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Case Series of Bedside Renal Cell Carcinoma Detected by Point-of-Care Ultrasound in the Ambulatory Setting

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Abstract

Background: Kidney and renal pelvic cancer was the sixth most common cancer in men and 10th most common in women in the United States in 2018. Renal cell carcinoma (RCC), accounts for 86% of malignancies of the kidney. RCC patients are often asymptomatic; up to 25-30% have metastases at diagnosis. Few present with the triad of gross hematuria, flank pain, and abdominal mass. In RCC patients, 36% had 2 symptoms of the triad, and 60% had gross hematuria as 1 symptom. Point-of-care ultrasound (POCUS) offers a way to identify clinically meaningful anatomic abnormalities. This case series presents 3 patients in whom routine POCUS examination performed in an outpatient cardiology clinic found asymptomatic renal masses, resulting in surgical resection and cure of early-stage RCCs. **Case Presentation:** Patient 1: 54-year-old female with hypertension (HTN). Two solid masses were identified with POCUS in the right kidney. Patient 2: 63-year-old male with coronary artery disease (CAD) and HTN was seen at an 8-month follow-up visit. A 6-cm mass was identified in the left kidney. Patient 3: 69-year-old male with CAD, HTN, and smoking history seen at 5-month follow-up visit. A 3-cm mass in the right kidney was identified. **Conclusions:** Incorporating POCUS into the routine physical examination in the ambulatory care setting may improve rates of detection and increase the pretest probability of identifying renal pathology with formal imaging studies. With minimal clinician training, earlier and increased detection of asymptomatic RCC may result in improved patient survival.

Keywords

renal cell carcinoma, kidney cancers, point-of-care ultrasound, ultrasound, renal mass, case report, case series

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Introduction

Cancer of the kidney and renal pelvis was the sixth most common type of cancer in men and 10th most common in women in the United States in 2018, with approximately 65 340 estimated new cases and 14 970 estimated deaths.[1] Renal cell carcinoma (RCC), which accounts for 86% of the malignancies of the kidney, has historically been easily diagnosed with radiologic imaging.[2] Many individuals with RCC remain asymptomatic for long periods, and by the time of diagnosis, up to 25% to 30% of patients already have metastases.[3,4] In patients who are symptomatic, only a fraction present with the "classic triad" of gross hematuria, flank pain, and an abdominal mass. In a clinical and pathologic study of over 300 patients with RCC, 36% of patients had a combination of any 2 symptoms of the triad, and 60% had gross hematuria as one of their symptoms.[5] With the increasingly widespread use of abdominal imaging over the past 3 decades, incidental detection of renal malignancies has likewise increased. A 2011 study found that at least 14% of patients undergoing unenhanced computed tomography (CT) colonography had an asymptomatic renal mass measuring 1 cm in diameter or larger, 13% of which required further investigation.[6] Given the insidious nature of most renal cell carcinomas, incidental detection of these tumors may confer better survival due to earlier stage at diagnosis.[3] Routine use of point-of-care ultrasound (POCUS) in the ambulatory setting offers an emerging radiation-free way to identify clinically meaningful anatomic abnormalities. This case series presents 3 patients in whom routine POCUS examination performed in an outpatient cardiology clinic setting detected asymptomatic renal masses which resulted in detection and surgical resection and cure of early-stage

