

Effective cardiac radiotherapy relieved life-threatening heart failure caused by advanced small cell lung cancer with cardiac metastasis: a case report

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Abstract: Cardiac radiotherapy is rarely used in clinical practice because of concern of adverse effects on the heart. We present a case of a 64-year-old man with advanced small cell lung cancer (SCLC) treated with chemo-radiotherapy who attained partial remission initially but had disease progression to bulky cardiac metastasis and significant pericardial effusion. Severe heart failure with hepatic failure was found. Chemotherapy and pericardiocentesis were contraindicated because of the associated high risk and bleeding tendency. Emergent palliative cardiac radiotherapy resulted in rapid improvements of dyspnea, liver function, and urine output. Pericardiocentesis was performed 5 days later and effusion cytology confirmed metastatic SCLC. To our knowledge, this is the first case of effective cardiac radiotherapy for SCLC with life-threatening cardiac metastasis. Palliative cardiac radiotherapy may be an effective alternative treatment for radiosensitive malignancy with cardiac metastasis in cases of multiple organ dysfunction and unsuitability for chemotherapy and pericardiocentesis.

Keywords: Cardiac tumor; pericardial effusion; radiotherapy; small cell lung cancer (SCLC)

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Introduction

Cardiac radiotherapy for radiation-sensitive cardiac tumor seems a reasonable treatment but is rarely used in clinical practice. Only few reports have described experiences in cardiac radiotherapy for cardiac tumors. Cardiac radiotherapy is far from a standard treatment in oncology. We report the first case of small cell lung cancer (SCLC) with life-threatening cardiac metastasis, complicated with both severe heart failure and hepatic failure, and were successfully relieved with cardiac radiotherapy.

Case presentation

A 64-year-old man had left upper lobe SCLC and neck lymph node metastasis, cT1N3M1b, stage IV. He received

chemotherapy with etoposide and platinum for six cycles and palliative radiotherapy for better symptomatic control, and achieved partial remission. Two months after completion of six courses of chemotherapy, he developed productive cough, exertional dyspnea, orthopnea, and right upper quadrant pain. On physical examination, the vital signs were stable, and both legs were edematous. Laboratory examination revealed the following results: white blood cell count, 9,550/ μ L; hemoglobin level, 12.5g/dL; and platelet count, 57,000/ μ L; elevated serum aminotransferase (AST/ALT) level of 1,174/1,892 U/L; elevated total bilirubin level, 6.6 mg/dL; international normalized ratio, 1.63; elevated lactate dehydrogenase level, 1,271 U/L; blood urea nitrogen level, 55 mg/dL; creatinine level, 1.28 mg/dL; sodium, 118 mEq/L; potassium, 5.5 mEq/L; negative

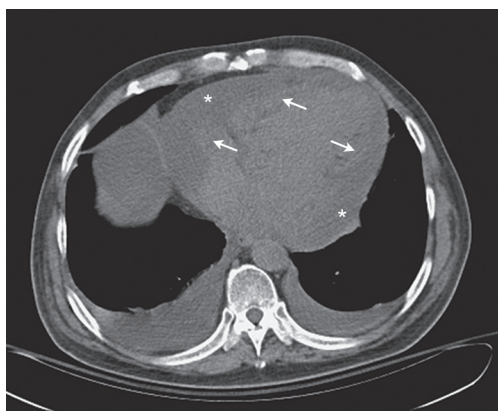


Figure 1 Chest CT image showing lobulated cardiac mass (arrows) with moderate pericardial effusion (asterisks), and mild bilateral pleural effusions.

hepatitis A, B, and C markers; creatine kinase level, 112 U/L; troponin I level, 0.25 ng/mL; and B-type natriuretic peptide level, 781.4 pg/mL.

Abdominal sonography revealed no significant liver or biliary lesion. Chest CT revealed pericardial effusion with lobulated epicardial tumor, and progressive tumors in the mediastinum and left pulmonary hilum (*Figure 1*). Echocardiography revealed moderate pericardial effusion, with epicardial mass encasement all over the heart, and suspected myocardial invasion. The left ventricle ejection fraction was 63%, with constrictive effect on cardiac filling motion (*Figure 2*).

