Table 20 Clinical stage (UICC-cTNM 5th)

*** Excluding 178 treatment unknown, missing cases of treatment types**

cStage	Endoscopic treatment (%)		Chemotherapy and/or radiotherapy (%)		Surgery				Total (%)	
					Palliative operation (%)		Esophagectomy (%)			
0	88	(16.2%)	4	(0.3%)	0	(0.0%)	19	(0.7%)	111	(2.3%)
I	369	(68.0%)	203	(13.2%)	13	(10.7%)	619	(23.3%)	1204	(24.7%)
IIA	7	(1.3%)	185	(12.0%)	13	(10.7%)	493	(18.5%)	698	(14.3%)
IIB	4	(0.7%)	103	(6.7%)	11	(9.1%)	344	(12.9%)	462	(9.5%)
III	30	(5.5%)	559	(36.3%)	70	(57.9%)	952	(35.8%)	1611	(33.1%)
IV	3	(0.6%)	117	(7.6%)	3	(2.5%)	34	(1.3%)	157	(3.2%)
IVA	6	(1.1%)	91	(5.9%)	1	(0.8%)	71	(2.7%)	169	(3.5%)
IVB	16	(2.9%)	204	(13.2%)	4	(3.3%)	76	(2.9%)	300	(6.2%)
Unknown	20	(3.7%)	75	(4.9%)	6	(5.0%)	53	(2.0%)	154	(3.2%)
Total	543		1541		121		2661		4866	
Missing	5		9		0		8		22	

II. Clinical results of patient treated with endoscopy in 2004

Table 21 Treatment modalities in patients receiving endoscopy

Treatment modarities	Cases (%)	
Endoscopic treatment only	438	(80.7%)
Endoscopic treatment + Radiotherapy	27	(5.0%)
Endoscopic treatment + Chemotherapy	16	(2.9%)
Endoscopic treatment + Chemoradiotherapy	54	(9.9%)
Endoscopic treatment + Chemoradiotherapy + Others	3	(0.6%)
Endoscopic treatment + Others	5	(0.9%)
Total	543	
Missing	5	

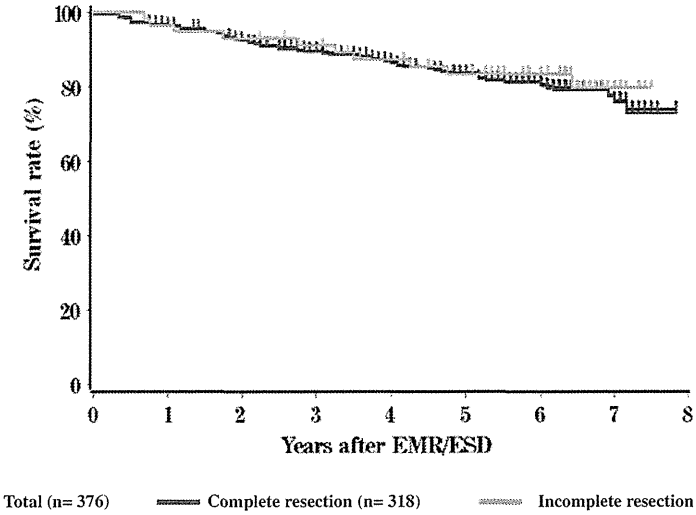

Fig. 1 Survival of patients treated by EMR/ESD

	Years after EMR/ESD							
	1	2	3	4	5	6	7	8
Total	96.5%	92.5%	89.4%	86.5%	83.7%	80.7%	76.4%	74.0%
Complete resection	96.5%	92.5%	89.4%	86.5%	83.7%	80.2%	75.7%	73.0%
Incomplete resection	96.5%	93.0%	91.2%	87.4%	83.4%	83.4%	79.7%	79.7%

