Preparation of Patients with Prostate Cancer for Intensity Modulated Radiotherapy

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Abstract

Purpose: To evaluate the efficacy of preparation of patients for intensity modulated radiotherapy (IMRT) for prostate cancer using a self-recorded sheet.

Patients and Methods: A total of 106 patients underwent preparation for IMRT using a self-recorded sheet. Patients noted stool condition, bowel movement time, medication for constipation, urinary frequency, and time of drinking of water. Before and after planning Computed Tomography (CT), patients visit our hospital several times for evaluation of bowel gas and stool using a treatment CT device (preparation CT) and the prescription was changed as necessary. After the start of IMRT, the rectum condition was evaluated by on board cone beam CT (CBCT) at every fraction. Medical staff entered "○" on the recording sheet when the rectum was empty in a preparation CT image or the prostate position could be adjusted by 3D-3D matching for each fraction. The "○" rates before the start of IMRT, during the first 14 days (F14) of IMRT, and in the first half (FH) and last half (LH) of the treatment period were compared for each patient.

Results: The average "○" rates were 71.1%, 87.9%, 88.9%, and 90.7% for PRE, F14, FH and LH, respectively, with significant differences (t-test) for PRE *vs.* F14 (p=0.000), Pre *vs.* FH (p=0.000), Pre *vs.* LH (p = 0.000), and F14 *vs.* LH (0.030), and a tendency for a difference between LH and FH (p = 0.058).

Conclusion: Use of a self-recorded sheet improves control of excretion and rectum conditions in preparation for IMRT in patients with prostate cancer.

Introduction

Advances in Intensity Modulated Radiotherapy (IMRT) in the current decade have led to common use of this treatment for prostate cancer. Development of new imaging systems for radiotherapy allow fine adjustment on the treatment bed. However, the location of the prostate is affected by the volume of the bladder and rectum, and sometimes this causes deviation that is beyond the adjustment. A large rectum volume due to gas and stool results in poor treatment results [1]. We consider that interprofessional support for patients and improved self-control of excretion are important for control of rectum condition, and have conducted preparation with an original self-recorded sheet. This sheet also makes it easy for all medical staffs to understand the patient condition. In this study, we evaluated the efficacy of preparation for IMRT for prostate cancer using this self-recorded sheet.

Patients and Methods

Patients

From 2015 to 2016, 106 patients received IMRT for localized prostate cancer at our center. In D'Amigo's risk-group definition, 8, 50 and 48 patients were classified as low, intermediate, and high risk, respectively. The median age was 72 years (range: 50-87). For precise IMRT, preparation was conducted in all patients using the original self-recorded sheet. With the approval of our Institutional Review Board, information on these sheets and clinical outcome was retrospectively analyzed.

Radiotherapy

All patients received definitive IMRT. Planning CT was performed with vacuum body fixation
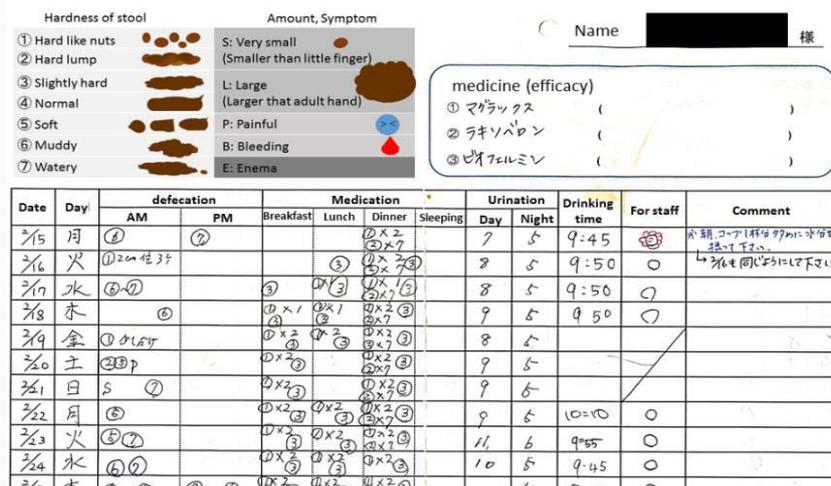
Figure 1: Self-recorded sheet. The language of the items was translated into English.
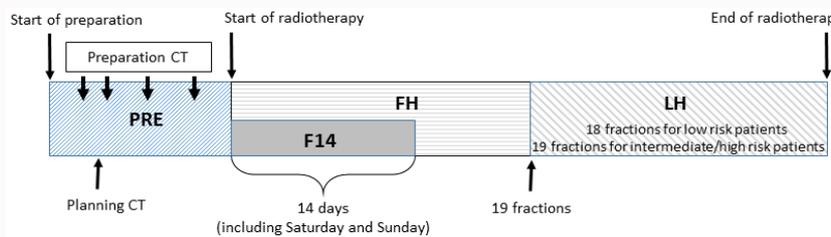

