The enhancement of the radiotherapy resources in Osaka, Japan; based on the Japanese structure surveys in 2003 and 2005

Y. Mochimaru[1], Y. Ohno[1], H. Numsaki[2,5], H.Shibuya[3,5], T. Nishimura[4,5], T. Teshima[2,5] and the JASTRO Committee[5].

[1] Dept. of Mathematical Health Science, Osaka University Graduate School of Medicine, Osaka, Japan
[2] Dept. of Medical Physics and Engineering, Osaka University Graduate School of Medicine, Osaka, Japan
[3] Head and Neck Reconstruction Division, Dept. of Diagnostic Radiology and Oncology, Tokyo Dental and Medical University Graduate School, Tokyo, Japan
[4] Dept. of Radiotherapy, Shizuoka Cancer Center, Shizuoka, Japan
[5] Japanese Society for Therapeutic Radiology and Oncology, Tokyo, Japan

Abstract—**In Japan, Japanese Society of Therapeutic Radiology and Oncology (JASTRO) has been conducting national surveys on radiation therapy (RT) facilities every two years. In the previous study, we linked the survey data at 2003 with Osaka Cancer Registry and found (1) the RT facilities were classified into four clusters by the characteristics of the hospitals, (2) there were strong relation between the clusters of facilities and the prognosis of breast cancer patients, the prognosis of patients treated at the facilities belonging to the first cluster showed better prognoses than other cluster's facilities. In this study, we analyzed the change of the characteristics of RT resources in Osaka, Japan by principal component analysis based on the JASTRO surveys at 2003 and 2005. Comparing the variables composing the principal components among the years, the enhancement of the RT facilities was discussed. As the results, the first component in 2003 consisted of variables relevant to facility equipment such as number of beds in the radiological departments, X-rays and X-ray CT scanners, beds in the hospitals and LINACs and so on. In 2005, variables associated with RT personnel showed the higher contribution to the first component, such as full-time radiology oncologists (ROs), nurses in the radiology departments, diagnostic doctors and medical technologists and so on. Plotting the both results on the same 1st –2nd component plane, the facilities belonging to the first cluster showed apparent change, that would be the effect of whether the introduction of ROs was early or not. For the future we are planning to examine the effect of the RT facilities for the change of the patients prognosis.**

.*Keywords*—**radiotherapy, treatment resource, principal component analysis**

I. Introduction

Radiotherapy (RT) has become widely recognized for its safety and utility and, along with surgery and chemotherapy, is an important treatment for cancer. In Japan, the number of patients receiving RT has doubled in the past 10 years and is estimated to double again in the next 10years[1)]. However, there are shortage of treatment resources at RT facilities, and even more so in personnel, for example radiation oncologists (ROs) and quality managers. In the previous study, we classified RT facilities in Osaka into four clusters in accordance with the representative treatment resources based on results from the Japanese Society of Therapeutic Radiology and Oncology (JASTRO) database by using cluster analysis. The 5-year survival rate was calculated for each cluster by the Kaplan-Meier method so that the relationship between breast cancer patient prognoses and treatment resources was analyzed. The results indicated the regional of breast cancer patients who received RT at hospitals in the first cluster, including University affiliated hospitals, is the highest, approximately 84.2%. The lowest prognosis was detected at the RT facilities that had few treatment resources or the privation of personnel, approximately 64.8%. These different outcomes might be affected by the varying amounts of the treatment resources or other characteristics.

In this study, we have followed the changes from 2003 to 2005 in treatment resources at the RT facilities in Osaka Japan in order to examine the influence of the expansion of personnel and structures.

II. Materials and Methods

JASTRO surveyed the basic structural characteristics of RT facilities in Japan every two years by mailing a questionnaire to the chief of each potential RT facility. Questions include whether the facility performed any type of RT during the surveyed year, the number of treatment devices

O. Dössel and W.C. Schlegel (Eds.): WC 2009, IFMBE Proceedings 25/XII, pp. 332–335, 2009.
www.springerlink.com

by type, the number of radiation oncologists, physicists, radiation technologists, other radiation staff, and the number of RT treated patients in the facility. In this study, we used the JASTRO database, including a datasets from 2003 and 2005. In the JASTRO database, 48 RT facilities in 2003 replied to the JASTRO survey and 44 RT facilities in 2005 replied. Seventeen items analyzed in this study were extracted previously from the JASTRO database as RT indices. FTE represents the ratio of RT in 40 hours of work in one week. For the missing data of a dataset in 2005, a data of same items of a dataset in 2003 were substituted. Treatment indices of RT facilities in both years were analyzed by a principal component with 17 RT items to ascertain treatment quality of each facility (Table 1). Then the RT facilities were plotted on a principal component plane with a first principal component contribution and a second principal contribution for 2003 and 2005 (Figure 1). To investigate how the treatment resource of RT facilities changed in the two years, 48 facilities in the 2003 and the 44 facilities from the 2005 dataset were plotted on the same principal component plane thus showing the changes of the values of the treatment indices.

III. Results

Using 17 items extracted from the dataset in 2003 and 2005, a principal component analysis was conducted for each year. As the results (Table 1), the first principal component's eigen value is 8.03. The others are 1.63, 1.54 and 1.30, respectively. The proportion of the first principal component is 47.3%. The cumulative proportion up to the forth principal component is 73.6%. The first component could explain more than 40% of treatment resources for whole of RT facilities. Examination of the principal components after further varimax rotation reveals that the first principal component is comprised of 13 items that included the "*Number of new patients in the radiological departments*", "*number of treatment cases*", "*FTE of full-time ROs*", "*beds in the radiological departments*", "*number of full-time ROs*", "*number of breast cancer patients*", "*number of X-rays and CT scanners*", "*number of beds in the hospitals*", "*number of LINACs*", "*number of MRIs*", "*number of radiological technologists*", "*number of diagnostic doctors*". By analyzing variable scores of the first principal component, three high-score items are "*Number of new patients in the radiological departments*", "*number of treatment cases*" and "*FTE of full-time ROs*". Also, the first principal component is composed of both the treatment equipment and the availability of treatment personnel technology.

