

# World Journal of *Clinical Cases*

*World J Clin Cases* 2021 August 6; 9(22): 6178-6581



**REVIEW**

- 6178 COVID-19 infection and liver injury: Clinical features, biomarkers, potential mechanisms, treatment, and management challenges  
*Sivandzadeh GR, Askari H, Safarpour AR, Ejtehad F, Raeis-Abdollahi E, Vaez Lari A, Abazari MF, Tarkesh F, Bagheri Lankarani K*
- 6201 Gastrointestinal manifestations of systemic sclerosis: An updated review  
*Luquez-Mindiola A, Atuesta AJ, Gómez-Aldana AJ*

**MINIREVIEWS**

- 6218 Mesenchymal stem cell-derived exosomes: An emerging therapeutic strategy for normal and chronic wound healing  
*Zeng QL, Liu DW*
- 6234 Role of autophagy in cholangiocarcinoma: Pathophysiology and implications for therapy  
*Ninfolle E, Pinto C, Benedetti A, Marzioni M, Maroni L*

**ORIGINAL ARTICLE****Case Control Study**

- 6244 Risk factors for intussusception in children with Henoch-Schönlein purpura: A case-control study  
*Zhao Q, Yang Y, He SW, Wang XT, Liu C*

**Retrospective Study**

- 6254 Sequential therapy with combined trans-papillary endoscopic naso-pancreatic and endoscopic retrograde pancreatic drainage for pancreatic pseudocysts  
*He YG, Li J, Peng XH, Wu J, Xie MX, Tang YC, Zheng L, Huang XB*
- 6268 Retrospective study of effect of whole-body vibration training on balance and walking function in stroke patients  
*Xie L, Yi SX, Peng QF, Liu P, Jiang H*
- 6278 Risk factors for preoperative carcinogenesis of bile duct cysts in adults  
*Wu X, Li BL, Zheng CJ, He XD*
- 6287 Diagnostic and prognostic value of secreted protein acidic and rich in cysteine in the diffuse large B-cell lymphoma  
*Pan PJ, Liu JX*
- 6300 Jumbo cup in hip joint renovation may cause the center of rotation to increase  
*Peng YW, Shen JM, Zhang YC, Sun JY, Du YQ, Zhou YG*

**Clinical Trials Study**

- 6308** Effect of exercise training on left ventricular remodeling in patients with myocardial infarction and possible mechanisms  
*Cai M, Wang L, Ren YL*

**Observational Study**

- 6319** Analysis of sleep characteristics and clinical outcomes of 139 adult patients with infective endocarditis after surgery  
*Hu XM, Lin CD, Huang DY, Li XM, Lu F, Wei WT, Yu ZH, Liao HS, Huang F, Huang XZ, Jia FJ*
- 6329** Health-related risky behaviors and their risk factors in adolescents with high-functioning autism  
*Sun YJ, Xu LZ, Ma ZH, Yang YL, Yin TN, Gong XY, Gao ZL, Liu YL, Liu J*
- 6343** Selection of internal fixation method for femoral intertrochanteric fractures using a finite element method  
*Mu JX, Xiang SY, Ma QY, Gu HL*

**META-ANALYSIS**

- 6357** Neoadjuvant chemotherapy for patients with resectable colorectal cancer liver metastases: A systematic review and meta-analysis  
*Zhang Y, Ge L, Weng J, Tuo WY, Liu B, Ma SX, Yang KH, Cai H*

**CASE REPORT**

- 6380** Ruptured intracranial aneurysm presenting as cerebral circulation insufficiency: A case report  
*Zhao L, Zhao SQ, Tang XP*
- 6388** Prostatic carcinosarcoma seven years after radical prostatectomy and hormonal therapy for prostatic adenocarcinoma: A case report  
*Huang X, Cai SL, Xie LP*
- 6393** Pyogenic arthritis, pyoderma gangrenosum, and acne syndrome in a Chinese family: A case report and review of literature  
*Lu LY, Tang XY, Luo GJ, Tang MJ, Liu Y, Yu XJ*
- 6403** Malaria-associated secondary hemophagocytic lympho-histiocytosis: A case report  
*Zhou X, Duan ML*
- 6410** Ileal hemorrhagic infarction after carotid artery stenting: A case report and review of the literature  
*Xu XY, Shen W, Li G, Wang XF, Xu Y*
- 6418** Inflammatory myofibroblastic tumor of the pancreatic neck: A case report and review of literature  
*Chen ZT, Lin YX, Li MX, Zhang T, Wan DL, Lin SZ*
- 6428** Management of heterotopic cesarean scar pregnancy with preservation of intrauterine pregnancy: A case report  
*Chen ZY, Zhou Y, Qian Y, Luo JM, Huang XF, Zhang XM*

