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Case Report

Adrenal oligometastasis cured with stereotactic ablative radiotherapy ☆☆☆,★,★★,†,††,†

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ABSTRACT

Stereotactic ablative radiotherapy (SABR) has emerged as an effective, noninvasive alternative to surgery in patients with oligometastatic disease. Historically, select patients with adrenal oligometastases have been treated with adrenalectomies which can offer durable local control and reasonable survival rates. SABR is a promising noninvasive treatment alternative to surgery capable of delivering ablative doses of radiation to the tumor with the goal of achieving durable local control of adrenal metastases. We report on a case of a patient who underwent initial surgical resection for a locally advanced lung adenocarcinoma and subsequently developed an early, biopsy-proven, oligometastatic recurrence in the adrenal gland. He underwent chemotherapy and SABR using CyberKnife to the adrenal metastasis and is in remission 7 years after treatment with no late toxicity. Fractionated SABR is an attractive noninvasive alternative to surgery for adrenal metastases. This case demonstrates that select patients with adrenal oligometastases, can achieve long-term remission and even cure following SABR.

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Introduction

Stereotactic ablative radiotherapy (SABR) has emerged as an effective, noninvasive alternative to surgery in patients with oligometastatic disease [1]. Treatment of both primary

tumors and metastases in the lungs, liver, adrenal, and kidneys remain technically challenging because of respiratory movement of the target lesion. Real-time tumor tracking on CyberKnife has made it possible to treat lesions in areas of high respiratory motion such as in the abdomen.

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Adrenal metastases can arise from various types of cancer, the most common being non-small cell lung cancer [2,3]. In autopsy series, adrenal metastases are relatively common occurring in up to 27% of patients with cancer [4]. Due to the asymptomatic nature of metastases to the adrenal gland, they are often only diagnosed on surveillance imaging.

Historically, patients with adrenal oligometastases have been treated with open or laparoscopic adrenalectomies. Surgery can offer durable local control and reasonable survival rates [5]. More recently, SABR has been used to treat adrenal metastases. The introduction of fiducial based tracking on robotic radiosurgery platforms like CyberKnife allows for small planning target volume (PTV) margins and high ablative doses of radiation. SABR using CyberKnife is a promising noninvasive treatment alternative capable of delivering ablative doses of radiation with the goal of achieving durable local control of adrenal metastases. This case report describes a patient with oligometastatic disease to the adrenal gland who is in remission 7 years after SABR treatment.

Case presentation

A 67-year-old male patient was diagnosed with a cT3N0M0, adenocarcinoma of the left apex involving the upper posterior chest wall in November 2010. At the time of diagnosis, he

also appeared to have a stage I lung primary in the contralateral upper lobe. The case was discussed at our institutional tumor board and the recommendation was to proceed with a left thoracotomy and left upper lobectomy with resection of the second and third ribs which the patient underwent the following month. There was no disease upstaging at surgery.

A computed tomography (CT) scan completed in March 2012 showed slight interval enlargement of the right upper lobe nodule as well as a new adrenal mass. A positron emission tomography scan in April 2012 revealed a 1.5 cm right upper lobe nodule with a maximum SUV of 5.7 (1.4 on the previous study) and a 4.5 cm lesion in the right adrenal gland with a maximum SUV of 19 (Fig. 1). The adrenal metastasis was biopsied and pathology confirmed a metastatic lung adenocarcinoma with the same histologic and immunophenotypic profile as the original primary tumor. The right upper lobe nodule was felt to be an early-stage primary lung cancer and was not biopsied.

The patient had recovered from his initial surgery, was asymptomatic and had an excellent performance status. The case was presented at our institutional multidisciplinary tumor board, and an aggressive treatment approach including radiation and chemotherapy for his metastatic disease was recommended. From May to August 2012, the patient underwent 6 cycles of docetaxel plus carboplatin which was well tolerated. Repeat CT imaging demonstrated partial tumor re-

