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Short-course Radiotherapy for Airway Stenting in Malignant Airway Obstruction: A Case Report and Literature Review

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Abstract. *Background: Malignant airway obstruction (MAO) secondary to tumor growth occurs in nearly a third of patients with lung cancer and portends a very poor prognosis if untreated. Treatment options include bronchoscopic intervention with tumor debulking, stent placement, endobronchial brachytherapy, or palliative radiotherapy. Case Report: This is a report of a 74-year-old woman with a medical history of metastatic lung adenocarcinoma, hospitalized for dyspnea, hemoptysis, and chest pain with a radiographic finding of MAO on chest X-ray and computed tomography. Patient underwent radiation with a total dose of 13 Gy in two once-weekly fractions of 6.5 Gy per fraction. Three days after the end of radiation treatment, chest X-ray showed a completely right lung re-expansion without atelectasis. Two weeks after radiotherapy treatment, the patient was discharged from hospital without pulmonary symptoms. Conclusion: A different fractionation with a lower equivalent dose in 2 Gy fraction compared to literature data showed efficacy in resolving MAO with excellent local control in the first three months of follow-up.*

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Malignant airway obstruction (MAO) secondary to tumor growth occurs in nearly a third of patients with lung cancer and portends a very poor prognosis, with median survival rates at diagnosis as low as 1-2 months if untreated (1). MAO often results in symptoms, such as dyspnea, hemoptysis, chest pain, hoarseness, cough, pneumonia and may be a risk factor for imminent death by suffocation. Metastatic or locally advanced lung cancer patients with airway obstruction have poor performance status and therefore they are often not fit for chemotherapy or surgery. Treatment options include bronchoscopic intervention with tumor debulking, stent placement, endobronchial brachytherapy, or palliative radiotherapy (2-5). External beam radiation therapy (EBRT) is a noninvasive, safe, and simpler treatment option than other invasive procedures. However, there are few clinical trials reporting the results of exclusive EBRT performed to improve airway obstruction and obstructive pneumonias (6-8). To date, there are no standardized guidelines about doses, fractionation, and timing for EBRT. In this article, we report a case of a patient diagnosed with MAO from metastatic non-small cell lung cancer (mNSCL) who underwent EBRT to the bronchus and hilar lymph-node achieving a complete re-expansion at chest X-rays image without acute toxicity.

Case Report

Here, we present the case of a 74-year-old woman with a medical history of early-stage lung adenocarcinoma who had undergone right upper lobectomy surgery followed by curative concurrent chemoradiation for a lymph node recurrence. After three years of negative clinical and radiological follow-up, the patient underwent stereotactic radiotherapy on a right lower lobe lesion. Subsequently due to radiological systemic progression she started first-line therapy with immunotherapy. After two years she started second-line chemotherapy for local progression. At the last