Figure 2: Process of treatment and definition of treatment terms: PRE, F14, FH, LH.

(Esform, Engineering System., Japan). To maintain bladder volume in daily treatment, the patient drank a cup of water (200 cc -400 cc) after urination, and planning CT was performed 30 min - 40 min later. The Clinical Target Volume (CTV) was defined as prostate only for T1-T2 patients, prostate plus a 1/3 section on the proximal seminal vesicle for T3a patients, and prostate and seminal vesicle for T3b patients. PTV was defined as the CTV plus 7-mm margins, except for a 5-mm posterior margin. The prescribed dose was defined as 95% of the PTV receiving 100% of the prescribed dose (D_{95}), and was 74 Gy in 37 fractions for low-risk and 76 Gy in 38 fractions for intermediate- and high-risk patients. All treatments were planned with a Volumetric Intensity Modulated Arc Therapy (VMAT) technique using a planning system (Pinnacle 9.10, Philips, USA) with 6 MV photons. Before daily irradiation, patients drank water, similarly to planning CT. Cone beam CT (CBCT) and structure-based 3D-3D matching with the treatment plan was performed just before daily irradiation. If gas was filling the rectum, gas drainage was performed using a Nelaton catheter or patients were encouraged to defecate. If the bladder volume was insufficient, irradiation was delayed until the defined volume was reached.

Preparation

On the first visit to a radiation oncologist, the patient was interviewed about daily urinary and stool conditions, and daily diet instructions were given by a nurse to avoid production of bowel gas, as follows:

- Do not eat quickly
- Do not eat too much fiber
- Drink more water

Depending on the severity of constipation, encouragement to drink water and medication with anti-flatulent and purgative agents was prescribed. Patients received the self-recorded sheet (described below) and started to fill this out. At first, bowel gas and stool were checked using the treatment CT device. The CT dose index for preparation is reduced (20 mAs ± 3 mAs) compared to that in planning CT (180 mAs ± 20 mAs). When bowel gas and stool were acceptable, planning CT was conducted, but if the bowel condition was not accepted, several times of preparation CT was required before treatment CT. The patient who is difficult to be controlled, preparation CT is also required after the planning CT as a rehearsal. The prescription, amount of water, and waiting time after drinking water were changed as necessary.

Self-Recorded Sheet

A self-recorded sheet on urinary and stool conditions (Figure 1) was prepared with all items listed on one page, with one line for each day. Patients recorded conditions of stool, medication for urination and time of Bowel Movement (BM), medication, urinary frequency, and time of drinking water before daily radiotherapy, and added some notes. Stool condition was classified into 7 patterns according to the modified Bristol stool scale [1,2], and amount of stool, symptoms, and use of enema were added. The medical staff wrote "○" or "×"on the sheet according to the CT images: During the pretreatment period, "○" was entered when the rectum was empty without gas on a preparation CT image. After the start of IMRT, "○" was entered when the rectum was empty and the CBCT image met our criteria that vector deviations of the rectum were within 3 mm of their position on the planning CT image, which allowed shifting by 3D-3D matching. This decision was made by 3 of 5 radiation technologists specializing

Table 1: The "○" rate in each period.