Severe heart failure due to cardiac metastasis and pericardial effusion, followed by hepatic failure and pre-renal azotemia, was impressed. However, pericardiocentesis was contraindicated because of the high procedural risk, coagulopathy, and initially moderate amount effusion. Chemotherapy was also hampered because of poor liver function and performance status. Therefore, emergent palliative cardiac radiotherapy was given (24 Gy in 8 fractions, *Figure 3*). His liver function and pre-renal azotemia significantly improved soon after cardiac radiotherapy (*Figure 4*). Five days later, despite the improving clinical condition and liver functions, echocardiography showed progression of pericardial effusion to massive amount (*Figures S1,S2*), therefore pericardiocentesis was performed and drained 1,080 mL bloody effusion with cytology confirming SCLC.

His exertional dyspnea and leg edema resolved, and follow-up echocardiography 2 weeks later revealed

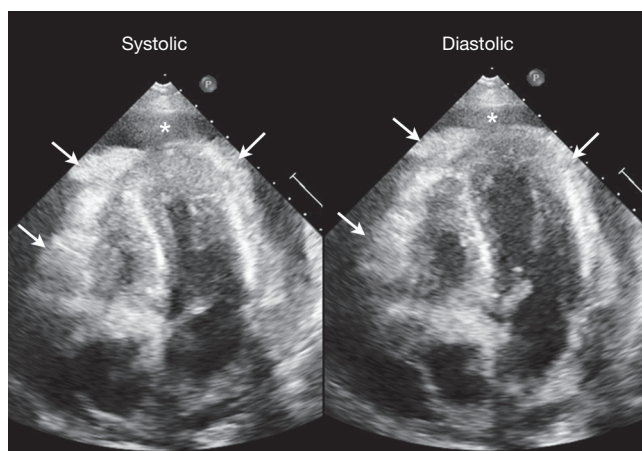


Figure 2 Echocardiogram showing significant pericardial effusion (asterisks) and epicardial mass (arrows) encasement all over the heart, with suspected myocardial invasion, especially around the right ventricle.

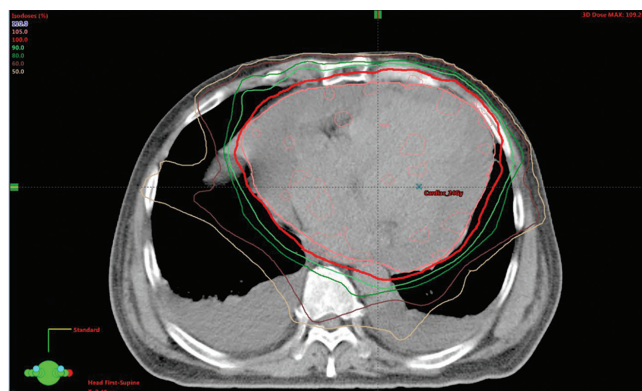


Figure 3 The radiation treatment plan for patient with cardiac metastasis from SCLC. The calculated iso-dose distribution was presented. The 100% prescribed dose was shown as red line (24 Gy). SCLC, small cell lung cancer.

decreased size of the cardiac mass (*Figures 5,S1,S2*). He was discharged and lived at home for a short period. One month later, SCLC further progressed, and he expired in the hospice ward.

Discussion

The cardiac metastasis rate varies in different autopsy series and ranges from 2.7% to 25% in all patients with cancer (1,2). The tumors with the highest tendency of cardiac

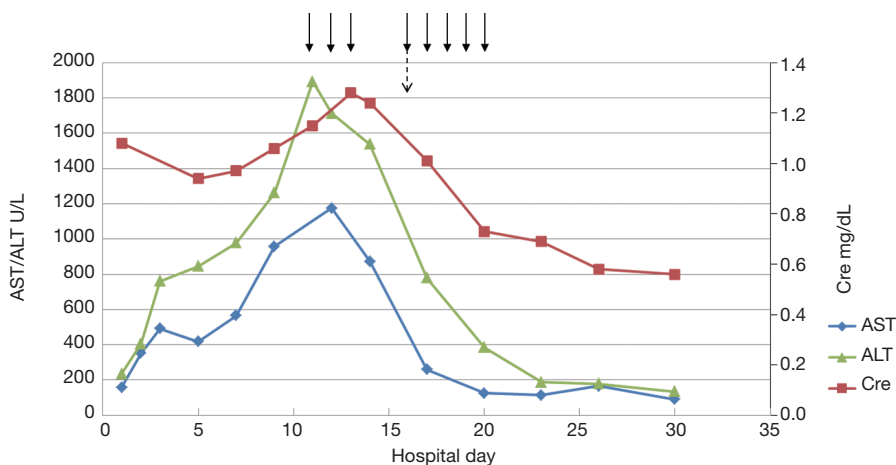


Figure 4 Trends of the liver and renal function data. Black arrow, cardiac radiotherapy on days 11–13 and days 16–20 (24 Gy in 8 fractions); dashed arrow, pericardiocentesis 1,080 mL on day 16. ALT, alanine aminotransferase; AST, aspartate aminotransferase; Cre, creatinine.

