Table 5. Primary sites of cancer treatment with radiotherapy in 2005 by Patterns of Care Study institutional stratification for new patients

Primary site	A1 (n = 71)		Comparison with data of 2005* (%)	A2 (n = 70)		Comparison with data of 2005* (%)	B1 (n = 282)		Comparison with data of 2005* (%)	B2 (n = 283)		Comparison with data of 2005* (%)	Total (n = 706)		Comparison with data of 2005* (%)
	n	%		n	%		n	%		n	%		n	%	
Cerebrospinal	2,021	4.1	−22.4	720	4.1	−6.5	5,569	7.2	25.7	1,396	5.9	75.6	9,706	5.8	12.9
Head and neck (including thyroid)	6,522	13.1	3.2	2,124	12.0	−10.5	6,262	8.1	3.8	1,655	6.9	0.3	16,563	9.8	1.2
Esophagus	3,448	6.9	9.0	1,179	6.7	0.7	4,068	5.3	−8.1	1,474	6.2	1.5	10,169	6.0	−0.4
Lung, trachea, and mediastinum	7,460	15.0	5.5	2,852	16.1	8.1	16,811	21.7	12.5	5,844	24.5	8.5	32,967	19.5	9.7
Lung	6,794	13.6	24.2	2,452	13.9	7.9	14,546	18.8	12.6	5,393	22.6	13.9	29,185	17.3	14.9
Breast	10,336	20.8	15.6	3,663	20.7	20.1	17,334	22.4	22.5	5,011	21.0	21.7	36,344	21.5	20.1
Liver, biliary tract, and pancreas	1,929	3.9	−0.4	674	3.8	−5.5	2,806	3.6	2.3	1,023	4.3	6.1	6,432	3.8	1.2
Gastric, small intestine, and colorectal	2,075	4.2	9.4	1,015	5.7	25.9	4,034	5.2	7.8	1,498	6.3	7.1	8,622	5.1	9.9
Gynecologic	3,315	6.7	1.9	1,058	6.0	−8.5	3,059	4.0	−10.2	781	3.3	−8.7	8,213	4.9	−5.3
Urogenital	6,772	13.6	22.2	2,498	14.1	22.3	9,750	12.6	20.8	2,993	12.6	3.0	22,013	13.0	18.6
Prostate	5,394	10.8	25.7	1,748	9.9	26.2	7,015	9.1	24.7	2,068	8.7	7.9	16,225	9.6	22.7
Hematopoietic and lymphatic	2,591	5.2	5.3	900	5.1	−14.4	3,631	4.7	0.2	935	3.9	3.4	8,057	4.8	0.2
Skin, bone, and soft tissue	1,456	2.9	−9.4	484	2.7	−35.4	1,879	2.4	2.7	751	3.2	−26.2	4,570	2.7	−12.2
Other (malignant)	894	1.8	26.8	237	1.3	0.9	897	1.2	9.1	292	1.2	−6.7	2,320	1.4	11.8
Benign tumors	988	2.0	48.8	266	1.5	−0.7	1,288	1.7	−0.1	186	0.8	37.8	2,728	1.6	15.8
Pediatric <15 y (included in totals kiabove)	440	0.9	1.1	116	0.7	−5.7	374	0.5	100.0	126	0.5	−58.3	1,056	0.6	0.9
Total	49,807	100	7.9	17,670	100	3.8	77,388	100	11.3	23,839	100	8.9	168.704†	100	9.1

Abbreviations: A1 = university hospitals/cancer centers treating 440 patients or more per year; A2 = university hospitals/cancer centers treating 439 patients or fewer per year; B1 = other national/public hospitals treating 140 patients or more per year; B2 = other national hospital/public hospitals treating 139 patients or fewer per year.

* Rate of increase compared with data of 2005. The calculating formula was as follows: $\frac{\text{data of 2007 }(n) - \text{data of 2005 }(n)}{\text{data of 2005 }(n)} \times 100$ (%)

† The total number of new patients was different with these data because no data on primary sites were reported by some institutions.

Table 6. Distribution of specific treatments and numbers of patients treated with these modalities by Patterns of Care Study stratification of institutions

Specific therapy	A1 (n = 71) n	A1 %	A2 (n = 71) n	A2 %	B1 (n = 288) n	B1 %	B2 (n = 291) n	B2 %	Total (n = 721) n	Total %	Comparison with data of 2005* (%)
Intracavitary RT											
Treatment facilities	65	91.5	32	45.1	70	24.3	5	1.7	172	23.9	
Cases	1,795		497		925		18		3,235		−0.3
Interstitial RT											
Treatment facilities	51	71.8	19	26.8	22	7.6	5	1.7	97	13.5	
Cases	1,968		392		895		46		3,301		19.0
Radioactive iodine therapy for prostate											
Treatment facilities	43	60.6	12	16.9	22	7.6	1	0.3	78	10.8	
Cases	1,613		311		759		7		2,690		52.4
Total body RT											
Treatment facilities	64	90.1	34	47.9	68	23.6	19	6.5	185	25.7	
Cases	701		185		688		133		1,707		−1.8
Intraoperative RT											
Treatment facilities	15	21.1	9	12.7	10	3.5	7	2.4	41	5.7	
Cases	92		39		105		15		251		−35.1
Stereotactic brain RT											
Treatment facilities	40	56.3	24	33.8	92	31.9	30	10.3	186	25.8	
Cases	1,920		433		8,805		1,396		12,554		12.9
Stereotactic body RT											
Treatment facilities	43	60.6	14	19.7	54	18.8	12	4.1	123	17.1	
Cases	878		204		1,189		219		2,490		50.2
IMRT											
Treatment facilities	25	35.2	4	5.6	25	8.7	4	1.4	58	8.0	
Cases	1,142		38		1,534		85		2,799		270.7
Thermoradiotherapy											
Treatment facilities	8	11.3	5	7.0	8	2.8	2	0.7	23	3.2	
Cases	233		34		69		4		340		−41.5

Abbreviations: A1 = university hospitals/cancer centers treating 440 patients or more per year; A2 = university hospitals/cancer centers treating 439 patients or fewer per year; B1 = other national/public hospitals treating 140 patients or more per year; B2 = other national hospital/public hospitals treating 139 patients or fewer per year; RT = radiotherapy; IMRT = intensity-modulated radiotherapy.

* Rate of increase compared with data of 2005. The calculating formula was as follows: $\frac{data\ of\ 2007\ (n) - data\ of\ 2005\ (n)}{data\ of\ 2005\ (n)} \times 100\ (\%)$

those in the United States or Europe. In Japan a unique, hybrid-like education system for medical physicists has been developed since the anticancer law actively started to support improvement in QA/quality control specialization for RT. However, the validity of this education and training system remains to be proven, not only for QA/quality control but also for unique research and developmental activities. The discrepancy between FTE medical physicists and the number of registered medical physicists in Japan reflects the fact that their role in the clinic is not recognized as a full-time position only for medical physics service.

The distribution of the primary site for RT showed that more lung cancer patients were treated in B1- or B2-type nonacademic institutions whereas more head-and-neck cancer patients were treated in A1- or A2-type academic institutions. These findings may reflect the fact that more curative patients are referred to academic institutions and more palliative patients with lung cancer are treated at nonacademic institutions

Table 7. Brain metastasis or bone metastasis patients treated with radiotherapy in 2005 by Patterns of Care Study institutional stratification

Metastasis	No. of patients: A1 (n = 71) n	A1 %	A2 (n = 71) n	A2 %	B1 (n = 288) n	B1 %	B2 (n = 291) n	B2 %	Total (n = 721) n	Total %	Comparison with data of 2005* (%)
Brain	3,761	6.2	1,402	6.4	13,097	13.9	2,977	10.4	21,237	10.4	38.6
Bone	6,893	11.4	2,761	12.6	13,332	14.2	4,984	17.4	27,970	13.6	1.8

Abbreviations: A1 = university hospitals/cancer centers treating 440 patients or more per year; A2 = university hospitals/cancer centers treating 439 patients or fewer per year; B1 = other national/public hospitals treating 140 patients or more per year; B2 = other national hospital/public hospitals treating 139 patients or fewer per year.

* Rate of increase compared with data of 2005. The calculating formula was as follows: $\frac{data\ of\ 2007\ (n) - data\ of\ 2005\ (n)}{data\ of\ 2005\ (n)} \times 100\ (\%)$

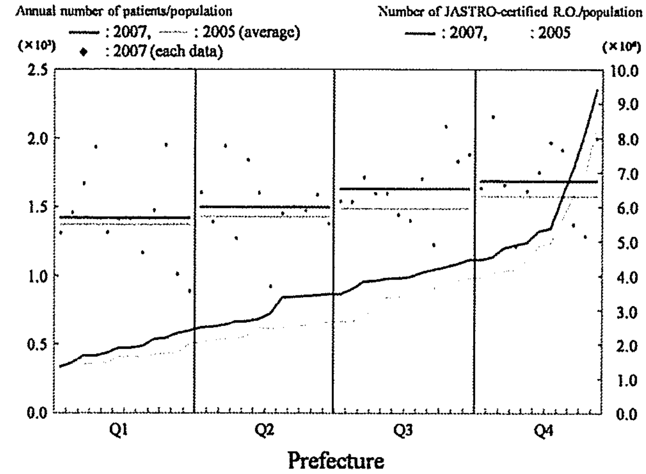

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Fig. 3. Geographic distribution for 47 prefectures of annual numbers of patients (new plus repeat) per 1,000 population arranged in order of increasing number of Japanese Society of Therapeutic Radiology and Oncology (JASTRO)–certified radiation oncologists (ROs)/1,000,000 population by prefecture: Q1, 0–25%; Q2, 26–50%; Q3, 51–75%; and Q4, 76–100%. Horizontal lines show average annual number of patients (new plus repeat) per 1,000 prefectural population per quarter.

in Japan. However, the increase in the number of lung cancer patients in A1 institutions and that in prostate cancer patients in A1-, A2-, and B1-type institutions in 2007 were noteworthy. This suggests that the use of stereotactic body RT for lung cancer in A1 and of 3D CRT for prostate cancer in A1, A2, and B1 increased in 2007. The number of patients with brain metastasis increased significantly by 38.6% over 2005. This may also reflect dissemination of stereotactic body RT for brain metastasis. The use of specific treatments and the number of patients treated with these modalities were significantly affected by institutional stratification, with more specific treatments being performed at academic institutions. These findings indicate that significant differences in patterns of care, as reflected in structure, process, and possibly outcome for cancer patients, continued to be prevalent in Japan in 2007. These differences point to opportunities for improvement. The Japanese PCS group published structural guidelines based on PCS data (20), and we are using the structural data obtained in 2007 to revise the Japanese structural guidelines for radiation oncology. The use of intraoperative RT and thermoradiotherapy decreased significantly, so these two modalities may not be considered as mainstay treatments anymore in Japan.