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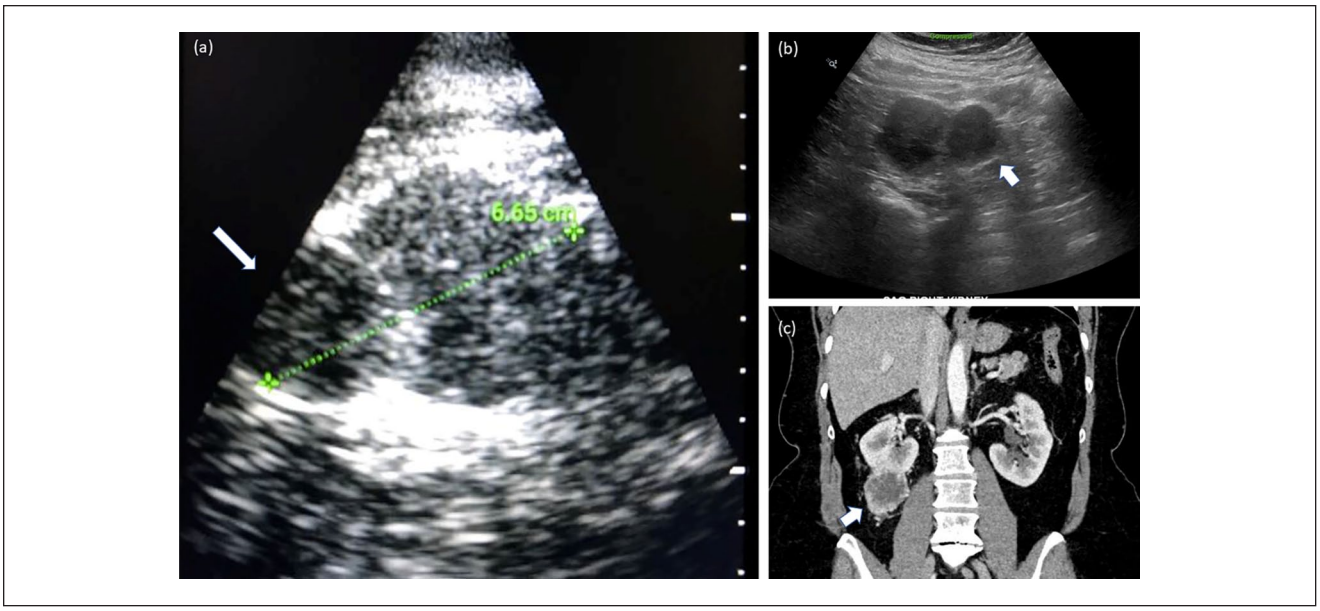

Figure 1. (a) Point-of-care ultrasound image of the right kidney in an asymptomatic 54-year-old woman shows a peripherally located isoechoic solid mass (arrow) causing distortion of the renal border. (b) Formal renal ultrasonography image of 1 (arrow) of 2 solid masses found in the inferior pole of the right kidney, the largest measuring 4.6 cm in its biggest dimension. (c) Contrast-enhanced computed tomography imaging of the abdomen and pelvis, coronal view shows a peripheral, likely multifocal renal cell carcinoma (arrow) in the inferior pole of the right kidney.

RCCs. The patients were observed in a high-volume ambulatory cardiology clinic within a 9-month period from the index case. As part of the standard clinical care in our cardiology clinic, a physical examination and POCUS physical exam using the GE Vscan Extend were performed as a part of the routine patient evaluation. We have been including POCUS with every outpatient evaluation since 2011 which includes approximately 2200 office visits per year. The cardiologist performing the evaluations had performed over 20 000 primarily cardiac POCUS evaluations in the 9 years prior to preparation of this case series.[7]

Case Presentations

Patient 1 Description

A 54-year-old female with hypertension and hyperlipidemia presented to cardiology clinic for follow-up 20 months since her most recent office visit. She was being evaluated for follow-up of cardiac risk factors and medication management. The patient was in her usual state of health and asymptomatic without changes in her exercise tolerance, weight, or energy levels. POCUS demonstrated a renal mass adjacent to the right kidney (Figure 1). She did not have any gross hematuria or flank pain. Follow-up with a formal renal ultrasound 5 days later revealed 2 solid masses in the inferior pole of the right kidney, measuring 4.6 and 3.4 cm in their largest dimensions and with demonstrated internal vascularity on Doppler. Abdominal CT obtained 7 days after the initial bedside findings requested by urology further detailed likely multifocal right RCC with at least 2 adjacent contiguous masses. The patient underwent robotic right partial nephrectomy, which revealed clear cell RCC with negative margins and no vein or fat invasion. At time of pathologic diagnosis, the patient was stage pT2a.

Patient 2 Description

A 63-year-old male with coronary artery disease status post coronary artery bypass surgery, dyslipidemia, hypertension, and gout presented for follow-up visit 8 months since his most recent appointment. The patient was clinically asymptomatic with an unremarkable review of systems and clinically stable from a cardiovascular standpoint. Routine POCUS revealed a previously undocumented 6-cm mass on the left kidney. Formal renal ultrasound performed 12 days later confirmed a centrally located 6.2-cm solid mass in the left kidney suggestive of renal cell carcinoma (Figure 2). Abdominal CT performed 41 days after the initial bedside examination confirmed an 8 cm × 5.5 cm × 8 cm heterogeneously enhancing mass consistent with a rapidly growing RCC. Ninety days after initial office bedside examination, the patient developed gross hematuria and was hospitalized for urgent fluoroscopic embolization and subsequent laparoscopic radical nephrectomy with retroperitoneal lymph node dissection. Pathologic examination revealed clear cell