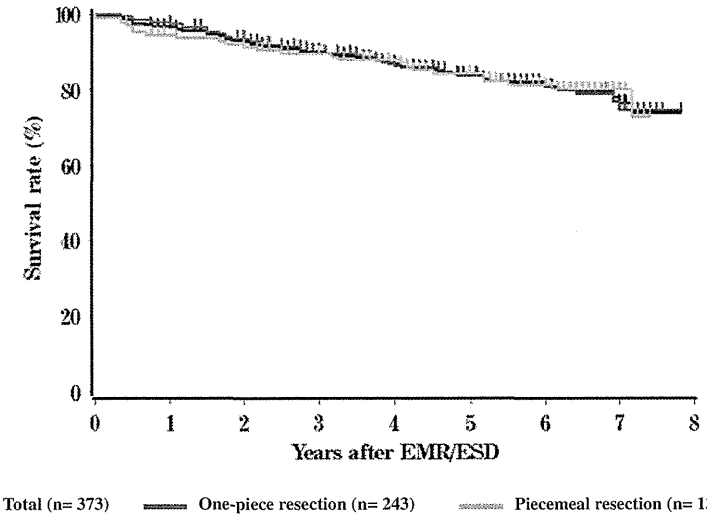

Fig. 2 Survival of patients in relation to type of EMR/ESD

	Years after EMR/ESD							
	1	2	3	4	5	6	7	8
Total	96.5%	92.8%	89.9%	86.9%	83.9%	80.9%	76.5%	73.9%
One piece resection	97.5%	93.7%	90.1%	86.3%	83.8%	80.7%	74.5%	74.5%
Piecemeal resection	94.6%	91.3%	89.7%	87.9%	84.2%	81.2%	80.0%	72.8%

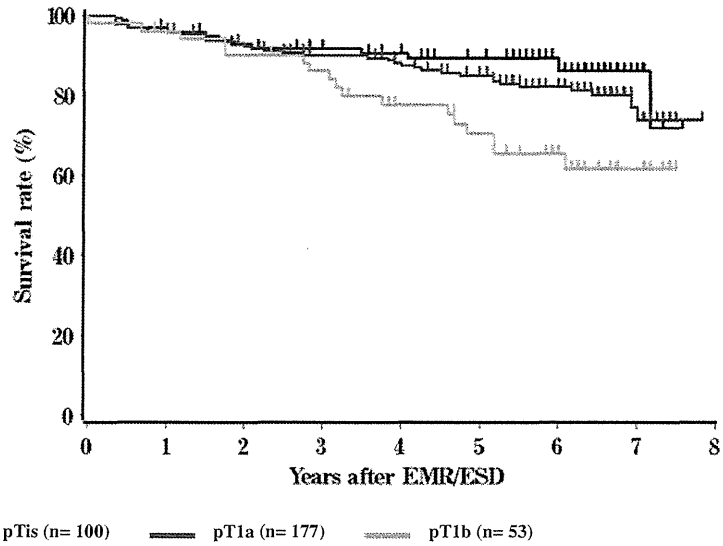

Fig. 3 Survival of patients treated by EMR/ESD in relation to the pathological depth of tumor invasion (pT)

	Years after EMR/ESD							
	1	2	3	4	5	6	7	8
pTis	95.9%	92.8%	91.8%	90.6%	89.4%	86.1%	86.1%	71.7%
pT1a	96.0%	92.5%	90.1%	87.6%	85.0%	82.1%	73.8%	73.8%
pT1b	96.2%	90.1%	86.0%	77.6%	70.4%	65.3%	61.5%	61.5%

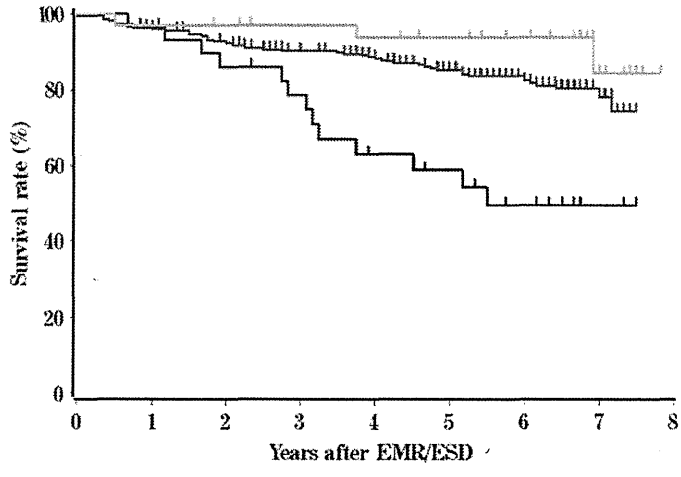

Fig. 4 Survival of patients treated by EMR/ESD in relation to the lymphatic or venous invasion

	Years after EMR/ESD							
	1	2	3	4	5	6	7	8
Lymphatic or venous invasion (+)	96.7%	85.9%	78.5%	62.9%	58.7%	49.3%	49.3%	49.3%
Lymphatic and venous invasion (-)	96.1%	92.4%	90.2%	88.2%	85.3%	82.4%	78.1%	74.2%
Unknown	97.1%	97.1%	97.1%	93.7%	93.7%	93.7%	84.3%	84.3%