Geographic patterns showed that there were significant differences among prefectures in the use of RT, and the number of JASTRO-certified physicians per population was associated with the utilization of RT in both 2005 (5) and 2007, so a shortage of ROs or medical physicists on a regional basis will remain a major concern in Japan. However, the overall utilization rate of radiation in 2007 improved further compared with 2005 (5). The Japanese Society of Therapeutic Radiology and Oncology has been making every effort to recruit and educate ROs and medical physicists through public relations, to establish and conduct training courses at academic institutions, to become involved in the national examination for physicians, and to seek an increase in the reimbursement by the government-controlled insurance scheme and other actions.

In conclusion, the Japanese structure of radiation oncology has clearly and steadily improved over the past 17 years in terms of installation and use of equipment and its functions, although a shortage of personnel and differences in maturity by type of institution and by caseload still remain. Structural immaturity is an immediate target for improvement, whereas for improvements in process and outcome, the PCS and National Cancer Database, which are currently operational and the subject of close examination, can be expected to play an important role in the near future in Japan.

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ORIGINAL ARTICLE

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National structure of radiation oncology in Japan with special reference to designated cancer care hospitals

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Abstract

Background. The structure of radiation oncology in designated cancer care hospitals in Japan was investigated in terms of equipment, personnel, patient load, and geographic distribution, and compared with the structure in other radiotherapy facilities.

Methods. The Japanese Society of Therapeutic Radiology and Oncology (JASTRO) conducted a questionnaire survey about the national structure of radiation oncology in 2005. In the current study, the structures of 326 designated cancer care hospitals and the other 386 radiotherapy facilities in Japan were compared.

Results. Designated cancer care hospitals accounted for 45.3% of all radiotherapy facilities. The patterns of equipment and personnel in designated cancer care hospitals and the other radiotherapy facilities were as follows: linear accelerators/facility, 1.2 and 1.0; dual-energy function, 73.1% and 56.3%; three-dimensional conformal radiotherapy function, 67.5% and 52.7%; intensity-modulated radiotherapy function, 30.0% and 13.9%; annual number of patients/linear accelerator, 289.7 and 175.1; ^{192}Ir remote-controlled afterloading systems, 27.6% and 8.6%; and average number of full-time equivalent radiation oncologists/facility, 1.4 and 0.9 ($P < 0.0001$). There were significant differences in equipment and personnel between the two types of facilities. Annual patient loads/full-time equivalent radiation oncologist in the designated cancer care hospitals and the other radiotherapy facilities were 252 and 240. Geographically, the number of designated cancer care hospitals was associated with the population, and the number of JASTRO-certified physicians was associated with the number of patients undergoing radiotherapy.

Conclusion. The Japanese structure of radiation oncology in designated cancer care hospitals was more mature than that in the other radiotherapy facilities in terms of equipment, although a shortage of personnel still exists. The serious understaffing problem in radiation oncology should be corrected in the future.

Key words Radiotherapy · Medical Engineering · Epidemiology

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Introduction

In Japan, the Cancer Control Act was implemented in 2007 in response to patients' urgent petitions to the government. This law strongly advocates the promotion of radiotherapy (RT) and an increase in the number of radiation oncologists (ROs) and medical physicists. At the same time, the Ministry of Health, Labour and Welfare began the accreditation of "designated cancer care hospitals" with the aim of correcting regional differences in the quality of cancer care and strengthening cooperation among regional cancer care hospitals. The Japanese Society of Therapeutic Radiology and Oncology (JASTRO) has conducted national structure surveys of RT facilities in Japan every 2 years since 1990.[1] The structure of radiation oncology in Japan has improved in terms of equipment and functions in accordance with the increasing number of cancer patients who require RT. Public awareness of the importance of RT is gradually expanding due to the above law. We introduced Patterns of Care Study (PCS) in Japan in 1996; these studies have been carried out every 4 years and have disclosed significant differences in the quality of RT according to the types of facilities and their caseloads.

In the present study, the structure of radiation oncology in designated cancer care hospitals in Japan was investigated in terms of equipment, personnel, patient load, and geographic distribution, and compared with these features of other RT facilities in Japan.

Materials and methods

JASTRO carried out a national structure survey of radiation oncology in 2005, in the form of a questionnaire, between March 2006 and February 2007.[2,3] The questionnaire consisted of questions about the number of treatment machines and modality by type, the number of personnel by job category, and the number of patients by type and the disease site. The response rate was 712 of 735 (96.9%) from all actual RT facilities in Japan.

The number of facilities certified by the Ministry of Health, Labour and Welfare as designated cancer care hospitals by the end of fiscal 2007 was 351. Of the total 351 facilities, 47 were designated prefectural cancer care hospitals and 304 were designated regional cancer care hospitals. Three hundred and fifty-three facilities, including the National Cancer Center Hospital and the National Cancer Center Hospital East were included in this group as designated cancer care hospitals. Seven facilities did not return the survey data, and 20 facilities did not have departments of RT at that point in the survey. The structures of 326 designated cancer care hospitals and the other 386 RT facilities were then analyzed. SAS 8.02[4] (SAS Institute, Cary, NC, USA) was used for the statistical analysis. The statistical significance was tested by means of a χ^2 test, Students' t-test, or analysis of variance (ANOVA).

The Japanese Blue Book guidelines[5] were used as the standard of comparison with the results of this study. These guidelines show the guidelines for the structure of radiation oncology in Japan based on PCS data.[5,6] The standard guidelines for annual patient load/external beam equipment were set at 250–300 (warning level 400); those for annual patient load /full-time equivalent (FTE) radiation oncologist (RO) were set at 200 (warning level 300), and those for annual patient load /FTE RT technologists at 120 (warning level 200).[5,6]

Results

Current situation of radiation oncology in designated cancer care hospitals and the other RT facilities in Japan

Table 1 shows the numbers of new patients and total numbers of patients (new plus repeats) requiring RT in 2005 at the total number of surveyed designated cancer care hospitals and other RT facilities in Japan (n = 712). Designated cancer care hospitals accounted for 45.3% (333/735) of all the RT facilities in Japan. The numbers of new patients and total numbers of patients in all the RT facilities in Japan were estimated at approximately 162 000 (156 318*735/712) and 198 000 (191 173*735/712), respectively (see Table 1 footnote). In designated cancer care hospitals, the corresponding numbers of patients were approximately 99 000 (96 558*333/326) and 121 000 (118 548*333/326), respectively (see Table 1 footnote). The number of patients in designated cancer care hospitals accounted for 61.1% of the number of patients in all RT facilities, for both new patients and the total number of patients (99 000/162 000 and 121 000/198 000; see Table 1 footnote). The average numbers of new patients/facility were 296.2 for designated cancer care hospitals and 154.8 for the other RT facilities, respectively (P < 0.0001). For the average numbers of total

Table 1. The numbers of new patients and total patients (new plus repeat) requiring radiotherapy (RT) in designated cancer care hospitals and the other RT facilities

	Designated cancer care hospitals	Other RT facilities	P value	Total
Facilities	326	386		712
New patients	96558[a]	59760		156318[b]
Average no. new patients/facility	296.2	154.8	<0.0001	219.5
Total patients (new + repeat)	118548[a]	72625		191173[b]
Average no. total patients/facility	363.6	188.1	<0.0001	268.5

[a]The number of designated cancer care hospitals with RT was 333, and the number of new patients in designated cancer care hospitals was estimated at approximately 99000 (96558*333/326); the corresponding number of total patients (new plus repeat) was 121000 (118548*333/326)
[b]The number of RT facilities was 735 in 2005, and the number of new patients was estimated at approximately 162000 (156318*735/712); the corresponding number of total patients (new plus repeat) was 198000 (191173*735/712)

patients/facility, the corresponding data were 363.6 and 188.1, respectively ($P < 0.0001$).

