

Clinical Characteristics of Radiation Oncology in Korea during Past 10 Years

To understand trends in the clinical characteristics of radiation oncology over the last 10 yr in Korea, annual survey questionnaires were sent to all of Korean radiation oncology facilities since 1990. Questionnaires addressed basic radiation therapy facilities and the clinical information. Responses were obtained from all facilities, and data collected from 1997 to 2006 was analyzed. The numbers of new patients that have undergone radiation therapy and the numbers of hospitals with a department of radiation oncology have steadily increased over the past 10 yr, and totaled 37,215 patients and 60 hospitals, respectively, in 2006. However, the proportion of patients irradiated among total cancer patients has remained below 30% over the last 10 yr. The numbers of prostate cancer, breast cancer, and hepatoma have increased by more than 3 fold over the past 10 yr. Moreover, the percentage of irradiated patients treated by brachytherapy was 10.3% in 1997, but this gradually fell to only 4.2% in 2006. The information collected described the role played by radiation oncology in Korea. Continuous surveys are required to enable trends to be detected.

Key Words : Radiation Oncology; Structure; Data Collection; Facility; Patient Loads

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INTRODUCTION

The Korean Institute of Radiological and Medical Sciences (KIRAMS) has conducted an annual nationwide survey to collate radiation oncology statistics since 1986 under the auspices of the Korean Society for Therapeutic Radiology and Oncology (KOSTRO). The survey requests information on human resources, radiation therapy equipment, facilities, and the clinical loads placed on radiation oncology department on a nationwide basis. Survey results are published annually in the Journal of KOSTRO (1-6), and represent a useful resource for understanding the infrastructure (7, 8) and characteristics of radiation oncology services in Korea over the past 20 yr.

In 1997, we described the infrastructures of departments of radiation oncology in Korea, and compared these with Japanese and American counterparts (9). However, progress in radiotherapy has developed rapidly over the past 10 yr, and especially in Korea, radiotherapy has evolved qualitatively and quantitatively. Accordingly, to understand clinical trends in radiation oncology over the past 10 yr and estimate future trends, we analyzed accumulated clinical data over the past 10 yr.

MATERIALS AND METHODS

Before 2000, survey questionnaires were prepared in hard copy form and forwarded by mail annually to appropriate personnel (primarily, chief of radiation oncologists) in radiation oncology facilities. The completed survey questionnaires were returned by mail. However, from 2000 the web-site of the department of radiation oncology at the Korea Cancer Center Hospital (KCCH) has included a means of collecting annual national statistics from departments of radiation oncology. Data are electronically entered deposited in the web site by designated personnel.

However, all questionnaires issued over the past 10 have been identical in terms of a series of questions. The first questionnaire requested details on basic radiation therapy facilities. The second questionnaire inquired clinical details of new patient numbers treated in department of radiation oncology in a calendar year (January through December) and details of sites treated. Sites were classified as follows: primary brain and spinal cord, head and neck (larynx, oral cavity, nasopharynx, oropharynx, hypopharynx, maxillary sinus, salivary gland,

nasal cavity, eye and orbit, lip, and non-specified), esophagus, lung, breast, pancreas, hepatobiliary, genitourinary (prostate, ureter and bladder, kidney, testis, urethra, and non-specified), gynecology (uterine cervix, uterine corpus, ovary and tubes, vagina, and non-specified), rectum including anus, soft tissue sarcoma, leukemia and lymphoma, metastasis (bone, brain, lymph node, and non-specified), and others. The third questionnaires included number of patients receiving brachytherapy, which was classified by treatment method, e.g., intracavitary radiation therapy (ICR), and others, such as, interstitial, intraluminal, and mold brachytherapy.

In the case of non-response facilities, multiple mailings and telephone calls ensured 100% responses from all facilities. Returned forms were then reviewed for completeness and logical consistency. Follow-up telephone calls were made to clarify inconsistent data or to obtain missing information on key questions. Logic checks were conducted after data entry to detect errors. All data collected were entered into a computer program at KOSTRO by authorized staff. We selectively analyzed the characteristics of facilities and patients entered into the computer database from 1997 to 2006 to evaluate trends over the past 10 yr.

