

A case of spontaneous pneumothorax following radiation therapy for non-small cell lung cancer

Himanshu Bhardwaj, Bhaskar Bhardwaj¹, Houssein A. Youness

Department of Pulmonary Medicine and Critical Care, Internal Medicine, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA, ¹Department of Pulmonary Medicine and Tuberculosis, Internal Medicine, Indira Gandhi Medical College Shimla, Himachal Pradesh, India

ABSTRACT

Spontaneous pneumothorax (SPTX) is a potentially devastating rare complication of the thoracic radiation therapy. Most of the cases in the medical literature, have been described in lymphoma patients receiving radiation therapy. The pathogenesis of this adverse event remains undefined although different mechanisms have been proposed. We present a case of post-radiation therapy SPTX in a non-small cell lung cancer (NSCLC), following intensity modulated radiation therapy (IMRT), which to our knowledge is the first such reported case related to this newer mode of radiation therapy. This report highlights the importance of keeping a close eye for this complication as timely treatment with chest tube insertion and drainage of the pneumothorax can be a lifesaving in these patients.

KEY WORDS: Chest tube, lung cancer, pleura, pneumothorax, radiation therapy

Address for correspondence: Dr. Himanshu Bhardwaj, Pulmonary Medicine and Critical Care, Internal Medicine, Department of Medicine, University of Oklahoma Health Sciences Center, WP1310, Oklahoma City, Oklahoma 73190, PO Box 26901, USA. E-mail: himanshu-bhardwaj@ouhsc.edu

INTRODUCTION

Spontaneous pneumothorax is a very rare but recognized complication of thoracic radiation therapy. In present day, radiation therapy is an integral part of the treatment of various intrathoracic and chest wall malignancies, chiefly breast carcinomas, bronchogenic carcinomas and lymphomas. Patients receive radiation therapy as palliative treatment, curative treatment or in combination of chemotherapy and surgery or both. Lung is one of the most sensitive tissues to the ionizing radiation used in different modalities of radiation therapy. Common pulmonary complications to the radiation therapy range from radiation pneumonitis to pulmonary fibrosis but pneumothorax has rarely been reported. Almost all of the cases of SPTX following radiation therapy have been reported in the lymphoma patients following mantle irradiation, which involves relatively larger amount of pleural surface area

compared to other thoracic radiation modalities.^[1-5] We report a patient of non-small cell lung cancer undergoing intensity-modulated radiation therapy (IMRT) presenting with large ipsilateral pneumothorax. To our knowledge, this is first such case of SPTX following IMRT.

CASE REPORT

A 64-year-old male with 50-pack-year of smoking history and moderately severe chronic obstructive lung disease (COPD-FEV₁ 54%) was recently diagnosed with right lower lobe non-small cell lung cancer (NSCLC Stage IIB T3N0M0-Squamous Cell). On the computerized tomographic scan, the lower lobe pulmonary mass was associated with significant post-obstructive atelectasis suggesting endobronchial location [Figures 1a and b]. This lung mass was deemed inoperable due to close proximity to the carina. It was decided to start patient on intensity-modulated radiation therapy (IMRT) with a planned total dose of 6660 cGy over 37 cycles. Right after the 12th cycle of his treatment, patient developed sudden shortness of breath and right-sided chest pain. He was tachypneic but normotensive. Physical exam showed hyper resonant right chest with absent breath sounds and left sided tracheal deviation concerning for pneumothorax. No jugular venous distention was noted.