Table 2 shows the equipment patterns, staffing patterns, and patient loads in designated prefectural cancer care hospitals and designated regional cancer care hospitals. There were significant differences in the average number of linear accelerators (Linacs)/facility, the ownership of the intensity-modulated RT (IMRT) function of the Linac, the average number of patients/facility, the average number of patients/Linac, the number of ^{192}Ir remote-controlled afterloading systems (RALSs) ($P < 0.0001$), and the number of computed tomography (CT) simulators in the two types of facilities ($P = 0.0015$). The IMRT function does not necessarily mean its actual use in 2005, but its availability as equipment. The average numbers of FTE ROs/facility were 3.1 for designated prefectural cancer care hospitals and 1.2 for designated regional cancer care hospitals ($P < 0.0001$). The average numbers of JASTRO-certified physicians/facility were 2.1 and 0.7 ($P < 0.0001$).

Facility and equipment patterns and patient load/Linac in designated cancer care hospitals and the other RT facilities

Table 3 shows the RT equipment patterns and related functions in the designated cancer care hospitals and the other RT facilities. In the designated cancer care hospitals, 397 Linacs, 7 telecobalt machines, 17 Gamma Knife machines, 46 ^{60}Co RALSs, and 91 ^{192}Ir RALSs were actually used. In the other RT facilities, the corresponding data were 368, 4, 31, 18, and 28, respectively. The ownership of equipment in designated cancer care hospitals, excluding telecobalt machines and Gamma Knife machines, was significantly higher than that in the other RT facilities (Linac, $P = 0.0002$; other equipment, $P < 0.0001$). In designated cancer care hospitals, the Linac system used dual-energy function in 291 systems (73.1%), three-dimensional conformal RT function (3DCRT) in 268 (67.5%), and IMRT function in 119 (30.0%). In the other RT facilities, the corresponding data

Table 2. Equipment patterns, staffing patterns, and patient loads in designated prefectural cancer care hospitals and designated regional cancer care hospitals

	Designated prefectural cancer care hospitals (n = 49)		Designated regional cancer care hospitals (n = 277)		P value
	n	%	n	%	
Linac	87	100.0[a]	310	95.7[a]	0.1377
With IMRT function	46	52.9[b]	73	23.5[b]	<0.0001
No. Linacs/facility	1.8		1.1		<0.0001
Annual no. patients/facility	722.3		300.2		<0.0001
Annual no. patients/Linac	406.8[c]		257.0[c]		<0.0001
^{192}Ir RALS (actual use)	37	75.5	54	8.6	<0.0001
No. of CT simulators	47	83.7[c]	170	59.9[c]	0.0015
Average no. of FTE ROs/facility	3.1		1.2		<0.0001
Average no. of JASTRO-certified ROs/facility	2.1		0.7		<0.0001

Linac, Linear accelerator; IMRT, intensity-modulated RT; RALS, remote-controlled afterloading system; CT, computed tomography; FTE, full-time equivalent (40 h/week only for RT practice); RO, radiation oncologist; JASTRO, Japanese Society of Therapeutic Radiology and Oncology

[a] Percentage calculated from the number of systems using this function and the total number of Linac systems

[b] Percentage calculated from the number of patients and the number of Linac systems. Facilities without Linacs were excluded from the calculation

[c] Percentage of facilities which have equipment

Table 3. Equipment, its function, and patient load per equipment in designated cancer care hospitals and the other RT facilities

	Designated cancer care hospitals (n = 326)		Other RT facilities (n = 386)		P-value	Total (n = 712)	
	n	%	n	%		n	%
Linac	397	96.3[a]	368	88.9[a]	0.0002	765	92.3[a]
With dual-energy function	291	73.1[b]	207	56.3[b]	<0.0001	498	65.1[b]
With 3D-CRT function (MLC width =<1.0 cm)	268	67.5[b]	194	52.7[b]	<0.0001	462	60.4[b]
With IMRT function	119	30.0[b]	51	13.9[b]	<0.0001	170	22.2[b]
Average no. Linacs/facility	1.2		1.0		<0.0001	1.1	
Annual no. patients/Linac	289.7[c]		175.1[c]		<0.0001	234.6[c]	
Telecobalt (actual use)	18 (7)		16 (4)			34 (11)	
Gamma Knife	17		31		0.1400	48	
^{60}Co RALS (actual use)	51 (46)	15.6 (14.1)	23 (18)	7.1[c] (5.5)	<0.0001	74 (64)	10.4[c] (9.0)
^{192}Ir RALS (actual use)	94 (91)	28.5[c] (27.6)	29 (28)	8.9[c] (8.6)	<0.0001	123 (119)	17.1[c] (16.6)

3D-CRT, three-dimensional conformal RT; other abbreviations as in Table 2

[a] Percentage of facilities which have this equipment (two or more pieces of equipment per facility)

[b] Percentage calculated from the number of systems using this function and the total number of Linac systems

[c] Percentage calculated from the number of patients and the number of Linac systems. Facilities without Linacs were excluded from the calculation

were 207 (56.3%), 194 (52.7%), and 51 (13.9%), respectively. The functions of Linac showed significant superiority, approximately 15% greater, in designated cancer care hospitals compared with the other RT facilities ($P < 0.0001$). The patient loads/Linac were 289.7 for designated cancer care hospitals and 175.1 for the other RT facilities ($P < 0.0001$). Fig. 1 shows the distribution of annual patient load/Linac in designated cancer care hospitals and the other RT facilities. Eighteen percent of designated cancer care hospitals and 6% of the other RT facilities were subject to treatment that exceeded the warning level of the Japanese Blue Book Guidelines,[5] of 400 patients/Linac. However, the average patient load/Linac in the other RT facilities was less than the guideline level.

Table 4 shows the RT planning and other equipment patterns. X-ray simulators were installed in 79.1% of the designated cancer care hospitals and 61.7% of the other RT facilities. CT simulators were installed in 63.5% and 48.4%, respectively. A noteworthy difference was found between designated cancer care hospitals and the other RT facilities in the rate of X-ray simulator and CT simulator installation ($P < 0.0001$). Only a very few facilities owned magnetic resonance imaging (MRI) equipment for the RT department, although computer use for RT recording was pervasive in both designated cancer care hospitals and the other RT facilities.

Staffing patterns and patient loads in designated cancer care hospitals and the other RT facilities

Table 5 shows the staffing patterns and patient loads in designated cancer care hospitals and the other RT facilities. We found that 50.3% of the designated cancer care hospitals and 31.9% of the other RT facilities had their own designated RT beds, and ROs also had to care for their inpatients. The total numbers of FTE ROs were 471.3 for the designated cancer care hospitals and 303.2 for the other RT facilities. The average numbers of FTE ROs/facility were 1.4 and 0.9, respectively ($P < 0.0001$). The patient loads/FTE RO were 251.5 and 239.6. Fig. 2 shows the distribution of annual patient load/FTE RO in designated cancer care hospitals and the other RT facilities. Twenty-four percent of designated cancer care hospitals and 11% of the other RT facilities treated more than 300 patients/RO, which exceeded the warning level of the Japanese Blue Book Guidelines.[5] Fig. 3 shows the percentage of facilities by patient load/FTE RO. The largest number of facilities featured a patient/FTE RO level in the 150–199 range for designated cancer care hospitals and in the 100–149 range for the other RT facilities. The second largest numbers featured patient/FTE RO levels in the 200–249 and 50–99 ranges, respectively. Facilities that had less than 1 FTE RO

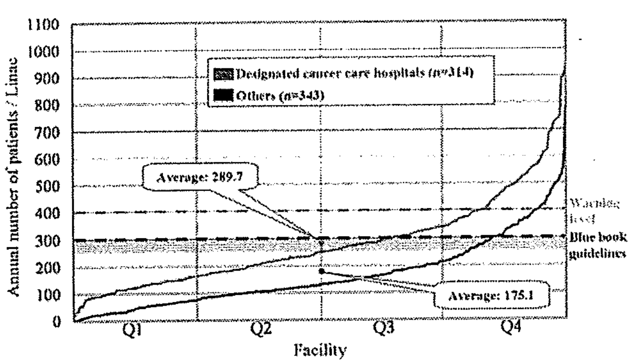

Fig. 1. Distribution of annual patient load/linear accelerator (*Linac*) in designated cancer care hospitals and the other radiotherapy (RT) facilities (*others*). *Horizontal axis* represents facilities arranged in order of increasing annual number of patients/Linac within facilities. The above-mentioned facilities are divided in quaters; *Q1*, 0%–25%; *Q2*, 26%–50%; *Q3*, 51%–75%; *Q4*, 76%–100%

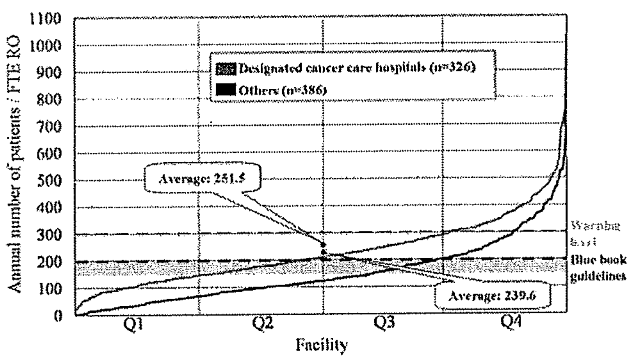

Fig. 2. Distribution of annual patient load/ full-time equivalent radiation oncologist (*FTE RO*) in designated cancer care hospitals and the other RT facilities. *Horizontal axis* represents facilities arranged in order of increasing annual numbers of patients / FTE RO within facilities. The number of FTE ROs for facilities with less than one FTE was calculated as FTE = 1 to avoid overestimating patient load / FTE RO. *Q1-Q4*, as in Fig. 1 legend

Table 4. Radiotherapy planning and other equipment in designated cancer care hospitals and the other RT facilities