"○" Rate	Before start of IMRT (PRE)	First 14 days (F14)	First half of the treatment period (FH)	Last half of the treatment period (LH)
Average	71.1%	87.9%	88.9%	90.7%
Range	0-100%	44.4-100%	52.6-100%	57.9-100%

Table 2: Comparison of "○" rates among periods.

Comparison	p-value
PRE *vs.* F14	0.000
PRE *vs.* FH	0.000
PRE *vs.* LH	0.000
F14 *vs.* FH	0.145
F14 *vs.* LH	0.030
FH *vs.* LH	0.058

in radiotherapy.

Analysis

The rate of meeting the criteria (the "○" rate) was calculated for each treatment period: before the start of IMRT (PRE); the first 14 days (F14) and the first half of the treatment period (FH) to the 19th treatment from the start of IMRT; and the last half of the treatment period (LH) (Figure 2). For the PRE period, the "○" rate was calculated as the number of "○"/ preparation days, and for other periods, the number of "○" was divided by the treatment days. The "○" rate for each period was compared by t-test using SPSS (IBM, USA).

Results

The treatment period was 52 to 66 days (median: 57) and the practice period before the start of IMRT was 6 to 56 days (median: 22). The average "○" rates were 71.1%, 87.9%, 88.9% and 90.7% for PRE, F14, FH and LH, respectively (Table 1), with a significant difference for PRE vs. F14 ($p = 0.000$), FH ($p = 0.000$), LH ($p = 0.000$), and F14 *vs.* LH ($p = 0.030$). LH showed a higher tendency than FH ($p = 0.058$) and there was no significant difference between F14 and FH ($p = 0.145$) (Table 2). During a median follow-up period of 15.5 months (range: 3-24 months), there were 2 deaths due to colon cancer and sudden death, respectively. PSA failure occurred in one patient with high risk prostate cancer 7 months after the start of IMRT. No severe (≥Grade 3) acute and late toxicity was observed. Four patients experienced temporal late rectum bleeding, but spontaneously improved.

Discussion

Prostate motion occurs due to external pressure from surrounding organs such as the bladder and rectum [3-7]. Reported that the prostate position changed by up to 20 mm when the rectum was filled with 30 cm^3 - 50 cm^3 of contrast medium [4,5]. Found that the posterior prostate border moved anteriorly by >5 mm and that the maximum posterior prostate shift was 8 mm in response to rectal and bladder distention, respectively, with addition of 60 cm^3 plus an additional 120 cm^3 of contrast medium [5]. Based on these results, it is important to maintain rectum and bladder filling volumes for precise IMRT. To maintain a constant rectum volume, a rectum balloon can be used during delivery of IMRT [8]. However, more favorable treatment results can be achieved with an empty rectum: The incidence of biochemical failure was higher among patients with distended rectums [1], and inter fractional variation of the rectum volume can be reduced with empty rectum for IMRT [8].

Appropriate patient instruction is also useful for reduction of prostate inter fraction error. Graf et al. [9] provided an information sheet for patients receiving radiotherapy for prostate cancer that described how to avoid flatulent food by reducing intake of fiber and the importance of emptying the rectum for planning CT and treatment fractions; after these instructions were given, the inter fraction error was only <1 mm to 2 mm.

Our preparation method also involves instruction for patients, but through a self-recording method. Our results suggest that the rectal conditions after the start of IMRT improved in the pretreatment period, and then further improved in the first 2 weeks after the start of IMRT, with favorable rectal toxicity. The main advantages of this method are simple sharing of information among patients and health professionals, including nurses, technologists, assistants and doctors, and encouragement of patient awareness of self-control through the self-recording system. The utilization of simple entries of "○" and "×" appears to be reliable because it was performed by the same technologist. This approach is not quantitative, but its simplicity makes the system easy to understand for patients and medical staff. Many patients felt happy and encouraged when they saw many "○" entries on their sheet, and improvement of the control rate with the time course of fractions was affected not only by the preparation, but also habituation to the treatment. One limitation is that we did not compare the results of our preparation method with those of other methods. However, considering the improvement from the pretreatment to treatment periods, preparation method using a self-recorded sheet seems to be useful to improve control of excretion and rectum conditions in patients undergoing IMRT.

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