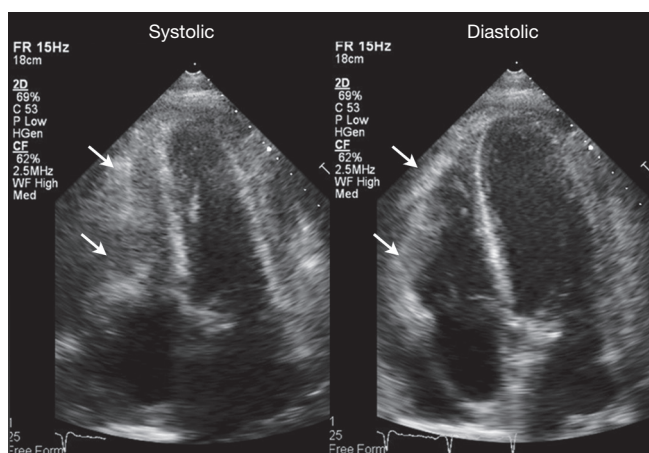


Figure 5 Echocardiogram 2 weeks after cardiac radiotherapy, showing the decreased size and thickness of the cardiac mass (arrows) and resolution of the pericardial effusion.

metastasis are melanoma, carcinomas of the breast and lung, and lymphoma (1). The parts of the heart involved in cardiac metastasis include the pericardium, myocardium, and endocardium, in the order of frequency (1,3).

Only about one-tenth of patients with autopsy-confirmed cardiac metastases presented with significant associated clinical symptoms before their deaths. Most cardiac metastases were small and clinically silent, some of which were masked by symptoms of diffuse tumor diseases (1).

Cardiac radiotherapy is overlooked and rarely used in clinical practice, probably because of the rarity of clinical

evident cardiac tumors and for fear of cardiac toxicity from radiation. The first reported case of radiotherapy for cardiac metastasis could be traced back to the 1940s (2). Few case reports and small case series (Table 1) have described various cardiac tumors, and most of which showed symptomatic or image resolution after cardiac radiotherapy (4-13). Despite being unable to cure metastatic cancer, cardiac radiotherapy has beneficial effects on transient local tumor control, symptomatic relief, and may improve life quality.

Radiotherapy at the thoracic region has been reported to have several potential adverse effects on the heart, including pericarditis, pericardial effusion, coronary artery disease, heart failure, arrhythmia, and valvular disease (14). The risk is associated with the radiation dose, treatment duration, and radiation volume. Most cardiovascular complications are chronic, whereas acute complications of cardiac radiotherapy are uncommon (4-14). Recent literatures report acute cardiac toxicities as early as 1 month after radiation (15,16). Cuculich *et al.* also demonstrated cardiac radiation for ablation of ventricular tachycardia in five patients, with increased ventricular tachycardia episodes initially, and then became well controlled (17). However, in patients like our case, emergent radiation is still reasonable and necessary to stabilize the life-threatening condition. Therefore, the acute, subacute and chronic cardiac toxicities of radiation are of lesser importance.

Conclusions

In our case, cardiac metastasis from SCLC showed an

Table 1 Summary of experiences in cardiac radiotherapy for cardiac tumors in published literature