In case of dataset in 2005, the eigen value is 1 or >1 up to the forth principal component. The first principal component's eigen value is 9.51 and the others were 1.78, 1.38 and 1.03, respectively. The proportion of the first principal component is 55.9% and the cumulative proportion up to forth principal component is 80.6%. After varimax rotation, 15 items consisted of the first principal component are "*Number of new patients in the radiological departments*", "*number of treatment cases*", "*FTE of full-time ROs*", "*Number of nurses in the radiation departments*", "*number*

Table 1 the contribution of RT resources at 2003 and 2005

	2003					2005			
	1st	2nd	3rd	4th		1st	2nd	3rd	4th
Eigen value	8.034	1.636	1.536	1.300	Eigen value	9.508	1.779	1.378	1.032
New patients in the radiology depts.	0.935	-0.119	0.118	-0.073	New patients in the radiology depts.	0.932	0.101	-0.129	-0.030
Total treatment cases	0.931	-0.105	0.113	-0.110	Total treatment cases	0.907	0.138	-0.164	-0.036
FTE of full-time ROs	0.876	0.016	-0.279	0.211	FTE of full-time ROs	0.898	-0.011	-0.339	0.167
Beds in the radiology depts	0.873	0.104	0.053	0.023	Full-time ROs	0.847	-0.045	-0.279	0.251
Full-time ROs	0.855	-0.039	-0.298	0.063	Nurses	0.832	-0.221	0.277	-0.033
Breast cancer patients	0.835	-0.032	0.024	-0.055	Diagnostic doctors	0.824	-0.140	0.401	0.028
X-rays, CTs	0.831	-0.058	0.063	-0.351	Radiation technologists	0.822	-0.033	0.192	0.148
Beds in the hospitals	0.773	-0.008	0.017	-0.227	Assistances	0.808	-0.230	0.158	0.300
LINACs	0.736	0.252	-0.297	-0.080	X-rays, CTs	0.805	0.001	0.199	-0.386
MRIs	0.705	0.127	0.029	-0.217	LINACs	0.796	0.138	-0.225	0.092
Radiation technologists	0.616	-0.232	0.417	0.399	Beds in the hospitals	0.752	0.116	-0.171	-0.403
Diagnostic doctors	0.606	0.092	-0.223	0.405	Breast cancer patients	0.738	0.158	-0.150	0.115
Assistances	0.489	-0.040	0.266	0.100	MRIs	0.650	-0.081	0.145	-0.578
Part-time ROs	0.041	0.802	0.333	0.021	Beds in the radiology depts	0.631	0.360	-0.359	0.067
FTE of part-time ROs	0.050	0.730	0.468	-0.088	Medical physicists	0.598	-0.488	0.470	0.218
Nurses	0.112	-0.416	0.744	0.315	FTE of part-time ROs	0.145	0.805	0.386	-0.104
Medical physicists	0.088	0.318	-0.260	0.750	Part-time radiation oncologists	0.039	0.739	0.424	0.308

of diagnosis doctors", "*number of radiological technologists*", "*Number of assistances*", "*number of X-rays and CT scanners*", "*number of LINACs*", "*number of beds in the hospitals*", "*number of breast cancer patients*", "*number of MRIs*", "*number of beds in the radiological departments*" and "*number of diagnosis doctors*".

Next, the 48 facilities from 2003 were plotted the results on principal component plane (Fig.1 above). The 44facilities from 2005 were also plotted (Fig.1 middle). Individual facilities were showed to have changed noticeably from 2003 to 2005(Fig.1 below). In accordance with the results, facilities in the first cluster, which had the highest survival rate, was plotted to the right of the axis of the first principal component score. In addition, they are scattered widely in the second principal component score. Facilities in the second cluster are plotted near the 0 point to the right of the axis of the first principal component score. Facilities in the third and forth clusters, which had the third lowest and worst survival rates, are plotted to the left of the axis of the first principal component score. The middle figure shows facilities in 2005 by using a principal component. Facilities of the first cluster are plotted to the right of the axis of the first principal component score and are again scattered widely in the second principal component score again. Facilities of the second cluster are plotted to the right of the axis of the first principal component score again. Facilities of the third and forth clusters are plotted even further to the left than in the first principal component score. Facilities of the first cluster were given the highest score in the first principal component, and facilities of the second cluster gained the highest score in the second principal component. Facilities of the third and forth cluster are not investigated as much as the others on the score plane. The last figure shows the change of individual facilities of the first cluster from 2003 and 2005. The facility of "a" plotted to the right of the axis of the first principal component score and on the axis of the second principal component score, then it moved to below the axis of the second principal component score from 2003 to 2005, "A". The facility of "c" plotted to the right of the axis of the first principal component score and on the axis of the second principal component score, then it moved to above the axis of the second principal component score from 2003 to 2005, "C". Other facilities of the other clusters did not move so much (data did not show), however, facilities of the first cluster moved among the second principal component score.

