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Original Article

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The Clinical Status of Radiation Therapy in Korea in 2009 and 2013

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Purpose

The purpose of this study is to estimate the clinical status of radiation therapy (RT) in Korea.

Materials and Methods

We analyzed open claims data from the Health Insurance Review and Assessment Service (HIRA). The subjects were patients with malignant neoplasms who had procedure codes concerning RT in 2009 and 2013.

Results

The total numbers of patients who underwent RT in 2009 and 2013 were 42,483 and 56,850, respectively. The numbers of men and women were 20,012 and 22,471 in 2009 and 26,936 and 29,914 in 2013, respectively. The five most frequent RT sites were metastatic, breast, gastrointestinal, thoracic, and gynecologic cancers in 2009, and metastatic, breast, gastrointestinal, thoracic and head and neck cancers in 2013. The three leading types of cancer among men were metastatic, gastrointestinal, and thoracic, and breast, metastatic, and gynecologic among women. According to age, the most common treatment site was the central nervous system for those aged 20 years or less, the breast for those in their 30s to 50s, and metastatic sites for those in their 60s or older.

Conclusion

Data from this study provide an overview of the clinical status of RT in Korea.

Key words
Neoplasms, Radiotherapy, Statistics, Korea, 2009, 2013

Introduction

As in many other parts of the world, cancer is the leading cause of death and is a major public health problem in Korea. According to the annual report of the Korea Central Cancer Registry, 224,177 patients were newly diagnosed with cancer in 2012, and overall incidence rates have increased by 3%-4% per year [1]. The number of individuals diagnosed with cancer has increased each year, due in large part to aging and particularly for some cancers (e.g., breast and colorectal cancer) because of the increasing prevalence of obesity attributed to westernized eating habits, and for some other cancers (e.g., thyroid and prostate cancer) because of the development of diagnostic tools and as a result of a medical system that encourages cancer screening [2].

In addition to surgery and chemotherapy, radiation therapy (RT) is one of the three primary modalities for modern cancer treatment. As the market and clinical demand for RT grow in importance, providing accurate, nationally based

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Table 1. The customized source population

List	Criterion
Treatment period	2009 Jan 1-2009 Dec 31, 2013 Jan 1-2013 Dec 31
Type of healthcare facility	Tertiary, secondary
Diagnostic code	C00-C97
Type of insurance	Health insurance, medical aid
Hospital region	National
Sex	Male, female
Age	All ages

databases concerning the clinical status of RT has become important for understanding the status and development of cancer treatment in Korea. Official records concerning the clinical status of RT were reported from 1999 to 2006 in Korea [3-6]. The results were compiled from questionnaires mailed to radiation oncology facilities. A website with relevant RT statistics from the Korean Society for Radiation Oncology (KOSRO) was recently developed and is being operated as an on-line statistical program [7]; these developments may be helpful for taking inventory of the RT equipment and for evaluating the manpower status for radiation oncology in Korea. However, these approaches require a long period of time as well as the cooperation of all RT facilities for data collection.

In this study, we analyzed the clinical status of RT in 2009 and 2013 in Korea using open claims data from the Health Insurance Review and Assessment Service (HIRA).

Materials and Methods

The claims data from the HIRA are open access to approved researchers who submit a profile of their work and R&D plan. The claims data from the HIRA contain information on 46 million patients per year who account for 90% of the total population in Korea; the claims data include information regarding patients' diagnoses, treatment, procedures,

Table 2. Procedure codes related to radiation therapy

Procedure code	Name of procedure codes
HD051	Teletherapy-Low energy-Single port
HD052	Teletherapy-Middle energy-Single port
HD053	Teletherapy-High energy-Single port
HD054	Teletherapy-Low energy-Paralleled opposed ports
HD055	Teletherapy-Middle energy-Paralleled opposed ports
HD056	Teletherapy-High energy-Paralleled opposed ports
HD058	Rotational irradiation- Middle energy radiation therapy
HD059	Rotational irradiation - High energy radiation therapy
HD061	3-Dimensional conformal therapy
HD080	External radioisotope therapy
HD081-HD082	Intracavitary therapy-High dose rate
HD083-HD084	Intracavitary therapy-Low dose rate
HD085-HD086	Interstitial, intraluminal therapy-High dose rate
HD088	Interstitial, intraluminal therapy-Low dose rate
HD089	Brachytherapy
HD091	Total body irradiation
HD092	Total body lymph node irradiation
HD093	Total skin electron beam therapy
HD110	Fractionated stereotactic radiotherapy
HD111-HD112	Body stereotactic radiosurgery-Using linear accelerator
HD113	Cranial stereotactic radiosurgery-Gamma knife
HD114	Cranial stereotactic radiosurgery-Cyber knife
HD115	Cranial stereotactic radiosurgery-Linear accelerator
HD121	Proton therapy
HD211-HD212	Stereotactic body radiosurgery-Using cyber knife
HZ271	Intensity modulated radiation therapy