	Designated cancer care hospitals (n = 326)		Other RT facilities (n = 386)		P-value	Total (n = 712)	
	n	%	n	%		n	%
X-ray simulator	262	79.1[a]	240	61.7[a]	<0.0001	502	69.7[a]
CT simulator	217	63.5[a]	190	48.4[a]	<0.0001	407	55.3[a]
RTP computer (>= 2)	510 (101)	96.3[a] (38.5)	430 (45)	90.4[a] (11.7)	0.0019 (<0.0001)	940 (146)	93.1[a] (20.5)
MRI (>= 2)	588 (203)	97.5[a] (77.5)	524 (135)	92.2[a] (35.0)	0.0017 (<0.0001)	1112 (338)	94.7[a] (47.5)
For RT only	6	1.8[a]	6	1.6[a]	–	12	1.7[a]
Computer use for RT recording	298	91.4[a]	328	85.0[a]	0.0086	626	87.9[a]

RTP, RT planning; MRI, magnetic resonance imaging; RT, radiotherapy; other abbreviations as in Table 2
[a]Percentage of institutions which have equipment (two or more pieces of equipment per institution)

Table 5. Staffing patterns and patient loads in designated cancer care hospitals and the other RT facilities

	Designated cancer care hospitals (n = 326)	Other RT facilities (n = 386)	P-value	Total (n = 712)
Facilities with RT beds	164 (50.3)	123 (31.9)		287 (40.3)
Average no. RT beds/facility	4.8	3.0	0.0001	3.6
Total (full-time + part-time) FTE ROs	471.3	303.2		774.5
Average no. FTE ROs/facility	1.4	0.9	<0.0001	1.1
No. of JASTRO-certified ROs (full-time)	293	133		426
Average no. JASTRO-certified ROs/facility	0.9	0.4	<0.0001	0.6
Patient load/FTE RO	251.5	239.6	0.0641	246.8
Total no. of RT technologists	889.9	744.6		1634.5
Average no. of RT technologists/facility	2.7	2.3	<0.0001	2.3
Patient load/RT technologist	133.2	97.5	<0.0001	117.0
Full-time medical physicists + part-time	65.0 + 17.1	52.0 + 13.0		117.0 + 30.1
Full-time RT QA staff + part-time	156.0 + 8.0	100.8 + 5.0		256.8 + 13.0
Total no. of nurses/assistants/clerks	476.8	430.2		907.0

Data values in parentheses are percentages
QA, quality assurance; other abbreviations as in Table 2

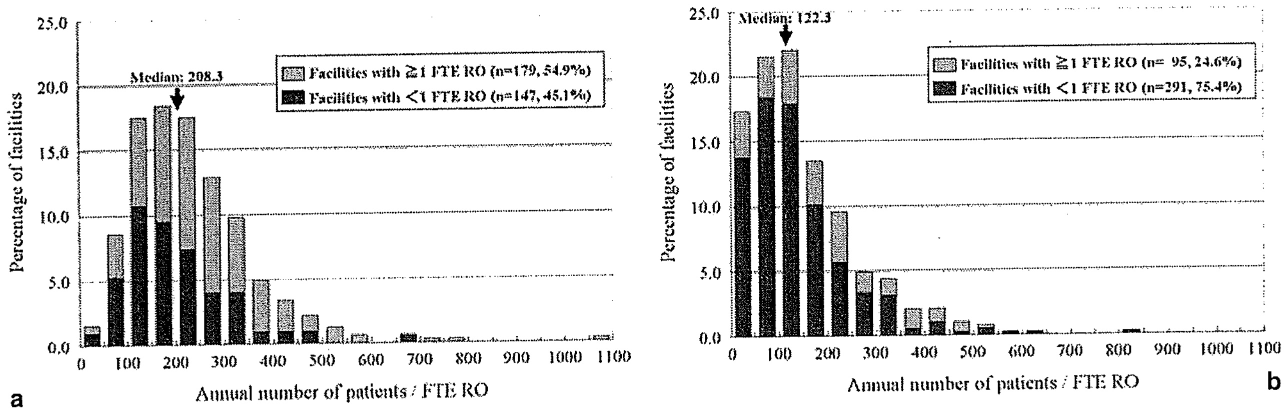

Fig. 3. **a** Percentage of facilities by patient load / FTE RO in designated cancer care hospitals. *Each bar* represents an interval of 50 patients per FTE RO. The number of FTE ROs for facilities with less than one FTE was calculated as FTE = 1 to avoid overestimating patient load / FTE RO. **b** Percentage of facilities by patient load / FTE RO in the other RT facilities. *Each bar* represents an interval of 50 patients per FTE RO. The number of FTE ROs for facilities with less than one FTE was calculated as FTE = 1 to avoid overestimating patient load / FTE RO

still accounted for about 45.1% of designated cancer care hospitals and 75.4% of the other RT facilities.

The total numbers of RT technologists were 889.9 for designated cancer care hospitals and 744.6 for the other RT facilities. The average numbers of RT technologists in the two types of facilities were 2.7 and 2.3, respectively (P < 0.0001). The patient loads/RT technologist were 133.2 and 97.5, respectively (P < 0.0001). Fig. 4 shows the distribution of annual patient load/RT technologist in designated cancer care hospitals and the other RT facilities. Fourteen percent of designated cancer care hospitals and 8% of the other RT facilities treated more than 200 patients per RT technologist, exceeding the warning level of the Japanese Blue Book Guidelines.[5] Fig. 5 shows the percentage of facilities by patient load/RT technologist. The largest number of facilities featured a patient/RT technologist level in the 80–99 range for both designated cancer care hospitals and the other RT facilities. The second largest numbers featured patient/RT technologist levels in the ranges of 100–119 and 60–79, respectively.

There were 65.0 FT (and 17.1 part-time) medical physicists for designated cancer care hospitals and 52.0 FT (and 13.0 part-time) medical physicists for the other RT facilities. There were 156.0 FT (and 8.0 part-time) RT quality assurance staff for designated cancer care hospitals and 100.8 FT (and 5.0 part-time) RT quality assurance staff for the other

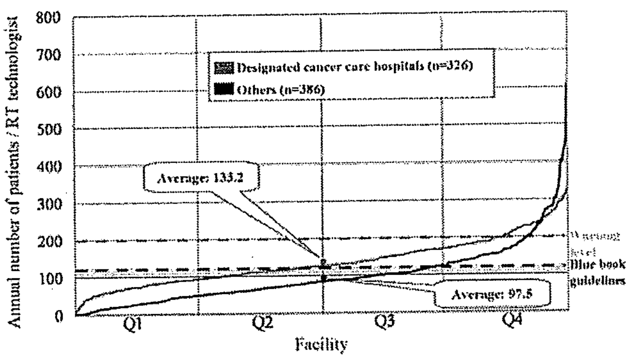

Fig. 4. Distribution of annual patient load / RT technologist in designated cancer care hospitals and the other RT facilities. *Horizontal axis* represents facilities arranged in order of increasing annual number of patients / RT technologist within facilities. *Q1-Q4*, As in Fig. 1 legend

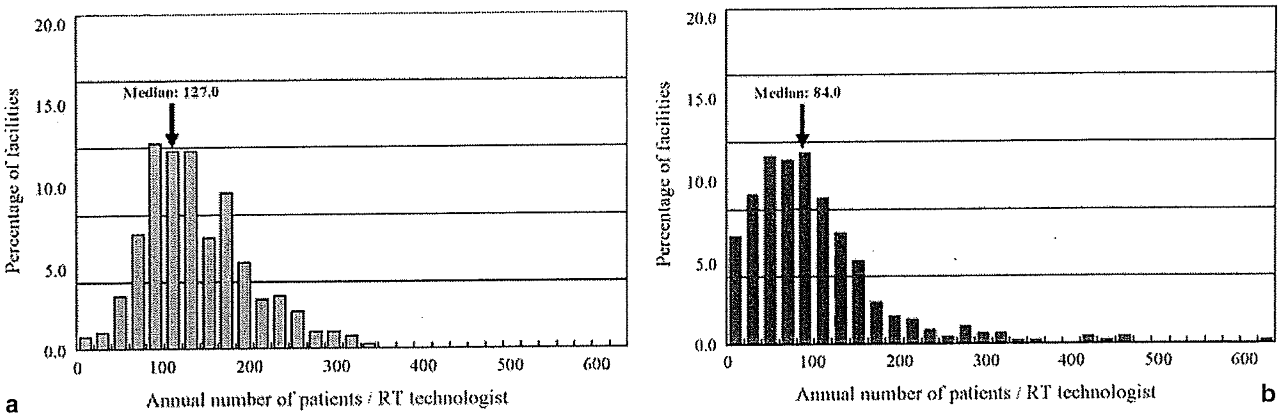

Fig. 5. **a** Percentage of facilities by patient load / RT technologist in designated cancer care hospitals. *Each bar* represents an interval of 20 patients per FTE staff. **b** Percentage of facilities by patient load / RT technologist in the other RT facilities. *Each bar* represents an interval of 20 patients per FTE staff

Table 6. Primary disease sites, and brain metastasis and bone metastasis treated with RT in designated cancer care hospitals and the other RT facilities