RESULTS

Facilities and distributions of patients in 2006

In 2006, 60 hospitals operated a department of radiation oncology in Korea (population of Korea: $48,297 \times 10^3$ in 2006). Thirty of these facilities (50.0%) were located in capital area including the city of Seoul, and Incheon (total population of $20,842 \times 10^3$ in 2006), and the remaining 30 facilities (50.0%) were located in provincial areas (total population of $27,455 \times 10^3$ in 2006). The percentages of hospitals treating <250, between 250 and 499, between 500 and 999, and >1,000 new patients per year, were 11 (18.3%), 26 (43.3%), 16 (10%), and 7 (11.6%), respectively, as showed in Table 1.

The distribution of patients by treatment site in 2006 is shown in Table 2. The most frequent sites for the 37,215 patients that underwent radiation therapy were: breast 6,948 (18.7%), metastasis (brain, bone, lymph node, and others) 6,938 (18.6%), lung 3,772 (10.1%), gynecology 3,263 (8.8%), rectum 3,242 (8.7%), head and neck 2,769 (7.4%), hep-

atobiliary 2,007 (5.4%), primary brain and spinal cord 1,683 (4.5%), and esophagus 959 (2.6%), as showed in Table 2.

Clinical trends over the past 10 yr

Fig. 1 shows trends in the number of new patients treated in radiation oncology facilities. The total number of new patients treated has steadily increased over past 10 yr to 37,215

Table 2. New patients and cancer sites in 2006

Treatment sites	No. (%) of patients
Primary brain & spinal cord	1,683 (4.5)
Head & Neck	
Larynx	622 (1.7)
Oral cavity	419 (1.1)
Nasopharynx	364 (1.0)
Oropharynx	341 (0.9)
Hypopharynx	273 (0.7)
Maxillary sinus	163 (0.4)
Salivary gland	143 (0.4)
Nasal cavity	107 (0.3)
Eye & orbit	94 (0.3)
Lip	17 (0.0)
Other	226 (0.6)
Subtotal	2,769 (7.4)
Esophagus	959 (2.6)
Lung	3,772 (10.1)
Breast	6,948 (18.7)
Pancreas	540 (1.5)
Hepatobiliary	2,007 (5.4)
Genitourinary	
Prostate	699 (1.9)
Ureter & Bladder	263 (0.7)
Kidney	110 (0.3)
Testis	72 (0.2)
Urethra	26 (0.1)
Other	7 (0.0)
Subtotal	1,177 (3.2)
Gynecology	
Uterine cervix	2,676 (7.2)
Uterine corpus	378 (1.0)
Ovary & tubes	104 (0.3)
Vagina	46 (0.1)
Other	59 (0.2)
Subtotal	3,263 (8.8)
Rectum	3,242 (8.7)
Soft tissue sarcoma	386 (1.0)
Leukemia & lymphoma	1,172 (3.2)
Metastasis	
Bone	3,648 (9.8)
Brain	2,115 (5.7)
Lymph node	706 (1.9)
Other	469 (1.3)
Subtotal	6,938 (18.6)
Other	2,359 (6.3)
Total	37,215 (100)

(Parenthesis) indicate the percentages of new patients versus all new patients.

Table 1. Numbers of radiation oncology facilities by new patient numbers in 2006

Annual new patients	No. (%) of hospitals
<250	11 (18.3)
250-499	26 (43.3)
500-999	16 (26.7)
>1,000	7 (11.7)
Total	60

in 2006 as compared with 18,857 in 1997. The number of new patients per radiation oncologist (staff and fellow) was analyzed to 220 on an average in 1997 and 1998, and it was

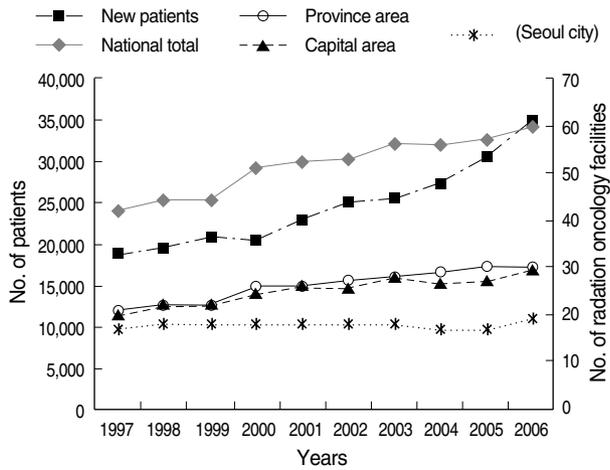


Fig. 1. The number of radiation oncology facilities and new patients per year over the past 10 yr (Provincial area includes all regions other than the Seoul, Incheon, and neighboring region of Gyeonggi-do).