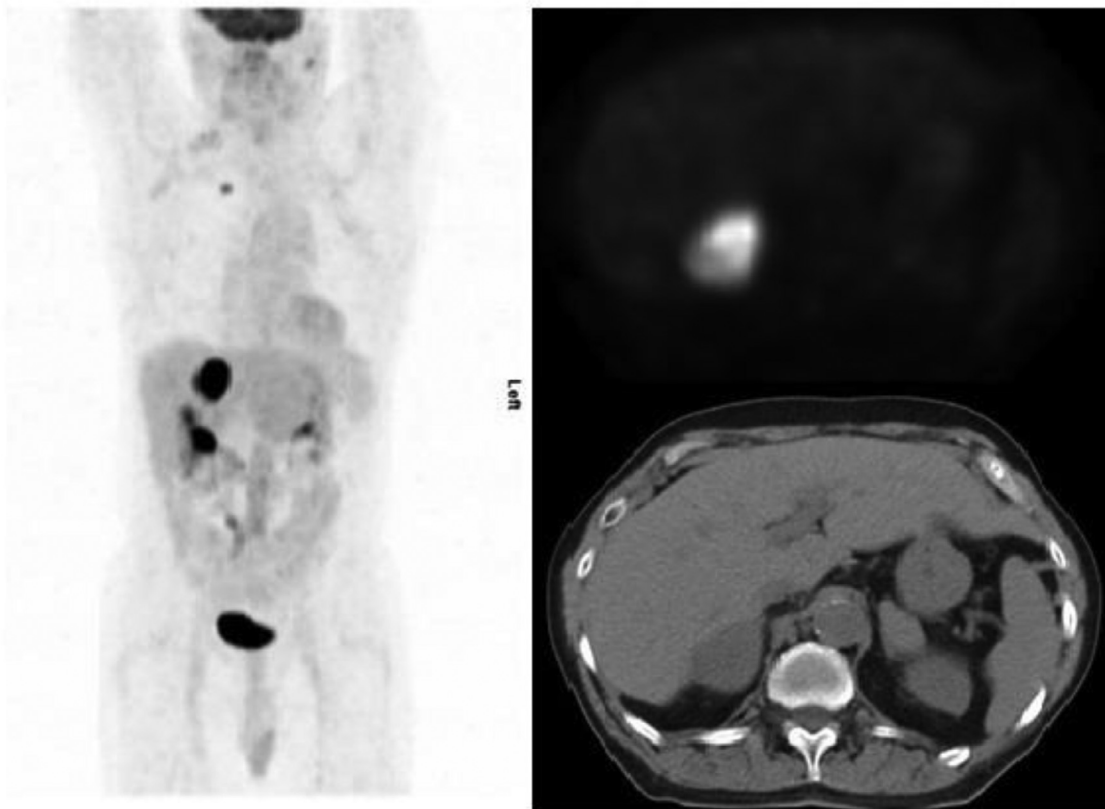


Fig. 1 – MIP image showing hypermetabolic right-sided adrenal mass and upper lobe nodule (on the left) and axial slice of PET and corresponding CT showing adrenal mass (on the right). Both are from the PET-CT performed in April 2012. MIP, maximal intensity projection; PET, positron emission tomography; CT, computed tomography.

