

Original article

Treating relapsing carcinoma with high-quality image-guided intensity-modulated radiation therapy using the TomoTherapy treatment system

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ABSTRACT

The purpose of this study was to examine solutions to the clinical problems that are suffered by patients. By employing sequential image-guided intensity-modulated radiation therapy (herein referred to as IGIMRT), the patients were observed and compared from the perspectives of various elements: Biochemical non-evidence of disease (bNED), Prostate-Specific Antigen (PSA), Quality of Life (QOL), etc. The TomoTherapy treatment system, which facilitates delivery of IGIMRT and targets all visible malignant tumors, was utilized in this study in order to provide local control for a total of 5 patients with far advanced prostate cancer. The observation period was between 21 and 37 months.

In the series of stage IV prostate cancer cases, it was possible to irradiate lesions in a single procedure in 4 of the 5 cases, including a positive lymph node and bone metastasis in addition to the primary lesion and the seminal vesicle, by employing the TomoTherapy treatment system and achieving bNED in these patients. Furthermore, in the remaining case, it was possible to achieve bNED by controlling liver metastasis that had repeated solitary recurrence. Additionally, in these cases there were a variety of responses to hormone therapy: one case of refusal from the patient, one acceptance from the patient for half a year, one acceptance for one and a half years, one case for continuance, and one refractory case.

In conclusion, treatment with high-quality IGIMRT using the TomoTherapy treatment system provides scope for treating cases of relapsing tumors.

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1. Introduction

Being a radiation oncologist who also gives a second opinion to cancer patients, one encounters patients with puzzling cancer-related problems. Such patients have a variety of complaints, of which the major ones include: "I was told by a doctor that surgery was inevitable for my cancer but I do not wish to undergo surgery," "My cancer condition is extremely malignant and progressive, thus only a systemic treatment is available," and "I was diagnosed as having cancer recurrence postoperatively but I have already undergone all available local and systemic treatments for my recurrence. Now, I am instructed by my doctor to shift my treatment protocol to palliative care regardless of my reluctance to do so." After carefully listening to patients' disease history and following a clinical examination that was presumed to be necessary, the results of the exam appear to correspond with the cancer-bearing conditions the patients complain of. At this stage, in

a majority of cases, it is possible to present a temporary solution that is concordant with needs of the patient or the family.

2. Materials and methods

Although we focus on prostate cancer in this study, we also clarify patients' clinical problems in a variety of clinical stages. Furthermore, we also describe the solutions to the clinical problems that were achieved by image-guided intensity-modulated radiation therapy (IGIMRT) targeting all tumors that could be targeted using the TomoTherapy treatment system.

In Japan, there were 42,997 prostate cancer cases in 2005, ranking 4th highest among males in terms of cancer site, and accounting for 10,036 deaths in 2009, ranking 7th in the same category [1]. These figures are estimated to increase due to Japan's hyper-aging population. Generally speaking, prostate cancer treatment is relatively highly systematized according to the following: NCIPDQ [3], NCCN [4], and the Japanese Urological Association Guidelines [5]. The treatment guidelines, when accommodated by these therapeutic systems, will also be discussed respectively for the cases presented in this study.

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2.1. Patient 1: 67 years old

[February 2007].

The value of prostate-specific antigen (PSA) increased from 4.5 ng/mL to 6.1 ng/mL at the facility where the follow-up was conducted.

[April 2007].

The follow-up course was uneventful.

[August 2008].

PSA levels further increased to 32.4 ng/mL.

[September 2008].

Biopsy was positive in 5/8, GS = 4 + 4.

[October 2008].

The result of bone scintigraphy was uneventful.

MRI results showed infiltration of the extra capsular left lobe. The seminal vesicle was intact. No information on the lymph node was available.

Surgery was recommended by a previous doctor and the patient had the first medical examination for the purpose of obtaining a second opinion.

[November 2008].

The patient was recommended and underwent PET-CT although it was not covered by insurance. The results showed metastasis to the left common iliac nodes (Fig. 1A,B), while, in a similar manner, MRI retrospectively showed lymphadenopathy on the left common iliac nodes. Application of endocrine therapy was suggested according to the Evidence-Based Medicine (EBM) [1–3]; however, the patient and the family showed eagerness to receive local control.

[November–December 2008].

