Published in final edited form as:

J Urol. 2011 March ; 185(3): 795–801. doi:10.1016/j.juro.2010.10.068.

Renal Oncocytosis: Management and Clinical Outcomes

Ari Adamy, William T. Lowrance, David S. Yee, Kian Tai Chong, Melanie Bernstein, Satish K. Tickoo, Jonathan A. Coleman, and Paul Russo*

Department of Surgery, Urology Service (AA, WTL, DSY, KTC, MB, JAC, PR) and Department of Pathology (SKT), Memorial Sloan-Kettering Cancer Center, New York, NY

Abstract

Purpose—Renal oncocytosis is an extremely rare pathological condition in which renal parenchyma is diffusely involved by numerous oncocytic nodules, in addition to showing a spectrum of other oncocytic changes. Our aim was to describe our experience with renal oncocytosis, focusing on management and outcomes.

Materials and Methods—Twenty patients with a final pathologic diagnosis of renal oncocytosis from July 1995 through June 2009 were included in the analysis. Patient demographics, intraoperative variables and postoperative outcomes are reported.

Results—The median age at nephrectomy was 71 years. Fifteen patients (75%) had bilateral disease. There were 23 operations performed on 20 patients. Thirteen (57%) were partial nephrectomies and 10 (43%) were radical nephrectomies. The median diameter of the dominant tumor mass was 4.1 cm (range 1–14.6). The most common dominant tumor histology was hybrid tumor between oncocytoma and chromophobe renal cell carcinoma in 13 of 23 specimens (57%), followed by chromophobe RCC in 6 (26%), oncocytoma in 3 (13%) and conventional RCC in 1 (4%). Ten patients (50%) had pre-existing chronic kidney disease before nephrectomy and 5 more developed CKD after surgery. After a median follow-up of 35 months, no patient developed metastatic disease.

Conclusions—Patients with renal oncocytosis usually present with multiple and bilateral renal nodules. Half of the patients had CKD at diagnosis and 25% developed new-onset of CKD. No patient developed distant metastatic disease during follow-up.

Our management approach is to perform a partial nephrectomy when possible and then employ careful surveillance of the remaining renal masses.

Keywords

renal oncocytosis; kidney neoplasms; chromophobe renal cell carcinoma; oncocytoma; nephrectomy

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***Correspondence and requests for reprints:** Department of Surgery Memorial Sloan-Kettering 1275 York Avenue New York, NY 10065 Phone: (646) 422-4391 Fax: (212) 988-0760 russop@mskcc.org.

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INTRODUCTION

Renal oncocytosis is an extremely rare pathological entity in which renal parenchyma is replaced by numerous oncocytic tumor nodules. The disease was first described in 1982 as oncocytomatosis in a case where both kidneys had diffuse involvement by more than 200 oncocytomas.¹ A subsequent analysis done by Tickoo et al showed that each kidney in patients with the disease contains numerous oncocytic nodules in addition to a dominant mass.² These nodules usually have a wide spectrum of oncocytic changes, rather than the presence of oncocytomas only. The dominant mass typically resembles an oncocytoma; less often it is a chromophobe renal cell carcinoma or hybrid tumor possessing both histological elements.² In addition, the kidneys show a spectrum of other oncocytic changes, including oncocytic cysts, dispersed oncocytic cells infiltrating between benign nephrons, and oncocytic changes in non-neoplastic tubules. Therefore, the authors suggested a more encompassing term, renal oncocytosis.

Some of these features have also been described in patients with Birt-Hogg- Dubé syndrome, an autosomal-dominant inherited syndrome with the gene locus located in the short arm of chromosome 17 (17p11.2).^{3,4} BHD-affected individuals are predisposed to the development of fibrofolliculomas, renal tumors, lung cysts and spontaneous pneumothoraces.⁵ In contrast to other renal cancer syndromes, BHD patients present with various renal tumor histological subtypes, including hybrid oncocytic tumors, chromophobe RCC and clear cell RCC. More than a half of these patients also show features of renal oncocytosis.^{6,7}

Approximately 25 cases of renal oncocytosis not associated with BHD syndrome have been published, most of them as isolated case reports.^{1,2,8-15} Our group previously published the morphologic features and imaging characteristics of renal oncocytosis.^{2,16} However, the prognosis and clinical behavior of these tumors remain unclear. In the present study we review our experience treating renal oncocytosis, focusing on the management of the renal tumors and clinical outcomes.