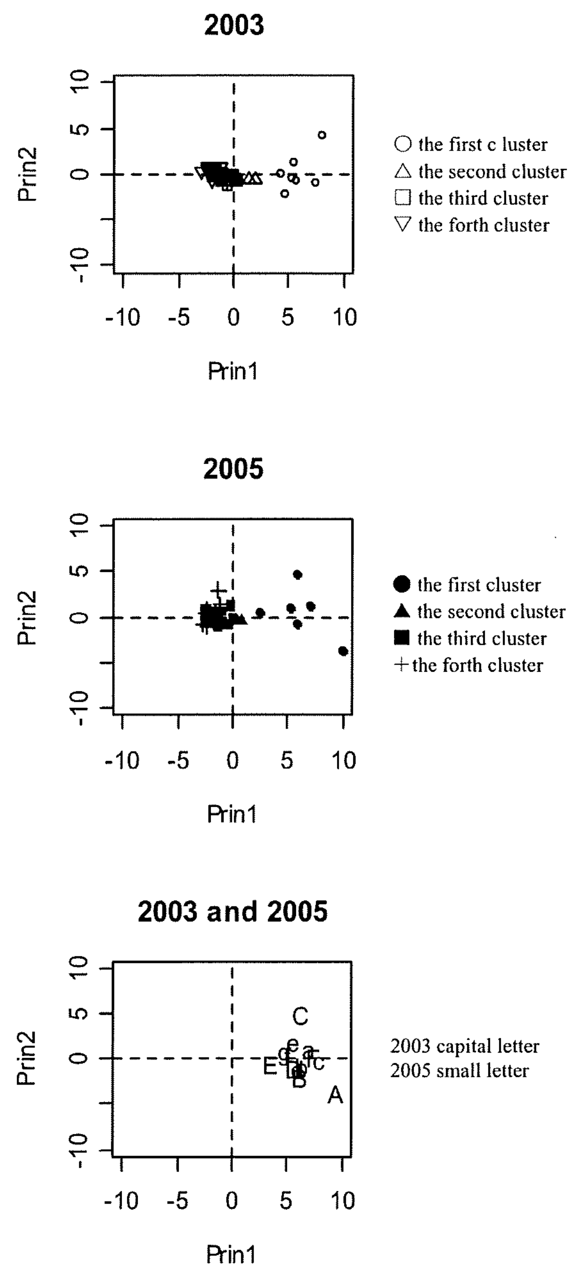


Fig. 1 The facilities on the principal component plane

IV. Discussion

Improving the treatment systems of RT facilities is an important issue in Japan, where cancer is the leading cause of death. In this study, the change of the characteristics of the RT resources was investigated based on the JASTRO surveys in 2003 and 2005. The results suggested the enhancement of the personnel and equipment in RT facilities during two years. As the RT equipment are expensive, once the RT machines are full equipped the replacement wouldn't happen during next several years. The results also suggested that the RT equipments seemed almost to be provided up to 2003 in Osaka and the expansion of personnel was improving in 2005. Facilities in the first cluster, the best group of the breast cancer treatment in Osaka, moved on the axis of the second principal component that including medical physicists and so on. These moved facilities might employee ROs or medical physicists that reflected the expansion of the personnel in the facilities. The small number of full-time working ROs and other RT oriented personnel would constrain the increase of the number of RT treatment. The improvement of the training course of the RT staffs and the rapid increase for the RT personnel would be the most important problem for the more enhancement and level up of RT in cancer treatment. More than 40 facilities are conducting RT in Osaka. It is thought that not only facilities having great treatment system but also facilities having small treatment system are undertaking current RT. In the future the centralized RT treatment requires for the improvement of patient prognoses, also facilities having the insufficient treatment resources requires to be expand personnel and improve structures. We are going to analyzed the survival rate of patients received RT at the facilities where analyzed in this study.

V. Conclusions

For RT facilities in Osaka, Japan, the improvement of the RT equipment and the personnel such as ROs were observed during 2003 and 2005. The change of the characteristics of the best hospital group in breast cancer treatment suggested the effect of the employment for the full-time RT experts. We are going to continue to analyze the potency of the prognosis and the RT facilities.

Acknowledgment

This study was supported by a Health and Labor Sciences Research Grant for Clinical Cancer Research (H19-009) and a Grants-in-Aid for Scientific Research (B) (18310105).

References

1. Inoue T , Onishi H, Teshima T, et al. (2005) Radiation Oncology in Multidisciplinart Cancer Therapy –Basic structural requirements for quality assurance of radiotherapy based on Patterns of Care Study in Japan-. Japanese PCS Working Group report (supported by Ministry of Health,Labour and Welfare,Planned Research Study14-6)
2. Mochimaru Y, Ohno Y, The JASTRO committee, et al. (2008) relation between radiotherapy facilities and breast cancer survival:database linkage study. COSA-IACR and ANZGOSA Annual Scientific Meeting 2008:A168
3. Numasaki H, Teshima T, Shibuya H, et al. (2009) National structure of radiation oncology in Japan with special reference to designated cancer care hospital. IJCO(in press)
4. Teshima T, Numasaki H, Shibuya H, et al. (2008) Japanese structure survey of radiation oncology in 2005 based on institutional stratification of patterns of care study. Int. J. radiation Oncology Biol. Phys.,72(1):144-152
5. The JASTRO database committee (2007) Japanese structure survey if radiation oncology in 2005 (in Japanese). J Jpan soc the Radiol Oncol,19:181-192
6. Shibuya H, Tsujii H (2005) the structural characteristics of radiateon oncology in Japan in 2003. Int. J. radiation Oncology Biol. Phys.,62(5):1472-1476
7. The JASTRO database committee (2005) Present status of radiotherapy in Japan - the regular structure survey in 2003- (in Japanese). J Jpan soc the Radiol Oncol,15:115-121

Author: Yuko OHNO
Institute: Osaka University Graduate School of Medicine
Street: 1-7 Yamadaoka
City: Osaka
Country: Japan
Email: + 81 (6) 6879 2526

Int J Clin Oncol (2009) 14:237–244
DOI 10.1007/s10147-008-0851-6

ORIGINAL ARTICLE

Hodaka Numasaki · Teruki Teshima · Hitoshi Shibuya
Masamichi Nishio · Hiroshi Ikeda · Hisao Ito
Kenji Sekiguchi · Norihiko Kamikonya
Masahiko Koizumi · Masao Tago · Yasushi Nagata
Hidekazu Masaki · Tetsuo Nishimura · Shogo Yamada
and the Japanese Society of Therapeutic Radiology and Oncology Database Committee

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

Received: August 22, 2008 / Accepted: October 9, 2008

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

H. Numasaki · T. Teshima (✉)
Department of Medical Physics and Engineering, Osaka University Graduate School of Medicine, 1-7 Yamadaoka, Suita, Osaka 565-0871, Japan
Tel. +81-6-6879-2570; Fax +81-6-6879-2570
e-mail: teshima@sahs.med.osaka-u.ac.jp

