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CASE REPORT

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Endobronchial brachytherapy combined with surgical procedure for synchronous multiple primary lung cancer: A case report

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Abstract

The management of synchronous multiple primary lung cancer is a challenge. In this report, we describe our experience in a patient with three synchronous multiple cancers. The first lesion was completely surgically removed, the second lesion received postoperative irradiation, and the third lesion was treated with radiotherapy alone. Radiation therapies were performed using a combination of external irradiation and endobronchial brachytherapy. Endobronchial brachytherapy is an effective radiation therapy for endobronchial tumors owing to its advantage of high-dose concentration. However, adverse events (AEs) such as hemoptysis or severe bronchitis are a problem. Thus, we have developed an applicator to keep the radioactive source in the center of the bronchial lumen. A total of 28 months after treatment, the patient had not experienced any relapses or AEs. Endobronchial brachytherapy using an applicator can be an alternative treatment for cases in which surgery is expected to lead to pulmonary dysfunction.

KEYWORDS

applicator, endobronchial brachytherapy, synchronous multiple primary lung cancer

INTRODUCTION

At present, surgery is considered as the first choice of treatment for multiple primary lung cancer (MPLC).[1] However, surgery for all lesions may lead to loss of pulmonary function. On the other hand, endobronchial brachytherapy (EBBT) is able to minimize lung damage due to its high dose concentration. Historically, EBBT has often been used for palliative irradiation and has been found to be effective in improving bronchial stenosis and obstruction caused by tumors.[2–5] Recently, several studies have reported the use of EBBT for radical irradiation to eliminate tumors (Table 1).[6–11] However, adverse events (AEs) such as hemoptysis or severe bronchitis due to overdosing owing to uneven dose distribution in the bronchus have been a problem.[12,13] Thus, we have developed an applicator (Figure 1(a)) to keep the radioactive source in the center of the bronchial lumen (Figure 1(b)) and attempted to improve the dose distribution in the bronchial lumen.[14] This report describes a case of lung cancer with three MPLCs in which two of the lesions received radiotherapy (RT) using a combination of external irradiation and EBBT using a source-centralizing applicator.

CASE REPORT

A 72-year-old man was referred to a previous hospital with an abnormal chest roentgenogram following physical examination. Computed tomography (CT) showed a 2.2 cm nodule in the left upper lobe (S3) of the lung with suggested pleural invasion. In addition, bronchoscopy revealed a 1.1 cm elevated lesion at the entrance of the left apical bronchus (B6) and a 0.3 cm mucosal abnormality of the spur

TABLE 1 Local control and overall survival rates in patients treated with EBRT AND EBBT

Author	Number of cases	Dose of EBRT	Dose of EBBT	Local control rate	Overall survival
Hosni et al.[6]	23	40–45 Gy	16 Gy/2 fr	89%, 2 years	67%, 2 years
Kawamura et al.[7]	13	45 Gy	20 Gy/4 fr	86%, 2 years	92%, 2 years
Saito et al.[8]	64	40 Gy	25 Gy (LDR)	87%, 5 years	72%, 5 years
Rochet et al.[9]	35	50 Gy	15 Gy/3 fr	N/A	61%, 2 years
Murakami et al.[10]	14	40–50 Gy	18 Gy/3 fr	92%, 2 years	82%, 2 years
Nomoto et al.[11]	15	40 Gy	18 Gy/3 fr	100%, 3 years	79%, 3 years

Abbreviations: EBBT, endobronchial brachytherapy; EBRT, external beam radiotherapy; fr, fractions; LDR, low dose rate brachytherapy.