Primary site	Designated cancer care hospitals (n = 321)		Other RT facilities (n = 380)		P-value	Total (n = 701)	
	n	%	n	%		n	%
Cerebrospinal	4130	4.3	4469	7.7	<0.0001	8599	5.6
Head and neck (including thyroid)	11199	11.6	5174	8.9	<0.0001	16373	10.6
Esophagus	6647	6.9	3566	6.1	<0.0001	10213	6.6
Lung, trachea, and mediastinum	18097	18.8	11943	20.5	<0.0001	30040	19.4
Lung	15341	15.9	10051	17.3	<0.0001	25392	16.4
Breast	18733	19.4	11528	19.8	0.0458	30261	19.6
Liver, biliary, tract, and pancreas	4116	4.3	2239	3.9	<0.0001	6355	4.1
Gastric, small intestine, and colorectal	4868	5.0	2976	5.1	0.5193	7844	5.1
Gynecologic	6277	6.5	2392	4.1	<0.0001	8669	5.6
Urogenital	11380	11.8	7180	12.4	0.0011	18560	12.0
Prostate	8133	8.4	5085	8.7	0.0291	13218	8.6
Hematopoietic and lymphatic	5499	5.7	2541	4.4	<0.0001	8040	5.2
Skin, bone, and soft tissue	3326	3.4	1878	3.2	0.0223	5204	3.4
Other (malignant)	1165	1.2	910	1.6	<0.0001	2075	1.3
Benign tumors	1033	1.1	1323	2.3	<0.0001	2356	1.5
Pediatric <15 years (included in totals above)	577	0.6	470	0.8	<0.0001	1047	0.7
Total	96470	100.0	58119	100.0	<0.0001	154589[a]	100.0
Metastasis	(n = 326)		(n = 386)		P-value	(n = 712)	
Brain	7212	6.1	8109	11.2	<0.0001	15321	8.0
Bone	16968	14.3	10508	14.5	0.3464	27476	14.4

[a]Total number of new patients was different from this number, because no data on primary sites were reported by some facilities

RT facilities. Finally, there were 476.8 nurses and clerks for designated cancer care hospitals and 430.2 nurses and clerks for the other RT facilities.

Distribution of primary disease sites and palliative treatment in designated cancer care hospitals and the other RT facilities

Table 6 shows the distribution of primary disease sites and palliative treatment in the designated cancer care hospitals and the other RT facilities. The most common disease site in designated cancer care hospitals was the breast; in the other RT facilities, it was lung/bronchus/mediastinum. Head/neck, esophagus, liver/biliary tract/pancreas, gynecologic, hematopoietic/lymphatic, and skin/bone/soft tissue cancers were treated at higher rates at designated cancer care hospitals than at the other RT facilities (skin/bone/soft tissue cancer, $P = 0.0223$; other cancers, $P < 0.0001$). The other RT facilities treated more patients with brain metastasis (11.2% of all new patients) than the designated cancer care hospitals ($P < 0.0001$).

Geographic patterns in designated cancer care hospitals and the other RT facilities

Fig. 6 a,b shows the geographic distribution, for 47 prefectures, of the number of RT facilities arranged in order of increasing population by all prefectures in Japan (Fig. 6a)

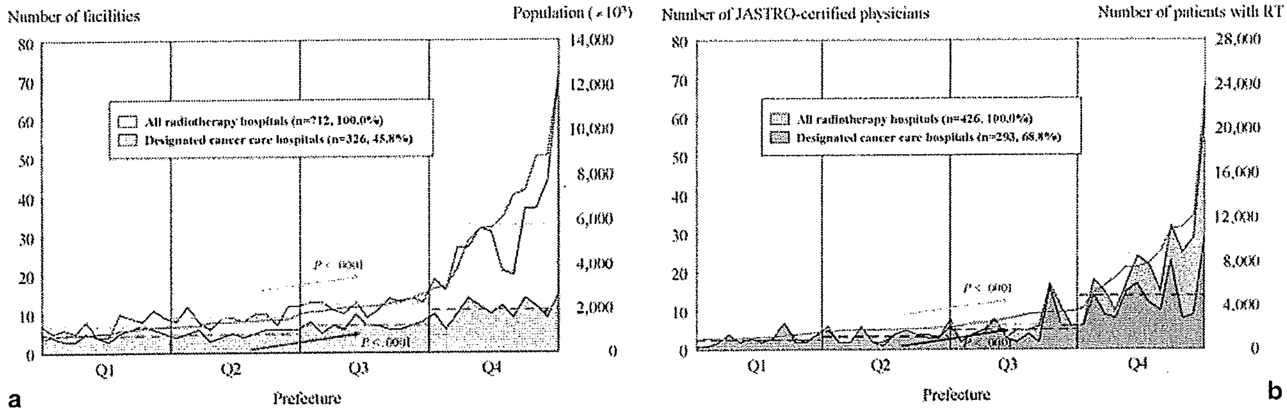

Fig. 6. **a** Geographic distribution, for 47 prefectures, of the number of facilities arranged in order of increasing population. *Upper dashed horizontal bar* shows average number of facilities in the prefectures per 4 separated groups (Q1–Q4) in all RT hospitals, and *lower dashed horizontal bar* shows that number in designated cancer care hospitals. **b** Geographic distribution, for 47 prefectures, of the number of Japanese Society of Therapeutic Radiology and Oncology (*JASTRO*)-certified physicians, arranged in increasing order of the number of patients undergoing RT, by prefecture. *Upper horizontal dashed bar* shows average number of JASTRO-certified physicians in the prefectures per quarter in all RT hospitals, and *lower dashed horizontal bar* shows that number in designated cancer care hospitals. *Q1-Q4*, As in Fig. 1 legend

and the number of JASTRO-certified physicians, arranged in order of increasing number of patients undergoing RT, by all prefectures in Japan (Fig. 6b).[7] The average number of RT facilities per 4 separated groups (Q1–Q4) ranged from 7.2 to 32.9 in all RT facilities in Japan. In designated cancer care hospitals, these numbers ranged from 4.7 to 11.2. There were significant differences in the average number of facilities per quarter in both all RT facilities and in designated cancer care hospitals (both, $P < 0.0001$). The average number of JASTRO-certified physicians per quarter ranged from 2.8 to 24.5 in all RT facilities in Japan. In designated cancer care hospitals, these numbers ranged from 2.8 to 14.0. The average number of JASTRO-certified physicians per quarter showed significant differences in both all RT facilities and designated cancer care hospitals (both, $P < 0.0001$).

Discussion

The number of patients in designated cancer care hospitals was 61.1% of the number of patients (both new patients and the total number of patients) in all RT facilities in Japan, although the designated cancer care hospitals accounted for 45.3% of all RT facilities. About 62.% of all RT facilities have less than 1 FTE RO, while about 45% of designated cancer care hospitals have less than 1 FTE RO. In Japan, the majority of facilities still rely on part-time ROs, especially in the facilities other than the designated cancer care hospitals. The percentage distribution of facilities by patient load/RO in designated cancer care hospitals proved to be largely similar to that of the United States in 1989.[8] However, facilities which have less than 1 FTE RO still account for about 45% of designated cancer care hospitals in Japan. In the United States, all facilities are supported by a full-time RO. The percentage distribution of facilities by patient load/RO in the other RT facilities in the present study was largely similar to that found in Japan in 1990,[8] so a shortage of ROs will remain a major concern in Japan. As for medical physicists, their numbers in Japan are still smaller than those in Europe and the United States. They work mainly in metropolitan areas or academic facilities such as university hospitals or cancer centers. At present, there is no national license for a medical physicist in Japan. Those with a master's degree in science or engineering or radiology technologists with enough clinical experience can take the Japan Radiological Society (JRS)-certified examination to become medical physicists. In Japan, a new educational system is developing to train specialists for cancer care, including medical physicists, medical oncologists, oncology nurses, and palliative care doctors. A sufficient number of RT technologists is ensured, as compared with ROs and medical physicists. However, RT technologists are busy, because they also partly play the role of medical physicists in Japan.

In terms of the distribution of the primary disease site for RT, designated cancer care hospitals treated more patients with head and neck cancers, while the other RT facilities treated more patients with cancers of the lung, trachea, and mediastinum Furthermore, more patients with brain or bone metastasis were treated in the other RT facilities. These results imply that designated cancer care hospitals which treat more potentially curative patients have better structures than the other hospitals.

On a regional basis, the number of all RT facilities and the number of designated cancer care hospitals were strongly associated with population (correlation coefficients were 0.95 and 0.83). These results proved that designated cancer care hospitals were in the appropriate places. However, in some regions where there was a large population, the proportion of designated cancer care hospitals was not sufficient, because many university hospitals were not certified by the Ministry of Health, Labour and Welfare as designated cancer care hospitals. There were two prefectures where the number of RT hospitals was extremely small, as shown in the Q4 region of Fig. 6a. They were located in metropolitan areas, so many cancer patients who lived in those areas might have received treatment in the hospitals in Tokyo. The numbers of JASTRO-certified physicians in all RT facilities and in the designated cancer care hospitals were also strongly associated with the number of patients undergoing RT (correlation coefficients were 0.92 and 0.83). The JASTRO-certified physicians were in the appropriate places. However, the absolute number of JASTRO-certified physicians was especially insufficient in regions where there were many patients undergoing RT. As shown in Fig. 6b, there were five peaks in the number of JASTRO-certified physicians in the Q3 and Q4 regions. These peaks were Tokyo, Kanagawa, Chiba, Hiroshima, and Gunma, in descending order. In the Tokyo metropolitan area, the Keihanshin area, and the Chukyo area, cancer patients can easily receive treatment at hospitals that are in other regions because these areas are conveniently located in terms of public transpotation (indicated by the jagged graph in Fig. 6b). In Japan, it is necessary to increase the number of designated cancer care hospitals and the number of JASTRO-certified physicians in regions where there is a large population and many patients.