IGIMRT with Simultaneous Integrated Boost (SIB) was performed on the prostate, the seminal vesicle, and the positive lymph node, with a dose of 70 Gy/20 F, as well as to the pelvic lymph nodes, with 50 Gy/20 F, for prophylactic purposes. During the process, the patient presented with temporary slight diarrhea and dull pain in the pelvic floor, both of which were relieved by conservative treatment.

As the tumor belonged to a high-risk group, hormone therapy was recommended as an adjuvant therapy but the patient and family refused owing to their concerns regarding deterioration in QOL.

[May 2009].

New PET-CT images showed that all lesions had vanished (Fig. 1C, D). A follow-up course showed PSA < 0.1 ng/mL and

biologically no evidence of disease (bNED) as of December 2011, and occurrence of the delayed toxicity of radiation by CTCAEV 4.0 [6] were all G0.

The patient was a member of the municipal assembly as of January 2012, and his social activity was remarkably enriched by developing an agricultural project in order to support disabled persons.

2.2. Patient 2: 74 years old

[March 2002].

The value of PSA, which had a tendency to be high, increased rapidly to 13.6 ng/mL.

[April 2002].

Biopsy showed positive. The patient was diagnosed as GS = 8 prostate cancer and began hormone therapy.

[January 2003].

Total prostatectomy was performed.

The patient subsequently continued hormone therapy making slight changes but PSA showed rapid transition to 5–9 ng/mL.

[October 2005].

Induration of the tumor bed was apparent and biopsy showed positive.

[January–March 2006].

Whole pelvis irradiation with a dose of 45 Gy and tumor bed irradiation with a boost dose of 23 Gy were performed.

The patient maintained a PSA level <1 ng/mL until January 2008, but the value increased subsequently with no reaction to hormone therapy.

[January 2009].

The value of PSA became 11.3 ng/mL and the patient was instructed to receive best supportive care (BSC). Therefore, the patient had a first consultation with the purpose of obtaining a second opinion.

[February 2009].

The patient had a PET-CT scan, which showed metastasis at liver S6 with central necrosis, but no other tumors were detected (Fig. 2A).

[March 2009].

IGIMRT of 51.5 Gy/10 F was performed.

Subsequently, the value of PSA favorably decreased to 1.72 ng/mL by December 2009; however, thereafter it increased to 7.85 ng/mL by September 2010.

[October 2010].

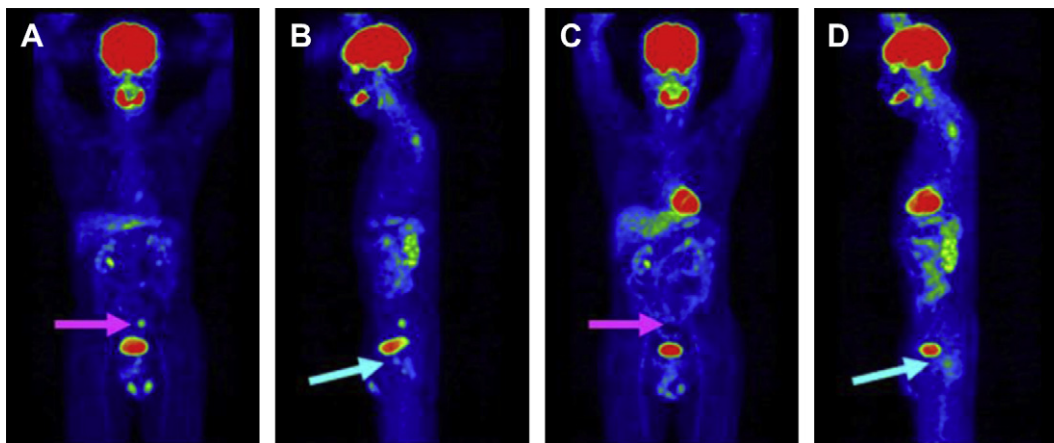


Fig. 1. PET-CT images of pre- and post-treatment in Case 1. A. A front image taken pre-treatment shows metastasis to the left common iliac nodes, indicated by a pink arrow. B. A side image taken pre-treatment shows moderate uptake in the primary tumor, indicated by a blue arrow. C. A front image taken post-treatment shows disappearance of metastasis to the left common iliac nodes, indicated by a pink arrow. D. A side image taken post-treatment shows disappearance of uptake in the primary tumor, indicated by a blue arrow. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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