

International Symposium on the 10th Anniversary of Permanent Prostate Brachytherapy in Japan

## Postmortem radiation safety and issues pertaining to permanent prostate seed implantation in Japan

Takefumi Satoh<sup>1,2,\*</sup>, Takushi Dokiya<sup>1,3</sup>, Hidetoshi Yamanaka<sup>1,4</sup>, Shiro Saito<sup>1,5</sup>,  
Hiromichi Ishiyama<sup>6</sup>, Jun Itami<sup>1,7</sup>, Hitoshi Shibuya<sup>1,8</sup>, Takashi Nakano<sup>1,9</sup>,  
Naoyuki Shigematsu<sup>1,10</sup>, Manabu Aoki<sup>1,11</sup>, Shin Egawa<sup>1,12</sup>, Mitsuyasu Hashimoto<sup>1,13</sup>,  
Tetsuo Nishimura<sup>1,14</sup>, Atsunori Yorozu<sup>1,15</sup>

<sup>1</sup>Working Group for Promotion of Permanent Seed Implantation Therapy of Prostate Cancer, Subcommittee of Brachytherapy, Medical Science and Pharmaceutical Committee, Japan Radioisotope Association, Tokyo, Japan

<sup>2</sup>Department of Urology, Kitasato University School of Medicine, Sagamihara, Kanagawa, Japan

<sup>3</sup>Department of Radiation Oncology, Comprehensive Cancer Center, Saitama Medical University, Saitama, Japan

<sup>4</sup>Institute for Preventive Medicine, Kurosawa Hospital, Gunma, Japan

<sup>5</sup>Department of Urology, National Hospital Organization Tokyo Medical Center, Tokyo, Japan

<sup>6</sup>Department of Radiation Oncology, Kitasato University School of Medicine, Sagamihara, Kanagawa, Japan

<sup>7</sup>Department of Radiation Oncology, National Cancer Center Hospital, Tokyo, Japan

<sup>8</sup>Department of Radiology, Tokyo Medical and Dental University, Tokyo, Japan

<sup>9</sup>Department of Radiation Oncology, Gunma University Graduate School of Medicine, Maebashi, Japan

<sup>10</sup>Department of Radiology, Keio University School of Medicine, Tokyo, Japan

<sup>11</sup>Department of Radiology, Jikei University School of Medicine, Tokyo, Japan

<sup>12</sup>Department of Urology, Jikei University School of Medicine, Tokyo, Japan

<sup>13</sup>Department of Radiological Sciences, International University of Health and Welfare, Tochigi, Japan

<sup>14</sup>Division of Radiation Oncology, Shizuoka Cancer Center, Shizuoka, Japan

<sup>15</sup>Department of Radiology, National Hospital Organization Tokyo Medical Center, Tokyo, Japan

### ABSTRACT

**PURPOSE:** If a prostate cancer patient treated with <sup>125</sup>I brachytherapy dies within 12 months after the treatment, prostate removal before cremation is recommended to avoid problems related to radioactivity in the ashes, such as inhalation of airborne particulate matter by crematorium staff or nearby residents. To provide guidance for such cases, a manual prepared under the editorial supervision of several professional associations was issued in 2008 in Japan. Herein, we investigated the incidence and causes of death, and the actions taken subsequent to death, among prostate cancer patients who died within 12 months after <sup>125</sup>I brachytherapy over a 10-year period in Japan; and we compared the results before and after the manual was issued.

**METHODS AND MATERIALS:** Data extracted from the Japan Radioisotope Association database for the period from September 2003 to the end of December 2013 were used.

**RESULTS:** Of 27,976 patients who underwent <sup>125</sup>I brachytherapy during the specified period, 79 died within 12 months after implantation, including 3 who died in the 2011 earthquake and tsunami. The prostate and brachytherapy source were retrieved at autopsy from 69 of the 79 patients. Autopsy could not be performed on the other 10 patients, 2 of whom died in the earthquake. Autopsy and retrieval of the brachytherapy source were significantly more common after issuance of the manual than before (22/28 cases before; 47/49 cases after;  $p = 0.021$ ).

**CONCLUSION:** In most cases of early death after <sup>125</sup>I brachytherapy in Japan, the brachytherapy source was retrieved. © 2015 American Brachytherapy Society. Published by Elsevier Inc. All rights reserved.

**Keywords:** Prostate cancer; Brachytherapy; Cremation; Radiation safety

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\* Corresponding author. Department of Urology, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan. Tel.: +81-42-778-9091; fax: +81-42-778-9374.

E-mail address: [tsatoh@kitasato-u.ac.jp](mailto:tsatoh@kitasato-u.ac.jp) (T. Satoh).