III. Clinical results in patients treated with chemotherapy and/or radiotherapy in 2004

Table 34 Dose of irradiation with or without chemotherapy (non-surgically treated and curative cases)

Dose of irradiation (Gy)	Chemotherapy with (%)	Chemotherapy without (%)	Preope RT (%)	Postope RT (%)
0	0	0	0	0
-29	6 (1.2%)	4 (4.7%)	15 (4.9%)	9 (5.3%)
30-39	12 (2.4%)	3 (3.5%)	78 (25.3%)	15 (8.8%)
40-49	26 (5.3%)	5 (5.8%)	179 (58.1%)	43 (25.1%)
50-59	58 (11.8%)	4 (4.7%)	10 (3.2%)	42 (24.6%)
60-69	366 (74.4%)	61 (70.9%)	24 (7.8%)	60 (35.1%)
70-	24 (4.9%)	9 (10.5%)	2 (0.6%)	2 (1.2%)
Total	492	86	308	171
Median (min - max)	60 (2 - 106)	61 (8 - 84)	40 (1.2 - 96)	50 (1.2 - 70)
Missing	2	0	12	9

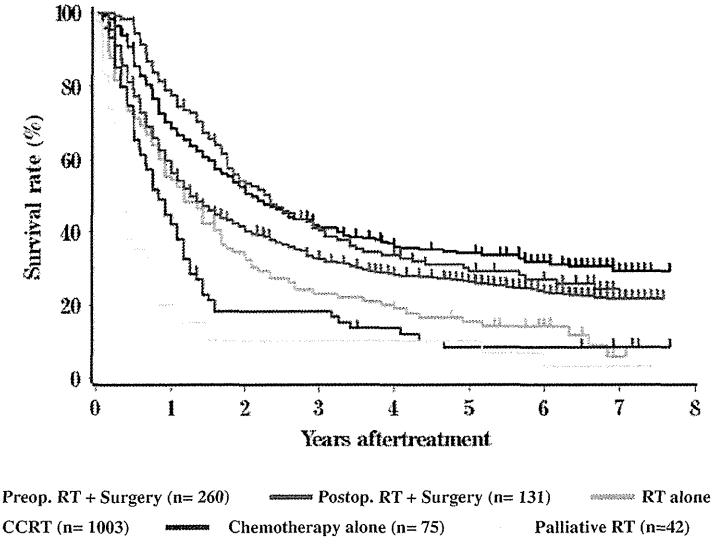

Fig. 5 Survival of patients treated by chemotherapy and/or radiotherapy

	Years after treatment							
	1	2	3	4	5	6	7	8
Preop. RT + Surgery	69.0%	51.0%	41.3%	36.1%	34.3%	31.9%	29.4%	29.4%
Postop. RT + Surgery	77.5%	53.5%	40.5%	33.8%	29.4%	27.2%	22.0%	22.0%
RT alone	54.4%	33.5%	23.2%	19.0%	15.5%	14.3%	6.0%	6.0%
CCRT	56.5%	40.7%	32.7%	28.3%	26.4%	23.7%	21.8%	21.8%
Chemotherapy alone	42.3%	18.3%	18.3%	13.7%	8.6%	8.6%	8.6%	8.6%
Palliative RT	20.4%	10.2%	10.2%	10.2%	10.2%	3.4%	3.4%	3.4%

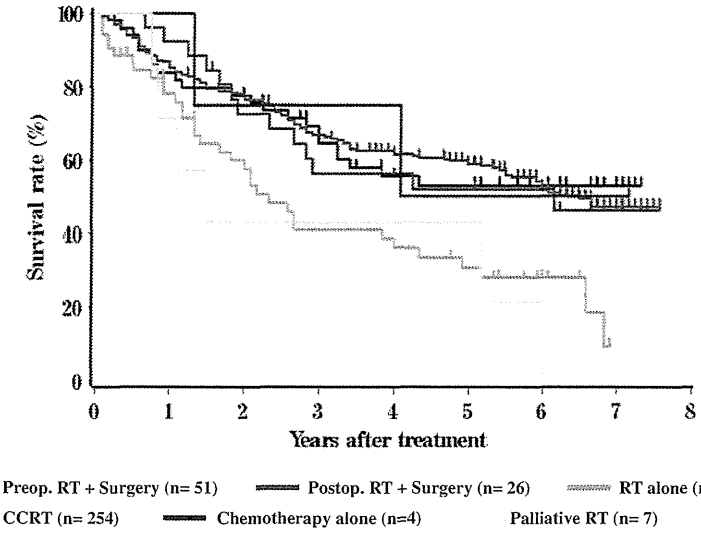

Fig. 6 Survival of patients treated by chemotherapy and/or radiotherapy (cStage I–IIA)