The utilization rate of RT for new cancer patients in Japan remains at about 25% (162 000/660 578[9]), less than half the ratio in the United States and European countries. The "anti-cancer" law was enacted in Japan to promote RT and education for ROs, medical physicists, and other staff members as of April 2007. In Japan, RT is expected to play an increasingly important role because the increase in the elderly population is the highest among other developed countries.

In the present study, the ownership of all equipment was more firmly in place in designated cancer care hospitals than in the other RT facilities.[10] The function of Linac, in particular the IMRT function, does not mean actual use of its function. In 2005, mainly due to severe shortages of personnel, only 6.0% of Linacs with their function were used for actual IMRT in the clinic. The average number of staff members for RT in designated cancer care hospitals was more than that in the other RT facilities. So, the accreditation of designated cancer care hospitals is closely correlated with the maturity of the structures of radiation oncology.[10] However, it is problematic that there are designated cancer care hospitals without their own RT departments. We consider that all the designated cancer care hospitals need to have their own RT departments, because the number of cancer patients requiring RT is rapidly increasing and currently RT in Japan is underutilized compared with that in Europe and the United States. The accreditation of designated cancer care hospitals by the Ministry of Health, Labour and Welfare would be a good start to consolidate RT facilities geographically in Japan.

The structural information on all RT facilities in Japan is regularly surveyed by JASTRO. Although the process and the outcome of cancer care in patients undergoing RT have been investigated by PCS every 4 years, the collection of the outcome information is insufficient. In the United States, a National Cancer Database was established and it has been collecting the data for cancer care. This database is used as the quality indicator for improvements in the processes and outcomes of cancer care. It is necessary to establish an informational system in Japan that can collect national data for cancer care. We have now established a Japanese National Cancer Database based on the RT data. We are preparing the collection of cancer care data by using this system.

In conclusion, the structure of radiation oncology in designated cancer care hospitals in Japan showed maturity, more so than that of other RT facilities, in terms of equipment and their functions, although a shortage of personnel still exists. It is necessary, as national policy, to solve the problem of the arrangement of designated cancer care hospitals and the shortage of personnel for cancer care as clarified by data in this survey.

Conflict of interest

H. Ikeda received a Grant-in-Aid for Cancer Research (No. 18-2) from the Ministry of Health, Labour and Welfare. The other authors have no conflict of interest.

Acknowledgments This study was supported by JASTRO. We wish to thank all ROs and radiation technologists throughout Japan who participated in this survey for their efforts in providing us with valuable information to make this study possible.

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SPECIAL ARTICLE

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Comprehensive Registry of Esophageal Cancer in Japan, 2001

Preface

The Registration Committee for Esophageal Cancer of the Japan Esophageal Society, has registered cases of esophageal cancer since 1976 and published the first issue of the Comprehensive Registry of Esophageal Cancer in Japan in 1979. The Act for the Protection of Personal Information was promulgated in 2003, and began to be enforced in 2005. The purpose of this Act is to protect the rights and interests of individuals while taking into consideration the usefulness of personal information, keeping in mind the remarkable increase in the use of personal information arising from the development of today's advanced information and communications society. The Registry of Esophageal Cancer Cases has required some adjustments to comply with these Acts. The new registration system has been considered for several years and was finally completed in 2008. The most important point was achieving unlinkable anonymity through hash function encryption. Finally, the registry resumed registering cases of esophageal cancer that had been treated in 2001.

A brief summary follows: a total of 3940 cases were registered from 241 institutions in Japan. As for the histologic type of cancer according to biopsy specimens, squamous cell carcinoma and adenocarcinoma accounted for 91.7% and 2.3%, respectively. The 5-year survival rates of patients treated using endoscopic mucosal resection, concurrent chemoradiotherapy, radiotherapy alone, chemotherapy alone, or esophagectomy were 88.5%, 19.3%, 19.6%, 4.0%, and 42.6%, respectively. Regarding the approach used to perform esophagectomy, 14.3% of the cases were performed endoscopically, that is, thoracoscopically, laparoscopically, or mediastinoscopically. The percentage of operative deaths occurring within 30 days or less after operation and the percentage of postoperative hospital deaths occurring 31 days or more after operation were 2.8% and 3.2%, respectively.

We hope that this Comprehensive Registry of Esophageal Cancer in Japan for 2001 helps to improve all aspects of the diagnosis and treatment of esophageal cancer.

These data were first issued on 12 March, 2009, as the *Comprehensive Registry of Esophageal Cancer in 2001*. Not all pages are reprinted here; however, the original tables and figure numbers have been kept. The authors were at the time members of the Registration Committee for Esophageal Cancer, the Japan Esophageal Society, and made great efforts and contributions in preparing this material.

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Contents

I. Clinical Factors of Esophageal Cancer Patients Treated in 2001

1. Institution-registered cases in 2001

Institutions	Institutions
Aichi Cancer Center	Kawakita General Hospital
Akashi Municipal Hospital	Kawasaki Medical School Hospital
Akita University Hospital	Kawasaki Municipal Hospital
Arao Municipal Hospital	Keio University Hospital
Asahikawa Medical College Hospital	Keiyukai Sappori Hospital
Chiba Cancer Center	Kikuna Memorial Hospital
Chiba Cardiovascular Center	Kin-ikyo Chuo Hospital
Chiba University Hospital	Kin-ikyo Sapporo Nishi-ku Hospital
Dokkyo Medical University Hospital	Kinki Central Hospital
Foundation for Detection of Early Gastric Carcinoma	Kinki University Hospital
Fuchu Hospital	Kinki University Nara Hospital
Fujioka General Hospital	Kinki University Sakai Hospital
Fujita Health University	Kiryu Kosei General Hospital
Fujita Health University Banbuntane Hotokukai Hospital	Kitaibaraki Municipal Hospital
Fukaya Red Cross Hospital	Kitakyushu Municipal Medical Center
Fukuoka University Hospital	Kitasato University Hospital
Fukushima Medical Universiy Hospital	Kitasato University Kitasato Institute Medical Center Hospital
Fukuyama Hospital	Kobe City Medical Center General Hospital
Gifu Prefectural General Medical Center	Kobe University Hospital
Gunma Central General Hospital	Kochi Health Science Center
Gunma University Hospital	Kumamoto University Hospital
Hachinohe City Hospital	Kurashiki Central Hospital
Hachioji Digestive Disease Hospital	Kurume Daiichi Social Insurance Hospital
Hakodate Goryokaku Hospital	Kurume University Hospital
Hamamatsu University School of Medicine, University Hospital	Kuwana City Hospital
Handa City Hospital	Kyorin University Hospital
Hannan Chuo Hospital	Kyoto Prefectural University of Medicine
Health Insurance Naruto Hospital	Kyoto University Hospital
Higashiosaka City General Hospital	Kyushu Central Hospital
Hino Memorial Hospital	Kyushu University Hospital
Hiratsuka City Hospital	Kyushu University Hospital at Beppu
Hiratsuka Kyosai Hospital	Matsuda Hospital
Hirosaki University Hospital	Matsudo City Hospital
Hiroshima City Asa Hospital	Matsushita Memorial Hospital
Hiroshima City Hospital	Matsuyama Red Cross Hospital
Hiroshima University Hospital	Mie University Hospital
Hiroshima University Research Institue for Radiation Biology Medicine	Mito Red Cross Hoapital
Hofu Institute of Gastroenterology	Miyazaki Social Insurance Hospital
Hokkaido University Hospital	Murakami General Hospital
Hyogo Prefectural Nishinomiya Hospital	Mutsu General Hospital
Ibaraki Prefectural Central Hospital	Nagahama City Hospital
Ibaraki Prefectural Central Hospital and Cancer Center	Nagano Prefectural Kiso Hospital
Ishikawa Prefectural Central Hospital	Nagano Red Cross Hospital
Ishinomaki Red Cross Hospital	Nagaoka Chuo General Hospital
Iwakuni Medical Center	Nagayoshi General Hospital
Iwate Medical University Hospital	Nagoya City University Hospital
Iwate Prefectural Isawa Hospital	Nagoya Tokushukai General Hospital
JFE Kenpo Kawatetsu Chiba Hospital	Nagoya University Hospital
Jiai Hospital	Nanpuh Hospital
Jichi Medical University Hospital	Nara Medical University Hospital
Juntendo University Hospital	National Cancer Center Hospital
Juntendo University Shizuoka Hospital	National Cancer Center Hospital East
Junwakai Memorial Hospital	National Defense Medical College Hospital
Kagawa Prefectural Central Hospital	National Hospital Organization Osaka National Hospital
Kagawa University Hospital	National Hospital Organization Chiba Medical Center
Kagoshima University Hospital	National Hospital Organization Chiba-Higashi Hospital
Kagoshima University Medical and Dental Hospital	National Hospital Organization Higashi-Saitama Hospital
Kanagawa Cancer Center	National Hospital Organization Kanmon Medical Center
Kanazawa University Hospital	National Hospital Organization Kasumigaura Medical Center
Kansai Medical University Hirakata Hospital	National Hospital Organization Kyushu Cancer Center
Kansai Rosai Hospital	National Hospital Organization Matsumoto National Hospital
Kashima Rosai Hospital	National Hospital Organization Nagano Medical Center
Katta Public General Hospital	National Hospital Organization Nagasaki Medical Center