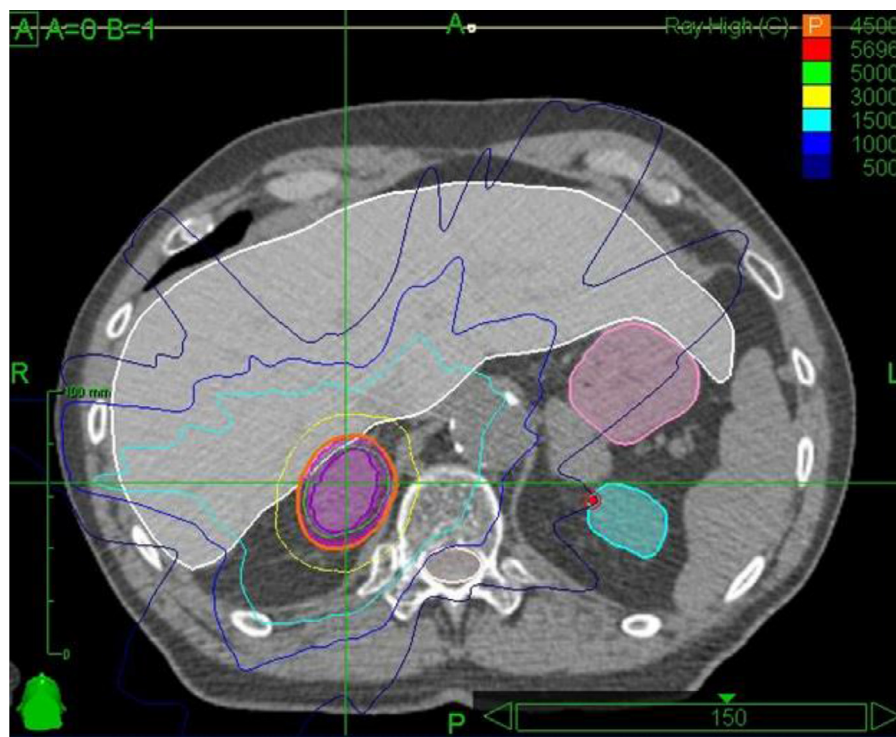


Fig. 2 – Axial CT image of dose distributions (cGy) from the CyberKnife treatment planning software, August 2012. CT, computed tomography; cGy, centigray.

gression of both the adrenal metastasis and right upper lobe nodule.

The patient subsequently underwent SABR to both the right upper lobe nodule and right adrenal metastasis. In preparation for SABR to the adrenal tumor, platinum fiducials were placed transcutaneously under CT guidance using a right lumbar paraspinal retroperitoneal approach.

The patient underwent a magnetic resonance imaging (MRI) and CT simulation for treatment planning. The patient was placed supine with arms by his sides and immobilized with a custom head rest and vac-loc bag. Prior to SABR treatment, the adrenal tumor measured 3.5×2.2 cm. The PTV consisted of the gross tumor volume with a 3 mm margin treated to a dose of 4500 cGy in 3 fractions using CyberKnife. Over 99% of the PTV was covered by the prescription dose (Fig. 2). The maximal point dose (located within the gross tumor volume) was 5696 cGy. Organ at risk dose statistics are shown in Table 1. The patient sustained no acute or subacute toxicity aside from grade 1 nausea experienced immediately after the treatment which subsided very quickly. The right upper lobe lung nodule received SABR to a dose of 5400 cGy in 3 fractions using a linear accelerator with daily cone beam CT for image guidance. The lung SABR was well tolerated with no toxicity.

Follow-up thoracic and abdominal CT imaging was performed on the patient every 6 months and revealed regression in tumor size of both SABR treated sites. In December 2012, CT imaging showed that the adrenal tumor had regressed and undergone central necrosis and the right upper lobe nodule had completely resolved. By May 2014, the adrenal tumor was also no longer discernable on imaging. The most recent follow-up imaging from May 2019 showed no local relapse in the

Table 1 – Organ at risk (OAR) dose statistics

	Minimum dose (cGy)	Mean dose (cGy)	Maximum dose (cGy)
Spinal cord	101.09	492.50	1087.18
Liver	75.01	852.75	5503.77
Right kidney	79.70	604.26	5156.18
Left Kidney	85.61	142.81	522.99
Stomach	97.70	594.69	1762.88
Esophagus	81.36	636.07	1863.88
Heart	74.75	420.42	1575.14
Small bowel	84.22	512.99	1617.99

cGy, centigray.

chest/abdomen and no new systemic metastases (Fig. 3). The patient has maintained stable renal function since undergoing adrenal SABR. At his last clinical follow-up, the patient has no evidence of late toxicity from both adrenal and lung SABR and has maintained an excellent performance status.

Discussion and conclusions

A small subset of patients with oligometastatic disease can achieve long-term survival following aggressive treatment with SABR to the primary tumor and metastases [6]. SABR has become an established treatment option for medically inoperable primary and metastatic lung tumors [7,8]. Adrenal metastases are far less commonly treated with SABR due to