- 6435** Manifestation of severe pneumonia in anti-PL-7 antisynthetase syndrome and B cell lymphoma: A case report  
*Xu XL, Zhang RH, Wang YH, Zhou JY*
- 6443** Disseminated infection by *Fusarium solani* in acute lymphocytic leukemia: A case report  
*Yao YF, Feng J, Liu J, Chen CF, Yu B, Hu XP*
- 6450** Primary hepatic neuroendocrine tumor – <sup>18</sup>F-fluorodeoxyglucose positron emission tomography/computed tomography findings: A case report  
*Rao YY, Zhang HJ, Wang XJ, Li MF*
- 6457** Malignant peripheral nerve sheath tumor in an elderly patient with superficial spreading melanoma: A case report  
*Yang CM, Li JM, Wang R, Lu LG*
- 6464** False positive anti-hepatitis A virus immunoglobulin M in autoimmune hepatitis/primary biliary cholangitis overlap syndrome: A case report  
*Yan J, He YS, Song Y, Chen XY, Liu HB, Rao CY*
- 6469** Successful totally laparoscopic right trihepatectomy following conversion therapy for hepatocellular carcinoma: A case report  
*Zhang JJ, Wang ZX, Niu JX, Zhang M, An N, Li PF, Zheng WH*
- 6478** Primary small cell esophageal carcinoma, chemotherapy sequential immunotherapy: A case report  
*Wu YH, Zhang K, Chen HG, Wu WB, Li XJ, Zhang J*
- 6485** Subdural fluid collection rather than meningitis contributes to hydrocephalus after cervical laminoplasty: A case report  
*Huang HH, Cheng ZH, Ding BZ, Zhao J, Zhao CQ*
- 6493** Phlegmonous gastritis developed during chemotherapy for acute lymphocytic leukemia: A case report  
*Saito M, Morioka M, Izumiyama K, Mori A, Ogasawara R, Kondo T, Miyajima T, Yokoyama E, Tanikawa S*
- 6501** Spinal epidural hematoma after spinal manipulation therapy: Report of three cases and a literature review  
*Liu H, Zhang T, Qu T, Yang CW, Li SK*
- 6510** Abdominal hemorrhage after peritoneal dialysis catheter insertion: A rare cause of luteal rupture: A case report  
*Gan LW, Li QC, Yu ZL, Zhang LL, Liu Q, Li Y, Ou ST*
- 6515** Concealed mesenteric ischemia after total knee arthroplasty: A case report  
*Zhang SY, He BJ, Xu HH, Xiao MM, Zhang JJ, Tong PJ, Mao Q*
- 6522** Chylothorax following posterior low lumbar fusion surgery: A case report  
*Huang XM, Luo M, Ran LY, You XH, Wu DW, Huang SS, Gong Q*
- 6531** Non-immune hydrops fetalis: Two case reports  
*Maranto M, Cigna V, Orlandi E, Cucinella G, Lo Verso C, Duca V, Picciotto F*

- 6538** Bystander effect and abscopal effect in recurrent thymic carcinoma treated with carbon-ion radiation therapy: A case report  
*Zhang YS, Zhang YH, Li XJ, Hu TC, Chen WZ, Pan X, Chai HY, Ye YC*
- 6544** Management of an intracranial hypotension patient with diplopia as the primary symptom: A case report  
*Wei TT, Huang H, Chen G, He FF*
- 6552** Spontaneous rupture of adrenal myelolipoma as a cause of acute flank pain: A case report  
*Kim DS, Lee JW, Lee SH*
- 6557** Neonatal necrotizing enterocolitis caused by umbilical arterial catheter-associated abdominal aortic embolism: A case report  
*Huang X, Hu YL, Zhao Y, Chen Q, Li YX*
- 6566** Primary mucosa-associated lymphoid tissue lymphoma in the midbrain: A case report  
*Zhao YR, Hu RH, Wu R, Xu JK*
- 6575** Extensive cutaneous metastasis of recurrent gastric cancer: A case report  
*Chen JW, Zheng LZ, Xu DH, Lin W*

**ABOUT COVER**

Editorial Board Member of *World Journal of Clinical Cases*, Salma Ahi, MD, Assistant Professor, Research Center for Noncommunicable Diseases, Jahrom University of Medical Sciences, Jahrom 193, Iran. salmaahi.61@gmail.com