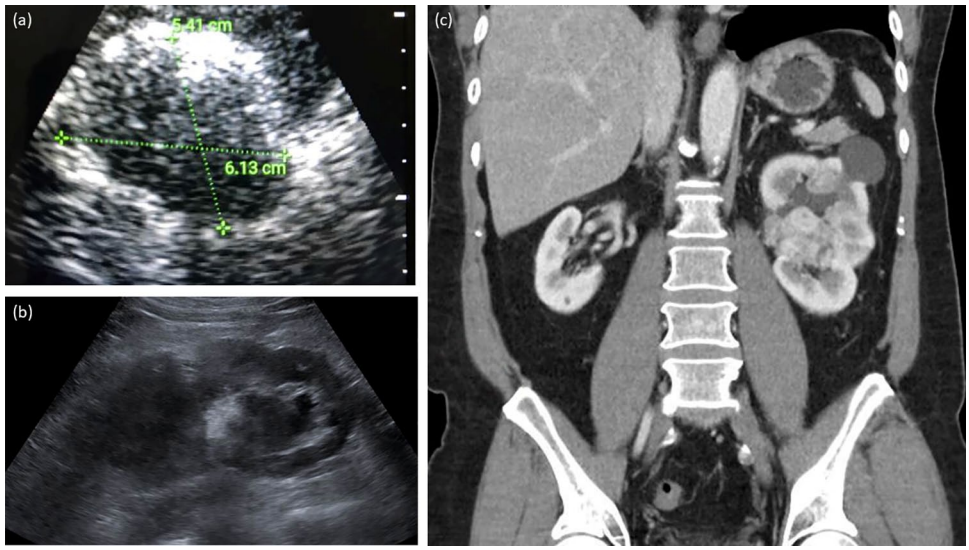

Figure 2. (a) Point-of-care ultrasound image of the left kidney in an asymptomatic 63-year-old man shows a large isoechoic solid mass measuring approximately 6 cm in its largest dimension. (b) Formal renal ultrasonography image of the left kidney showing distortion of normal renal architecture with a centrally located heterogeneous solid mass. (c) Contrast-enhanced computed tomography imaging of the abdomen and pelvis, coronal view shows an 8 cm × 5.5 cm × 8 cm heterogeneously enhancing mass consistent with renal cell carcinoma in the left kidney, as well as a simple renal cyst in the superior pole of the left kidney. Three months after these images were obtained, the patient developed gross hematuria.

RCC extending into the renal vein with no evidence of lymph node metastases, stage pT3aN0.

Patient 3 Description

A 69-year-old male with hypertension, dyslipidemia, coronary artery disease status post percutaneous coronary intervention, and remote smoking history presented for a 5-month interval follow-up visit for management of his coronary artery disease. The patient described stable symptoms of dyspnea and fatigue. A routine POCUS examination revealed a 3-cm heterogeneous mass in the right kidney. He denied weight loss, flank pain, hematuria, or other systemic symptoms. Formal renal ultrasonography with Doppler was obtained 15 days later and confirmed the presence of a 3-cm solid mass in the right kidney with demonstrable blood flow consistent with renal cell carcinoma (Figure 3). Abdominal CT performed 29 days following the initial bedside examination confirmed the presence of a 3.6 × 2.8 cm renal lesion without evidence of renal vein extension or other metastatic disease. The patient underwent a laparoscopic partial nephrectomy, which revealed clear cell RCC with clear margins, pT1a.

Discussion

RCC, if diagnosed while still localized, has approximately a 93% 5-year patient survival rate. For the roughly 25% of individuals who already have either locoregional or distant metastases at diagnosis, 5-year patient survival drops to 67% and, in the case of distant metastatic disease, 5-year patient survival is less than 15%.[1] RCC is almost twice as likely to develop in men than in women across all age groups after age 50 years with only 5% of RCC presenting before the age of 40 years.[1,8] Asian Americans or Pacific Islanders have the lowest incidence of RCC in the United States, and survival is generally worse among the black population.[1] These 3 patients all had a history of hypertension, which is associated with an 67% increased risk of developing RCC.[9] Obesity and smoking are also 2 well-established risk factors, which were also present in these patients.[10,11] All 3 patients were asymptomatic on initial detection of the renal masses with POCUS.

