

Case report

Salvage surgery for local recurrence after carbon ion radiotherapy for lung cancer: A case report

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ARTICLE INFO

Keywords:

Lung cancer
Carbon ion radiation therapy
Salvage surgery

ABSTRACT

Background: The good local control rate of radiation therapy has been reported due to recent advances in irradiation technology. Carbon ion radiation therapy (CIRT) has been shown to be effective for early lung cancer. We report a case of performing salvage surgery on the local recurrence of lung cancer after CIRT.

Case presentation: A 79-year-old man was referred to our hospital for treatment of local recurrence of left lung cancer at fifty nine months after CIRT. We performed wedge resection for diagnostic purposes. It was diagnosed as squamous cell carcinoma and was regarded as local recurrence. Subsequently, we performed left upper lobectomy and mediastinal lymph node dissection. The patient had recurrent lesions at 4 months after surgery and died 10 months after surgery.

Conclusions: Surgery was safe even after CIRT. We considered that salvage surgery after CIRT may be one of the options of local control therapy for lung cancer.

1. Introduction

Surgery has been performed in early lung cancer for curative; however, with recent advances in irradiation techniques, radiotherapy reportedly achieves comparable local control to surgery. In particular, carbon ion radiation therapy (CIRT) has been shown to be effective [1]. However, local recurrence sometimes occurs [2] and optimal treatment for recurrence has not yet been established. We report a patient who underwent salvage surgery for local recurrence of clinical Stage I lung cancer after CIRT.

2. Case report

A 79-year-old man was referred to our hospital for treatment of local recurrence of lung cancer 59 months after CIRT. The nodule was 15 mm in diameter (Fig. 1A). Five years previously he had refused surgery for lung cancer and undergone CIRT at 52.8 Gy equivalents in four fractions (Fig. 1B). Lung nodule had resolved completely, having been decreased in size 1 year after CIRT (Fig. 1C) and undetectable 3 years after CIRT (Fig. 1D). Four years later, chest computed tomography (CT) showed a 20-mm nodule (Fig. 1E) and he was referred to our hospital for treatment (Fig. 1F). ¹⁸F-Fluorodeoxyglucose-positron emission tomography

revealed FDG uptake in the lung nodule with a maximum standardized uptake value of 2.6. No significant hilar or mediastinal lymph node swelling and distant metastases were detected. A bronchoscopic biopsy failed to demonstrate malignancy. We performed wedge resection; however, because squamous cell carcinoma was diagnosed by intra-operative pathological examination of a specimen, left upper lobectomy and mediastinal lymphadenectomy were performed. There were no adhesions between the apex of the left lung and chest wall, despite the previous CIRT. Pathological examination showed tumor cells (Fig. 2A) in scar tissue (Fig. 2B) with remarkable fibrosis and squamous cell carcinoma was confirmed. The histologic tumor response to CIRT was one (E1). Pathological stage was T1bN0M0. He had an uneventful post-operative course. Four months post-surgery, chest CT showed mediastinal lymph node recurrence. Chemotherapy was recommended but he refused. He died 10 months later.

3. Discussion

In general, radiation can damage the microcirculation, resulting in hyalinization of arterioles and fibrosis, which in turn induces scar or fibrotic tissue. Such fibrosis often causes adhesions and difficulty in performing curative resection [3,4]. Mizobuchi [5] have reported safely

