



Radiation safety of receptive anal intercourse with prostate cancer patients treated with low-dose-rate brachytherapy

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ABSTRACT

PURPOSE: Prostate low-dose-rate (LDR) brachytherapy involves implantation of radioactive seeds permanently into the prostate gland. During receptive anal intercourse, the penis of the partner may come in close proximity to the implanted prostate gland. We estimate the potential intrarectal dose rates and suggest guidance on radiation precautions.

METHODS AND MATERIALS: One hundred two patients were included in the study. After implantation, with patients under anesthesia in the dorsal lithotomy position, a new set of ultrasound (US) images and a CT scan were obtained. The images were fused, radioactive seeds and US probe locations were determined on the CT, and prostate, bladder, and rectal contours were drawn on the US. Dose rates (cGy/h) were calculated for the portion of the US probe spanning the prostate for several dose-volume histogram parameters.

RESULTS: Twenty patients were treated with ¹²⁵I and 82 patients with ¹⁰³Pd. Average dose rates at Day 0 to the portion of the US probe spanning the prostate were 2.1 ± 1.3 cGy/h and 2.5 ± 0.8 cGy/h for patients treated with ¹²⁵I and ¹⁰³Pd, respectively. After 60 days, average calculated probe dose drops to 1.0 ± 0.6 cGy/h and 0.2 ± 0.1 cGy/h for ¹²⁵I and ¹⁰³Pd, respectively.

CONCLUSIONS: During the immediate weeks after prostate seed implant, the estimated intrarectal dose rates are higher in ¹⁰³Pd compared to ¹²⁵I. As ¹⁰³Pd decays faster than ¹²⁵I, 2 months after the implant, radiation exposure from ¹⁰³Pd becomes lower than ¹²⁵I. Receptive anal intercourse time should be kept as low as possible during 2 and 6 months after low-dose-rate brachytherapy of the prostate with ¹⁰³Pd and ¹²⁵I, respectively. © 2016 American Brachytherapy Society. Published by Elsevier Inc. All rights reserved.

Keywords: Prostate brachytherapy; Anal sex; Radiation precautions; Homosexual

Introduction

Prostate cancer is the most common malignancy among men (1). Low-dose-rate (LDR) brachytherapy is an efficient treatment for low-risk, and selected patients with intermediate-risk disease as a single modality (2, 3), and is used in combination with external beam radiation for intermediate- and high-risk patients to achieve radiation dose

escalation (4–8). LDR prostate brachytherapy is performed by permanently implanting radioactive seeds inside the prostate in a distribution that results in proper radiation coverage to the prostate and a margin around it (9, 10). The most used radionuclides in prostate LDR brachytherapy are ¹²⁵I with a radioactivity half-life of 59.4 days or ¹⁰³Pd with a half-life of 17 days (11). The International Commission on Radiological Protection (ICRP) issued guidance on radiation precautions based on potential external exposures to members of the public and/or carers for prostate seed brachytherapy (12). Prostate brachytherapy patients are provided with instructions on precaution actions recommended to maintain doses to other individuals as low as is reasonably achievable (ALARA) (13). Typical anterior skin surface dose after a prostate implant is about 37 μ Sv/h for ¹²⁵I and 8 μ Sv/h for ¹⁰³Pd (13). The time required to reach an effective dose equivalent

Received 2 February 2016; received in revised form 29 March 2016; accepted 29 March 2016.

Nicola J. Nasser and Gil'ad Cohen contributed equally to this manuscript.

Conflict of interest: None.

Financial disclosure: None.

