
Single-lung stereotactic body radiotherapy: A Case report and discussion of therapeutic challenges

Sir,

Management of a second primary lung cancer (SPLC) after prior pneumonectomy (PP) poses a significant therapeutic challenge. Treatment options include sublobar surgical resection, conventional radiotherapy (RT), and stereotactic body RT (SBRT). Low cardiopulmonary reserve limits the use of surgery in a majority of patients. SBRT has been shown to be a safe and effective treatment option for medically inoperable early-stage lung cancer. However, there are limited data on the use of SBRT in patients with a single lung. Herein, we discuss the challenges in the management and case summary of one such patient.

68 year old gentleman presented with an incidentally detected right lung lesion. He had a history of left lung nonsmall cell lung cancer diagnosed in 2012. He received three cycles of neoadjuvant chemotherapy (pemetrexed and carboplatin), followed by preoperative external beam RT to the mediastinum and left hemithorax, using intensity-modulated RT, to a dose of 45 Gy in 25 fractions, following which he underwent a right pneumonectomy and left mediastinal nodal dissection. On routine

follow-up, a new opacity was seen in the right lung on chest radiograph. 18-Fluorodeoxyglucose positron emission tomography/computed tomography (CT) scan showed a peripheral upper lobe lung nodule (3.3 cm × 3 cm, maximum standardized uptake value [SUV_{max}] of 16.6). Another subcentimeter nodule in the right lower lobe was too small to be characterized with low metabolic activity.

His pulmonary evaluation revealed severe obstructive changes with a forced expiratory volume in 1 s of 41% and a reduced diffusion capacity. He was considered unfit for any surgical intervention, including a transthoracic biopsy. His case was discussed in a multidisciplinary clinic, and it was decided to go ahead with SBRT for the larger upper lobe lesion and observe the smaller lesion. The dosimetric parameters from the last radiation were unavailable for review; however, the patient did not have any late radiation sequelae in the lung.

SBRT was planned using standard four-dimensional CT simulation and treatment planning process. The gross disease was contoured on maximum intensity projection images. The internal gross target volume was 12.84 cc,

and planning treatment volume (PTV) was 38.20 cc. Treatment was delivered using volumetric modulated arc therapy (VMAT) technique to a total dose of 60 Gy in 8 alternate day fractions (7.5 Gy/fraction). The treatment plan was optimized to achieve D95 PTV (dose received by 95% volume) of 100%. The mean right lung dose was 4.6 Gy. The volume of lung receiving a dose of 5 Gy (V5) was 21%, V10 16%, and V20 10%. The mean dose to the esophagus was 24.3 Gy, and the maximum dose to the spinal cord was 17 Gy. The patient successfully completed treatment without acute radiation-induced pulmonary or esophageal toxicity.

At 3-month follow-up, the treated nodule showed complete metabolic response and near-complete morphologic response [Figure 1]. However, the lower lobe nodule increased in size (1.7 cm × 1 cm, SUV_{max} of 9). Pulmonary function test showed stable pulmonary function. The patient was not willing for any form of systemic therapy, and it was decided to go ahead with SBRT.

SBRT was delivered using VMAT technique to a dose of 60 Gy in 5 alternate day fractions (12 Gy/fraction). The mean lung dose was 4.7 Gy. The V5, V10, and V20 of the lung were 19%, 13%, and 7%, respectively. The patient completed treatment without acute toxicity.

At 3-month follow-up, the nodule showed complete response. The patient did not have signs or symptoms of late radiation-induced pulmonary toxicity at the time of last follow-up.

In the absence of effective surgical options, SBRT provides an effective and safe therapeutic option in patients with PP. It can be safely offered to all patients irrespective of the pulmonary reserve^[1] and provides superior local control to conventional RT.^[2] Table 1 summarizes the studies showing

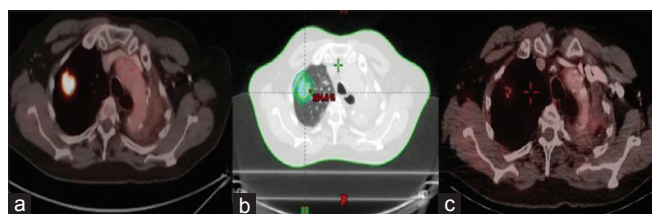


Figure 1: (a) Upper lobe nodule in ¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography scan at presentation, (b) 95% dose coverage of the planning treatment volume on planning computed tomography scan, (c) response ¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography scan at 3 months showing complete metabolic and near complete morphologic response

Table 1: Outcomes with radiotherapy after pneumonectomy for second primary

Author	Year	n	Median tumor size	RT technique	Local control (years)	Overall survival (years)	G _{≥2} RT pneumonitis (%)
Lagerwaard <i>et al.</i> ^[3]	2001	6	-	Conventional RT	66% (1)	33% (2)	16.6
Senthi <i>et al.</i> ^[4]	2013	27	2.7 cm	SBRT/hypofractionated RT/conventional RT	75% (3)	63% (3)	13
Thompson <i>et al.</i> ^[5]	2014	13	-	SBRT	100% (2)	61% (2)	15
Testolin <i>et al.</i> ^[6]	2015	13	2.1 cm	SBRT	64.5% (2)	80% (2)	0

RT: Radiotherapy, SBRT: Stereotactic body radiotherapy

outcomes for SPLC after PP with curative RT.

The most common toxicity after SBRT is pneumonitis, of which only 10% is symptomatic. The risk of grade ≥ 2 pneumonitis with SBRT after PP has been shown to be similar to non-operated patients.^[7] Testolin *et al.*^[6] showed that when keeping V5, V10, and V20, <50%, 20%, and 7%, respectively, the risk of significant lung toxicity was low and that biologically effective dose >100 Gy could be reached for most patients.

Hence, SBRT can be offered to all SPLC patients after PP, irrespective of pulmonary function with local control superior to conventional fractionation and without an increased risk of pulmonary morbidity.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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