	Years after treatment							
	1	2	3	4	5	6	7	8
Preop. RT + Surgery	83.8%	77.7%	64.7%	55.6%	53.1%	53.1%	53.1%	53.1%
Postop. RT + Surgery	92.3%	72.5%	56.4%	52.1%	52.1%	52.1%	46.3%	46.3%
RT alone	78.0%	59.8%	41.1%	36.2%	30.8%	30.8%	28.0%	9.3%
CCRT	86.0%	77.5%	66.7%	61.6%	58.9%	52.4%	47.3%	47.3%
Chemotherapy alone	100.0%	75.0%	75.0%	75.0%	75.0%	50.0%	50.0%	50.0%
Palliative RT	71.4%	42.9%	42.9%	42.9%	42.9%	21.4%	-	-

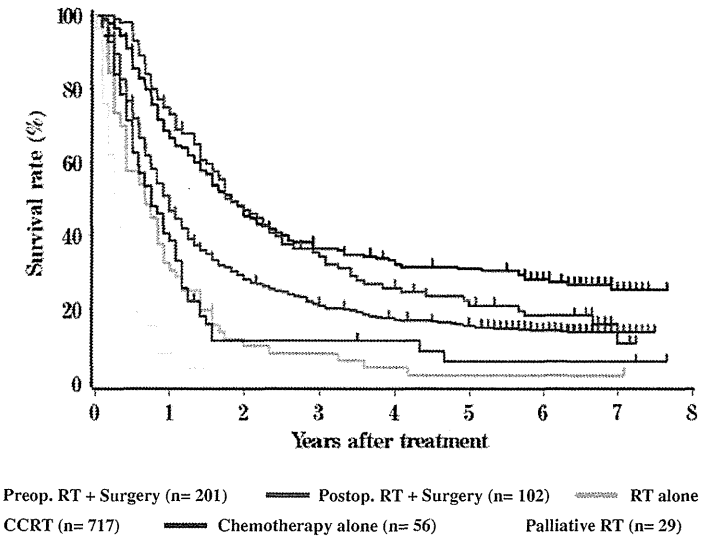

Fig. 7 Survival of patients treated by chemotherapy and/or radiotherapy (cStage IIB–IVB)

	Years after treatment							
	1	2	3	4	5	6	7	8
Preop. RT + Surgery	67.0%	45.9%	36.5%	32.1%	31.0%	28.1%	25.2%	25.2%
Postop. RT + Surgery	73.0%	47.0%	34.4%	25.8%	21.1%	18.2%	10.6%	10.6%
RT alone	30.5%	9.9%	7.9%	4.0%	2.0%	2.0%	2.0%	2.0%
CCRT	46.9%	28.2%	21.1%	17.1%	15.6%	14.2%	13.7%	13.7%
Chemotherapy alone	38.7%	11.3%	11.3%	11.3%	5.7%	5.7%	5.7%	5.7%
Palliative RT	7.8%	0.0%	-	-	-	-	-	-

IV. Clinical results in patients treated with esophagectomy in 2004

Table 45 Tumor location

Locations	Cases (%)	
Cervical	101	(3.8%)
Upper thotacic	298	(11.3%)
Middle thoracic	1242	(46.9%)
Lower thoracic	799	(30.2%)
Abdominal	148	(5.6%)
EG	24	(0.9%)
EG-Junction (E=G)	20	(0.8%)
Unknown	15	(0.6%)
Total lesions	2647	
Total cases	2647	
Missing	7	

EG: esophago-gastric

Table 46 Approaches to tumor resection

Approaches	Cases (%)	
Cervical approach	115	(4.3%)
Right thoracotomy	2143	(80.8%)
Left thoracotomy	43	(1.6%)
Left thoracoabdominal approach	61	(2.3%)
Laparotomy	86	(3.2%)
Transhiatal (without blunt dissection)	24	(0.9%)
Transhiatal (with blunt dissection)	74	(2.8%)
Sternotomy	14	(0.5%)
Others	79	(3.0%)
Unknown	14	(0.5%)
Total	2653	
Missing	16	