**AIMS AND SCOPE**

The primary aim of *World Journal of Clinical Cases* (*WJCC*, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

*WJCC* mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

**INDEXING/ABSTRACTING**

The *WJCC* is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2021 Edition of Journal Citation Reports® cites the 2020 impact factor (IF) for *WJCC* as 1.337; IF without journal self cites: 1.301; 5-year IF: 1.742; Journal Citation Indicator: 0.33; Ranking: 119 among 169 journals in medicine, general and internal; and Quartile category: Q3. The *WJCC*'s CiteScore for 2020 is 0.8 and Scopus CiteScore rank 2020: General Medicine is 493/793.

**RESPONSIBLE EDITORS FOR THIS ISSUE**

Production Editor: Yan-Xia Xing; Production Department Director: Yan-Jie Ma; Editorial Office Director: Jin-Lai Wang.

**NAME OF JOURNAL**

*World Journal of Clinical Cases*

**ISSN**

ISSN 2307-8960 (online)

**LAUNCH DATE**

April 16, 2013

**FREQUENCY**

Thrice Monthly

**EDITORS-IN-CHIEF**

Dennis A Bloomfield, Sandro Vento, Bao-Gan Peng

**EDITORIAL BOARD MEMBERS**

<https://www.wjgnet.com/2307-8960/editorialboard.htm>

**PUBLICATION DATE**

August 6, 2021

**COPYRIGHT**

© 2021 Baishideng Publishing Group Inc

**INSTRUCTIONS TO AUTHORS**

<https://www.wjgnet.com/bpg/gerinfo/204>

**GUIDELINES FOR ETHICS DOCUMENTS**

<https://www.wjgnet.com/bpg/GerInfo/287>

**GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH**

<https://www.wjgnet.com/bpg/gerinfo/240>

**PUBLICATION ETHICS**

<https://www.wjgnet.com/bpg/GerInfo/288>

**PUBLICATION MISCONDUCT**

<https://www.wjgnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjgnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjgnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

<https://www.f6publishing.com>

## Bystander effect and abscopal effect in recurrent thymic carcinoma treated with carbon-ion radiation therapy: A case report

Yan-Shan Zhang, Yi-He Zhang, Xiao-Jun Li, Ting-Chao Hu, Wei-Zuo Chen, Xin Pan, Hong-Yu Chai, Yan-Cheng Ye

**ORCID number:** Yan-Shan Zhang 0000-0003-4621-148X; Yi-He Zhang 0000-0003-0800-8747; Xiao-Jun Li 0000-0002-1885-4747; Ting-Chao Hu 0000-0003-3901-3637; Wei-Zuo Chen 0000-0002-6826-2950; Xin Pan 0000-0003-1235-3869; Hong-Yu Chai 0000-0002-7907-6918; Yan-Cheng Ye 0000-0002-6548-9244.

**Author contributions:** Zhang YS and Zhang YH have the same contribution to this article; Zhang YS, Li XJ, Zhang YH and Hu TC designed the experiment; Chen WZ, Pan X and Chai HY drafted the work; Ye YC collected the data; Zhang YS and Li XJ analyzed and interpreted data; Zhang YH and Hu TC wrote the article.

**Supported by** Key R&D Plan of Science and Technology Program of Gansu Province, China, No. 19YF3FH001.

**Informed consent statement:** All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

**Conflict-of-interest statement:** Dr. Ye reports grants from Key R&D plan of Science and Technology Program of Gansu Province, China. (NO. 19YF3FH001) during the conduct of the study.

**Yan-Shan Zhang, Yi-He Zhang, Xiao-Jun Li, Ting-Chao Hu, Wei-Zuo Chen, Xin Pan, Hong-Yu Chai, Yan-Cheng Ye,** Department of Heavy Ion Center, Wuwei Cancer Hospital, Wuwei 733000, Gansu Province, China

**Corresponding author:** Yan-Cheng Ye, PhD, Chief Doctor, Department of Heavy Ion Center, Wuwei Cancer Hospital, No. 31 Sanitary Alley, Haizang Road, Wuwei 733000, Gansu Province, China. [zlyyyyc@163.com](mailto:zlyyyyc@163.com)

### Abstract

#### BACKGROUND

Although the bystander effect and abscopal effect are familiar in medicine, they are relatively rare in clinical practice. Herein, we report the case of a patient who demonstrated an obvious bystander effect and abscopal effect response following carbon-ion irradiation for recurrent thymic carcinoma.