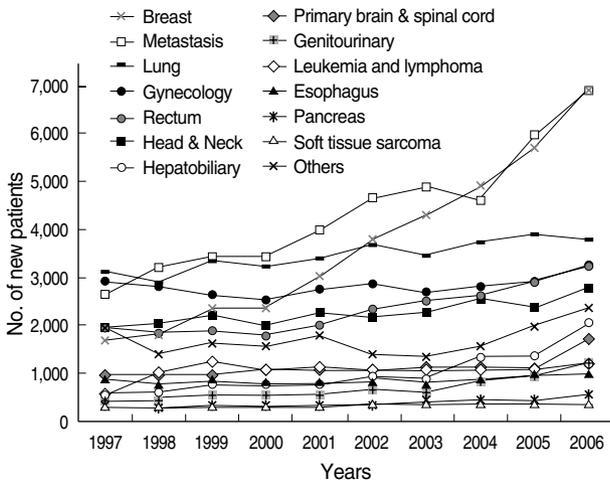


Fig. 2. New cancer patients that underwent radiotherapy by lesion type.

increased to 285 on an average in 2005 and 2006.

The statistics of the Korean Ministry of Health and Welfare show that numbers of new cancer patients registered per annum were 101,025, 101,385, 110,804, and 116,034 over the 1999 to 2002 period, respectively, indicating that the percentages of total cancer patients irradiated were 21.7%, 21.0%, 21.7%, and 22.5%, respectively. Unfortunately, cancer registration statuses were not available for 2003, 2004, and 2005. However, for 2006 the statistical data of the Health Insurance Review and Assessment Service (<http://www.hira.or.kr>) showed that 21.8% of new cancer patients were irradiated, i.e., 37,215 of 170,365 cancer patients underwent radiation therapy. Therefore, over the past 10 yr, percentages of cancer patients irradiated have been consistently below 30%.

Fig. 2 shows clinical trends in the numbers of new oncology patients that received radiation treatment on the primary lesions during the past 10 yr. Notably, metastases and the breast, lung, gynecology, rectum, and head and neck cancers were most prevalent. Moreover, metastatic lesions, including those of the brain and bone, lymph node, etc. have accounted for approximately 19% of all irradiated patients. In addition, the incidences of breast cancer and metastasis have increased rapidly from 2000.

The increasing rates of major cancer over the past 10 yr are shown in Fig. 3. The prostate, breast, hepatobiliary, metastat-

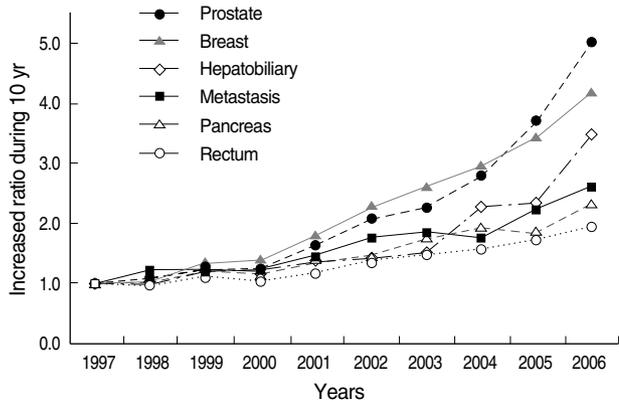


Fig. 3. Fold increases in the incidences of major cancers over the past 10 yr since 1997.