Table 47 Endoscopic surgery

Endoscopic surgery	Cases (%)	
None	2154	(81.8%)
Thoracoscopy-assisted	265	(10.1%)
Laparoscopy-assisted	81	(3.1%)
Thoracoscopy + Laparoscopy-assisted	108	(4.1%)
Mediastinoscopy-assisted	15	(0.6%)
Thoracoscopy + Mediastinoscopy-assisted	0	
Laparoscopy + Mediastinoscopy-assisted	1	(0.0%)
Others	3	(0.1%)
Unknown	7	(0.3%)
Total	2634	
Missing	35	

Table 48 Fields of lymph node dissection according to the location of the tumor

*** Excluding pharynx and missing 35 cases of locations**

Locations	Cevical		Upper thoracic		Middle thoracic		Lower thoracic		Abdominal		EGJ		Total	
Region of lymphadenectomy	Cases	(%)	Cases	(%)	Cases	(%)	Cases	(%)	Cases	(%)	Cases	(%)	Cases	(%)
None	10	(10.0%)	18	(6.1%)	46	(3.7%)	22	(2.8%)	5	(3.4%)	0		101	(3.9%)
C	31	(31.0%)	0		9	(0.7%)	4	(0.5%)	0		0		44	(1.7%)
C+UM	23	(23.0%)	4	(1.4%)	0		1	(0.1%)	0		0		28	(1.1%)
C+UM+MLM	4	(4.0%)	7	(2.4%)	19	(1.5%)	5	(0.6%)	0		0		35	(1.3%)
C+UM+MLM+A	22	(22.0%)	179	(60.7%)	532	(43.1%)	258	(32.3%)	17	(11.4%)	2	(4.5%)	1010	(38.6%)
C+UM+A	2	(2.0%)	5	(1.7%)	1	(0.1%)	0		0		0		8	(0.3%)
C+MLM	0		0		0		0		0		0		0	
C+MLM+A	1	(1.0%)	1	(0.3%)	3	(0.2%)	3	(0.4%)	0		0		8	(0.3%)
C+A	2	(2.0%)	1	(0.3%)	2	(0.2%)	1	(0.1%)	0		0		6	(0.2%)
UM	0		1	(0.3%)	3	(0.2%)	4	(0.5%)	1	(0.7%)	0		9	(0.3%)
UM+MLM	0		3	(1.0%)	22	(1.8%)	7	(0.9%)	4	(2.7%)	0		36	(1.4%)
UM+MLM+A	2	(2.0%)	65	(22.0%)	523	(42.4%)	353	(44.2%)	39	(26.2%)	7	(15.9%)	989	(37.8%)
UM+A	0		0		3	(0.2%)	2	(0.3%)	0		0		5	(0.2%)
MLM	0		0		8	(0.6%)	7	(0.9%)	0		0		15	(0.6%)
MLM+A	1	(1.0%)	7	(2.4%)	44	(3.6%)	98	(12.3%)	57	(38.3%)	21	(47.7%)	228	(8.7%)
A	0		3	(1.0%)	10	(0.8%)	29	(3.6%)	25	(16.8%)	14	(31.8%)	81	(3.1%)
Unknown	2	(2.0%)	1	(0.3%)	8	(0.6%)	4	(0.5%)	1	(0.7%)	0		16	(0.6%)
Total	100		295		1233		798		149		44		2619	
Missing	1		3		9		1		1		0		15	

C: bilateral cervical nodes

UM: upper mediastinal nodes

MLM: middle-lower mediastinal nodes

A: abdominal nodes

Table 49 Extent of lymph node dissection

Grade of dissection (D)	Cases	(%)
DX	42	(1.6%)
D0	127	(4.8%)
DI	355	(13.4%)
DII	1234	(46.7%)
DIII	885	(33.5%)
Total	2643	
Missing	26	

Table 50 Reconstruction route

Reconstruction route	Cases	(%)
None	40	(1.6%)
Antethoracic	236	(9.2%)
Retrosternal	919	(36.0%)
Intrathoracic	419	(16.4%)
Posterior mediastinal	906	(35.5%)
Others	21	(0.8%)
Unknown	12	(0.5%)
Total	2553	
Missing	73	