H. Shibuya
Department of Radiology, Tokyo Medical and Dental University, Tokyo, Japan

M. Nishio
Department of Radiology, National Hospital Organization Hokkaido Cancer Center, Sapporo, Hokkaido, Japan

H. Ikeda
Department of Radiology, Sakai Municipal Hospital, Sakai, Osaka, Japan

H. Ito
Department of Radiology, Graduate School of Medicine, Chiba University, Chiba, Japan

K. Sekiguchi
Department of Radiation Oncology, St. Luke's International Hospital, Tokyo, Japan

N. Kamikonya
Department of Radiology, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan

M. Koizumi
Department of Radiation Oncology, Osaka University Graduate School of Medicine, Suita, Osaka, Japan

M. Tago
Department of Radiology, the University of Tokyo Hospital, Tokyo, Japan

Y. Nagata
Department of Radiology, Hiroshima University Hospital, Hiroshima, Japan

H. Masaki
Department of Radiology, National Center for Child Health and Development, Tokyo, Japan

T. Nishimura
Division of Radiation Oncology, Shizuoka Cancer Center, Shizuoka, Japan

S. Yamada
Tohoku University Hospital Cancer Center, Sendai, Miyagi, Japan

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

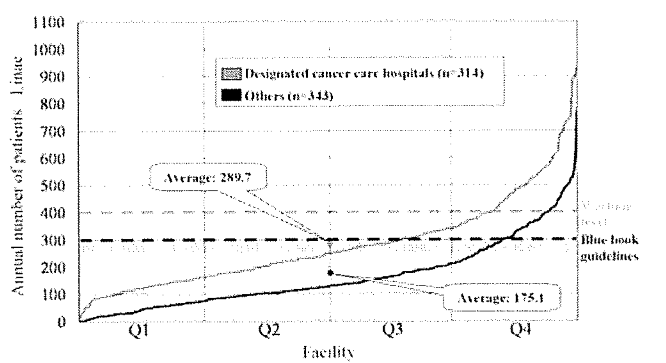


Fig. 1. Distribution of annual patient load/linear accelerator (*Linac*) in designated cancer care hospitals and the other radiotherapy (RT) facilities (*others*). *Horizontal axis* represents facilities arranged in order of increasing annual number of patients/Linac within facilities. The above-mentioned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

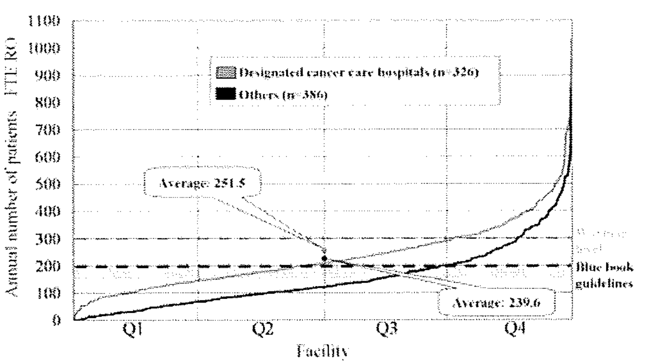


Fig. 2. Distribution of annual patient load/ full-time equivalent radiation oncologist (*FTE RO*) in designated cancer care hospitals and the other RT facilities. *Horizontal axis* represents facilities arranged in order of increasing annual numbers of patients / FTE RO within facilities. The number 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

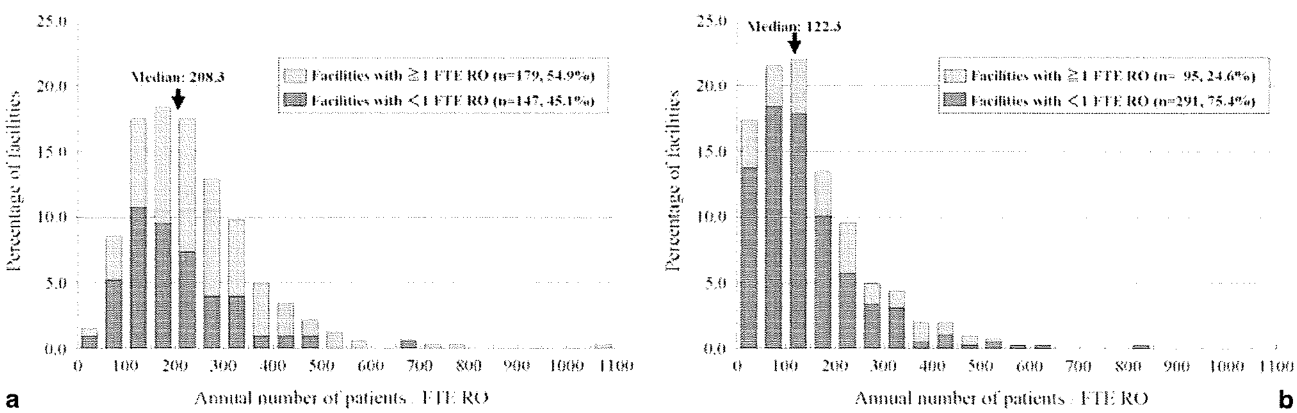


Fig. 3. a Percentage of facilities by patient load / FTE RO in designated cancer care hospitals. *Each bar* represents an interval of 50 patients per FTE RO. The number of FTE ROs for facilities with less than one FTE was calculated as FTE = 1 to avoid overestimating patient load / FTE RO. **b** Percentage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

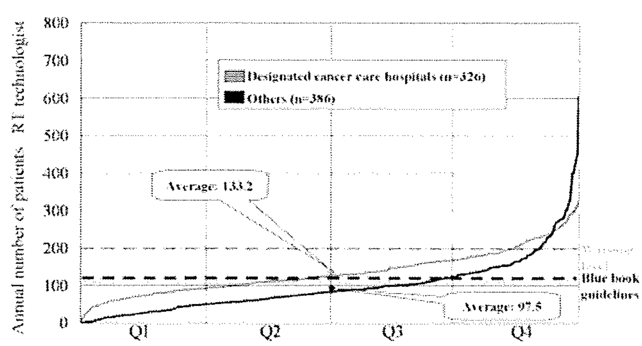
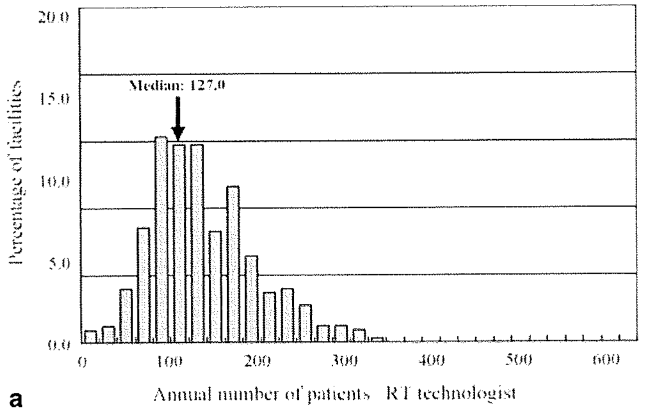