#### CASE SUMMARY

A 44-year-old female presented with shortness of breath. Eleven years prior, she was diagnosed with athymic tumor located in the anterosuperior mediastinum. She underwent extensive tumor resection, and the postoperative pathologic diagnosis was thymic carcinoma. She was administered 50 Gy/25 Fx of postoperative radiation. In 2019, she was diagnosed with a recurrence of thymic carcinoma, with multiple recurrent nodules and masses in the left thoracic chest and peritoneal cavity, the largest of which was in the diaphragm pleura proximal to the pericardium, with a size of 6.7 cm × 5.3 cm × 4.8 cm. She received carbon-ion radiotherapy. After carbon-ion radiotherapy treatment, the treated masses and the untreated masses were observed to have noticeably shrunk on the day of carbon-ion radiotherapy completion and on follow-up imaging. We followed the CARE Guidelines for consensus-based clinical case reporting guideline development and completed the CARE Checklist of information to report this case.

#### CONCLUSION

This report is the first of obvious abscopal and bystander effects following carbon-ion irradiation in a human patient, and further research is needed to better elucidate the mechanisms of bystander and abscopal effects.

**Key Words:** Bystander effect; Abscopal effect; Recurrent thymic carcinoma; Carbon-ion

**CARE Checklist (2016) statement:**

The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Manuscript source:** Unsolicited manuscript

**Specialty type:** Medicine, research and experimental

**Country/Territory of origin:** China

**Peer-review report's scientific quality classification**

Grade A (Excellent): 0  
Grade B (Very good): B  
Grade C (Good): 0  
Grade D (Fair): 0  
Grade E (Poor): 0

**Received:** April 15, 2021

**Peer-review started:** April 15, 2021

**First decision:** May 10, 2021

**Revised:** May 15, 2021

**Accepted:** June 17, 2021

**Article in press:** June 17, 2021

**Published online:** August 6, 2021

**P-Reviewer:** Shintani Y

**S-Editor:** Fan JR

**L-Editor:** Filipodia

**P-Editor:** Zhang YL



radiation therapy; Case report

©The Author(s) 2021. Published by Baishideng Publishing Group Inc. All rights reserved.

**Core Tip:** We presented the case of a patient who demonstrated a bystander effect and an abscopal effect following carbon-ion irradiation for recurrent thymic carcinoma. In this report, obvious abscopal and bystander effects after carbon-ion irradiation in a patient was initially presented, and more research is needed to further elucidate the mechanism of bystander and abscopal effects.

**Citation:** Zhang YS, Zhang YH, Li XJ, Hu TC, Chen WZ, Pan X, Chai HY, Ye YC. Bystander effect and abscopal effect in recurrent thymic carcinoma treated with carbon-ion radiation therapy: A case report. *World J Clin Cases* 2021; 9(22): 6538-6543

**URL:** <https://www.wjnet.com/2307-8960/full/v9/i22/6538.htm>

**DOI:** <https://dx.doi.org/10.12998/wjcc.v9.i22.6538>

## INTRODUCTION

Radiation-induced bystander effect is an excessive biological phenomenon in unirradiated cells due to the transmission of signals from irradiated cells[1-5]. An abscopal effect is a result of the deterioration of unirradiated metastatic lesions after the irradiation of a distant tumor location[6-10]. The rarity and associated mechanisms of bystander and abscopal effects remain under study. To date, there have been no reports of both effects in one patient, even with photon or proton irradiation. Carbon-ion radiotherapy is a form of heavy-ion radiation modality with stronger effects on tumor cells by physical dose (higher relative biological effect) and better dose distribution compared with photon-based therapies[11,12].

Here, we have followed the CARE Guidelines for consensus-based clinical case reporting guideline development[13]. We present the case of a patient who demonstrated a bystander effect and an abscopal effect following carbon-ion irradiation for recurrent thymic carcinoma.

## CASE PRESENTATION

### Chief complaints

In December 2019, a 44-year-old female presented shortness of breath and palpitation.

### History of present illness

In December 2019, a 44-year-old female presented shortness of breath and palpitation.