Institutions	Institutions
National Hospital Organization Tochigi National Hospital	Showa University Hospital
National Hospital Organization Tokyo Medical Center	Shozankai Saiki Hospital
Nihon University Itabashi Hospital	Social Insurance Omuta Tenryo Hospital
Niigata Cancer Center Hospital	Social Insurance Tagawa Hospital
Niigata City General Hospital	Social Insurance Yokohama Central Hospital
Niigata Prefectural Shibata Hospital	Sonoda Daiichi Hospital
Niigata University Medical and Dental Hospital	Southern Region Hospital
Nikko Memorial Hospital	St. Luke's International Hospital
Nippon Medical School Chiba Hokusoh Hospital	St.Therese Hospital
Nippon Medical School Hospital	Sugita Genpaku Memorial Obama Municipal Hospital
Nippon Medical School Musashi Kosugi Hospital	Suita Municipal Hospital
Nippon Medical School Tama Nagayama Hospital	Tachikawa Hospital
Nishiki Hospital	Takaoka Hospital
Nishi-Kobe Medical Center	Takasago Municipal Hospital
Nishinomiya Municipal Central Hospital	Teikyo University School of Medicine Hospital, Mizonokuchi
NTT West Osaka Hospital	The University of Tokyo Hospital
Numazu City Hospital	Toho University Omori Medical Center
Obitsusankei Hospital	Tohoku University Hospital
Ohta General Hospital Foundation Ohta Nishinouchi Hospital	Tokai University Hospital
Ohtawara Red Cross Hospital	Tokai University Tokyo Hospital
Oita Red Cross Hospital	Tokushima University Hospital
Oizumi Gastrointestinal Medical Clinic	Tokyo Dental College Ichikawa General Hospital
Okayama Saiseikai General Hospital	Tokyo Medical and Dental University Hospital
Okayama University Hospital	Tokyo Medical University Hospital
Okitama Public General Hospital	Tokyo Medical University Kasumigaura Hospital
Onomichi Municipal Hospital	Tokyo Metropolitan Cancer and Infectious Center Komagome Hospital
Osaka City University Hospital	Tokyo Women's Medical University Hospital
Osaka Koseinenkin Hospital	Tokyo Women's Medical University Medical Center East
Osaka Medical Center for Cancer and Cardiovascular Diseases	Tonan Hospital
Osaka Medical College Hospital	Toranomon Hospital
Osaka Prefectural Hospital Organization Osaka General Medical Center	Tottori Prefectural Central Hospital
Osaka University Hospital	Tottori University Hospital
Otsu Municipal Hospital	Toyama Hospital, International Medical Center of Japan
Otsu Red Cross Hospital	Toyama Prefectual Central Hospital
Saiseikai Fukuoka General Hospital	Toyama University Hospital
Saiseikai Fukushima General Hospital	Tsuchiura Kyodo Hospital
Saiseikai Kyoto Hospital	Tsukuba University Hospital
Saiseikai Maebashi Hospital	Tsuruoka Municipal Shonai Hospital
Saiseikai Utsunomiya Hospital	University of Fukui Hospital
Saitama City Hospital	University of Miyazaki Hospital
Saitama Medical Center	University of Occupational and Environmental Health
Saitama Medical University Hospital	University of the Ryukyus Hospital
Saitama Medical University International Medical Center	Wakayama Medical University Hospital
Saitama Red Cross Hospital	Yamagata Prefectural Central Hospital
Saitama Social Insurance Hospital	Yamaguchi University Hospital
Sakai Municipal Hospital	Yamanashi Prefectural Central Hospital
Saku Central Hospital	Yamanashi University Hospital
Sanno Hospital	Yao Municipal Hospital
Sato Clinic	Yokohama City University Hospital
Self Defense Forces Sendai Hospital	Yokohama City University Medical Center
Sendai City Hospital	Yokohama Rosai Hospital
Sendai Medical Center	Yuri General Hospital
Shiga University of Medical Science Hospital	
Shikoku Cancer Center	
Shimada Hospital	
Shimane University Hospital	
Shimura Hospital	
Shinbeppu Hospital	
Shinshiro Municipal Hospital	
Shinshu University Hospital	
Shizuoka City Shimizu Hospital	
Showa Inan General Hospital	
Showa University Fujigaoka Hospital	

(Totoal 241 institutions)

2. Patient Background

Table 1 Age and gender

* Excluding 18 cases of unknown gender

Age	Male	Female	Unknown	Cases (%)
~29	3	1	0	4 (0.1%)
30~39	6	3	0	9 (0.2%)
40~49	112	34	0	146 (3.8%)
50~59	813	113	0	926 (24.2%)
60~69	1379	167	2	1548 (40.4%)
70~79	897	139	0	1036 (27.0%)
80~89	119	36	0	155 (4.0%)
90~	4	2	0	6 (0.2%)
Total	3333	495	2	3830
Missing	72	20	0	92

A missing case was defined as a case when no option was selected.
An unknown case was defined as a case when the option named "Unknown" was selected.

Table 12 Tumor location

* Excluding 291 treatment unknown, missing cases concerning treatment type

Location of tumor	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery: Palliative operation (%)		Surgery: Esophagectomy (%)		Total (%)	
Cervical	8	(2.0%)	68	(6.7%)	2	(2.4%)	87	(4.1%)	165	(4.6%)
Upper thoracic	43	(10.6%)	173	(17.0%)	11	(13.4%)	240	(11.4%)	467	(12.9%)
Middle thoracic	249	(61.2%)	508	(50.0%)	43	(52.4%)	1019	(48.3%)	1819	(50.3%)
Lower thoracic	74	(18.2%)	216	(21.3%)	17	(20.7%)	591	(28.0%)	898	(24.9%)
Abdominal	8	(2.0%)	18	(1.8%)	8	(9.8%)	129	(6.1%)	163	(4.5%)
EG	1	(0.2%)	3	(0.3%)	1	(1.2%)	12	(0.6%)	17	(0.5%)
EG-junction(E=G)	0		0		0		19	(0.9%)	19	(0.5%)
Cardia (G)	0		0		0		0		0	
Others	0		0		0		0		0	
Unknown	24	(5.9%)	30	(3.0%)	0		11	(0.5%)	65	(1.8%)
Total	407		1016		82		2108		3613	
Missing	8		5		0		9		22	

EG: esophago-gastric

Table 15 Histologic types of cancer according to biopsy specimens

* Excluding 291 treatment unknown, missing cases concerning treatment type

Histologic types	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery: Palliative operation (%)		Surgery: Esophagectomy (%)		Total (%)	
Not examined	24	(5.9%)	29	(2.9%)	0		8	(0.4%)	61	(1.7%)
SCC	353	(86.7%)	926	(91.1%)	77	(93.9%)	1963	(92.8%)	3319	(91.7%)
SCC	282	(69.3%)	473	(46.5%)	47	(57.3%)	1022	(48.3%)	1824	(5.0%)
Well diff.	22	(5.4%)	68	(6.7%)	12	(14.6%)	218	(10.3%)	320	(8.8%)
Moderately diff.	42	(10.3%)	282	(27.7%)	14	(17.1%)	534	(25.2%)	872	(24.1%)
Poorly diff.	7	(1.7%)	103	(10.1%)	4	(4.9%)	189	(8.9%)	303	(8.4%)
Adenocarcinoma	13	(3.2%)	7	(0.7%)	2	(2.4%)	61	(2.9%)	83	(2.3%)
Undifferentiated	1	(0.2%)	8	(0.8%)	0		6	(0.3%)	15	(0.4%)
Carcinosarcoma	0		0		1	(1.2%)	7	(0.3%)	8	(0.2%)
Malignant melanoma	0		2	(0.2%)	0		6	(0.3%)	8	(0.2%)
Other tumors	1	(0.2%)	4	(0.4%)	0		14	(0.7%)	19	(0.5%)
Dysplasia	0		0		0		0		0	
Unknown	15	(3.7%)	41	(4.0%)	2	(2.4%)	50	(2.4%)	108	(3.0%)
Total	407		1017		82		2115		3621	
Missing	10		7		0		11		28	

SCC: Squamous cell carcinoma

V. Clinical Results in Patients treated with Esophagectomy in 2000

I. Clinical Factors of Esophageal Cancer Patients treated in 2000

1. Institutions-registered cases in 2000

Inst#	Institutions
1406	First Dept. of Medicine, Hirosaki Med. Univ. School of Med.
1501	First Dept. of Surg., Iwate Med. Univ. School of Med.
1801	First Dept. of Surg., Tohoku Univ. School of Med.
2101	First Dept. of Surg., Gunma Univ. School of Med.
2102	Second Dept. of Surg., Gumma Univ. School of Med.
2201	Dept. of Gastroenterol. Surg., Jichi Medical School
2301	First Dept. of Surg., Dokkyo Med. Univ. School of Med.
2705	Dept. of Endoscopic Diagnostics & Therapautics, Chiba Univ.
3201	First Dept. of Surg., Nippon Medical School
3303	First Dept. of Surg., Tokyo Med. & Dental Univ. School of Med.
3401	First Dept. of Surg., Juntendo Univ. School of Med.
3501	First Dept. of Surg., Juntendo Univ. School of Med.
3811	Dept. of Surg., Inst. of Gastroenterology, Tokyo Women's Medical Univ.
4001	First Dept.of Surg., Yamanashi Med. Univ. School of Med.
4511	Dept. of Digestive Surg., Kitasato Univ. East Hospital
5101	First Dept. of Surg., Niigata Univ. School of Med.
5301	First Dept. of Surg., Shinshu Univ. School of Med.
5506	Second Dept. of Medicine, Nagoya Univ. School of Med.
5803	Dept. of Funabiki-Surg., Fujita Health Univ. School of Med.
6304	Dept. of Radiology, Kyoto Univ. School of Med.
6311	Dept. of Surgical Oncology, Kyoto Univ. School of Med.
6502	Second Dept. of Surg., Kansai Medical Univ.
7102	Second Dept. of Surg., Kanazawa Univ. School of Med.
7301	First Dept. of Surg., Kobe Univ. School of Med.
8001	First Dept. of Surg., Okayama Univ. School of Med.
8032	Second Dept. of Surg., Shimane Medical Univ.
8502	Second Dept. of Surg., Yamaguchi Univ. School of Med.
8507	First Dept. of Int. Med., Yamaguchi Univ. School of Med.