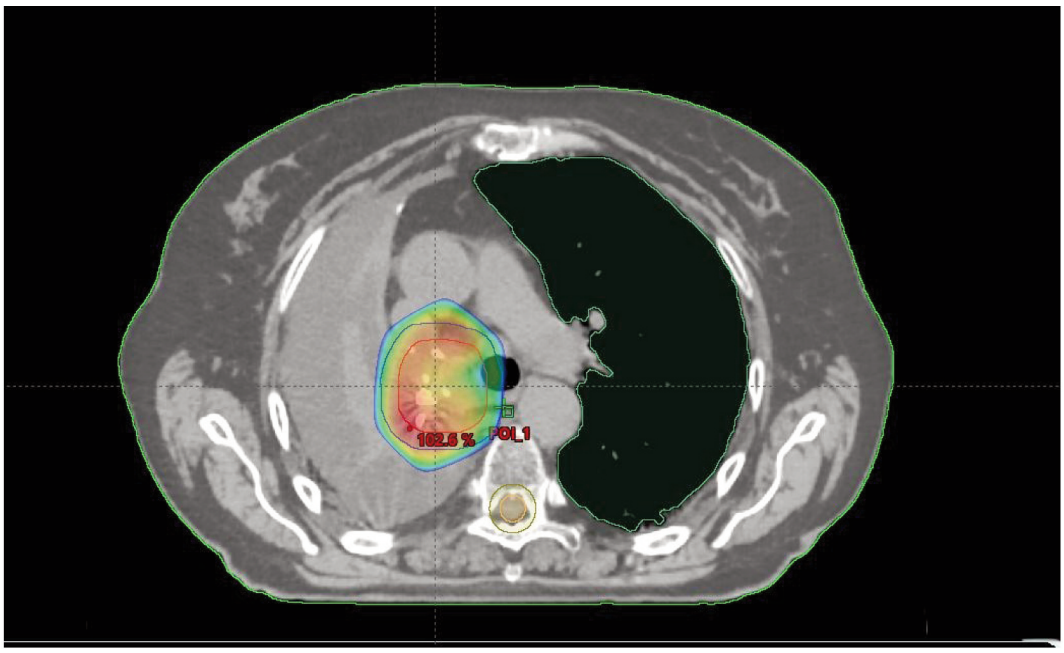

Figure 1. *Details of target delineation and dose distribution.*

revaluation, computed tomography (CT) showed massive growth of solid tissue in the right hilar site, which resulted in complete obliteration of the lower lobar bronchus and the right main bronchus associated with complete and/or partial atelectasis of the right lung. The patient was therefore hospitalized for dyspnea, hemoptysis, and chest pain with a radiographic finding of MAO on chest X-ray and CT. The patient was not a surgical candidate due to her poor pulmonary function and performance status.

The patient received radiotherapy with a total dose of 13 Gy in two once-weekly fractions of 6.5 Gy per fraction to the pathological solid tissue in the right hilar site. The choice of this dose was influenced by the initial clinical conditions of the patient and the previous radiotherapy treatments. She underwent CT simulation in supine position and was immobilized in a vacuum-assisted body mold to recreate patient positioning during daily sessions of radiotherapy. The planning data set was co-registered with a pre-treatment diagnostic contrast enhanced computed tomography (CECT) to define the clinical target volume (CTV) and organ at risks (OARs). A 5 mm isotropic expansion was generated from the CTV to obtain planning target volume (PTV). OARs were delineated depending on the target lesion location without margins. The Eclipse v15.0 (Varian Medical Systems, Palo Alto, CA, USA) treatment planning system, and VMAT/ IMRT technique on a 6/15 MV linear accelerator were used for radiotherapy. The patient underwent image-guided radiotherapy (IGRT) using a cone-beam computed tomography (CBCT) system as daily pre-treatment imaging. Details of target delineation and dose distribution are shown in Figure 1.

Three days after radiation treatment completion, chest X-ray showed total re-expansion of the right lung without atelectasis. Two weeks after radiotherapy treatment, the patient was discharged from the hospital, with complete clinical resolution of dyspnea, hemoptysis, and chest pain and without the onset of any acute radiation side effects. The radiological response of palliative EBRT is shown in Figure 2 by comparing chest X-ray images before and after treatment. There was no evidence of an inflammatory process geometrically associated with the radiotherapy field suspicious for radiation pneumonitis. Three months after treatment the patient is alive in stationary clinical conditions with no more evidence of MAO.

Discussion

Here we report an excellent clinical and radiological response achieved using a different EBRT fractionation, namely 13 Gy in two weekly fractions, for a patient with MAO a few days after the end of the treatment.

MAO is a common complication in patients with advanced stage lung cancer, that leads to decreased quality of life and ultimately to death, usually within 1-2 months if left untreated. However, durable relief of obstructing symptoms by reducing tumor burden and, therefore, a potential survival benefit can be provided only if active treatment is given (9,