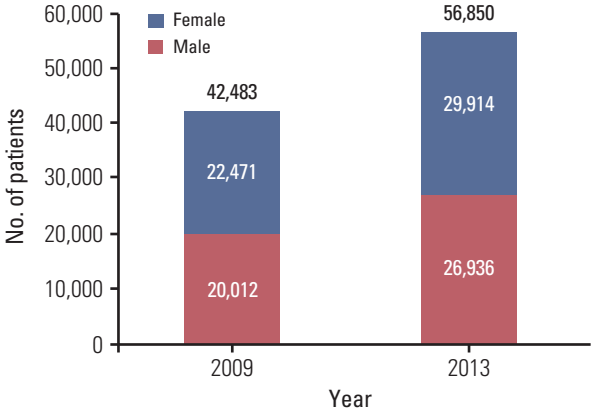

Fig. 1. Total number of patients who underwent radiation therapy in 2009 and 2013 in Korea.

surgical history, and prescription drugs, which provide a valuable resource for healthcare research [8].

The customized source population criteria for this study are shown in Table 1. The source population consisted of all patients who had any of the International Classification of Diseases 10 (ICD-10) cancer diagnoses (C00-C97) and at least one of the procedure codes related to receiving RT (Table 2) from January to December in 2009 and 2013. Patients who received two or more sessions of RT with interruption through January to December were counted as one patient. Patients with a diagnostic code concerning metastases (C77-79) were categorized as having received RT to a metastatic site. Patients with two or more diagnostic codes related to malignant neoplasms were categorized as having received RT to the metastatic site, followed by the main, secondary, and third diagnostic codes.

The site of RT category classification was based on the annual reports from the KOSRO, except for the breast and thyroid, which were classified independently rather than as part of the thoracic category.

Results

The total numbers of patients who underwent RT in 2009 and 2013 were 42,483 and 56,850, respectively. The total numbers of male and female patients who received RT were 20,012 and 22,471 in 2009, 26,936 and 29,914 in 2013, respectively (Fig. 1). The numbers of patient who received RT in 2009 and 2013 by cancer sites and sex are shown in Table 3. The five most frequent sites for patients who underwent RT in 2009 were as follows: metastatic (brain, bone, lymph node, and others), breast, gastrointestinal, thoracic, and gynecologic. However, the fifth most frequent site in 2013 was head and neck cancer instead of gynecologic cancer. The three leading sites among male patients were metastatic, gastrointestinal, and thoracic cancer, and breast, metastatic, and gynecologic cancer among women, in that order. The numbers of patients who received RT according to site and age group in 2013 are shown in Table 4. The most common treatment site was the central nervous system for those in their 20s or younger, while the breast was the most frequent site through the 30s to 50s, and metastasis was most common for those in their 60s or older. Similar trends were observed in 2009.

Discussion

This study was conducted to analyze the clinical status of RT in 2009 and 2013 in Korea using claims data from the HIRA. Using the annual reports of KOSRO, we determined that the total number of patients who received RT increased by 33% every 4 years (Fig. 2). Although the absolute number of patients who received RT has been increasing steadily, because the cancer incidence has also increased steadily over the same period [9-12], the percentages of cancer patients who underwent irradiation were expected to be consistently below 30% over the period from 1999 to 2013.

Breast, gastrointestinal, and genitourinary cancers have shown the steepest increase in number and proportion (Fig. 3). This tendency could be explained not only by the increasing cancer incidence, but also by the increasing evidence supporting the use of RT through well-designed studies and with the advancement of RT techniques.

This approach, using claims data from the HIRA, could reduce the amount of time required to obtain data from participants from each RT facility and eliminate the possible recall bias associated with questionnaire-based studies. In addition, claims data from the HIRA can be analyzed easily by age group, as shown in Table 4.

