## **RESIDENT'S CORNER**

# Long term control and preservation of renal function after multiple courses of stereotactic body radiation therapy for renal cell carcinoma

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Renal cell carcinoma (RCC) is usually treated with surgery, with or without systemic therapy. For select patients, stereotactic body radiation therapy (SBRT) may be a suitable alternative. Although many reports exist on the successful use of SBRT, very few have described long

Introduction

Renal cell carcinoma (RCC) is the third most common genitourinary malignancy in the United States and results in approximately 15,000 deaths each year.<sup>1</sup> The most common treatment for RCC is nephrectomy, with or without systemic therapy for more advanced stages of disease. However, for some patients, including those with medically inoperable disease, a single kidney, or renal impairment, stereotactic body radiation therapy

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Address correspondence to Dr. Abhinav V. Reddy, Riverside Regional Medical Center, 500 J. Clyde Morris Blvd., 2 Annex, Newport News, VA 23601 USA term outcomes with regard to disease progression and renal function. We report a rare case of a single patient with primary, metastatic, and locally recurrent renal cell carcinoma who was successfully treated with SBRT. The patient has been disease-free for 8 years since treatment, with stable renal function even after two courses of SBRT to her solitary functioning kidney.

**Key Words:** stereotactic body radiation therapy, renal cell carcinoma, retreatment, recurrence, preserved renal function

(SBRT) may be a suitable alternative. Although studies have shown that SBRT can provide a high degree of local control,<sup>2-5</sup> the role for SBRT in the treatment of RCC is not well established. Furthermore, questions remain regarding renal function following SBRT. To our knowledge, this is the first case of SBRT achieving durable local control in a single patient with primary, metastatic, and locally recurrent RCC. Long term renal function was preserved even after multiple courses of SBRT to the patient's solitary functioning kidney.

### Case

A 61-year-old female presented with a 1 month history of painless hematuria in January 2009. Abdominal computed tomography (CT) identified a solid mass in the upper pole of the right kidney measuring 2.5 cm, and a 9.5 cm mass inferior to this. There was an additional mass in the upper pole of the left kidney measuring 6.0 cm in diameter, Figure 1. Staging positron emission tomography/computed tomography (PET/CT) revealed abnormal hypermetabolic activity in the T7 vertebral body as well.

Her case was discussed at a multidisciplinary tumor board. Given her oligometastatic disease, it was decided that the patient would be treated with aggressive local therapy to all sites. The patient underwent right radical nephrectomy in March 2009. Pathology revealed Fuhrman grade 2 clear cell RCC with negative surgical margins. In May 2009, her T7 vertebral lesion was treated with SBRT with a dose of 24 Gy in 3 fractions.

Management of the remaining left kidney was rediscussed at the multidisciplinary tumor board. The patient adamantly refused dialysis, and consensus was reached that her left renal mass would be treated with SBRT. A CT abdomen/pelvis without contrast was obtained for simulation and treatment planning. The gross tumor volume (GTV) and organs at risk (OARs) were delineated and contoured. The GTV was isometrically expanded by 4 mm to generate the planning target volume (PTV). Prior to each treatment, the patient was placed in an immobilization device (BodyFIX, Medical Intelligence, Schwabmuenchen, Germany) and cone-beam CT scans were obtained to verify set up. In July 2009, the patient was treated on an Elekta Synergy-S unit (Elekta, Stockholm, Sweden) with a prescription dose of 36 Gy in 3 fractions to the left renal tumor.

In December 2009, the patient developed local recurrence in the right nephrectomy bed with CT



**Figure 1.** Initial CT reveals a solid mass in the upper pole of the right kidney measuring 2.5 cm (**A**), a 9.5 cm mass inferior to this (**B**), and a solid mass measuring 6.0 cm in the upper pole of the left kidney (**C**).



**Figure 2.** CT abdomen 9 months post-nephrectomy shows a 3.4 cm x 2.4 cm soft tissue recurrence in the right nephrectomy bed **(A)**. CT abdomen 12 months post-SBRT shows an increase in size of the left renal mass from 6.0 cm to 7.9 cm **(B)**.

abdomen demonstrating a 3.4 cm x 2.4 cm soft tissue mass abutting the posterior lateral wall of the ascending colon Figure 2a. In January 2010, the patient was treated with SBRT with a dose of 36 Gy in 3 fractions to the right nephrectomy bed.

In June 2010, CT abdomen demonstrated progression of the left renal mass with an increase in size from 6.0 cm to 7.9 cm, Figure 2b. The patient was again referred to the radiosurgery center. In July 2010, she underwent SBRT retreatment to her left renal disease with a prescription dose of 15 Gy in 4 fractions.