Access this article online

Quick Response Code:



Website:

www.lungindia.com

DOI:

10.4103/0970-2113.120624

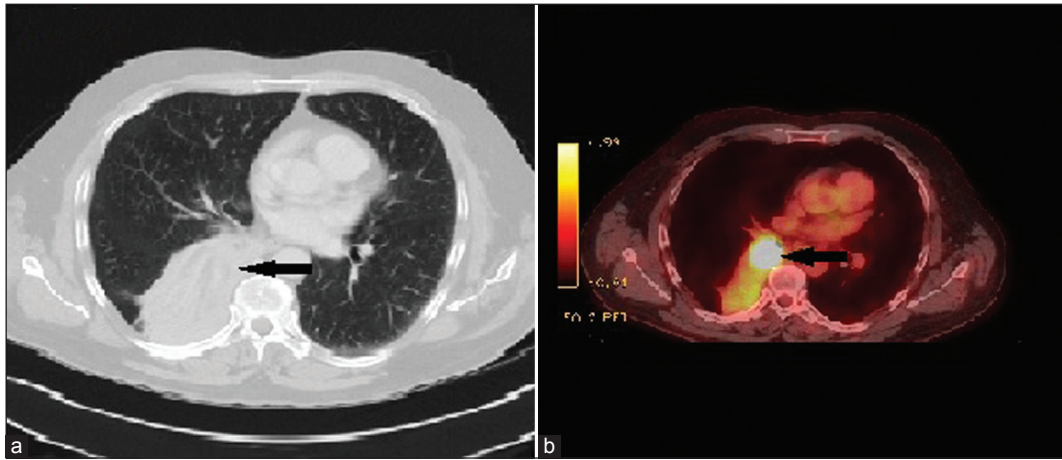


Figure 1: (a) CT Thorax showing right lower lobe lung carcinoma with post obstructive atelectasis (arrow); (b) Corresponding PET-CT showing the increased activity in the same area (arrow)

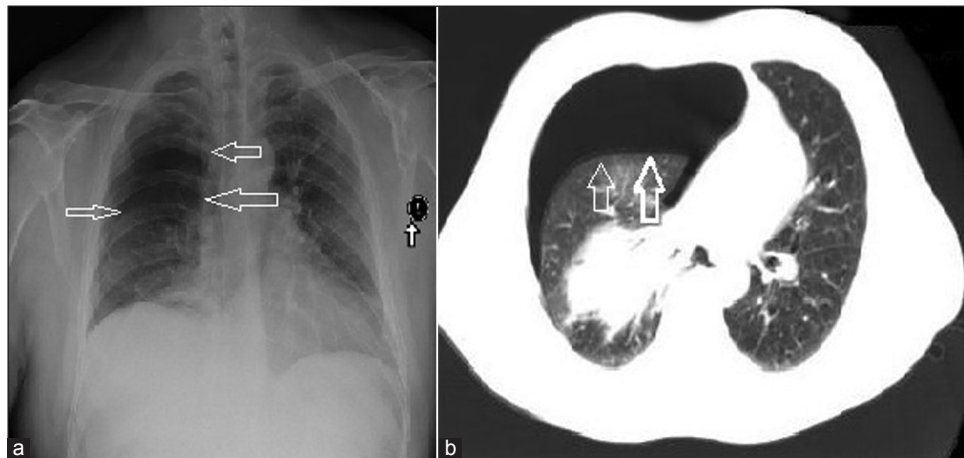


Figure 2: (a) Chest radiograph showing large right-sided pneumothorax (arrows); (b) Chest CT showing large right-sided pneumothorax with left mediastinal shift (arrows)

An arterial blood gas analysis showed hemoglobin oxygen saturation of 96%, partial pressure of oxygen (PaO₂) at 80 mmHg, partial pressure of carbon dioxide (PaCO₂) at 40 mmHg, and pH 7.36. Chest radiograph and computerized tomographic scan confirmed the presence of large right-sided pneumothorax involving around 50 percent of right lung field with some left mediastinal shift [Figures 2a and b]. A small bore 14-French pigtail catheter was inserted into right pleural cavity resulting in complete resolution of the pneumothorax and re-expansion of the lung [Figure 3]. Air leakage stopped in the pleural pigtail catheter drain setup within 48 hours and the catheter was removed. Patient refused pleurodesis for recurrence prevention.