Table 51 Organs used for reconstruction

Organs used for reconstruction	Cases	(%)
None	49	(1.8%)
Whole stomach	104	(3.8%)
Gastric tube	2189	(79.7%)
Jejunum	115	(4.2%)
Free jejunum	62	(2.3%)
Colon	99	(3.6%)
Free colon	22	(0.8%)
Skin graft	1	(0.0%)
Others	97	(3.5%)
Unknown	8	(0.3%)
Total lesions	2746	
Total cases	2655	
Missing	14	

Table 58 Histological classification

Histological classification	Cases (%)	
Not examined	6	(0.2%)
SCC	2337	(89.3%)
SCC	352	(13.5%)
Well diff.	517	(19.8%)
Moderately diff.	1067	(40.8%)
Poorly diff.	401	(15.3%)
Adenocarcinoma	73	(2.8%)
Barrett's adenocarcinoma	32	(1.2%)
Adenosquamous cell carcinoma	11	(0.4%)
(Co-existing)	3	(0.1%)
(Mucoepidermoid carcinoma)	1	(0.0%)
Adenoid cystic carcinoma	0	
Basaloid carcinoma	40	(1.5%)
Undiff. carcinoma (small cell)	9	(0.3%)
Undiff. carcinoma	2	(0.1%)
Other carcinoma	3	(0.1%)
Sarcoma	5	(0.2%)
Carcinosarcoma	17	(0.6%)
Malignant melanoma	10	(0.4%)
Dysplasia	10	(0.4%)
Other	24	(0.9%)
Unkown	33	(1.3%)
Total	2616	
Missing	53	

SCC: Squamous cell carcinoma

Table 59 Depth of tumor invasion

pT-category	Cases (%)	
pXT	16	(0.6%)
pT0	36	(1.4%)
pTis	47	(1.8%)
pT1a	231	(8.9%)
pT1b	601	(23.1%)
pT2	317	(12.2%)
pT3	1132	(43.5%)
pT4	184	(7.1%)
Other	0	
Unknown	36	(1.4%)
Total	2600	
Missing	69	

Table 60 Subclassification of superficial carcinoma

Subclassification	Cases (%)	
Not superficial carcinoma	1679	(65.4%)
m1 (ep)	43	(1.7%)
m2 (lpm)	73	(2.8%)
m3 (mm)	137	(5.3%)
sm1	86	(3.3%)
sm2	136	(5.3%)
sm3	242	(9.4%)
Unknown	172	(6.7%)
Total	2568	
Missing	101	

ep: epithelium

lpm: lamina propria mucosa mm: muscularis mucosa

Table 61 Pathological grading of lymph node metastasis

Lymph node metastasis	Cases (%)	
n (-)	1262	(49.1%)
n1 (+)	334	(13.0%)
n2 (+)	601	(23.4%)
n3 (+)	189	(7.4%)
n4 (+)	160	(6.2%)
Unknown	25	(1.0%)
Total	2571	
Missing	98	

Table 62 Numbers of the metastatic nodes

Numbers of lymph node metastasis	Cases (%)	
0	1181	(44.2%)
1-3	886	(33.2%)
4-7	351	(13.2%)
8-	216	(8.1%)
Unknown	35	(1.3%)
Total	2669	
Missing	0	

Table 63 Pathological findings of distant organ metastasis

Distant metastasias (M)	Cases (%)	
MX	44	(1.7%)
M0	2546	(96.0%)
M1	62	(2.3%)
Total	2652	
Missing	17	

Table 64 Residual tumor

Residual tumor (R)	Cases (%)	
RX	149	(5.7%)
R0	2138	(82.4%)
R1	170	(6.5%)
R2	139	(5.4%)
Unknown	0	
Total	2596	
Missing	73	

Table 75 Causes of death

Cause of death	Cases (%)	
Death due to recurrence	933	(73.5%)
Death due to other cancer	63	(5.0%)
Death due to other disease (rec+)	32	(2.5%)
Death due to other disease (rec-)	129	(10.2%)
Death due to other disease (rec?)	15	(1.2%)
Operative death*	35	(2.8%)
Hospital death**	57	(4.5%)
Unknown	5	(0.4%)
Total of death cases	1269	
Missing	6	

rec: recurrence

* **Operative death means death within 30 days after operation in or out of hospital.**

Operative mortality : 1.3%

** **Hospital death is defined as death during the same hospitalization, regardless of department at time of death.**

Hospital mortality : 2.1%

Follow-up period (years)	
Median (min - max)	3.25 (0.00 - 7.50)