However, this study had several limitations. Because the claims data from the HIRA only include the insured cases, uninsured treatments, such as intensity modulated RT, cannot be analyzed. In addition, we included patients with the 'C' code and excluded benign disease. Therefore, patients who had a 'D' diagnostic code, which is expected to be a somewhat large portion of patients with ductal carcinoma in situ of the breast treated by RT, were excluded from this analysis. As a result, the actual number of patients who received RT is expected to be more than what is reported. To the contrary, because the patients who received RT on mul-

Table 3. Distribution of patients who received radiation therapy according to tumor site and sex in 2009 and 2013

Site	Sub-site (diagnostic code)	No. of patients in 2009			No. of patients in 2013		
		Male	Female	Total	Male	Female	Total
Metastasis	(C77-C79)	7,435	6,280	13,715	8,529	6,894	15,423
Breast	(C50)	11	8,731	8,742	17	13,480	13,497
Gastrointestinal	Colorectum (C18-C20)	2,129	1,109	3,238	2,416	1,203	3,619
	Hepatobiliary (C22-C24)	1,706	566	2,272	2,329	746	3,075
	Esophagus (C15)	737	43	780	992	79	1,071
	Pancreas (C25)	226	147	373	397	275	672
	Stomach (C16)	232	108	340	290	133	423
	Anus (C21)	49	72	121	62	109	171
	Small bowel (C17)	13	5	18	17	12	29
	Other (C26)	2	0	2	1	0	1
	Subtotal	5,094	2,050	7,144	6,504	2,557	9,061
Thoracic	Lung (C34)	2,576	551	3,127	4,073	1,045	5,118
	Thymus (C37)	86	70	156	115	80	195
	Mediastinum (C38)	20	4	24	31	7	38
	Trachea (C33)	6	7	13	6	8	14
	Other (C39)	1	0	1	1	0	1
	Subtotal	2,689	632	3,321	4,226	1,140	5,366
Head and neck	Larynx (C32)	575	32	607	832	36	868
	Oral cavity (C02-C06)	183	89	272	304	178	482
	Oropharynx (C01, C09-C10)	193	35	228	395	66	461
	Nasopharynx (C11)	125	42	167	271	92	363
	Salivary gland (C07-C08)	127	77	204	163	116	279
	Hypopharynx (C12-C13)	181	14	195	248	17	265
	Paranasal sinus (C31)	57	27	84	82	39	121
	Nasal cavity (C30)	48	19	67	64	34	98
	Eye and orbit (C69)	17	16	33	23	16	39
	Lip (C00)	8	2	10	5	5	10
	Other (C14)	4	1	5	15	0	15
	Subtotal	1,518	354	1,872	2,402	599	3,001
Gynecologic	Uterine cervix (C53)	-	1,942	1,942	-	2,095	2,095
	Uterine corpus (C54-C55)	-	521	521	-	618	618
	Ovary and tubes (C56)	-	72	72	-	111	111
	Vagina and vulva (C51-C52)	-	87	87	-	84	84
	Other (C57-C58)	-	3	3	-	5	5
	Subtotal	-	2,625	2,625	-	2,913	2,913
Genitourinary	Prostate (C61)	847	-	847	2,097	-	2,097
	Ureter and bladder (C66-C67)	178	52	230	291	69	360
	Kidney (C64-C65)	47	17	64	77	38	115
	Penis and testis (C60, C62-C63)	34	-	34	53	-	53
	Other (C68)	0	4	4	0	7	7
	Subtotal	1,106	73	1,179	2,518	114	2,632
Central nervous system	Brain (C70-C71)	700	557	1,257	815	656	1,471
	Spinal cord (C72)	20	12	32	17	24	41
	Other (C47)	11	7	18	23	18	41
	Subtotal	731	576	1,307	855	698	1,553
Lymphoma	Hodgkin's disease (C81)	58	23	81	61	26	87
	Non-Hodgkin's lymphoma (C82-C88)	541	398	939	676	542	1,218
	Other (C96)	2	2	4	9	7	16
	Subtotal	601	423	1,024	746	575	1,321

Table 3. Continued

Site	Sub-site (diagnostic code)	No. of patients in 2009			No. of patients in 2013		
		Male	Female	Total	Male	Female	Total
Soft tissue	(C46, C49)	177	140	317	295	219	514
Myeloma and plasmacytoma	(C90)	132	125	257	179	163	342
Leukemia	(C91-C95)	159	115	274	170	132	302
Skin	(C44)	84	83	167	123	102	225
Thyroid	(C73)	57	122	179	72	134	206
Malignant melanoma	(C43)	38	34	72	68	61	129
Primary bone and cartilage	(C40-C41)	69	42	111	59	38	97
Endocrine	(C74-C75)	26	14	40	37	22	59
Others	(C45, C48, C76, C80, C97)	85	52	137	136	73	209
Total		20,012	22,471	42,483	26,936	29,914	56,850

Table 4. The number of patients who received radiation therapy by site and age group in 2013