Fig. 4. Distribution of annual patient load / RT technologist in designated cancer care hospitals and the other RT facilities. *Horizontal axis* represents facilities arranged in order of increasing annual number of patients / RT technologist within facilities. *Q1-Q4*, As in Fig. 1 legend



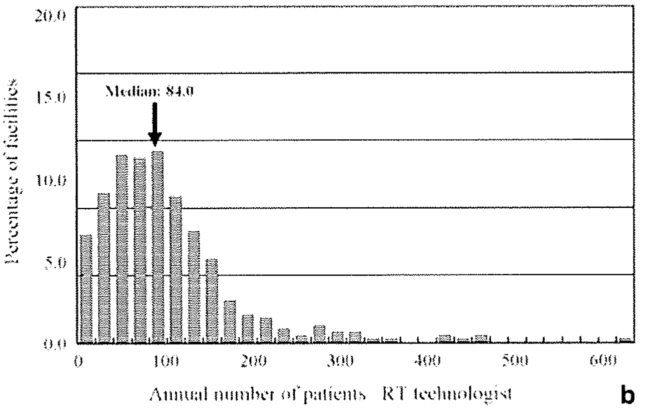


Fig. 5. a Percentage of facilities by patient load / RT technologist in designated cancer care hospitals. *Each bar* represents an interval of 20 patients per FTE staff. **b** Percentage of facilities by patient load / RT technologist in the other RT facilities. *Each bar* represents an interval of 20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

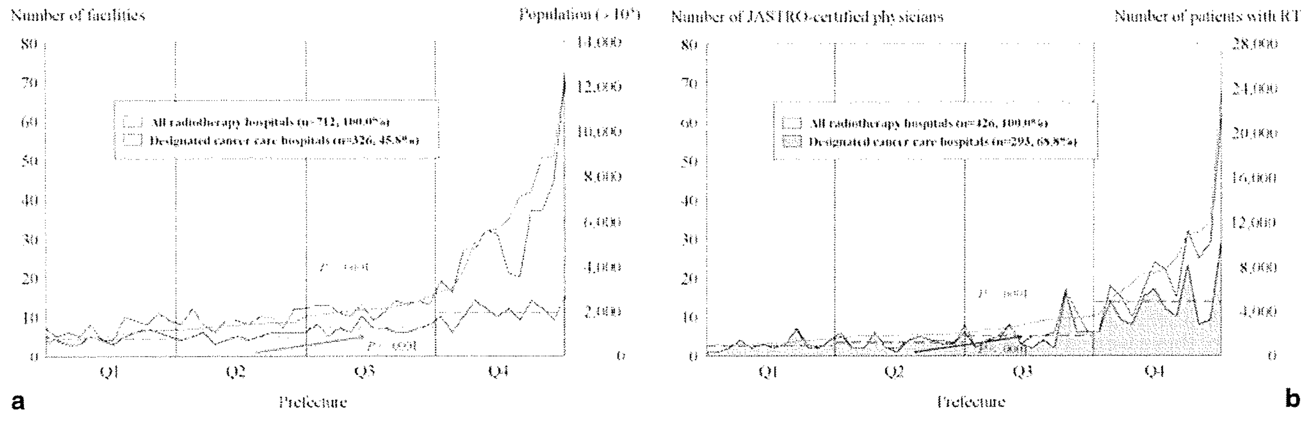


Fig. 6. **a** Geographic distribution, for 47 prefectures, of the number of facilities arranged in order of increasing population. *Upper dashed horizontal bar* shows average number of facilities in the prefectures per 4 separated groups (Q1–Q4) in all RT hospitals, and *lower dashed horizontal bar* 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.

References

1. Shibuya H, Tsujii H (2005) The structural characteristics of radiation oncology in Japan in 2003. Int J Radiat Oncol Biol Phys 62:1472–1476
2. Teshima T, Numasaki H, Shibuya H, et al. (2007) Japanese Structure Survey Of Radiation Oncology In 2005 (first report; in Japanese). J Jpn Soc Ther Radiol Oncol 19:181–192
3. Teshima T, Numasaki H, Shibuya H, et al. (2007) Japanese Structure Survey Of Radiation Oncology in 2005 (second report; in Japanese). J Jpn Soc Ther Radiol Oncol 19:193–205
4. SAS Institute (1985) SAS user's guide: statistics. Cary, NC: SAS Institute
5. Japanese PCS Working Group (2005) Radiation oncology in multidisciplinary cancer therapy. Basic structure requirement for quality assurance of radiotherapy based on Patterns of Care Study in Japan. Self-publication supported by the Ministry of Health, Welfare and Labour, of Japan. Ministry of Health, Welfare and Labour, Tokyo
6. Teshima T, Tatsuzaki H, Mitsumori M, et al. (2006) Revision of guideline for structure of radiation oncology by the Patterns of Care Study (in Japanese). J Jpn Soc Ther Radiol Oncol 18:107–112
7. Statistics Bureau, Ministry of Internal Affairs and Communications: the 2005 population census, First basic complete tabulation. Available from: http://www.stat.go.jp/english/data/kokusei/2005/kihon1/00/hyodai.htm. Accessed Jun 30, 2008
8. Teshima T, Owen JB, Hanks GE, et al. (1996) A comparison of the structure of radiation oncology in the United States and Japan. Int J Radiat Oncol Biol Phys 34:235–242
9. Oshima A, Kuroishi T, Tajima K (eds) (2004) Cancer statistics – 2004. Shinohara, Tokyo, p 207
10. Ikeda H, Nishio M, Kataoka M, et al. (2008) Structure analysis of designated hospitals for cancer control in Japan from JASTRP census survey database 2005 (in Japanese). J Jpn Soc Ther Radiol Oncol 20:13–22