Table 76 Initial recurrent lesion

Initial recurrence lesion of fatal cases	Cases (%)	
Lymph node	580	(35.0%)
Lung	242	(14.6%)
Liver	199	(12.0%)
Bone	119	(7.2%)
Brain	31	(1.9%)
Primary lesion	141	(8.5%)
Dissemination	92	(5.5%)
Anastomotic region	10	(0.6%)
Others	90	(5.4%)
Unknown	155	(9.3%)
Total of recurrence lesion	1659	
Total	1230	
Missing	47	

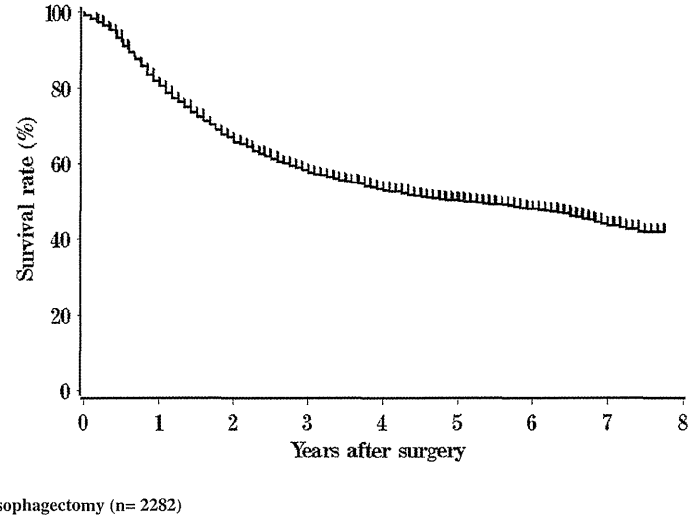

Fig. 8 Survival of patients treated by esophagectomy

	Years after surgery							
	1	2	3	4	5	6	7	8
Esophagectomy	80.7%	66.1%	57.7%	53.1%	50.2%	48.1%	43.8%	42.0%

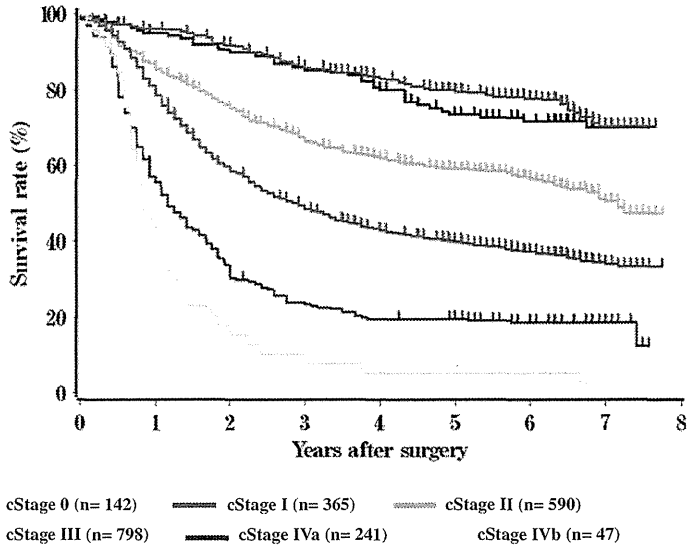

Fig. 9 Survival of patients treated by esophagectomy in relation to clinical stage (JSED-cTNM 9th)

	Years after surgery							
	1	2	3	4	5	6	7	8
cStage 0	95.0%	89.7%	85.3%	79.9%	73.4%	71.4%	69.8%	69.8%
cStage I	96.0%	91.7%	85.7%	83.0%	79.5%	77.7%	70.2%	70.2%
cStage II	85.5%	75.0%	66.3%	61.9%	58.9%	56.6%	50.4%	47.2%
cStage III	79.0%	58.9%	48.5%	42.8%	39.8%	37.3%	34.1%	33.3%
cStage IVa	55.6%	30.8%	23.4%	19.5%	19.5%	18.5%	18.5%	12.3%
cStage IVb	43.5%	17.8%	10.2%	5.1%	5.1%	5.1%	0.0%	-