Table 3. Numbers of new patients treated using brachytherapy over the past 10 yr

Treatment methods	New patients/year									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
ICR	1,758	1,627	1,614	1,507	1,597	1,542	1,716	1,462	1,412	1,445
Others	277	330	286	138	95	103	176	155	97	116
Total	2,035	1,957	1,900	1,645	1,692	1,645	1,892	1,617	1,509	1,561
	(10.3%)	(9.7%)	(8.6%)	(7.7%)	(7.0%)	(6.3%)	(7.0%)	(5.6%)	(4.7%)	(4.2%)
	for	for	for	for	for	for	for	for	for	for
	19,773	20,226	22,008	21,345	24,125	26,218	26,920	28,789	31,847	37,215

(Parenthesis) indicates percentages of radiotherapy treated patients that received brachytherapy for total new patients that received radiotherapy treatment. ICR, Intracavitary Radiation Therapy.

ic, pancreatic, and rectal cancer have shown the most notable increases during recent years. In fact, the incidences of the prostate, breast, and hepatobiliary cancer in 2006 have increased by more than 3 fold over the past 10 yr.

Only 1,561 new patients received brachytherapy in 2006 (Table 3). While 10.3% of total irradiated patients received brachytherapy in 1997, only 4.2% did so in 2006.

DISCUSSION

In Korea, radiation therapy is administered by individual hospital-based facilities. Based on the 2006 annual statistics for the departments of radiation oncology in Korea, the number of radiation oncology facilities in Korea was 60 and the number of facilities per million of the population (facility resource) was 1.24, which compared with 3.36 in France in 1996, 5.31 in the U.S.A. in 1989, and 3.04 in Japan in 1990 (10, 11). Over the past 10 yr the number of radiation oncology facilities in Korea has increased by 1.43 fold in both capital area (Seoul city, Incheon city, and neighboring area of Gyeonggi-do) and provincial areas. However, the number of radiation therapy facilities in Seoul, capital city of Korea, increased by only 1.12 fold over the past 10 yr, and therefore, it is believed to have reached saturation.

The Health Insurance Review and Assessment Service (12) reported in 2008 that the major seven cancer sites are; the stomach (20.8%), colorectum (15.8%), liver (15.5%), lung (14.3%), thyroid (10.8%), breast (9.4%), and bladder (3.5%) in 2006. However, major cancer sites treated at departments of radiation oncology were reported to be (in descending order); the breast, metastatic, lung, gynecology, rectum, head and neck, and hepatobiliary. Thus, there appears to be a discrepancy between irradiated cancer patients in departments of radiation oncology and all cancer patients, which appears to be the result of the limited role of radiation therapy in gastric cancer, hepatoma, colon cancer, and thyroid cancer, which are common in Korea.

Trends in radiation therapy over the past 10 yr show that the number of irradiated patients with primary lesions of breast cancer, hepatoma, and prostate cancer, and metastasis have increased more than 2.5 times. However, when cancer incidence in 2006 was compared with that in 2002 using the statistics of the Ministry of Health and Welfare, Republic of Korea only the incidence of thyroid cancer was found to have increased by more than 2-fold (13). Therefore, these rapid increases in breast cancer, hepatoma, and prostate cancer are presumed to have been caused by the adoption of multimodality treatments and the increased role of radiation therapy in the treatment of these cancers. However, the percentage of patients underwent radiation therapy among total new cancer patients did not yet exceed 30%, which is a very low number compared to 60% in the U.S.A. (11, 14). Furthermore, in the future, the cancer incidence will increase due

to aging of the Korean population, and this with changes in disease management and radiotherapeutic developments will increase demand for radiation therapy. Thus, approximately 40% of all total cancer patients are likely to require radiotherapy in 10 yr time.

Brachytherapy, including interstitial and intracavitary radiation, has traditionally been used to administer higher doses selectively to tumors to achieve local control. However, due to experiences of increased invasiveness compared to external beam, especially in interstitial brachytherapy, the proportions of the patients that undergo brachytherapy among total irradiated patients have reduced, e.g., from 10.3% in 1997 to 4.2% in 2006. This status of brachytherapy is similar in Japan (3% of radiotherapy treated patients in 2003) (15).

We believe that the described collation of information annually from nationwide hospitals with a department of radiation oncology is unique. The cooperative efforts of staff members at these departments nationwide have ensured the success of this survey over 10 yr. The information obtained provides an overview of the real role of radiation oncology in Korea. It is hoped that the present study will aid those planning administrative policies in radiation oncology by providing directions for future developments. Future surveys are required to strengthen our abilities to predict future trends based on analytic approaches.

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