### History of past illness

Eleven years ago, she transferred to our hospital in February 2009 because of mediastinum tumor. Chest computed tomography (CT) showed a huge mass in the anterosuperior mediastinum, considered a thymic tumor. After detailed workup and multidisciplinary team consultation, she underwent tumor resection and extensive resection of tumor, including part of the left upper lobe of the lung, phrenic nerve and a small part of the pericardium, which were *via* median sternotomy. Postoperative pathology revealed macroscopic invasion into the pericardium and lung, without great vessel invasion and pathologic diagnosis as Masaoka Staging IIIA, World Health Organization Type C: Thymic carcinoma. On 35 d postoperative, she was administered radiation 50 Gy/25Fx, covering the surgical tumor bed and upper mediastinum. There was no chemotherapy. After that, the patient did not receive any chemotherapy, only regularly thorax CT follow-up.

### Personal and family history

No similar medical history in the family.

### **Physical examination**

After instructing the patient to inhale deeply, the symptoms worsened.

### **Laboratory examinations**

No abnormalities in routine blood work, biochemistry and electrolytes.

### **Imaging examinations**

Chest CT revealed multiple nodules and masses in the left thoracic chest and peritoneum cavity, along with the pleura and peritoneum. The biggest one was at the diaphragm pleura proximity to the pericardium, sized 6.7 cm × 5.3 cm × 4.8 cm, and other multiple masses along with pleura and peritoneum cavity.

---

## **FINAL DIAGNOSIS**

We diagnosed it as recurrence of thymic carcinoma, after fine-needle aspiration of the biggest mass, which was close to the pericardium. The diagnosis still was Masaoka Staging IIIA, World Health Organization Type C: Thymic carcinoma.

---

## **TREATMENT**

Referred to multidisciplinary team consultation, experts considered the patient to have a long disease-free period, and the tumor demonstrated an indolent biological behavior. They decided to irradiate the biggest mass adjacent to the pericardium with carbon ion, which would have probably relieved the patient's palpitation and shortness of breath, *etc.* We therefore selected definitive carbon-ion radiotherapy (CIRT) because it could be administered within dose limitations and sparing the lung and heart. Carbon ions can provide a better distribution of physical dose because of lessened lateral scattering, which have higher relative biological effectiveness and a lower oxygen enhancement ratio, with desirable features in eradicating radioresistant, hypoxic tumors[14]. A CIRT plan was developed to deliver 60 Gy [Relative Biological Effectiveness (RBE)] (RBE = 3.0) to the planned target volume in 12 fractions by the broad-beam method. Doses of carbon ions were expressed as photon equivalent doses (GyE), namely, physical doses multiplied by RBE of carbon ions was assumed to be 3.0 [15].

The patient was given CIRT once daily for 5 d within 1 wk (Monday–Friday), 12 fixed fractions (fr.) more than 3 wk in total. Clinical target volume coupling with a safety margin accounting for organ motion (respiratory and heartbeat) and setup inaccuracies were involved in planning target volumes. CIRT planning was conducted by Ci-plan planning software (KJTJ, Lanzhou, China). In order to spare the left ventricle, 1 cm of the tumor was set aside near the left ventricle and was not included in planning target volumes. Treatment planning aims to cover planning target volumes *via* 90%-isodose lines.

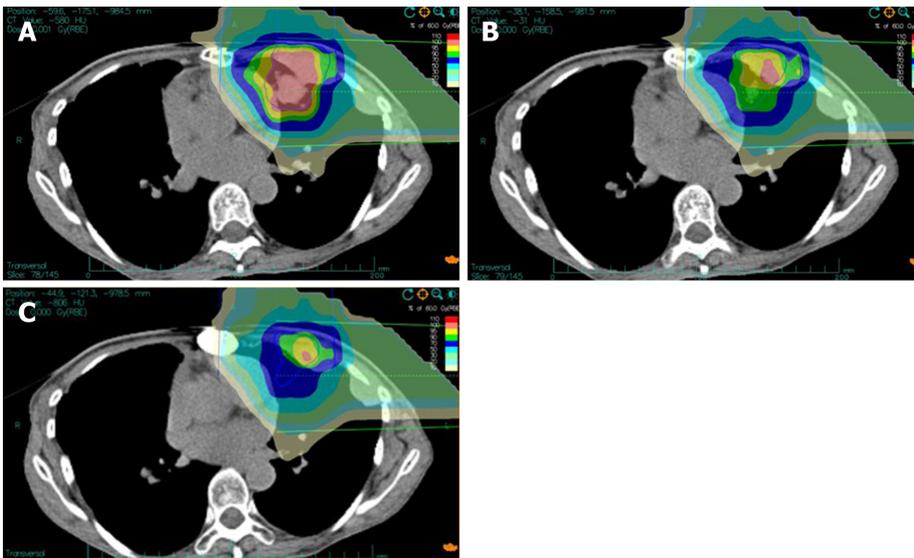
Figure 1 shows the color wash isodose distributions for CIRT. One horizontal and one vertical ports were used for irradiation of the mass with 60 GyE delivered in 12 fractions.