Esophagus (2009) 6:27–47
DOI 10.1007/s10388-009-0185-0

SPECIAL ARTICLE

**Hiroko Ide · Soji Ozawa · Hisahiro Matsubara
Takao Saito · Masayuki Shinoda · Yuji Tachimori
Otsuo Tanaka · Harushi Udagawa · Hideaki Yamana
Teruki Teshima · Hodaka Numasaki · J. Patrick Barron**

Comprehensive Registry of Esophageal Cancer in Japan, 2000

Contents

These data were first issued on June 26, 2003, as the *Comprehensive Registry of Esophageal Cancer in 2000.* Not all pages are reprinted here; however, the original table numbers have been kept. New figures showing survival rates were added. Authors were at the time members of the Registration Committee for Esophageal Cancer, the Japan Esophageal Society, and made great contributions in preparing this material.

Japan Esophageal Society, Sun-city Inohana B, 3-2-4 Inohana, Chuo-ku, Chiba 260-0856, Japan
Tel./Fax +81-43-222-5665

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	Esophagectomy	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

Table 5) Reason and basis for diagnosis according to clinical T-category

Reason for diagnosis	Superficial cancer (cTis cT1)	Advanced cancer (cT2 cT3 cT4)	Total (%)
Chief complaint	164 (31.4%)	998 (82.5%)	1162 (69.7%)
Detection survey / dock	215 (41.2%)	88 (7.8%)	303 (18.2%)
Examination for other disease	137 (26.2%)	51 (4.5%)	188 (11.3%)
Unknown	6 (1.1%)	9 (5.2%)	15 (0.9%)
Total	522 (100%)	1146 (100%)	1668* (100%)

Detection methods	Superficial cancer (cTis cT1)	Advanced cancer (cT2 cT3 cT4)	Total (%)
Esophagography	44 (8.4%)	243 (21.2%)	287 (17.2%)
Esophagoscopy	470 (90.0%)	848 (74.0%)	1318 (79.0%)
CT-scan	0	15 (1.3%)	15 (0.9%)
US	0	1 (0.1%)	1 (0.06%)
Biopsy	0	5 (0.4%)	5 (0.3%)
Others	1 (0.2%)	2 (0.2%)	3 (0.2%)
Unknown	7 (1.3%)	32 (2.8%)	39 (2.3%)
Total	522 (100%)	1146 (100%)	1668* (100%)

*: excluding 113 cTX, cT0, cT unknown cases

Table 6) Symptoms according to clinical T-category

Symptom	cTis cT1	cT2 cT3 cT4	Total (%)
	Cases (%)	Cases (%)	
None	317 (60.7%)	96 (8.4%)	413 (24.8%)
Chest pain	28 (5.4%)	37 (3.2%)	65 (3.9%)
Sense of stricture	45 (8.6%)	495 (43.2%)	540 (32.4%)
Unusual sensation	34 (6.5%)	49 (4.3%)	83 (5.0%)
Dysphagia	15 (2.9%)	329 (28.7%)	344 (20.6%)
Nausea / Vomiting	5 (1.0%)	27 (2.4%)	32 (2.0%)
Appetite loss	10 (1.9%)	14 (1.2%)	24 (1.4%)
Weight loss	7 (1.3%)	12 (1.0%)	19 (1.1%)
Swollen lymph node(s)	7 (1.3%)	7 (0.6%)	14 (0.8%)
Hoarseness	1 (0.2%)	21 (1.8%)	22 (1.3%)
Others	32 (6.1%)	38 (3.3%)	70 (4.2%)
Unknown	21 (4.0%)	21 (1.8%)	42 (2.5%)
Total	522 (100%)	1146 (100%)	1668* (100%)

*: excluding 113 cTX, cT0, cT unknown cases

Table 7) Double / multiple primary cancers

	Endoscopic treatment (EMR/Stenting)	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
None	127 (61.1%)	325 (75.4%)	12 (92.3%)	861 (79.5%)	1325 (76.3%)
Double	24 (11.5%)	44 (10.2%)	0	116 (10.7%)	184 (10.6%)
Metachronous					
Before E-Ca	42 (20.2%)	49 (11.4%)	0	76 (7.0%)	167 (9.6%)
After E-Ca	2 (1.0%)	1 (0.2%)	0	17 (1.6%)	20 (1.2%)
Multiple	5 (2.4%)	4 (0.9%)	0	8 (0.7%)	17 (1.0%)
Unknown	8 (3.8%)	8 (1.9%)	1 (7.7%)	5 (0.4%)	22 (1.3%)
Total	208 (100 %)	431 (100 %)	13 (100 %)	1083 (100 %)	1735* (100 %)