Inst#	Institutions
8601	First Dept. of Surg., Tokushima Univ. School of Med.
9102	Second Dept. of Surg., Kyushu Univ. School of Med.
9301	Dept. of Surg., Kurume Univ. School of Med.
9302	Medical Center, Kurume Univ. School of Med.
9702	Second Dept. of Surg., Oita Medical Univ.
9991	First Dept. of Surg., Univ. of the Ryukyus School of Med.
9994	Dept. of Radiology, Univ. of the Ryukyus School of Med.
10081	National Shikoku Cancer Center Hospital
10091	National Kyushu Cancer Center Hospital
11201	Dept. of Surg., Sendai National Hospital
14401	Dept. of Surg., Kasumigaura National Hospital
14801	National Kanazawa Hospital
17601	National Iwakuni Hospital
21041	Dept. of Surg., Yamagata Prefectual Central Hospital
21091	Dept. of Surg., Iwaki City Sogo Iwakikyoritsu Hospital
23011	Dept. of Surg., Metropolitan Komagome General Hospital
23017	Dept. of Gastroenterol., Metropolitan Komagome General Hospital
24011	Dept. of Surg., Gunma Cancer Center Toumou Hospital
24031	Dept. of Surg., Tochigi Cancer Center
25032	Dept. of Thoracic Surg., Aichi Cancer Center
26011	Osaka Adult Disease Center
27031	Dept. of Surg., Hyogo Prefectual Kakogawa Hospital
27041	Dept. of Surg., Tottori Prefectual Central Hospital
29011	Dept. of Surg., Saga Prefectual Kouseikan Hospital
34021	Urawa Municipal Hospital
34051	Dept. of Surg., Numazu City Hospital
34061	Kakegawa Municipal Hospital
34131	Hiratsuka City Hospital
34151	Dept. of Surg., Yamato City Hospital

Inst#	Institutions
35041	Dept. of Surg., Gifu City Hospital
36041	Dept. of Surg., Suita City Hospital
36081	Dept. of Surg., Izumi City Hospital
37111	Dept. of Surg., Kobe City Central Hospital
37200	Hiroshima City Asa Hospital
37211	Dept. of Surg., Matsue City Hospital
39121	Dept. of Surg., Kitakyushu City Yahata Hospital
40311	Dept. of Surg., Toranomon Hospital
40711	Dept. of Surg., Kinki Center Hospital
42121	Akita Red Cross Hospital
42211	Dept. of Surg., Nagaoka Red Cross Hospital
42311	Japanese Red Cross Medical Center
42831	Dept. of Surg., Matsuyama Red Cross Hospitral
43131	Dept. of Surg., Akita Rosai Hospital
43611	Dept. of Surg., Osaka Rosai Hospital
44311	Dept. of Surg., Social Insurance General Center Hospital
44411	Dept. of Surg., Social Insurance Saitama Center Hospital
44541	Social Insurance Chukyo Hospital
45111	Dept. of Medicine, Yamamoto Union General Hospital
46011	Obihiro Kousei Hospital
47421	Dept. of Surg., Yokosuka Kyosai Hospital
48611	Dept. of Surg., Osaka Teishin Hospital
50001	Dept. of Surg., Cancer Institute Hospital
60021	Dept. of Surg., Obihiro Kyokai Hospital
60041	Dept. of Surg., Keiyukai Sapporo Hospital
61051	Dept. of Surg., Hiratsuka Sogo Hospital
64502	Kamitsuga General Hospital

Inst#	Institutions
65131	Dept. of Surg., Daiyukai General Hospital
66371	Dept. of Surg., Osaka Police Hospital
67111	Dept. of Surg., Shinko Hospital

2. Patient Background

Table 1) Age, gender and treatment

Age	Cases (%)	Male	Female	Unknown	EMR*/ Stenting	Chemotherapy/ Radiotherapy	Palliative operation	Esopha-gectomy	None/ Unknown
~29	3 (0.2%)	2	1	0	0	2	0	1	0
30~39	4 (0.2%)	4	0	0	1	0	0	3	0
40~49	84 (4.7%)	70	14	0	7	13	1	60	3
50~59	486 (27.3%)	428	58	0	48	91	2	337	8
60~69	661 (37.1%)	599	62	0	69	151	5	414	22
70~79	457 (25.7%)	394	63	0	68	133	2	244	10
80~89	77 (4.3%)	63	14	0	12	37	3	22	3
90~	4 (0.2%)	3	1	0	0	3	0	1	0
Unknown	5 (0.3%)	5	0	0	3	1	0	1	0
Total	1781 (100%)	1568 (88.0%)	213 (12.0%)	0	208 (11.7%)	431 (24.2%)	13 (0.7%)	1083 (60.8%)	46 (2.6%)

*EMR: endoscopic mucosal resection

Table 2) Area of patient's residence and occupation

Area	No. of cases (%)	Area	No. of cases (%)
Total	**1781 (100%)**	Miyazaki	0 (0.0%)
Aichi	65 (3.7%)	Nagano	14 (0.8%)
Akita	39 (2.2%)	Nagasaki	8 (0.4%)
Aomori	5 (0.3%)	Nara	6 (0.3%)
Chiba	44 (2.5%)	Niigata	48 (2.7%)
Ehime	29 (1.6%)	Oita	34 (1.9%)
Fukui	0 (0.0%)	Okayama	31 (1.7%)
Fukuoka	112 (6.3%)	Okinawa	5 (0.3%)
Fukushima	11 (1.2%)	Osaka	115 (6.5%)
Gifu	20 (0.6%)	Saga	22 (1.2%)
Gunma	51 (2.9%)	Saitama	94 (5.3%)
Hiroshima	23 (1.3%)	Shiga	4 (0.2%)
Hokkaido	190 (10.7%)	Shimane	18 (1.0%)
Hyogo	96 (5.4%)	Shizuoka	29 (1.7%)
Ibaraki	21 (1.2%)	Tochigi	99 (5.6%)
Ishikawa	8 (0.4%)	Tokushima	7 (0.4%)
Iwate	33 (1.9%)	Tokyo	294 (16.5%)
Kagawa	2 (0.1%)	Tottori	6 (0.3%)
Kagoshima	3 (0.2%)	Toyama	3 (0.2%)
Kanagawa	81 (4.5%)	Wakayama	0 (0.0%)
Kouchi	1 (0.06%)	Yamagata	15 (0.8%)
Kumamoto	4 (0.2%)	Yamaguchi	16 (0.9%)
Kyoto	28 (1.6%)	Yamanashi	12 (0.7%)
Mie	11 (0.6%)	Others	2 (0.1%)
Miyagi	15 (0.8%)	Unknown	7 (0.4%)

Occupation	Cases (%)
None	248 (13.9%)
Professional	147 (8.3%)
Management	155 (8.7%)
Office worker	295 (16.6%)
Sales worker	98 (5.5%)
Farm/Forestry/Fishery	112 (6.3%)
Mining and Quarrying	13 (0.7%)
Transport and communication	53 (3.0%)
Industrial technician	93 (5.2%)
General worker/Service industry	94 (5.3%)
Others	35 (2.0%)
Unclassified	7 (0.4%)
Unknown	431 (24.2%)
Total	1781 (100%)

Table 3) Familial history of carcinoma

Familial history	Cases (%)
No	989 (55.5%)
Yes	527 (29.6%)
Unknown	265 (14.9%)
Total	1781 (100%)

Table 4) Tumors in familial history of carcinoma

Diseases	No. of cases (%)	Diseases	No. of cases (%)
Malig. lymphoma	4 (0.6%)	Gallbladder ca.	5 (0.7%)
Leukemia	8 (1.1%)	Pancreas ca.	31 (4.4%)
Brain tumor	4 (0.6%)	Colon ca.	44 (6.3%)
Mandibular ca.	2 (0.3%)	Rectal ca.	20 (2.8%)
Paranasal sinus ca.	0 (0.0%)	Uterus ca.	45 (6.4%)
Thyroid ca.	2 (0.3%)	Ovarian ca.	7 (1.0%)
Breast ca.	30 (4.3%)	Seminoma	0 (0.0%)
Lung ca.	90 (12.8%)	Renal ca.	2 (0.3%)
Maxilla ca.	0 (0.0%)	Bladder ca.	12 (1.7%)
Tongue ca.	4 (0.6%)	Prostate ca.	6 (0.9%)
Oral ca.	0 (0.0%)	Osteosarcoma	0 (0.0%)
Pharyngeal ca.	4 (0.6%)	Spinal tumor	0 (0.0%)
Laryngeal ca.	16 (2.3%)	Malig. melanoma	0 (0.0%)
Esophageal ca.	69 (9.8%)	Skin ca.	3 (0.4%)
Gastric ca.	216 (30.7%)	Others	1 (0.1%)
Hepatoma	52 (7.4%)	Unknown	18 (2.6%)
Cholangioma	8 (1.1%)		
Jejunal ca.	0 (0.0%)	Total cases (%)	704 (100%)
Duodenal ca..	1 (0.1%)	No. of patients	527