---

## **OUTCOME AND FOLLOW-UP**

The day after finishing the 60 Gy (RBE) CIRT, we ran a CT review. Amazingly, we found the biggest tumor decreased, including the 1 cm of the tumor that was set aside near the left ventricle, and other masses near or distant of irradiated area were decreased.

Following treatment, the treated masses as well as the untreated masses shrank noticeably the day after finishing CIRT on follow-up imaging. No additional treatment was administered. During and after CIRT, the patient's shortness of breath and palpitation were relieved. There was only radiation dermatitis grade 1 acute adverse event and mild erythema. There were no ≥ grade 2 Radiation Therapy Oncology Group acute effect. The patient did not develop any later radiation adverse events 10 mo post-treatment, according to the Radiation Therapy Oncology Group/European Organization for Research and Treatment of Cancer criterion.



**Figure 1** Color wash isodose distributions for carbon-ion radiotherapy. One horizontal and one vertical ports were used for irradiation of mass with 60 GyE delivered in 12 fractions. The lowest 1% isodose area is shown. A-C panels represent scanning at different levels.

## DISCUSSION

In the case, the patient exhibited both bystander-like and abscopal-like effects after carbon-ion irradiation, with a disease remission for 3 mo. A reduction in the size of unirradiated tumor was noted when radiation therapy was completed, without any additional treatment, but the reduction in the masses was easily noted on CT. Of note, both high-dose irradiated masses and low-dose irradiated masses as well as masses not irradiated (near or distant masses) obviously shrank. It is still difficult to discern whether this indicates an underlying susceptibility of the patient's thymic carcinoma or specific characteristics of this patient's immune system, or whether the bystander and abscopal effects can be taken as advantages of carbon-ion beam system used.

This patient was officially our heavy-ion center's second patient to receive treatment. The Wuwei Heavy-Ion Center (WWHIC), located in Wuwei City, Gansu Province, is the first Chinese dedicated heavy-ion cancer therapy facility and was designed by the Institute of Modern Physics of the Chinese Academy of Sciences. The device was manufactured by Lanzhou KejinTaiji (KJTj) Corporation Ltd. The WWHIC initiated the clinical application of carbon ions generated by the dedicated heavy-ion medical accelerator in Wuwei on November 2018. On September 29, 2019, the facility's device was approved by the National Medical Products Administration and registered as a class III medical device. With its high-end medical equipment, the first Carbon-Ion Cancer Therapy Facility in China is a heavy-ion treatment facility designated for the treatment of malignant tumors. The WWHIC is affiliated with Wuwei Cancer Hospital, and the clinical usage of the WWHIC officially started on April 1, 2019. As of January 25, 2020, 9 mo after the operation, the WWHIC has treated 218 patients with CIRT. In the WWHIC, CIRT planning is performed using the carbon-ion Plan (ciPlan, version 1.0, Institute of Modern Physics, Lanzhou, China), including biological plan optimization, taking local values of RBE calculated by ciPlan software based on the local effect model into account. CIRT is delivered using the ciTreat (Institute of Modern Physics, Lanzhou, China). A passive beam and intensity-modulated raster scan system was developed by the WWHIC. For the patient of this case, the passive beam delivery system was involved, together with two different conformal irradiation methods.

Abscopal effects were reported first in 1953[16], and there have been more and more clinical reports for numerous diseases treated with conventional irradiation, such as malignant lymphoma, hepatocellular carcinoma, cervical carcinoma, melanoma and colorectal cancer from then on[17]. There are almost no case reports of the bystander effect, but there are many laboratory studies and literature reviews on the bystander effect[18-20]. Nevertheless, the mechanisms underlying the bystander and abscopal effects remain indeterminate.

The present study shows the development of a post-irradiated in situ tumor vaccine, in rare cases, leading to a systemic response to tumor tissues, which involves enhancing the target tumor by irradiation and inducing a strong response of CD8 $\beta$

effector T cells to the target tumor. Radiation can both suppress immunity and stimulate it. After irradiation, tumors can translocate a variety of recognizable antigens, such as calreticulin, to their surface, enhancing recognition and response by the immune system. Durante *et al*[21] produced evidence recently suggesting that irradiated cells exhibit common T-cell sensitivity, which may boost the enhanced immune system response to primary tumors post irradiation[21]. Nonetheless, the mechanisms by which the bystander and abscopal effects in the tumor are revealed to the immune system remain undetermined.