## Introduction

Since the prostate-specific antigen screening test was introduced into clinical practice, the rate of detection of prostate cancer has improved dramatically, and the number of diagnosed cases has rapidly increased in both the United States and Japan. Prostate cancer currently ranks as the fourth most common malignant tumor among males (1), but it is predicted to become the most common tumor by 2025 (2).

Brachytherapy with  $^{125}\text{I}$  is becoming a common modality for the treatment of prostate cancer worldwide. However, when a patient dies and is cremated within a few months of implantation, several problems arise related to the radioactivity in the ashes and airborne particulate matter, which may be inhaled by crematorium staff or nearby residents. The International Commission on Radiological Protection recommends removing the prostate before cremation if death occurs within 12 months after  $^{125}\text{I}$  brachytherapy (3). As per the Japanese regulations (4–6), the brachytherapy source must be removed during autopsy before cremation of the body of a patient who has died within 12 months after  $^{125}\text{I}$  brachytherapy. To specify the actions to be taken in cases of early death in Japan, a manual prepared under the editorial supervision of the Japanese Society for Therapeutic Radiology and Oncology, the Japanese Urological Association, the Japan Radiological Society, the Japanese Society of Pathology, and the Japan Radioisotope Association was issued in August 2008 (7).

In this study, we updated our previously published work (8) with more-recent data on the incidence and causes of death and the postmortem actions taken in cases of prostate cancer in which death occurred within 12 months after  $^{125}\text{I}$  brachytherapy, and we compared the data before and after the publication of the above-described manual. In addition, we describe the Japanese safety guidelines for and notifications regarding permanent implantation brachytherapy (4–6).

## Methods and materials

### Study population

The study population comprised prostate cancer patients who underwent  $^{125}\text{I}$  brachytherapy in Japan during the period from September 2003 to the end of December 2013 and included patients who received  $^{125}\text{I}$  brachytherapy alone and patients who received external radiation therapy along with  $^{125}\text{I}$  brachytherapy. Cases of early death (i.e., cases in which death occurred within 12 months after  $^{125}\text{I}$  implantation) were included in the analysis.

The research variables were the total number of  $^{125}\text{I}$  implantation cases during the study period, the number of early deaths occurring within 12 months after implantation, the causes of death, and postmortem handling of the body, including retrieval of the brachytherapy source.

In Japan, medical institutions obtain medical isotopes from radiation source supply companies via the Japan Radioisotope Association, which provided its database for

our analysis. The variables were agreed on and investigated by the Working Group for Promotion of Permanent Seed Implantation Therapy of Prostate Cancer, Subcommittee of Brachytherapy, Medical Science and Pharmaceutical Committee, the Japan Radioisotope Association.

### Definitions

For all patients, Day 0 was defined as the date of  $^{125}\text{I}$  implantation. Causes of death were classified into four groups, namely malignant tumor; cerebrovascular or cardiovascular disease; infection or respiratory disease; and non-natural causes, which included suicide.

## Results

During the study period, 27,976 patients underwent  $^{125}\text{I}$  brachytherapy in Japan (Table 1). The first early death case was reported in 2004, and the number of cases per year thereafter ranged from 3 to 17. From September 2003 to the end of December 2013, a total of 79 early deaths were reported (incidence: 0.28%).

Figure 1 shows the postmortem actions taken in the 79 cases of early death. The brachytherapy source was retrieved at autopsy along with the prostate gland in 69 of the 79 cases (87%). In the remaining 10 cases (13%), the body was cremated without retrieval of the prostate gland. Among the 69 patients from whom the brachytherapy source was retrieved, 33 (42%) died at the medical institution where the  $^{125}\text{I}$  implantation had been done and were autopsied at that same institution. Among the 36 patients who died at an institution other than the one where the implantation had been done, 32 (41%) were transported for autopsy to the implantation institution; in the remaining 4 cases (5%), a physician from the implantation institution went to the institution where the patient died for the autopsy, and the prostate gland was transported to the implantation institution.

Cerebrovascular or cardiovascular disease was the most common cause of early death, followed by malignant tumor, respiratory disease or infection, and non-natural

Table 1

Number of early deaths after  $^{125}\text{I}$  implantation for brachytherapy in Japan, September 2003 to the end of December 2013

Year	No. of early deaths (%)	No. of $^{125}\text{I}$ brachytherapy cases
2003	0 (0)	55
2004	3 (0.41)	723
2005	4 (0.23)	1750
2006	8 (0.36)	2200
2007	5 (0.17)	2880
2008	8 (0.28)	2882
2009	9 (0.28)	3172
2010	6 (0.17)	3484
2011	9 (0.24)	3794
2012	17 (0.47)	3653
2013	10 (0.30)	3383
Total	79	27,976

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