MATERIALS AND METHODS

After receiving institutional review board approval, we searched the prospective renal surgery database at Memorial Sloan-Kettering Cancer Center and identified 2,976 patients that had undergone nephrectomy between July 1995 and June 2009. Of these patients, 20 had a final pathological diagnosis of renal oncocytosis and were included in the study. All patients had surgical excision of the dominant tumor.

Patient demographic data were collected and relevant operative and radiographic variables were reviewed. Variables collected from the database included age, gender, clinical presentation, laterality, procedure performed, dominant tumor histology, tumor size, preoperative and postoperative serum creatinine and follow-up procedures. For the purpose of the study, all specimens were reviewed by a single genitourinary pathologist (SKT). The tumors were classified as chromophobe RCC, oncocytoma or hybrid tumors based on previously published criteria.² Briefly, hybrid tumors had features of oncocytoma and

chromophobe RCC, or tumors with features intermediate between these two histologic subtypes and were considered low-grade oncocytic RCC, unclassified.

Follow-up visits were tailored according to final pathology, size of the tumors on the contralateral kidney and renal function. Serial follow-up imaging was obtained on all patients using computed tomography, magnetic resonance imaging or ultrasound as indicated. Estimated glomerular filtration rate was calculated according to the abbreviated Modification of Diet in Renal Disease equation, accounting for patient age, race and serum creatinine.¹⁷ Estimated GFR of <60 ml/min per 1.73 m² was considered chronic kidney disease. To assess the postoperative renal function and evaluate the effect of the nephrectomy and disease on renal function, we calculated the GFR for two different times, at 1 month after operation and at the last follow-up.

RESULTS

Patient Characteristics

The median age at nephrectomy was 71 years (range 47–82) and 13 patients (65%) were males (table 1). At diagnosis, 17 (85%) patients were asymptomatic with multiple renal tumors detected incidentally on radiologic imaging (Fig. 1 and 2). The remaining 3 patients were symptomatic, 2 with gross hematuria and 1 with weight loss and anemia. Bilateral renal masses were identified on preoperative imaging in 15 patients (75%). Among the 5 patients (25%) with unilateral renal tumors, 3 had a solitary kidney at presentation due to prior radical nephrectomy. Reasons for prior RN comprised: a childhood Wilms tumor, a conventional RCC 9 years before the second presentation and a chromophobe RCC 5 years earlier. Three patients (15%) had a family history of renal tumors. One patient with multiple bilateral tumors and incidentally discovered lung cysts was evaluated and confirmed to have BHD syndrome; the remaining 19 patients did not have cutaneous lesions or presence of lung cysts and therefore did not undergo genetic evaluation for BHD.

Surgical Management of Renal Tumors

There were 23 operations performed on 20 patients. Of these operations, 13 (57%) were partial nephrectomies and 10 (43%) were radical nephrectomies. Only 3 patients underwent bilateral kidney procedures. One patient had a RN followed by a PN five years later. Another patient underwent staged RN for large volume disease and received a kidney transplant 10 years later. The third patient underwent a right RN and remained under close observation for a 12 cm contralateral renal mass. After 6 years of surveillance, renal dysfunction progressed to end-stage renal disease requiring hemodialysis, due to compressive tumor growth in the left kidney. A RN was then performed which confirmed histology of oncocytoma.

Renal Tumor Pathology

The median tumor diameter of the dominant mass was 4.1 cm (range 1–14.6) (table 2). The most common dominant tumor histology was hybrid tumor in 13 specimens (57%), followed by chromophobe RCC in 6 (26%), oncocytoma in 3 (13%), and conventional RCC in 1 patient (4%). In addition to the dominant mass, each kidney contained multiple tumors

varying greatly in size. In the majority of cases, these tumors were of various histologies and patients had up to three different histologies in a single specimen. Hybrid tumors either as a dominant mass or as secondary histology were present in 91% of patients, chromophobe RCC in 70% and oncocytoma in 61%. Only 3 patients had a single histology in all tumors (Fig. 3).

Oncologic Outcomes

Two patients died from unrelated causes 22 and 100 months after nephrectomy. Neither patient had evidence of locally recurrent disease or metastasis at the time of death. The median follow-up from time of nephrectomy for patients alive at the last follow-up was 35 months. Four patients (20%) had no evidence of local or distant recurrent disease at the last follow-up, including both patients that underwent bilateral RN. The remaining 14 patients (70%) had multiple localized renal tumors in the operated or contralateral kidney managed under careful surveillance. The median radiographic tumor diameter in these patients is 2.8 cm (range 1–6.2). No metastatic events or death from disease were identified in any of the 20 patients in this series.