---

## CONCLUSION

In this report, obvious abscopal and bystander effects after carbon-ion irradiation in a patient was initially presented, and more work is needed to further elucidate the mechanism by which bystander and abscopal effects occur.

---

## REFERENCES

- 1 **Heeran AB**, Berrigan HP, O'Sullivan J. The Radiation-Induced Bystander Effect (RIBE) and its Connections with the Hallmarks of Cancer. *Radiat Res* 2019; **192**: 668-679 [PMID: [31618121](#) DOI: [10.1667/RR15489.1](#)]
- 2 **Hargitai R**, Kis D, Persa E, Szatmári T, Sáfrány G, Lumniczky K. Oxidative Stress and Gene Expression Modifications Mediated by Extracellular Vesicles: An In Vivo Study of the Radiation-Induced Bystander Effect. *Antioxidants (Basel)* 2021; **10** [PMID: [33494540](#) DOI: [10.3390/antiox10020156](#)]
- 3 **Du Y**, Du S, Liu L, Gan F, Jiang X, Wangrao K, Lyu P, Gong P, Yao Y. Radiation-Induced Bystander Effect can be Transmitted Through Exosomes Using miRNAs as Effector Molecules. *Radiat Res* 2020; **194**: 89-100 [PMID: [32343639](#) DOI: [10.1667/RADE-20-00019.1](#)]
- 4 **Tan W**, Zhang Y, Li M, Zhu X, Yang X, Wang J, Zhang S, Zhu W, Cao J, Yang H, Zhang L. miR-27a-containing Exosomes Secreted by Irradiated Skin Keratinocytes Delayed the Migration of Unirradiated Skin Fibroblasts. *Int J Biol Sci* 2019; **15**: 2240-2255 [PMID: [31592237](#) DOI: [10.7150/ijbs.35356](#)]
- 5 **Deng C**, Wu J, Wang T, Wang G, Wu L, Wu Y, Bian P. Negative Modulation of Bystander DNA Repair Potential by X-Ray Targeted Tissue Volume in Arabidopsis thaliana. *Radiat Res* 2019; **191**: 556-565 [PMID: [31017526](#) DOI: [10.1667/RR15314.1](#)]
- 6 **Espenel S**, Vallard A, Rancoule C, Garcia MA, Guy JB, Chargari C, Deutsch E, Magné N. Melanoma: Last call for radiotherapy. *Crit Rev Oncol Hematol* 2017; **110**: 13-19 [PMID: [28109401](#) DOI: [10.1016/j.critrevonc.2016.12.003](#)]
- 7 **Ishiyama Y**, Takagi T, Yoshida K, Iizuka J, Kakuta Y, Okumi M, Ishida H, Tanabe K. Possible abscopal effect in urothelial carcinoma of the upper urinary tract after treatment with immune checkpoint inhibitors. *IJU Case Rep* 2020; **3**: 25-27 [PMID: [32743462](#) DOI: [10.1002/iju5.12133](#)]
- 8 **D'Andrea MA**, Reddy GK. Extracranial systemic antitumor response through the abscopal effect induced by brain radiation in a patient with metastatic melanoma. *Radiat Oncol J* 2019; **37**: 302-308 [PMID: [31918469](#) DOI: [10.3857/roj.2019.00437](#)]
- 9 **Trommer M**, Yeo SY, Persigehl T, Bunck A, Grüll H, Schlaak M, Theurich S, von Bergwelt-Baildon M, Morgenthaler J, Herter JM, Celik E, Marnitz S, Baues C. Abscopal Effects in Radio-Immunotherapy-Response Analysis of Metastatic Cancer Patients With Progressive Disease Under Anti-PD-1 Immune Checkpoint Inhibition. *Front Pharmacol* 2019; **10**: 511 [PMID: [31156434](#) DOI: [10.3389/fphar.2019.00511](#)]
- 10 **Abbas W**, Goel V, Verma A, Gupta VG, Rao RR. Harnessing the Immunomodulatory Effects of Radiation in Urinary Bladder Cancer. *Cureus* 2019; **11**: e4108 [PMID: [31058002](#) DOI: [10.7759/cureus.4108](#)]
- 11 **Gagnier JJ**, Kienle G, Altman DG, Moher D, Sox H, Riley D; CARE Group. The CARE guidelines: consensus-based clinical case reporting guideline development. *BMJ Case Rep* 2013; **2013** [PMID: [24155002](#) DOI: [10.1136/bcr-2013-201554](#)]
- 12 **Haefner MF**, Verma V, Bougatf N, Mielke T, Tonndorf-Martini E, König L, Rwigema JM, Simone CB 2nd, Uhlmann L, Eichhorn F, Winter H, Grosch H, Haberer T, Herfarth K, Debus J, Rieken S. Dosimetric comparison of advanced radiotherapy approaches using photon techniques and particle therapy in the postoperative management of thymoma. *Acta Oncol* 2018; **57**: 1713-1720 [PMID: [30264630](#) DOI: [10.1080/0284186X.2018.1502467](#)]
- 13 **Mohamad O**, Tabuchi T, Nitta Y, Nomoto A, Sato A, Kasuya G, Makishima H, Choy H, Yamada S, Morishima T, Tsuji H, Miyashiro I, Kamada T. Risk of subsequent primary cancers after carbon ion radiotherapy, photon radiotherapy, or surgery for localised prostate cancer: a propensity score-weighted, retrospective, cohort study. *Lancet Oncol* 2019; **20**: 674-685 [PMID: [30885458](#) DOI: [10.1016/S1470-2045\(18\)30931-8](#)]
- 14 **Kamada T**, Tsujii H, Blakely EA, Debus J, De Neve W, Durante M, Jäkel O, Mayer R, Orecchia R,