DISCUSSION

SPTX is an unusual and potentially devastating complication of thoracic radiation therapy. Most of the cases in medical literature have been reported in patients receiving mantle irradiation for lymphoma. Mean time of the onset of pneumothorax after radiation therapy is around 16 months and occasionally bilateral and recurrent

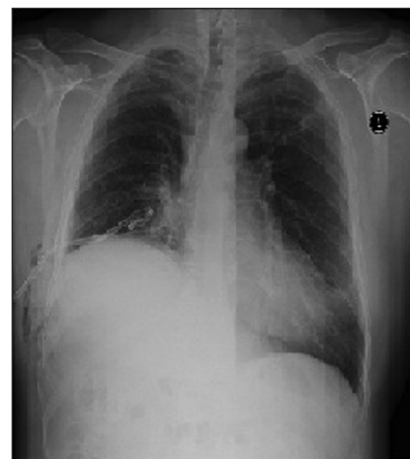


Figure 3: Chest radiograph showing resolved pneumothorax. Pigtail catheter is visible in the right pleural cavity. Incidental elevated right hemidiaphragm is visible

pneumothoraces have been reported.^[6] In one retrospective review, Pezner *et al.*, reported a 2.2% frequency of SPTX in mantle irradiation receiving Hodgkin lymphoma patients

without concurrent lung disease.^[1] Another review by Rowinsky *et al.*, described 11 patients of SPTX following radiation therapy, 10 out of total 11 described patients had received thoracic irradiation for lymphoma and 1 patient had the diagnosis of breast cancer.^[9] Nakasone *et al.*, reported development of bilateral tension pneumothorax after adjuvant radiation therapy in a patient with thymoma and myasthenia gravis.^[7] In patients with NSCLC, only few cases of spontaneous pneumothorax following thoracic radiation therapy have been reported.^[8-11] In a recent report, Ohnishi *et al.*, described two patients of SPTX after retrospectively reviewing treatment data of 113 NSCLC patients receiving stereotactic radiotherapy (SRT).^[9] To our knowledge this is the first reported case of SPTX following IMRT.

The pathogenesis behind the post-radiation pneumothorax has not been defined yet. Radiation-induced pulmonary changes, apical pleural, and parenchymal injury may be responsible for the development of SPTX.^[10] Focal emphysema and fibrosis due to radiation therapy increase the chances of the formation and rupture of the subplural blebs. Another possible mechanism involves post-radiation shrinkage of the centrally located obstructing tumor and partial resolution of obstruction leading to a check-valve effect. This results in air-trapping, alveolar hyperinflation and rupture, thus leading to the subsequent pneumothorax. Patients with concurrent lung diseases like chronic obstructive pulmonary disease, interstitial fibrosis and pneumonia are at higher risk of developing this complication. These patients also tend to develop more severe, bilateral, and/or recurrent post-radiation pneumothorax.^[4] Although no dose-response effect to the radiation dose received has been reported but post-radiation pneumothorax is rare in the patients who have received less than 3000 cGy of radiation.^[2,4] Concurrent chemotherapy by itself is also not known to increase the risk of radiation induced pneumothoraces, unless patient has history of chemotherapy induced pulmonary adverse effects.^[7] It is also important to note that solid cancers involving thorax themselves increase the overall risk of the development of spontaneous pneumothorax.^[11,12] In a retrospective review by Chan *et al.*, they described total 25 patients of SPTX after reviewing total 546 solid cancer patients retrospectively. Eight out these twenty-five patients had received prior radiotherapy.^[11]

Although a small percentage of SPTX patients with small size pneumothorax who are clinically stable can be managed with 100% oxygen, but chest tube insertion and subsequent pleurodesis for recurrence prevention is the recommended treatment approach for the management of any secondary SPTX including post-radiation pneumothorax. For pleurodesis, a thoracoscopic approach