Treatment site	Age group						Total
	20s or under	30s	40s	50s	60s	70s or older	
Metastasis	150	614	2,150	4,351	4,240	3,918	15,423
Breast	137	1,411	4,976	4,412	1,872	689	13,497
Gastrointestinal	15	178	880	2,605	2,753	2,630	9,061
Respiratory	18	60	300	989	1,774	2,225	5,366
Head and neck	54	132	343	816	867	789	3,001
Gynecologic	45	257	611	911	529	560	2,913
Genitourinary	13	20	58	289	854	1,398	2,632
Central nervous system	227	159	285	343	300	239	1,553
Lymphoma	126	127	215	333	243	277	1,321
Soft tissue	61	53	75	99	105	125	518
Myeloma and plasmacytoma	0	8	34	87	118	95	342
Leukemia	118	66	47	45	23	3	302
Skin	3	11	25	32	42	112	225
Thyroid	7	10	26	60	42	61	206
Malignant melanoma	0	8	17	36	37	31	129
Primary bone and cartilage	25	5	12	26	16	13	97
Endocrine	18	5	10	8	10	8	59
Others	9	6	24	51	53	62	205
All cancer	1,026	3,130	10,088	15,493	13,878	13,235	56,850

tiple sites including primary or metastatic sites throughout the treated years could be re-counted as annual new patients, the actual total number of patients who received RT is expected to be less than what we reported. Therefore, the annual number of patients who received RT should be considered under these limitations. In addition, the 'metastasis' category, which accounts for the largest proportion of patients in this study, may reduce the number of patients who received RT to each primary cancer site. Because we cannot distinguish whether the patients actually received RT to a metastatic site or to a primary site in cases with a metastatic diagnostic code, we assumed that the patients with metastatic diagnostic codes received RT to a metastatic site. As a result, the proportions of patients who received RT to metastatic sites were high in this study. According to the RT statistics data published in KOSRO, the portion of the 'metastasis' category for all patients receiving RT was 15%-18% between 1999 and 2006 [3-6]; however, the proportions of the 'metastasis' category were 32% in 2009 and 27% in 2013 in the current study. This may have been an under-estimation of the number of each primary cancer site.

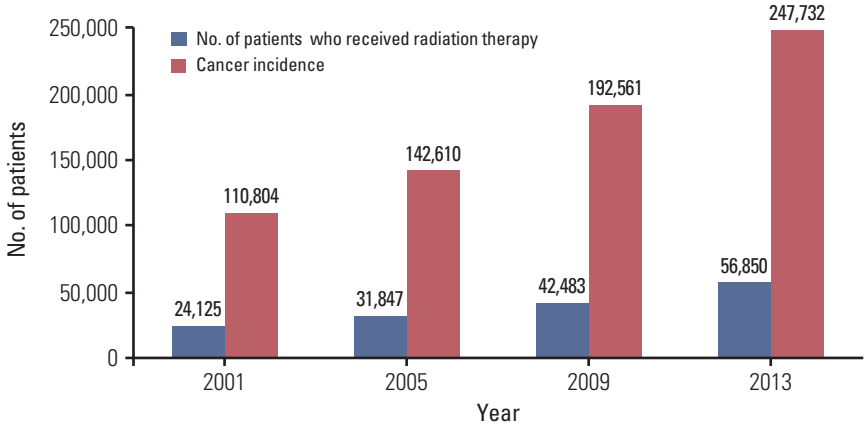

Fig. 2. Cancer incidence and total number of patients who received radiation therapy through 2001 to 2013 in Korea. The cancer incidence for 2013 is the value predicted by Jung et al. [12].

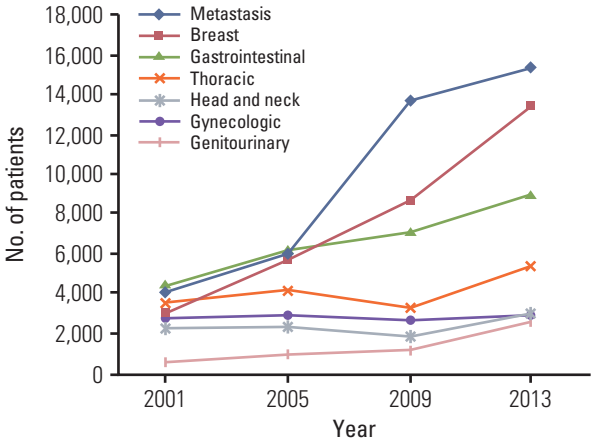

Fig. 3. Time course of the number of patients who received radiation therapy at seven main sites.

Conclusion

In conclusion, the number of patients who received RT in Korea has shown a steady increase; however, the percentages of cancer patients who underwent irradiation were expected to still be below 30%. Although the use of claims data from the HIRA has some limitations, it provided useful cumulative clinical data supporting RT as one of the main modalities for cancer treatment in Korea.

Conflicts of Interest

Conflict of interest relevant to this article was not reported.

Acknowledgments

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