*: excluding 46 treatment unkown cases

Table 8) Double / multiple primary cancers and organs

Organs	Synchronous	Metachronous	Multiple	Total
Larynx/Maxilla	4 (2.0%)	24 (11.8%)	2 (5.4%)	30 (6.9%)
Pharynx	37 (18.9%)	28 (13.8%)	6 (16.2%)	71 (16.3%)
Oral cavity/gum/tongue	2 (1.0%)	7 (3.4%)	1 (2.7%)	10 (2.3%)
Stomach	93 (47.4%)	70 (34.5%)	9 (24.3%)	172 (39.4%)
Colon/Rectum	25 (12.8%)	18 (8.9%)	4 (10.8%)	47 (10.8%)
Liver	5 (2.6%)	3 (1.5%)	0	8 (1.8%)
Choledochus/Gallbladder	0	1 (0.5%)	1 (2.7%)	2 (0.5%)
Pancreas	2 (1.0%)	2 (1.0%)	0	4 (0.9%)
Lung/trachea/bronchus	7 (3.6%)	14 (6.9%)	1 (2.7%)	22 (5.0%)
Remnant esophagus	1 (0.5%)	7 (3.4%)	1 (2.7%)	9 (2.1%)
Uterus/ovarium	0	2 (1.0%)	0	2 (0.5%)
Breast	0	3 (1.5%)	0	3 (0.7%)
Prostate	2 (1.0%)	1 (0.5%)	1 (2.7%)	4 (0.9%)
Urinary bladder	3 (1.5%)	4 (2.0%)	1 (2.7%)	8 (1.8%)
Leukemia	0	0	1 (2.7%)	1 (0.2%)
Skin	0	1 (0.5%)	1 (2.7%)	2 (0.5%)
Brain	0	1 (0.5%)	0	1 (0.2%)
Thyroid	4 (2.0%)	0	0	4 (0.9%)
Bone	0	1 (0.5%)	0	1 (0.2%)
Kidney	3 (1.5%)	5 (2.5%)	1 (2.7%)	9 (2.1%)
Others	8 (4.1%)	11 (5.4%)	5 (13.5%)	24 (5.5%)
Unknown	0	0	2 (5.4%)	2 (0.5%)
Lesions	196 (100%)	203 (100%)	37 (100%)	436 (100%)
Cases	184	187	17	388

Table 13) Location of tumor

Location	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
Not detected	2 (1.0%)	0	0	0	2 (0.1%)
Pharynx	7 (3.4%)	5 (1.2%)	1 (7.7%)	6 (0.6%)	19 (1.1%)
Cervical esophagus	5 (2.4%)	30 (7.0%)	1 (7.7%)	46 (4.2%)	82 (4.7%)
Upper thoracic esoph.	19 (9.1%)	77 (17.9%)	3 (23.1%)	129 (11.9%)	228 (13.1%)
Middle thoracic esoph.	112 (53.8%)	220 (51.0%)	4 (30.8%)	523 (48.3%)	859 (49.5%)
Lower thoracic esoph.	50 (24.0%)	84 (19.5%)	2 (15.4%)	284 (26.2%)	420 (24.2%)
Abdominal esophagus	6 (2.9%)	11 (2.6%)	1 (7.7%)	73 (6.7%)	91 (5.2%)
EG-Junction (E=G)	1 (0.5%)	1 (0.2%)	0	14 (1.3%)	16 (0.9%)
Cardia (G)	0	0	0	3 (0.3%)	3 (0.2%)
Unknown	6 (2.9%)	3 (0.7%)	1 (7.7%)	5 (0.5%)	15 (0.9%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

Table 14) Longitudinal tumor length on esophagography

Length	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
not examined	2 (1.0%)	9 (2.1%)	3 (23.1%)	10 (0.9%)	24 (1.4%)
~1cm	7 (3.4%)	1 (0.2%)	1 (7.7%)	10 (0.9%)	19 (1.1%)
~2cm	24 (11.5%)	9 (2.1%)	0	61 (5.6%)	94 (5.4%)
~3cm	24 (11.5%)	25 (5.8%)	0	92 (8.5%)	141 (8.1%)
~4cm	15 (7.2%)	26 (6.0%)	0	124 (11.4%)	165 (9.5%)
~5cm	4 (1.9%)	39 (9.1%)	1 (7.7%)	132 (12.2%)	176 (10.1%)
~6cm	3 (1.4%)	40 (9.3%)	2 (15.4%)	144 (13.3%)	189 (10.9%)
~7cm	2 (1.0%)	55 (12.8%)	0	125 (11.5%)	182 (10.5%)
~8cm	5 (2.4%)	49 (11.4%)	1 (7.7%)	98 (9.0%)	153 (8.8%)
~9cm	1 (0.5%)	32 (7.4%)	0	70 (6.5%)	103 (5.9%)
~10cm	3 (1.4%)	21 (4.9%)	0	37 (3.4%)	61 (3.5%)
~11cm	1 (0.5%)	26 (6.0%)	0	30 (2.8%)	57 (3.3%)
~12cm	0	12 (2.8%)	0	12 (1.1%)	24 (1.4%)
~13cm	0	6 (1.4%)	1 (7.7%)	10 (0.9%)	17 (1.0%)
~14cm	0	3 (0.7%)	0	1 (0.1%)	4 (0.2%)
~15cm	0	4 (0.9%)	1 (7.7%)	2 (0.2%)	7 (0.4%)
~16cm	0	3 (0.7%)	0	4 (0.4%)	7 (0.4%)
~17cm	0	0	0	1 (0.1%)	1 (0.1%)
17.1cm~	0	1 (0.2%)	0	6 (0.6%)	7 (0.4%)
Unknown	117 (56.2%)	70 (16.2%)	3 (23.1%)	114 (10.5%)	304 (17.5%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

Table 15) Endoscopic features

Type	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
Not examined	0	4 (0.9%)	0	1 (0.1%)	5 (0.3%)
0-I	4 (1.9%)	15 (3.5%)	0	61 (5.6%)	80 (4.6%)
0-IIa	24 (11.5%)	15 (3.5%)	0	74 (6.8%)	113 (6.5%)
0-IIb	24 (11.5%)	3 (0.7%)	1 (7.7%)	24 (2.2%)	52 (3.0%)
0-IIc	124 (59.6%)	43 (10.0%)	0	129 (11.9%)	296 (17.1%)
0-III	0	5 (1.2%)	0	12 (1.1%)	17 (1.0%)
0-V	3 (1.4%)	3 (0.7%)	0	4 (0.4%)	10 (0.6%)
1	2 (1.0%)	20 (4.6%)	1 (7.7%)	70 (6.4%)	93 (5.4%)
2	8 (3.8%)	131 (30.4%)	3 (23.1%)	326 (30.1%)	468 (27.0%)
3	6 (2.9%)	140 (32.5%)	7 (53.8%)	301 (27.8%)	454 (26.2%)
4	3 (1.4%)	9 (2.1%)	0	17 (1.6%)	29 (1.7%)
5	0	7 (1.6%)	0	13 (1.2%)	20 (1.2%)
Unknown	10 (4.8%)	36 (8.4%)	1 (7.7%)	51 (4.7%)	98 (5.6%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