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limit of 5 mSv for caregivers was estimated to be 19 days on contact with the skin surface for ^{125}I , and the total doses to decay for ^{125}I at a distance of 30 cm from the anterior skin surface or for ^{103}Pd on contact with the skin surface and at 30 cm from the anterior skin surface were found to be less than 5 mSv (13). Typical radiation safety ALARA instructions to patients after permanent prostate brachytherapy include avoiding close contact, that is, within 30 cm, with others (including children and pregnant women) for extended periods of time; and avoiding sleeping in the “spoon” position (i.e., in contact) with the primary caregiver (12, 13). A more recent study from Memorial Sloan Kettering Cancer Center with radiation exposure rate measurements obtained from 1279 patients with prostate cancer who underwent transperineal ^{125}I or ^{103}Pd seed implantation found that for the typical ^{103}Pd patient, no radiation safety precautions are required and that for the typical ^{125}I patient, no precautions are required for coworkers, nonpregnant adults who do not sleep with the patient, or nonpregnant adults who sleep with the patient (14). Typical ^{125}I patients should only avoid sleeping in the “spoon” position (i.e., in contact) with pregnant adults and avoid holding a child for long periods of time in the lap for about 2 months (14). The only precaution that was provided to patients regarding sexual activity was the use of a condom for the first two to three occasions of intercourse after implantation because it is theoretically possible for a seed to be expelled in the semen on ejaculation and in the very rare event that this happens it is usually in the first one or two ejaculations (15). Some centers advise patients who are not interested in using a condom, to masturbate on five occasions before engaging in unprotected sexual activity, so if a seed were to be expelled it would not be ejaculated into the body of the partner. No special precautions have been typically provided for patients regarding receptive anal intercourse (RAI). During RAI, the penis of the partner may come in close proximity to the implanted prostate gland (Fig. 1). Here, using the transrectal ultrasound (US) probe as a surrogate for the partners’ penis, we estimate the potential intrarectal partners’ penile dose rates during RAI with prostate cancer patients treated with LDR brachytherapy.

Methods and materials

Patients

This retrospective study was approved by Memorial Sloan Kettering Cancer Center institutional review board. Eligible patients for inclusion in the study were men with clinically localized prostate cancer, who elected to be treated with LDR prostate brachytherapy as a single treatment modality or combined with external beam radiation, and had intraoperative CT scan performed at the end of the seed implantation procedure for intraoperative dosimetry.

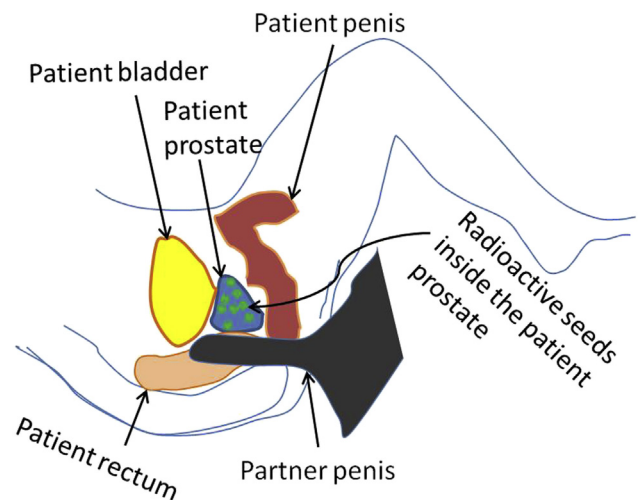


Fig. 1. Schematic drawing of the internal anatomy of prostate cancer patients after low-dose-rate brachytherapy during receptive anal intercourse (RAI). During RAI, the penis of the partner may come in close proximity to the implanted prostate gland.

Brachytherapy technique

The LDR seed implantation procedure and intraoperative planning technique used in this study have been previously described in details (16). Briefly, the patients were intubated under general anesthesia, and intravenous dexamethasone (8 mg) was given at the time of induction (17). The patients were positioned in the dorsal lithotomy position using Allen Stirrups. Interstitial needles were inserted into the peripheral substance of the prostate gland through a perineal template under sagittal and axial transrectal US image guidance. Transurethral aerated gel was applied to maximize urethral visualization, and axial US images of the prostate were subsequently acquired at 5-mm increments from the base of the prostate to the apex and transferred into the brachytherapy treatment planning system (17). Contours of the target volume and organs at risk were drawn on each axial image for computer-based three-dimensional reconstruction. Needle positions were identified and reconstructed. An inverse planning system using a genetic optimization algorithm for intraoperative US-guided transperineal technique was used. A conformal treatment plan was generated to determine the optimal seed distribution to deliver a prescription dose to the target volume (prostate). Patients treated with brachytherapy as monotherapy were prescribed a dose of 144 Gy or 125 Gy for ^{125}I or ^{103}Pd seeds, respectively (11, 18). For patients treated with brachytherapy combined with external beam radiation, ^{103}Pd seeds were used with a prescription dose of 100 Gy to the prostate (11). Urethral dose was kept below 120% and rectal dose below 80% of prescription dose (17). Radioactive seeds were placed with a Mick applicator (Mick Radio-Nuclear Instruments, Inc, Mount Vernon, NY) under US and fluoroscopic image guidance according to the approved treatment plan.

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