Common ultrasound findings of RCC include solid masses that are isoechoic and peripherally located, often with Doppler signal present; however, the renal lesions can also be centrally located, as was seen in patient 2, and be hypo- and hyperechoic.[2] While POCUS may not always have the resolution required to make these distinctions at the bedside, it can be used to identify common abnormal imaging patterns and be used to detect distortions in normal renal architecture and kidney borders that would prompt formal imaging with an increased pretest probability for detection of meaningful pathology. Although it may not be feasible or practical to anticipate that cardiologists or general practitioners will become universally knowledgeable

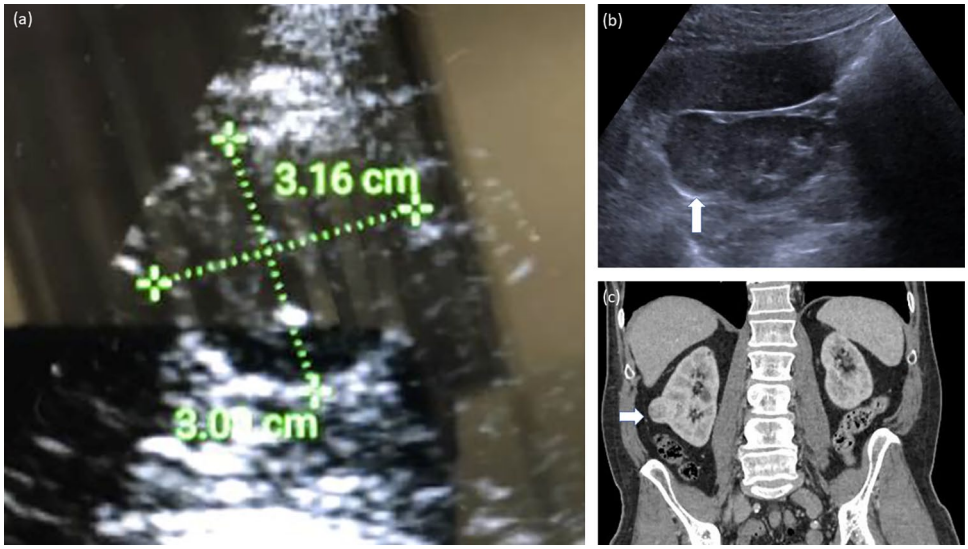

Figure 3. (a) Point-of-care ultrasound image of right kidney in an asymptomatic 69-year-old man with a history of tobacco use shows a heterogeneous solid mass measuring approximately 3 cm in its largest dimension. (b) Formal renal ultrasonography image of a peripherally located solid mass (arrow) found in the right kidney, measuring 3 cm in its largest dimension. This mass demonstrated increased blood flow (not pictured) consistent with renal cell carcinoma. (c) Contrast-enhanced computed tomography imaging of the abdomen and pelvis, coronal view shows a peripheral mass (arrow) on the right kidney with no evidence of renal vein involvement or metastatic disease in the rest of the abdomen.

and confident in renal imaging pathology criteria like the Bosniak classification of cystic renal masses, the identification of solid renal masses with POCUS likely increases the pretest probability of identifying malignant renal pathology.[12] With purposeful repetition and pattern recognition that naturally accrues with clinical practice over time, it may be plausible for nonradiologists like primary care physicians or other clinical subspecialists to detect renal malignancies with reasonably higher pretest probabilities than population-based screening imaging might.[13] Additionally, anatomic evaluation of the kidneys especially in the cardiology care setting may offer valuable insights in the assessment and chronic disease management of patients with ubiquitous diagnoses of hypertension, heart failure, and atherosclerotic vascular disease. Our case series may serve to generate interest in hypothesis testing of novel approaches in primary care and in the community health settings that may increase detection of RCC or facilitate improved outcomes for RCC in vulnerable populations and patients with limited access to modern imaging technologies.

In a population-based study in Iceland, incidentally diagnosed asymptomatic tumors were on average 2.3 cm smaller than symptomatic tumors, and absence of symptoms conferred significantly improved patient survival. This survival benefit may be explained by earlier diagnosis and less advanced lower staged cancers seen in the asymptomatic cohort relative to RCC patients presenting with symptoms. The earlier diagnosis and lower stage offer an improved opportunity for an increased probability for surgical cure and fewer indications for the use of adjuvant systemic therapies.[3]

Conclusions

Prior to the advent of POCUS, incidental malignancies were typically diagnosed while imaging patients for other complaints or problems or nonstandard screening examinations. Incorporating POCUS into the routine physical examination of a patient in the ambulatory care setting may improve rates of incidental detection and increase the pretest probability of identifying renal pathology with formal imaging studies. Most importantly, with minimal clinician training, earlier and increased detection of asymptomatic RCC may result in improved patient survival.

Author Contributions

GS contributed to the literature review and manuscript writing and preparation. IK contributed to project design, manuscript writing, and manuscript preparation.

Declaration of Conflicting Interests

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Ethical Approval

Consent to participate and consent for publication was obtained from each patient. Ethics approval was sought from the Cedars Sinai Hospital Institutional Review Board (IRB). The requirement for approval was waived by the Cedars Sinai IRB on October 7, 2019.

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