclei with prominent nucleoli, HE, 200x; **C**. Immunohistochemistry staining for CK18, 100x; **D**. Immunohistochemistry staining for CD117, 200x; **E**. Immunohistochemistry staining for Cyclin-D1, 200x; **F**. Immunohistochemistry staining for CK20, 200x; **G**. Immunohistochemistry staining for CK7, 200x; **H**. Immunohistochemistry staining for Ki-67, 100x

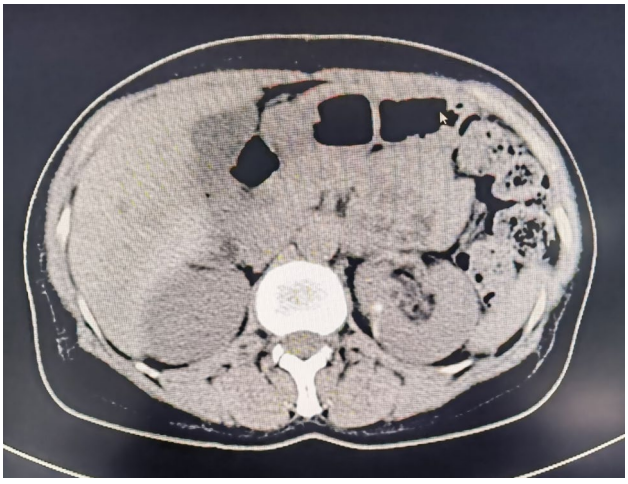

Fig. 4 Abdominal CT after 4 years follow-up

magnification, the tumor exhibited a nested and focal tubulocystic architecture, with some tubules containing serous fluid. The tumor cells displayed abundant oncocytic cytoplasm characterized by prominent intracytoplasmic vacuoles, along with round to oval nuclei featuring distinct nucleoli, but lacking perinuclear halos (Fig. 3B). Mitoses were infrequently observed in this specimen.

The neoplastic cells exhibited immunoreactivity for AE1/AE3, PAX8, CK18 (refer to Fig. 2C), CD10, CD117 (see Fig. 3D), and AMACR; both SDHB and FH demonstrated positivity (retained expression). Cyclin D1 displayed focal reactivity (illustrated in Fig. 3E). CK20 and CK7 were positive in only a few isolated cells (depicted in Fig. 3F-G), while Ki67 positivity was observed in less than 3% of the neoplastic population (shown in Fig. 3H). Markers CAIX, EMA, RCC, TFE-3, HMB45, and Vimentin were uniformly negative across all tumor cells.

The patient undergoes annual follow-up, which includes a physical examination, renal function assessment, and imaging studies. After four years of monitoring, there are no significant surgical complications noted, and the abdominal CT scan did not reveal any tumor recurrence (Fig. 4).

Conclusion

Extrarenal vascular tumor (EVT) represents a novel solid neoplasm of the kidney, exhibiting a higher prevalence in females, with a male-to-female ratio of 1:2.5. The age of onset spans a broad spectrum, predominantly affecting individuals between 25 and 73 years, with a mean age of 50.9 years. Most cases present as solitary tumors, averaging 3.4 to 4.3 cm in diameter [6]. EVT typically manifests as a solid mass, characterized by a grayish-brown to brown coloration, with a rare sex cord-stromal component. Histologically, the cellular morphology demonstrates similarities to renal oncocytoma (RO) and chromophobe renal cell carcinoma (ChRCC). Notably, the cytoplasm of EVT is enriched with acidic granules and features distinctive vacuoles of varying sizes, alongside prominent nucleoli, with a nuclear grade frequently classified as high (WHO/ISUP grade 3). Immunohistochemical profiling reveals diffuse positivity for CD117 and negativity for CK7 as the most prevalent findings. Additionally, markers such as Cathepsin K, CD10, PAX8, CK(AE1/AE3), and CK18 are commonly expressed in the

majority of cases [7]. Current research indicates frequent deletions of chromosome 1 or 19 in EVT [2].

Notably, recent hypotheses suggest that somatic biallelic deletions of TSC2 and TSC1, along with the activation of the MTOR signaling pathway, may constitute the fundamental molecular alterations involved.

occurring in eosinophilic solid and cystic renal cell carcinoma (ESC RCC), a newly recognized renal neoplasm. In contrast to Eosinophilic vacuolated tumor (EVT), ESC RCC is characterized by both solid and cystic proliferation, with cells exhibiting pronounced purplish-blue cytoplasmic granularity and dense eosinophilic to purple cytoplasmic globules, albeit with only focal cytoplasmic vacuolation. Immunohistochemical analysis reveals that ESC RCC tumor cells demonstrate frequent and extensive CK20 positivity, while being negative for CD117. Collectively, the morphological and immunohistochemical findings strongly indicate that this case should be classified as EVT rather than ESC RCC.