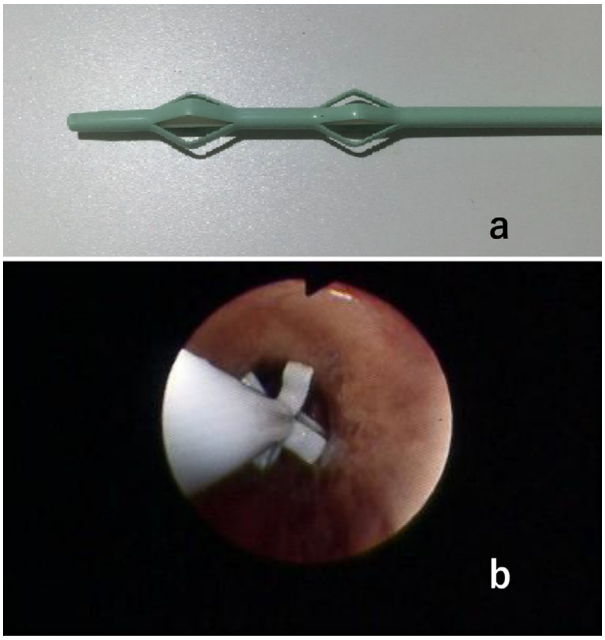

FIGURE 1 Source-centralizing applicator. (a) The tip of the applicator. It has two wings to keep the source. (b) The applicator keeps the radioactive source in the center of the lumen

between the right apical and posterior division bronchus (B1/2), suggestive of early stage lung cancer. Biopsy was performed, and squamous cell carcinoma was detected in all three lesions. Lymph node metastasis and distant metastasis were not detected on imaging examinations.

The patient underwent left S3 segmentectomy and left S6 sleeve segmentectomy and bronchoplasty. The left S3 tumor was completely resected, but the left S6 tumor remained in the mucosa of the bronchial anastomotic lesion. The patient was referred to our hospital for treatment of the remaining left S6 tumor (Figure 2(a)) and the right B1/2 tumor (Figure 2(b)) using RT including EBBT.

External RT for the two lesions was performed prior to EBBT. Using megavoltage equipment with 6 MV photon beams, five fractions of 2 Gy were applied weekly with a total dose of 40 Gy. The radiation field was limited to the primary lesion, without extension to the regional lymph nodes. The clinical target volume was delineated with reference to bronchoscopic findings. Subsequently, EBBT was performed using a high-dose-rate Ir-192 after-loading machine. We used an endobronchial applicator for every session. The prescription dose was 18 Gy/3 fr for the left post-bronchoplasty lesion (Figure 3(a)) and 20 Gy/4 fr for the right B1/2 lesion (Figure 3(b)). The reference dose points were 3–7 mm from the source axis according to the bronchial diameter measured on planning CT images. The irradiated length was 5 cm at the left post-bronchoplasty lesion and 4.5 cm at the right B1/2 lesion. After irradiation, the right B1/2 tumor disappeared. The patient was followed up using CT and bronchoscopy, and neither lesion recurred for 28 months with no AEs such as severe bronchitis or hemoptysis.

DISCUSSION

The most serious AEs of EBBT are fatal hemoptysis and severe bronchitis due to over irradiation. If EBBT is performed using only the source transfer tube, it may be placed at eccentric locations in the bronchial lumen, leading to localized hot spots on the bronchial mucous membrane. The applicator we have developed[11] has two "wings" that open at the irradiation site and keep the radioactive source in the center of the bronchus to prevent excessive irradiation to the bronchial mucosa. We reported that there were fewer AEs such as hemoptysis and bronchial stenosis using this applicator for EBBT.[12]

In this case report, the patient was diagnosed with three lung cancers simultaneously. The first tumor of left S3 was radically resected. Sleeve segmentectomy was performed for the second tumor of left S6, but the tumor remained at the anastomotic site and required postoperative irradiation. The residual tumor at the anastomotic site is a good indication of EBBT because the tumor exists within the bronchial wall and is more curative than external irradiation alone. The third tumor of right S1/2 was an early stage lung cancer found on preoperative bronchoscopy and was subjected to