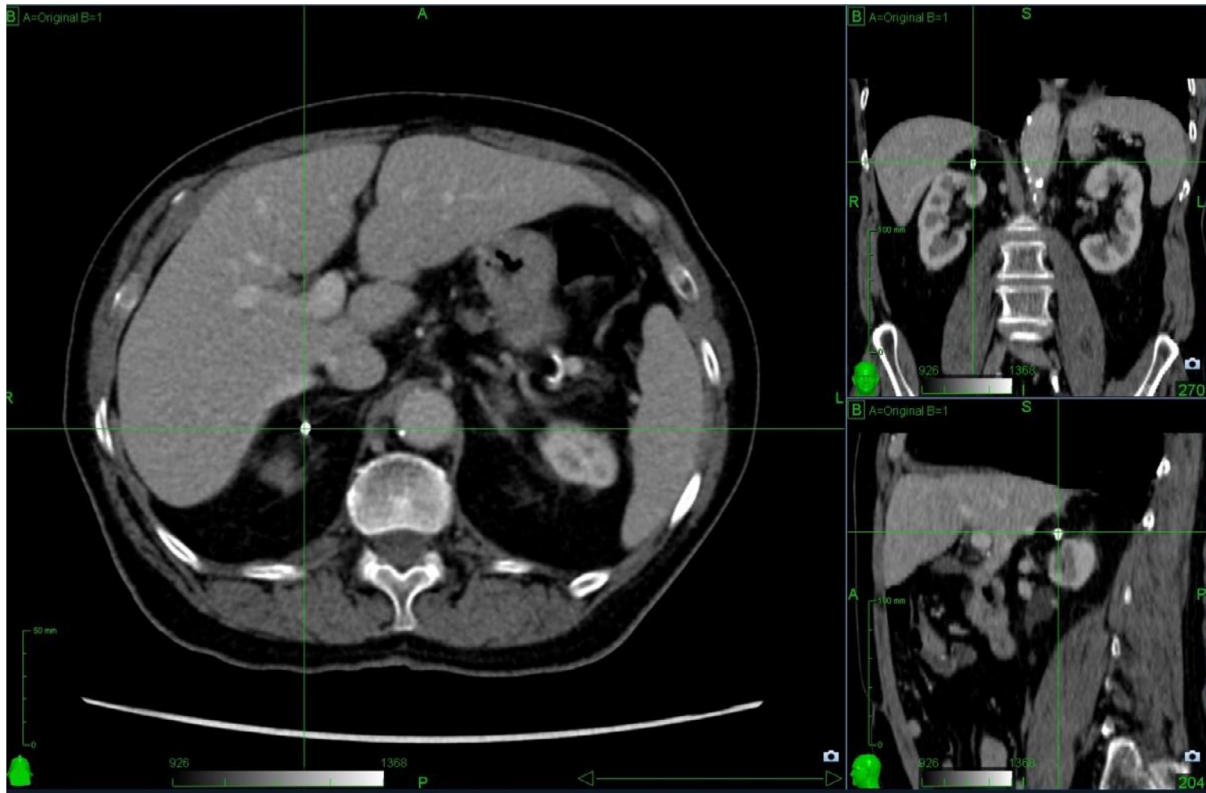


Fig. 3 – Axial, sagittal, and coronal CT image of treated right adrenal metastasis, 7 years postradiosurgery, May 2019. CT, computed tomography.

the technical difficulties associated with respiratory induced tumor motion. Fiducials are placed in the adrenal gland to allow for real time tumor tracking on Cyberknife. Our local institution experience has shown that for left adrenal tumors, fiducials can be placed endoscopically by our gastroenterology colleagues under ultrasound guidance. Right adrenal tumors typically require CT guided fiducial placement. Our complication rate for acute bleeding, infection or bile leak for fiducials placed in the adrenal, kidney or liver is less than 1%.

Although surgery is the historic standard treatment method for adrenal and other abdominal metastases, CyberKnife radiosurgery has been demonstrated as a highly-effective, noninvasive alternative especially well suited in elderly patients. Scorsetti performed a study that presented local control rates of 66% and 32% for adrenal metastases treated using SABR at one and 2 years, respectively [2]. Another study demonstrated local failure of 7.6% and 19.2% at 1 year and 3 years after SABR treatment of their adrenal metastases with no significant impact on renal function [9]. Casamassima et al. used SABR to treat adrenal metastases and achieved a local control rate of 90% after 2 years [10]. The aforementioned studies and our case report demonstrate very low rates of toxicity, suggesting that SABR is a safe and effective nonsurgical alternative in the treatment of adrenal metastases.

Fractionated SABR is an attractive noninvasive alternative to surgery for adrenal metastases. This case demonstrates that select patients with adrenal oligometastases can achieve long-term remission and even cure following SABR.

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