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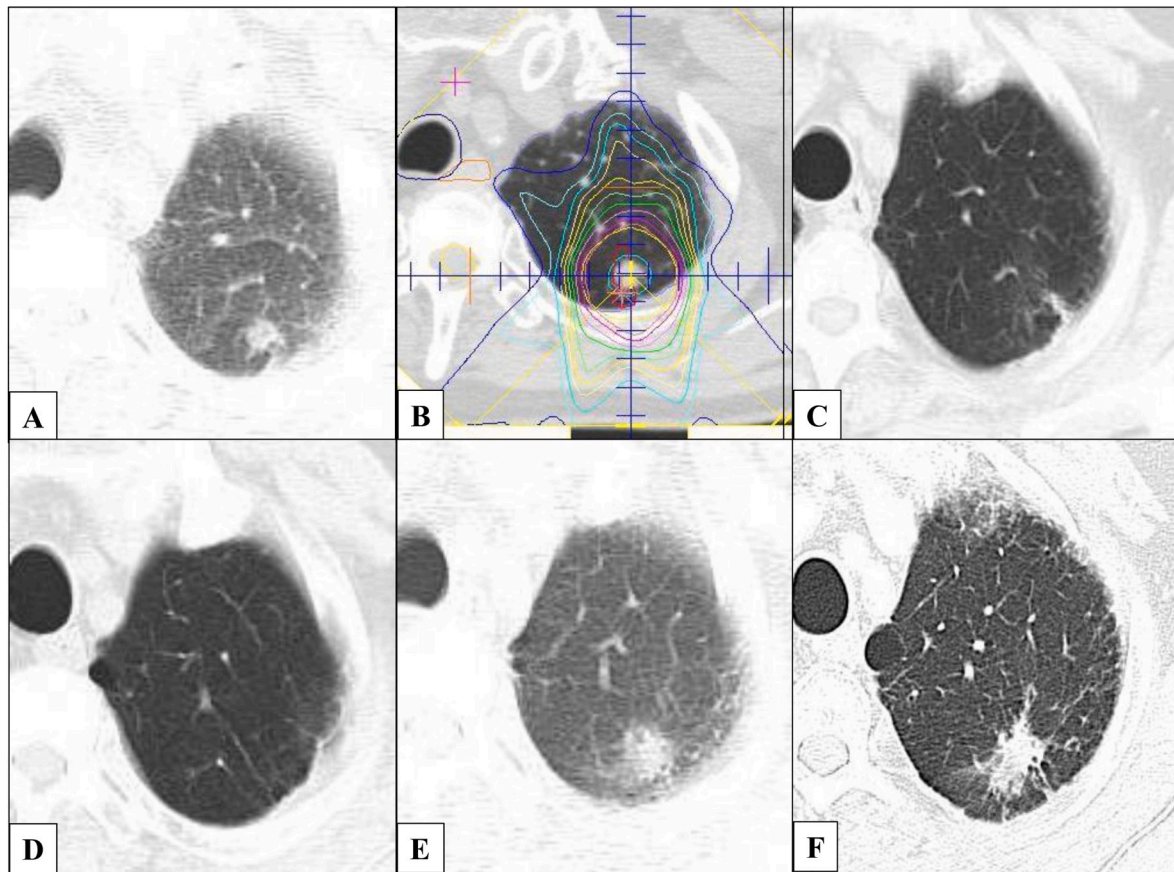


Fig. 1. CT showed a lung nodule before CIRT (A). Radiation isodose distribution of CIRT (B). One year after CIRT, the left lung nodule had decreased in size (C). Three years after CIRT, the original lesion is undetectable (D). Four years after CIRT a new nodule has appeared (E) and has increased in size one year later (F).