- Pötter R, Vatnitsky S, Chu WT. Carbon ion radiotherapy in Japan: an assessment of 20 years of clinical experience. *Lancet Oncol* 2015; **16**: e93-e100 [PMID: 25638685 DOI: 10.1016/S1470-2045(14)70412-7]
- 15 **Kanai T**, Endo M, Minohara S, Miyahara N, Koyama-ito H, Tomura H, Matsufuji N, Futami Y, Fukumura A, Hiraoka T, Furusawa Y, Ando K, Suzuki M, Soga F, Kawachi K. Biophysical characteristics of HIMAC clinical irradiation system for heavy-ion radiation therapy. *Int J Radiat Oncol Biol Phys* 1999; **44**: 201-210 [PMID: 10219815 DOI: 10.1016/s0360-3016(98)00544-6]
  - 16 **MOLE RH**. Whole body irradiation; radiobiology or medicine? *Br J Radiol* 1953; **26**: 234-241 [PMID: 13042090 DOI: 10.1259/0007-1285-26-305-234]
  - 17 **Ebner DK**, Kamada T, Yamada S. Abscopal effect in recurrent colorectal cancer treated with carbon-ion radiation therapy: 2 case reports. *Adv Radiat Oncol* 2017; **2**: 333-338 [PMID: 29114600 DOI: 10.1016/j.adro.2017.06.001]
  - 18 **Ariyoshi K**, Miura T, Kasai K, Akifumi N, Fujishima Y, Yoshida MA. Radiation-induced bystander effect in large Japanese field mouse (*Apodemus speciosus*) embryonic cells. *Radiat Environ Biophys* 2018; **57**: 223-231 [PMID: 29785486 DOI: 10.1007/s00411-018-0743-8]
  - 19 **Jia R**, Chen Y, Jia C, Hu B, Du Y. Suppression of innate immune signaling molecule, MAVS, reduces radiation-induced bystander effect. *Int J Radiat Biol* 2021; **97**: 102-110 [PMID: 32776819 DOI: 10.1080/09553002.2020.1807642]
  - 20 **Singh AP**, Seigel GM, Guo L, Verma A, Wong GG, Cheng HP, Shah DK. Evolution of the Systems Pharmacokinetics-Pharmacodynamics Model for Antibody-Drug Conjugates to Characterize Tumor Heterogeneity and *In Vivo* Bystander Effect. *J Pharmacol Exp Ther* 2020; **374**: 184-199 [PMID: 32273304 DOI: 10.1124/jpet.119.262287]
  - 21 **Durante M**, Brenner DJ, Formenti SC. Does Heavy Ion Therapy Work Through the Immune System? *Int J Radiat Oncol Biol Phys* 2016; **96**: 934-936 [PMID: 27869095 DOI: 10.1016/j.ijrobp.2016.08.037]



Published by **Baishideng Publishing Group Inc**  
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA  
**Telephone:** +1-925-3991568  
**E-mail:** [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
**Help Desk:** <https://www.f6publishing.com/helpdesk>  
<https://www.wjgnet.com>