Renal Function

The median preoperative eGFR was 59 ml/min per 1.73 m² (IQR 42–73) (table 3). Ten patients (50%) had pre-existing CKD before nephrectomy. At 1 month postoperatively the median eGFR was 42 ml/min per 1.73 m² (IQR 31–62). Median time from surgery to last eGFR was 1.6 years (IQR 0.9–4.4). Median eGFR at last follow-up was 46 ml/min per 1.73 m² (IQR 33–59) with 15 patients (75%) who met criteria for CKD. A progression from a GFR $\geq$ 60 ml/min per 1.73 m² to CKD was observed in 5 patients. Two patients required hemodialysis for renal failure, 1 following bilateral nephrectomy and one from progressive renal dysfunction in a solitary tumor-bearing kidney. The later patient underwent a contralateral RN only after she progressed to end-stage renal disease.

DISCUSSION

Renal oncocytosis is characterized by the presence of oncocytic tumors and other oncocytic changes scattered throughout the renal parenchyma.² These findings appear isolated to the kidneys and demonstrate variable morphology including infiltrative microscopic growth and nodular tumor formation. Initially described as renal oncocytomatosis, the condition was renamed as renal oncocytosis to embrace the wide spectrum of oncocytic changes observed in these patients.^{1,2} Further studies validating these findings are summarized in table 4. In this study, hybrid tumors with features between oncocytoma and chromophobe RCC were the most common histology associated with renal oncocytosis, followed by chromophobe RCC and oncocytoma. The majority of patients had multiple different histologies in the same kidney. The reason for the wide range of histological subtypes occurring in renal oncocytosis is not known.

The concurrence of oncocytoma and chromophobe RCC histology in the same lesion is suggestive of a common pathobiology expressed as a spectrum of cellular phenotypes from oncocytoma to chromophobe RCC.^{2,18} In an attempt to confirm this theory, several

cytogenetic studies have been done using renal oncocytosis as a model. One study analyzed a hybrid tumor and an oncocytoma from a patient with renal oncocytosis.¹⁹ The hybrid tumor had losses that involved chromosomes 1, 14, 21, and Y while the pure oncocytoma had a normal karyotype. The authors hypothesized that renal oncocytosis demonstrated multiple chromosomal losses associated with evidence of progression to chromophobe RCC. However, further studies done in patients with similar characteristics failed to show chromosomal cytogenetic changes that could justify this hypothesis.^{12,20,21} Using selective centromeric probes, Gobbo and colleagues did not find genetic similarities between oncocytosis, oncocytoma and chromophobe RCC, leading the authors to suggest that all three tumor types represent independent entities with distinct phenotype and genotypic alterations.²¹

Although prior cytogenetics studies of oncocytosis have failed to show any similarity with BHD syndrome, in which the involved gene has been localized to the short arm of chromosome 17 (17p11.2),⁷ consideration of BHD syndrome in patients with renal oncocytosis is warranted. Previous reports showed that the most common kidney tumor histology in patients with BHD syndrome is hybrid oncocytic tumors and 58% to 86% of patients had multiple nodules consistent with oncocytosis.^{6,7} Lack of a family history for renal tumors should not preclude the diagnosis of BHD syndrome since 88% of families with renal tumors have only one family member with kidney cancer.⁵ The phenotypic evidence of renal oncocytosis in BHD syndrome, defined by a germline mutation producing aberrant expression of folliculin, offers compelling support of common molecular pathways for tumor development in this disease.

The malignant potential of hybrid tumor is relatively unknown due to the paucity of data about its natural history. Studies analyzing hybrid tumors as sporadic cases (in the absence of BHD syndrome and oncocytosis) did not report the tendency for metastasis.²²⁻²⁴ However, all patients had a solitary lesion and were surgically treated. In the present study, 15 of 20 patients either had contralateral disease at the time of surgery or ipsilateral local recurrence after nephrectomy. Consistent with prior reported series, no patient developed distant metastatic disease during the follow-up period. The association of RCC subtypes with renal oncocytosis has also been used to suggest radical treatment for all patients.¹⁵ The presence of papillary RCC subtype in a patient with oncocytosis has been previously reported,¹² and we also report a case of conventional RCC in association with oncocytosis. However, these are rare findings and the most common RCC subtype in oncocytosis is chromophobe RCC. Compared with other RCC subtypes, chromophobe is associated with the least malignant potential and best prognosis.²⁵