0- I : superficial and protruding type
0- IIa : superficial and slight elevated type
0- IIb : superficial and flat type
0- IIc : superficial and slightly depressed
0- III : superficial and distinctly depressed

1 : protruding type
2 : ulcerative and localized type
3 : ulcerative and infiltrating type
4 : diffusely infiltrating type
5 : miscellaneous type

Table 17) Depth of tumor invasion cT (clinical TNM-classification)

cT	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
cTx	2 (1.0%)	3 (0.7%)	0	1 (0.1%)	6 (0.3%)
cT0	6 (2.9%)	3 (0.7%)	0	4 (0.4%)	13 (0.7%)
cTis	45 (21.6%)	1 (0.2%)	0	8 (0.7%)	54 (3.1%)
cT1	29 (13.9%)	24 (5.6%)	0	58 (5.4%)	111 (6.4%)
cT1a	71 (34.1%)	13 (3.0%)	0	40 (3.7%)	124 (7.1%)
cT1b	13 (6.3%)	34 (7.9%)	0	182 (16.8%)	229 (13.2%)
cT2	2 (1.0%)	41 (9.5%)	1 (7.7%)	171 (15.8%)	215 (12.4%)
cT3	4 (1.9%)	151 (35.0%)	3 (23.1%)	494 (45.6%)	652 (37.6%)
cT4	11 (5.3%)	139 (32.3%)	6 (46.2%)	107 (9.9%)	263 (15.2%)
Unknown	25 (12.0%)	22 (5.1%)	3 (23.1%)	18 (1.7%)	68 (3.9%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

Table 18) Lymph node metastasis, cN; and organ metastasis, cM (clinical TNM-classification)

cN	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
cNx	5 (2.4%)	10 (2.3%)	0	11 (1.0%)	26 (1.5%)
cN0	164 (78.8%)	122 (28.3%)	2 (15.4%)	485 (44.8%)	773 (44.6%)
cN1	13 (6.3%)	272 (63.1%)	8 (61.5%)	567 (52.4%)	860 (49.6%)
Unknown	26 (12.5%)	27 (6.3%)	3 (23.1%)	20 (1.8%)	76 (4.4%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

cM	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
cMx	4 (1.9%)	5 (1.2%)	0	3 (0.3%)	12 (0.7%)
cM0	172 (82.7%)	271 (62.9%)	7 (53.8%)	954 (88.1%)	1404 (80.9%)
cM1	1 (0.5%)	20 (4.6%)	1 (7.7%)	15 (1.4%)	37 (2.1%)
cM1a	2 (1.0%)	31 (7.2%)	2 (15.4%)	42 (3.9%)	77 (4.4%)
cM1b	4 (1.9%)	83 (19.3%)	0	49 (4.5%)	136 (7.8%)
Unknown	25 (12.0%)	21 (4.9%)	3 (23.1%)	20 (1.8%)	69 (4.0%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)

Table 19) Metastatic organs in cM1 cases (clinical TNM classification)

Metastatic organs	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
PUL	1 (3.0%)	22 (11.9%)	0	8 (6.1%)	31 (8.7%)
OSS	0	9 (4.9%)	0	3 (2.3%)	12 (3.4%)
HEP	2 (6.1%)	34 (18.4%)	0	7 (5.3%)	43 (12.1%)
BRA	0	2 (1.1%)	0	0	2 (0.6%)
LYM	3 (9.1%)	81 (43.8%)	2 (33.3%)	83 (62.9%)	169 (47.5%)
MAR	0	0	0	0	0
PLE	0	0	0	1 (0.8%)	1 (0.3%)
PER	0	0	0	0	0
SKI	0	1 (0.5%)	0	2 (1.5%)	3 (0.8%)
OTH	0	2 (1.1%)	0	0	2 (0.6%)
Unknown	27 (81.8%)	34 (18.4%)	4 (66.7%)	28 (21.2%)	93 (26.1%)
Lesions	33 (100%)	185 (100%)	6 (100%)	132 (100%)	356 (100%)
One organ	4 (12.5%)	97 (62.6%)	2 (33.3%)	92 (73.0%)	195 (61.1%)
Two organs	1 (3.1%)	18 (11.6%)	0	5 (4.0%)	24 (7.5%)
Three organs	0	6 (3.9%)	0	1 (0.8%)	7 (2.2%)
Four organs~	0	0	0	0	0
Unknown	27 (84.4%)	34 (21.9%)	4 (66.7%)	28 (22.2%)	93 (29.2%)
Total cases	32 (100%)	155 (100%)	6 (100%)	126 (100%)	319 (100%)

Table 20) Clinical stage (clinical TNM-classificacation)

cStage	Endoscopic treatment	Chemotherapy and/or radiotherapy	Surgery		Total (%)
			Palliative operation	Esophagectomy	
0	64 (30.8%)	2 (0.5%)	0	11 (1.0%)	77 (4.4%)
I	93 (44.7%)	50 (11.6%)	0	225 (20.8%)	368 (21.2%)
IIA	2 (1.0%)	38 (8.8%)	0	221 (20.4%)	261 (15.0%)
IIB	1 (0.5%)	17 (3.9%)	0	109 (10.1%)	127 (7.3%)
III	8 (3.8%)	151 (35.0%)	7 (53.8%)	378 (34.9%)	544 (31.4%)
IV	1 (0.5%)	18 (4.2%)	1 (7.7%)	14 (1.3%)	34 (2.0%)
IVA	2 (1.0%)	30 (7.0%)	2 (15.4%)	42 (3.9%)	76 (4.4%)
IVB	4 (1.9%)	83 (19.3%)	0	49 (4.5%)	136 (7.8%)
Unknown	33 (15.9%)	42 (9.7%)	3 (23.1%)	34 (3.1%)	112 (6.5%)
Total	208 (100%)	431 (100%)	13 (100%)	1083 (100%)	1735 (100%)