(medical or surgical) with an effective surgical pleurodesis technique (pleural abrasion, partial pleurectomy, or talc poudrage) is preferred over instillation of a sclerosant (tetracycline, talc slurry, etc.) through a chest tube. Simple needle or cannula aspiration of the small to mid size pneumothorax is part of British Thoracic Guidelines for pneumothorax management, but currently this approach is not endorsed by current American College of Chest Physicians (ACCP) guidelines due to lack of convincing evidences in the randomized controlled trials.^[13]

Briefly, this case highlights a rare but serious complication of thoracic radiation therapy, which can be associated with frequent recurrence and increased mortality. Symptoms of dyspnea, chest pain, and cough should prompt evaluation for SPTX in patients with history of thoracic irradiation as quick chest tube insertion and drainage of pneumothorax in symptomatic patients can be lifesaving.

REFERENCES

1. Pezner RD, Horak DA, Sayegh HO, Lipsett JA. Spontaneous pneumothorax in patients irradiated for Hodgkin's disease and other malignant lymphomas. *Int J Radiat Oncol Biol Phys* 1990;18:193-8.
2. Epstein DM, Littman P, Gefter WB, Miller WT, Raney RB Jr. Radiation-induced pneumothorax. *Med Pediatr Oncol* 1983;11:122-4.
3. Rowinsky EK, Abeloff MD, Wharam MD. Spontaneous pneumothorax following thoracic irradiation. *Chest* 1985;88:703-8.
4. Penniment MG, O'Brien PC. Pneumothorax following thoracic radiation therapy for Hodgkin's disease. *Thorax* 1994;49:936-7.
5. Libshitz HI, Banner MP. Spontaneous pneumothorax as a complication of radiation therapy to the thorax. *Radiology* 1974;112:199-201.
6. Mesuroille B, Qanadli SD, Merad M, Mignon F, Baldeyrou P, Tardivon A, *et al.* Unusual radiologic findings in the thorax after radiation therapy. *Radiographics* 2000;20:67-81.
7. Nakasone E, Nakayama M, Bando M, Endo S, Hironaka M, Sugiyama Y, *et al.* A case of radiation-related pneumonia and bilateral tension pneumothorax after extended thymectomy and adjuvant radiation for thymoma with myasthenia gravis. *Nihon Kokyuki Gakkai Zasshi* 2010;48:584-8.
8. Okada M, Ebe K, Matsumoto T, Karino Y, Kawamura M, Tokuda O, *et al.* Ipsilateral spontaneous pneumothorax after rapid development of large thin-walled cavities in two patients who had undergone radiation therapy for lung cancer. *AJR Am J Roentgenol* 1998;170:932-4.
9. Ohnishi K, Shioyama Y, Nomoto S, Sasaki T, Ohga S, Yoshitake T, *et al.* Spontaneous pneumothorax after stereotactic radiotherapy for non-small-cell lung cancer. *Jpn J Radiol* 2009;27:269-74.
10. Hay M, Cho K, Shin H. Pneumothorax as a complication of radiation therapy for primary lung cancer. *Australas Radiol* 1976;20:338-40.
11. Chan SN, Okuno SH, Jatoi A. Causes and outcomes of spontaneous pneumothoraces in solid tumor cancer patients: An update for the medical oncologist. *J Thorac Oncol* 2006;1:335-8.
12. Dixit R, Joshi N, Prasad N. Pneumomediastinum, pneumothorax and subcutaneous emphysema during radiotherapy in primary cavitating bronchogenic carcinoma. *Indian J Chest Dis Allied Sci* 2002;44:61-4.
13. Baumann MH, Strange C, Heffner JE, Light R, Kirby TJ, Klein J, *et al.* Management of spontaneous pneumothorax: An American college of chest physicians Delphi consensus statement. *Chest* 2001;119:590-602.

How to cite this article: Bhardwaj H, Bhardwaj B, Youness HA. A case of spontaneous pneumothorax following radiation therapy for non-small cell lung cancer. *Lung India* 2013;30:360-2.

Source of Support: Nil, **Conflict of Interest:** None declared.