Tumor origin	Radiotherapy dose/fractions	Survival since cardiac RT	Reference and case number
Primary cardiac tumor			
Cardiac lymphoma	Median dose 34.8 [15–59] Gy	Median survival 22 mo (RT + C/T)	Petrich 2011 (4) (19 cases, survival no better than C/T alone)
Cardiac angiosarcoma	42 Gy/21 Fr	12–16 mo	Suderman 2011 (5), Nakamura-Horigome 2008 (6) (2 cases)
Metastatic cardiac tumor			
Lung adenocarcinoma	50 Gy/20 Fr, 20 Gy/5 Fr, and 6 Gy/1 Fr	4 mo; 3.5 mo*; 0 mo* (died during RT course)	Lee 2012 (7) and Fotouhi Ghiam 2016 (8) (3 cases)
Melanoma	45 Gy/25 Fr	6 mo	Magnuson 2010 (9) (1 case)
Sarcoma	25–60 Gy, 1.8–5 Gy per fraction	5–24 mo	Fotouhi Ghiam 2016 (8), Takenaka 2011 (10) (9 cases)
Lymphoma	25 Gy/10 Fr	3 mo*	Fotouhi Ghiam 2016 (8) (1 case)
Rectal adenocarcinoma	20 Gy/5 Fr; 16 Gy/4 Fr	3 mo*; 0 mo* (died during RT course)	Fotouhi Ghiam 2016 (8) (2 cases)
Esophageal cancer	20 Gy/5 Fr	2.5 mo	Al-Mamgani 2008 (2) (1 case)
Cervical cancer	28.8 Gy/16 Fr; 60 Gy/30 Fr	1 mo; 7 mo	Lemus 1998 (11) (7 cases*)
Thyroid cancer	37.5 Gy/15 Fr; 35 Gy/10 Fr	2 mo; 4 mo	Dasgupta 2011 (12), Chen 2012 (13) (2 cases)
Thymoma/thymic carcinoma	30 Gy/20 Fr; 36 Gy/18 Fr	6 mo*; 11 mo*	Fotouhi Ghiam 2016 (8) (2 cases)
Hepatocellular carcinoma	54 Gy/27 Fr	6 mo*	Fotouhi Ghiam 2016 (8) (1 case)

*, duration of response (from completion of cardiac radiotherapy to cardiac tumor progression or death without tumor regrowth);

*, radiotherapy dose is available in only 2 of the 7 cases. C/T, chemotherapy; Fr, fraction; Gy, gray; mo, months; RT, radiotherapy.

immediately marked response to cardiac radiotherapy. This palliative treatment effectively relieved multi-organ failure, decreased the cardiac tumor burden, and also improved quality of life. We suggest that cardiac radiotherapy could be an effective and, at least in short-term, safe palliative treatment for radiosensitive malignancy with cardiac metastasis, especially in life-threatening conditions.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient's relative for publication of this manuscript

and any accompanying images

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Figure S1 Echocardiogram revealing bulky cardiac metastasis from small cell lung cancer (18).

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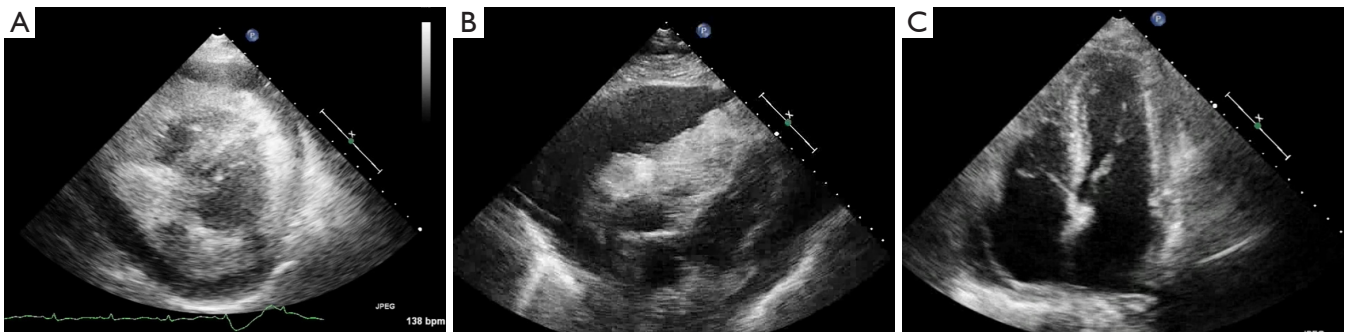


Figure S2 Explanation for the video. (A) First part (before cardiac radiotherapy): echocardiogram on long axis view, short axis view and 4 chamber view showed significant pericardial effusion and bulky epicardial mass encasement all over the heart, and with myocardial invasion around the right ventricle. The left ventricle ejection fraction was 63%, with constrictive effect on cardiac filling motion; (B) second part (five days after cardiac radiotherapy): echocardiogram 5 days after the beginning of cardiac radiotherapy (7 days after the first echocardiogram) showed progression of pericardial effusion to massive amount. Bulky cardiac metastasis especially around the right heart can be clearly delineated. Then pericardiocentesis was done at this day, and 1080ml bloody effusion was drained out; (C) third part (two weeks after cardiac radiotherapy): echocardiogram showed significant decreased size and thickness of the cardiac mass, and resolution of the pericardial effusion. The constrictive effect on heart chambers resolved and the diastolic function of heart also improved.

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