The differential diagnosis of extravillous trophoblast (EVT) is of paramount importance. In this instance, the preoperative dynamic contrast-enhanced abdominal imaging revealed a "fast-in and fast-out" enhancement pattern, raising the suspicion of clear cell carcinoma, which could potentially mislead clinicians. The further categorization of renal tumors exhibiting eosinophilic cytoplasm presents a significant challenge in pathological diagnosis. This category encompasses several recognized tumor entities, including eosinophilia [9], chromophobe renal cell carcinoma, papillary renal cell carcinoma, succinate dehydrogenase (SDH) deficient renal cell carcinoma, eosinophilic variant clear cell renal cell carcinoma [10], and epithelioid leiomyolipoma. Additionally, tumors that are either tentatively or not included in the WHO (2022) classification of renal tumors must also be considered, such as low-grade eosinophilic tumors, acidic solid and cystic renal cell carcinomas, and ALK rearranged renal cell carcinomas [5]. Each of these tumors possesses distinct morphological features, specific immunophenotypes, and molecular genetic alterations, often necessitating identification through a comprehensive panel of immunohistochemical or molecular diagnostic techniques.

The clinical biological behavior of extravillous trophoblast (EVT) is indolent, and numerous partial nephrectomies are conducted in clinical practice, yielding favorable prognoses, with no documented cases of postoperative recurrence. Given the rarity of this tumor, it is imperative for clinicians and pathologists to enhance their comprehension of this tumor type and improve differentiation, thereby facilitating more accurate classification of renal tumors and informing clinical management and prognostic assessment.

Abbreviations

RO	Renal oncocytoma
EVT	Eosinophilic vacuolated tumor
HOT	High-grade eosinophilic tumor
ChRCC	Chromophobe cell carcinoma
ESC RCC	Eosinophilic solid and cystic renal cell carcinoma
SDH	Succinate dehydrogenase

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Data availability
The raw data supporting the conclusions of this article will be made available by the authors without undue reservation. Please contact the author Shida Fan (email: 18523636523@163.com).

Declarations

Ethics approval and consent to participate
Written informed consent to participate was obtained from the patient of this case report. A copy of the written consent is available for review by the Editor of this journal.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor of this journal.

Competing interests
The authors declare no competing interests.

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References

1. Low G, Huang G, Fu W, Moloo Z, Girgis S. Review of renal cell carcinoma and its common subtypes in radiology. World J Radiol. 2016;8(5):484–500. https://doi.org/10.4329/wjr.v8.i5.484.
2. He H, Trpkov K, Martinek P, et al. High-grade oncocytic renal tumor: morphologic, immunohistochemical, and molecular genetic study of 14 cases. Virchows Arch. 2018;473(6):725–38. https://doi.org/10.1007/s00428-018-2456-4.
3. Chen YB, Mirsadraei L, Jayakumaran G, et al. Somatic mutations of TSC2 or MTOR characterize a morphologically distinct subset of sporadic renal cell Carcinoma with Eosinophilic and Vacuolated Cytoplasm. Am J Surg Pathol. 2019;43(1):121–31. https://doi.org/10.1097/PAS.0000000000001170.
4. Trpkov K, Williamson SR, Gill AJ et al. Novel, emerging and provisional renal entities: The Genitourinary Pathology Society (GUPS) update on renal neoplasia [published correction appears in Mod Pathol. 2021;34(5):1037]. Mod Pathol. 2021;34(6):1167–1184. https://doi.org/10.1038/s41379-021-00737-6
5. Tateo V, Mollica V, Rizzo A, Santoni M, Massari F. Re: WHO classification of tumours, 5th Edition, 8: urinary and male genital tumours. Eur Urol. 2023;84(3):348–9. https://doi.org/10.1016/j.eururo.2023.04.030.
6. Farcaş M, Gatalica Z, Trpkov K, et al. Eosinophilic vacuolated tumor (EVT) of kidney demonstrates sporadic TSC/MTOR mutations: next-generation sequencing multi-institutional study of 19 cases [published correction appears in mod pathol. 2021;:] [published correction appears in mod pathol. 2021]. Mod Pathol. 2022;35(3):344–51. https://doi.org/10.1038/s41379-021-00923-6.

7. Kapur P, Gao M, Zhong H, et al. Eosinophilic vacuolated tumor of the kidney: a review of evolving concepts in this Novel Subtype with additional insights from a case with MTOR mutation and concomitant chromosome 1 loss. Adv Anat Pathol. 2021;28(4):251–7. https://doi.org/10.1097/PAP.0000000000000299.
8. Siadat F, Trpkov K, ALK ESC, HOT. and LOT: Three Letter Acronyms of Emerging Renal Entities Knocking on the Door of the WHO Classification. Cancers (Basel), 2020. 12(1).
9. Mirkheshti N, Farrukh N, Legesse T, Rowe SP, Gordetsky J, Hussain A. Renal oncocytoma: a challenging diagnosis. Curr Opin Oncol. 2022;34(3):243–52. https://doi.org/10.1097/CCO.0000000000000829.
10. Bahadoram S, Davoodi M, Hassanzadeh S, Bahadoram M, Barahman M, Mafakher L. Renal cell carcinoma: an overview of the epidemiology, diagnosis, and treatment. G Ital Nefrol. 2022;39(3):2022–vol3. Published 2022 Jun 20.

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