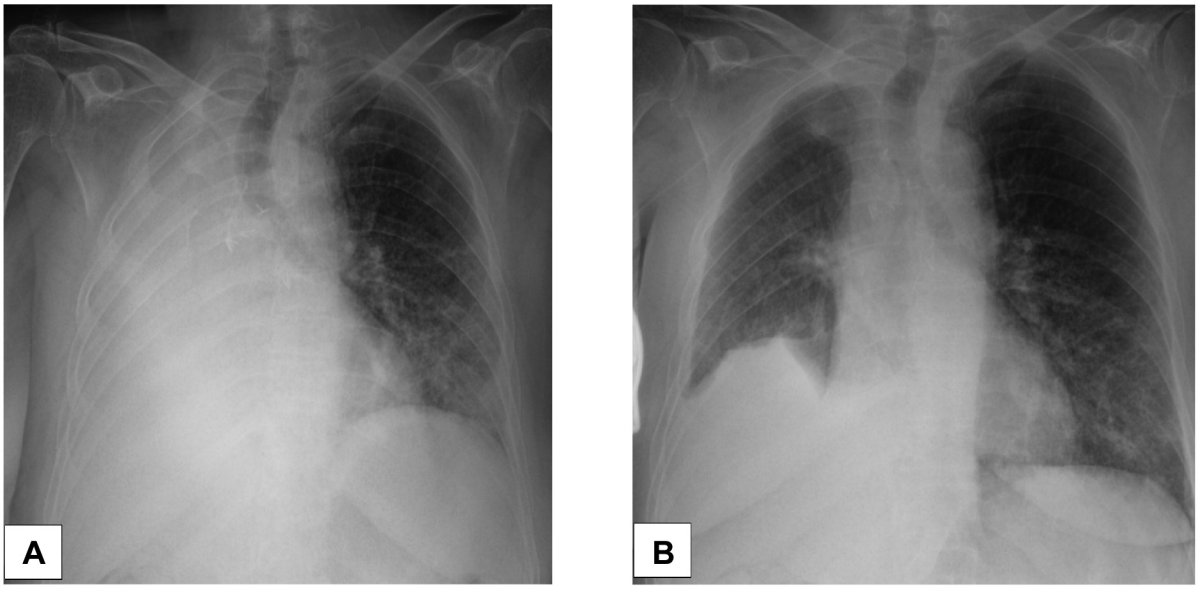

Figure 2. *Images of the chest of the patient who underwent palliative radiotherapy for malignant airway obstruction. A) Pre-treatment chest X-ray. B) Post-treatment chest X-ray.*

10). Although three major interventions, bronchoscopy with airway stenting, combination of stenting with EBRT and exclusive EBRT are used to treat MAO, there is a paucity of comparative survival data between them. EBRT may also treat more distal airways where bronchoscopic therapies and airway stenting may not be feasible (11).

In the current literature, EBRT is generally delivered as 3 Gy per daily fraction up to a total of 30 Gy. This schedule takes about two weeks to deliver the planned total dose. Several published retrospective studies mostly use a standard palliative dose ranging from 8 Gy in a single fraction to 30-40 Gy in 10/20 fractions (6, 7, 9-13). Therefore, there is currently no dose standard for treating patients with airway obstruction.

Nihei *et al*. gave 30 Gy in 10 fractions EBRT to 24 patients with airway stenosis in NSCLC. They assessed treatment response by chest images and reported a response rate of 54.2% (6). In another retrospective study, Utsumi *et al*. showed that median survival time was 135 days for the responders to EBRT and 45 days for non-responders (p=0.03) and one-year overall survival rate for the responders and non-responders was 18.5% and 0%, respectively (12). Re-expansion rates as high as 79% were observed in a report by Lee *et al*., and 83% received treatment to a biological equivalent dose (BED) ≥39 (10-15 fractions) (7). In the study of Johnson *et al*. palliative EBRT effectively achieved lung re-expansion in only 23% of patients with a median time to effect of 35 days. Death within 30 days of palliative radiation therapy occurred in 38% (14).

In conclusion, based on current literature high-dose irradiation (EQD2 ≥30-40 Gy) and prompt treatment (time to radiotherapy ≤14 days) may improve the response rate in this setting of patients.

Instead, in this case report we showed that even a different fractionation, consisting in 13 Gy in two weekly fractions, with a lower EQD2 compared to literature data may be effective in resolving MAO with excellent local control in the first three months of follow-up.

Conflicts of Interest

The Authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Authors' Contributions

GF and MT treated the patient and drafted the manuscript. GF, TC, CR, GP, GV, EM and MT researched the literature relevant to the topic. All Authors contributed to the manuscript and gave final approval for publication.

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The patient has given permission for images and details to be published.

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