Perhaps the most important consideration when treating patients with renal oncocytosis is preservation of renal function. The loss of renal function appears to occur due to the presence of multiple and bilateral oncocytic nodules which replace and compress the normal parenchyma. In the present cohort, 10 patients (50%) already had CKD at the time of diagnosis with 5 additional patients developing CKD after surgery, 4 of them developing in the first month after surgery. This rate of preoperative CKD was much higher than our previously published cohort of patients undergoing nephrectomy for sporadic renal tumors, where 32% of patients had CKD at diagnosis.²⁶ These data are corroborated by other

reported cases in the literature, since at least 6 patients were diagnosed either during evaluation for hemodialysis or developed CKD with necessity for dialysis during follow-up.^{9,12-15}

The overall imaging appearance of renal oncocytosis, demonstrating bilateral solid, enhancing renal tumors, is not specific to this disease process.¹⁶ Imaging features of the individual lesions can vary and the final diagnosis requires histologic confirmation. Unfortunately, the role of percutaneous biopsy in this setting is not established and hampered by the variety of tumor histologies. For example, one report analyzed patients with solitary renal cortical tumors and compared the results between renal tumor biopsies and nephrectomy specimens, showing that 2 (15%) out of 13 patients with oncocytomas diagnosed in the biopsy had hybrid tumors with features between oncocytoma and surgery.²⁷ However, if we consider that both oncocytoma and hybrid tumors have excellent prognosis, a renal tumor biopsy showing one of the two entities may favor active surveillance instead of nephrectomy.

Our results suggest that renal oncocytosis, though seemingly and oncologically indolent form of renal neoplasia, is a disease that may have a significant adverse impact on renal function. Avoiding aggressive overtreatment balanced with concern for progressive loss of functional renal parenchyma should be a priority of management when such cases are recognized. Currently, we tend to perform PN for histological diagnosis and removal of the dominant mass and then careful surveillance, even in the presence of diffuse renal lesions. Subsequent PN may be considered in patients with interval growth on imaging follow-up. In selected patients, when a preoperative diagnosis can be made with certainty, even nephrectomy may be unnecessary and active surveillance may be offered as an alternative to surgery after careful patient counseling.

This study, though covering 15 years of experience at a tertiary cancer center and representing the largest series of renal oncocytosis, has several limitations inherent to its retrospective design and the small number of patients with this uncommon disease. First, the follow-up interval may not be long enough to assess for the long-term metastatic potential of these tumors though the intermediate findings are encouraging. Clinicians should be cognizant of this when counseling patients. Second, although the majority of patients included in the study probably had sporadic disease, some of them may have BHD syndrome as a potential cause for renal oncocytosis. This could happen because the BHD gene was initially described in 2002 and our series started in 1995.⁴ Also, some patients may have the syndrome without cutaneous manifestations of BHD or the fibrofolliculomas may appear later in life.⁶ Third, only three patients underwent bilateral nephrectomy and the definitive diagnosis of concordant bilateral disease could only be made with histological evaluation. However, all patients had multiple tumors on both kidneys with similar imaging findings. Lastly, all of these patients were initially managed surgically. Although the majority of the m had additional lesions in the ipsilateral or contralateral kidney, we cannot conclude that the outcomes would be the same if the patients were not surgically treated.

CONCLUSIONS

Renal oncocytosis is a rare disease causing multiple and often bilateral renal nodules that replace and compress normal kidney parenchyma. The disease process appears associated with renal dysfunction. None of the 20 managed patients in this series developed metastatic disease during limited follow-up.

Acknowledgments

Supported by: The Sidney Kimmel Center for Prostate and Urologic Cancers

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FIG. 1.

73-year old male with an incidental diagnosis of bilateral renal masses. Axial contrastenhanced CT image through mid kidneys showing numerous bilateral solid enhancing renal masses (A). Axial contrast-enhanced CT image demonstrates a dominant mass in the posterior lower pole of the left kidney measuring up to 4 cm (B, arrow). This lesion was diagnosed as a chromophobe RCC on surgical pathology.

FIG. 2. 71-year old male with an incidental diagnosis of bilateral renal masses. Axial contrast-enhanced CT image through the upper poles showing bilateral renal lesions extending into the renal sinus fat (A). Axial contrast-enhanced CT image through the lower

poles demonstrates a large mass in the left kidney measuring up to 6 cm (B, arrow). A few additional small low attenuation bilateral lesions are also seen (B, arrowheads).