After completing SBRT retreatment to the left kidney mass, the patient was monitored with imaging every 3 months for the first 4 years and every 6 months thereafter. Interval imaging demonstrated no evidence of disease progression or recurrence. The left renal mass demonstrated a partial response (7.8 cm to 5.5 cm) 4 years after SBRT retreatment. Her most recent abdominal CT in October 2018, more than 9 years from her initial diagnosis, revealed a 4.8 cm left renal mass with dystrophic calcification and complete resolution of the right nephrectomy bed recurrence, Figure 3. Her



**Figure 3.** Most recent CT demonstrates a 4.8 cm mass in the upper pole of the left kidney with dystrophic calcification **(A)** and complete resolution of the soft tissue recurrence in the right nephrectomy bed **(B)**.

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most recent PET/CT in December 2016 demonstrated complete resolution of her T7 vertebral body lesion.

The patient has done remarkably well since her last SBRT treatment in July 2010. She continues to have an excellent quality of life, with a Karnofsky Performance Status of 100. She has not experienced any acute or late toxicity, and her renal function has been preserved since receiving SBRT. After the right radical nephrectomy, the patient developed stage 3 chronic kidney disease with a decline in her estimated glomerular filtration rate (eGFR) from 93 mL/min to 36 mL/min and an elevation in her creatinine (Cr) from 0.7 mg/dL to 1.6 mg/dL. However, there has been no deterioration in her renal function for 8 years since undergoing two courses of SBRT to her solitary functioning left kidney. Her most recent (October 2018) eGFR and Cr were 37 mL/min and 1.5 mg/dL versus 36 mL/min and 1.6 mg/dL in 2009 (pre-SBRT).

### Discussion

In this report, we show that SBRT can achieve durable control for primary, metastatic, and locally recurrent RCC and that renal function can be preserved after SBRT retreatment to a single functioning kidney. This case adds to the growing literature<sup>2-5</sup> on the successful treatment of primary and metastatic RCC with SBRT. However, there are very few reports of SBRT for local recurrence after nephrectomy and for retreatment of primary RCC.

Local recurrence of RCC following nephrectomy is a rare phenomenon and is usually managed with surgery alone.<sup>6,7</sup> However, one report<sup>8</sup> describes the successful treatment of locally recurrent RCC with SBRT. Maclean et al<sup>8</sup> report a case of a 72-year-old male with a history of primary RCC who developed local recurrence 18 years after undergoing radical nephrectomy. He was treated with SBRT with a dose of 50 Gy in 3 fractions to the nephrectomy bed. The patient had an excellent response with no evidence of disease for 30 months following radiation. Our patient had a similar outcome with no evidence of recurrence for 8 years following SBRT to her right nephrectomy bed. These patient experiences suggest that SBRT is a viable treatment option for locally recurrent RCC after nephrectomy.

Additionally, there is very little evidence regarding the efficacy and safety of SBRT retreatment for primary RCC. Svedman et al<sup>9</sup> report on a series of 7 patients with primary or metastatic RCC who were treated with SBRT. A patient with primary RCC developed progression at 54 months follow up. She underwent SBRT retreatment with no evidence of disease progression or recurrence for 12 months. She experienced a mild elevation in her Cr (from 1.0 mg/dL to 1.2 mg/dL) after re-irradiation. Similarly, the patient in our report also demonstrated an excellent response after SBRT retreatment to her left kidney with disease control noted at 8 years follow up. However, our patient experience is unique in that there was no deterioration in renal function with stable Cr and eGFR after multiple SBRT treatments.

Preservation of renal function in the treatment of RCC is particularly relevant for patients with solitary functioning kidneys or chronic kidney disease as these patients are on the brink of lifelong dialysis. Studies have reported conflicting findings regarding kidney function following SBRT for RCC.<sup>3,10</sup> This can partly be explained by differences in treatment design<sup>10</sup> and tumor size and location. In this report, we show that long term renal function can be preserved even after multiple courses of SBRT to a solitary functioning kidney. Our patient had no decline in renal function for 8 years following treatment, and as a result, has avoided lifelong dialysis. This report suggests that SBRT for RCC is a non-invasive, nephron-sparing treatment, which can provide durable tumor control while preserving long term renal function.

### Conclusion

Our case shows that SBRT can achieve durable tumor control for primary, metastatic, and locally recurrent RCC and that long term renal function can be preserved even after SBRT retreatment to a solitary functioning kidney.

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