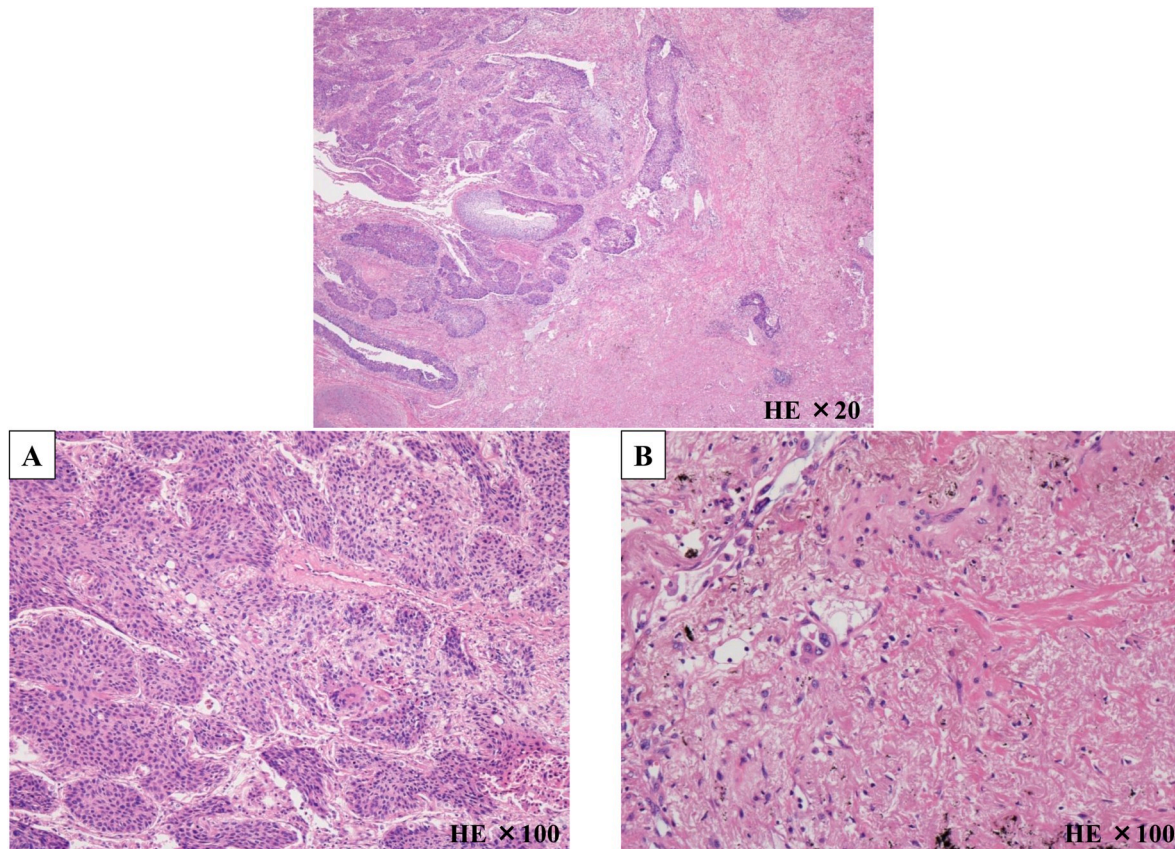


Fig. 2. Hematoxylin and eosin stain in tumor tissue (original magnification $\times 20$). Photomicrographs showing squamous cell carcinoma (A) in an area of scarring with remarkable fibrosis (B).

performing salvage surgeries for local recurrence after CIRT and consider such surgery to be feasible, and this case was similar. We believe that CIRT does not cause pleural adhesion or difficulties in curative resection as opposed to conventional radiotherapy and attribute this difference to the characteristics of the heavy particle beams of CIRT. Heavy particle beams penetrate the body and stop abruptly, forming a Bragg peak. A considerable amount of energy is deposited, resulting in dense ionization and high-linear energy transfer (LET) [6]. These physical properties help achieve excellent dose localization for deep-seated tumors, sparing critical normal organs while the high LET exerts a powerful biological effect. In other words, these heavy particle beams irradiate the target lesion while providing maximal protection of surrounding normal tissue. Thanks to this, irradiation has little effect on the hilar region where there are important vessels, making surgery feasible.

Pathological examination showed tumor cells adjacent to fibrotic tissue that was considered to denote scar formation after CIRT. That is, although the tumor was within the field irradiated by CIRT, the irradiation dose delivered was insufficient to completely destroy the tumor cells. Chen [7] have reported that the effect of irradiation in the center of the irradiated site may be attenuated because this region tends to be hypoxic. The form of our patient's recurrence raises several questions. One concerns the long interval of 5 years between CIRT and detection of local recurrence. A second is that no lymph node metastases were identified at the time of salvage surgery, but lymph node recurrence developed thereafter. We consider that predicting such recurrences is important in determining the role of salvage surgery. Additionally, accumulation of further cases is necessary to verify the effectiveness of salvage surgery.

Declaration of competing interest

Not declared.

Acknowledgments

We are deeply grateful to Dr. Sayaka Tanaka, Department of Diagnostic Pathology, Graduate School of Medicine, Osaka City University, for both histopathological reviewing this case and providing helpful advice.

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