FIG 3. 69-year old male with bilateral renal masses who underwent a left radical nephrectomy. Tumor nodules ranged in size from 0.1 to 9 cm (A and B). The dominant tumor was a hybrid tumor with features between oncocytoma and chromophobe RCC. Histological characteristics consistent with hybrid tumors and chromophobe RCC were found in the remaining nodules (C to F; Reduced from x100).

Table 1

Summary of patient characteristics at time of surgery

	No. of Patients (n = 20)
Age, years (IQR)	71 (59-75)
Gender(%)	
Male	13 (65)
Female	7 (35)
Initial symptoms (%)	
Incidental	17 (85)
Hematuria	2 (10)
Weight loss	1 (5)
Involvement (%)	
Bilateral	15 (75)
Unilateral*	5 (25)
Procedures by type [†] (%)	
Partial nephrectomy	13 (56)
Radical nephrectomy	10 (43)
Procedures by side [†] (%)	
Right	9 (43)
Left	14 (56)

* 3 patients with unilateral disease had solitary kidney at diagnosis.

[†] 23 procedures from 20 patients.

Table 2
Summary of pathological findings

	Specimens (n = 23)
Median tumor size, cm (IQR, range)	4.1 (3-6.4, 1-14.6)
Pathological stage (%) [*]	
pT1a	10 (43)
pT1b	6 (26)
pT2	4 (17)
pT3a	3 (13)
Dominant tumor histology (%)	
Hybrid tumor [†]	13 (57)
Chromophobe RCC	6 (26)
Oncocytoma	3 (13)
Clear cell RCC	1 (4)
Secondary histology (%) [‡]	
Hybrid tumort	21 (91)
Chromophobe RCC	16 (70)
Oncocytoma	14 (61)
Conventional RCC	1 (4)
Clear cell papillary RCC	1 (4)

^{*} Pathological stage of the dominant tumor.

[†] Tumors with hybrid features of oncocytoma and chromophobe RCC, or tumors with features intermediate between these two histologic subtypes.

[‡] Includes specimens with more than one histology.

Table 3

Baseline and follow-up GFR calculated by the MDRD equation

Median eGFR, ml/min per 1.73 m ² (IQR)	
Preoperative	59 (42-73)
At 1 month	42 (31-62)
At last follow-up	46 (33-59)
No. Patients with CKD [*] (%)	
Preoperative	10 (50)
At 1 month	14 (70)
At last follow-up	15 (75)

^{*} CKD defined as eGFR <60 ml/min per 1.73 m²

Table 4

Summary of the reported cases of renal oncocytosis

Reference	No. of Patients	Bilateral	Dominant Tumor Histology	Treatment	Follow-up	Renal Function
Warfel & Eble, 1982 ¹	1	Yes	Oncocytoma	Observed at autopsy	NA	NA
Israeli et al, 1995 ⁹	1	Yes	Oncocytoma	Bilateral RN	12 m, NED	CKD on HD at diagnosis
Katz et al, 1996 ¹⁰	1	Yes	Oncocytoma	Surveillance	60 m, no metastasis	Rising creatinine
Farkas et al, 1999 ⁸	1	Yes	Oncocytoma	Bilateral RN	60 m, NED	Rapidly progressive CKD on HD
Tickoo et al, 1999 ²	14	Yes (6)	Oncocytoma	NA	NA	NA
Leroy et al, 2001 ¹¹	1	Yes	Oncocytoma	Right RN	NA	CKD on HD at diagnosis
Shiga et al, 2002 ¹³	1	No	Oncocytosis	Left RN	6 m, NED	CKD on HD at diagnosis
Ach et al, 2003 ⁷	1	Yes	Oncocytoma	Bilateral RN	48 m, NED	CKD
Nagashima et al, 2005 ¹²	1	Yes	Oncocytosis	Right RN	20 y, no metastasis	CKD on HD at diagnosis
Sydor et al, 2009 ¹⁴	2	Yes	Oncocytoma	Surveillance	14 m, 72m, no metastasis	Both developed CKD and required HD
Present series	20	Yes (15)	Hybrid Tumors	PN (13), RN (10)	Median 35 m, no metastasis	15 patients on HD (bilateral RN)

NA: not available or not applicable; RN: radical nephrectomy; PN: partial nephrectomy; m: months; NED: no evidence of disease; y: years; CKD: chronic kidney disease; HD: hemodialysis.