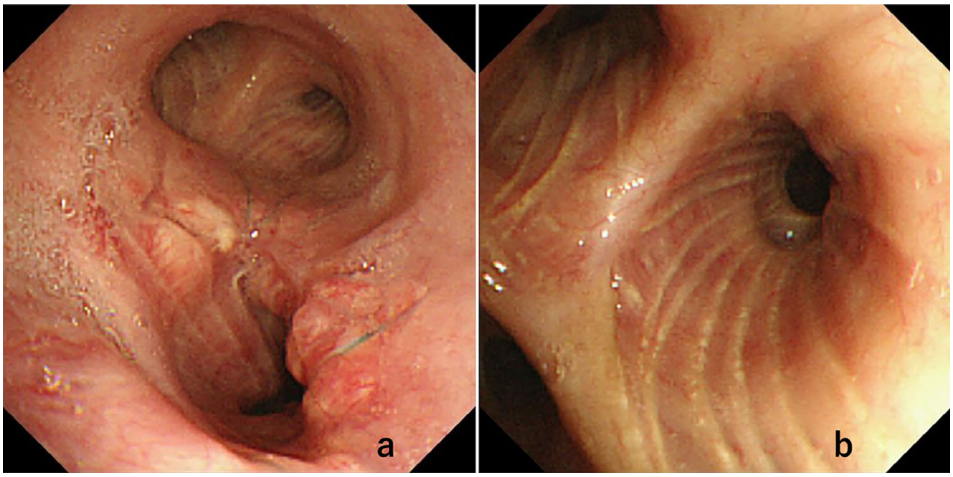

FIGURE 2 Bronchoscopic image. (a) Left S6 lesion after bronchoplasty. (b) Right S1/2 lesion. Biopsy-proven squamous cell carcinoma at the spur of B1 and B2

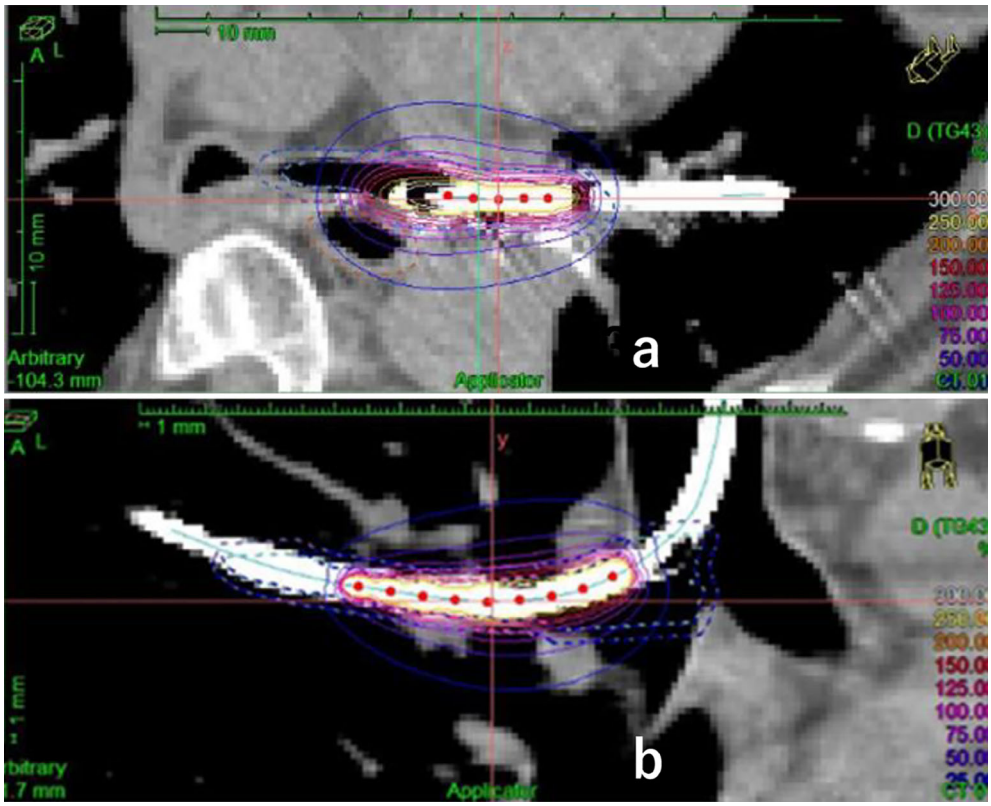

FIGURE 3 Dose distribution of endobronchial brachytherapy. (a) Left S6 lesion. (b) Right S1/2 lesion

radical irradiation. For this tumor, EBBT was chosen as surgery was expected to cause pulmonary dysfunction. Since the right S1/2 tumor was superficially located in the bronchi and without extension to the outside of the bronchial wall, it was considered a good indication for EBBT.

These lesions have not recurred in the 28 months after irradiation with no AEs, such as hemoptysis or chronic bronchitis. Thus, we consider that EBBT using a source-centralizing applicator is an effective and safe treatment method for lung cancers, such as superficially located tumors and pathologically residual cancer at the bronchial anastomosis. Furthermore, EBBT is considered an effective alternative treatment for cases, such as with multiple lesions, in which surgery is expected to lead to pulmonary dysfunction.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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