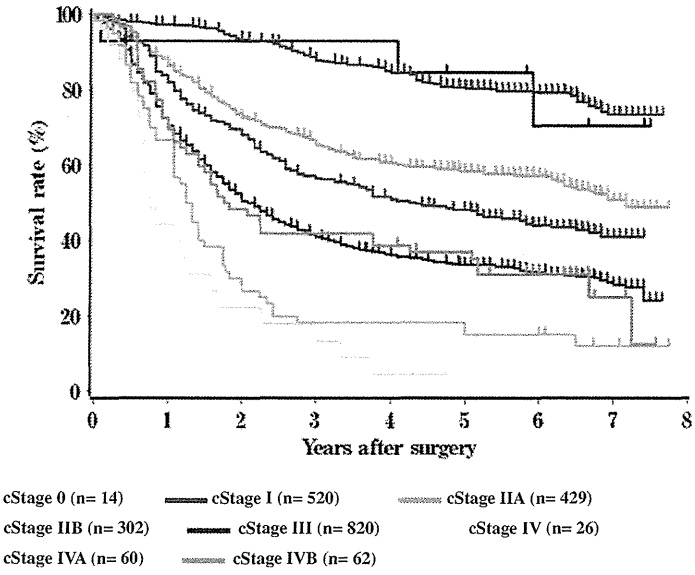

Fig. 10 Survival of patients treated by esophagectomy in relation to clinical stage (UICC-cTNM 5th)

	Years after surgery							
	1	2	3	4	5	6	7	8
cStage 0	92.9%	92.9%	92.9%	92.9%	84.4%	70.3%	70.3%	70.3%
cStage I	97.2%	93.4%	87.8%	84.6%	80.5%	79.2%	73.4%	73.4%
cStage IIA	86.8%	72.7%	65.4%	60.5%	58.3%	57.3%	50.7%	48.8%
cStage IIB	82.1%	68.0%	56.9%	50.9%	48.3%	44.0%	41.1%	41.1%
cStage III	70.6%	51.1%	40.9%	36.0%	33.5%	31.6%	28.2%	24.1%
cStage IV	44.2%	22.1%	17.7%	4.4%	4.4%	-	-	-
cStage IVA	66.7%	28.3%	18.3%	18.3%	15.0%	15.0%	12.0%	12.0%
cStage IVB	69.4%	48.4%	41.9%	38.7%	37.0%	31.1%	24.9%	12.4%

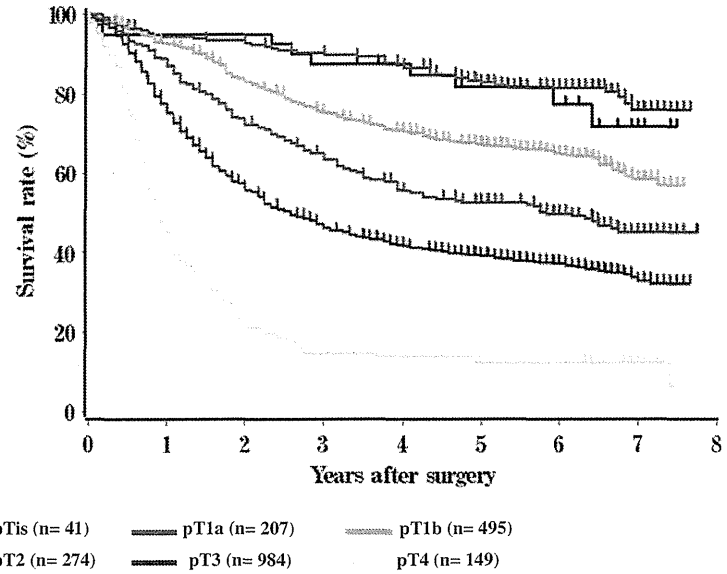

Fig. 11 Survival of patients treated by esophagectomy in relation to the depth of tumor invasion (JSED-pTNM 9th: pT)

	Years after surgery							
	1	2	3	4	5	6	7	8
pTis	95.1%	95.1%	87.6%	87.6%	81.8%	77.3%	71.7%	71.7%
pT1a	94.5%	93.0%	89.8%	86.7%	82.8%	81.5%	75.9%	75.9%
pT1b	92.7%	83.1%	75.3%	70.5%	67.3%	64.9%	58.6%	57.0%
pT2	87.0%	72.2%	63.8%	55.5%	52.6%	49.8%	45.2%	45.2%
pT3	75.5%	56.2%	46.3%	41.7%	39.2%	37.3%	32.9%	32.2%
pT4	45.0%	21.8%	14.6%	13.8%	12.3%	12.3%	12.3%	6.1%

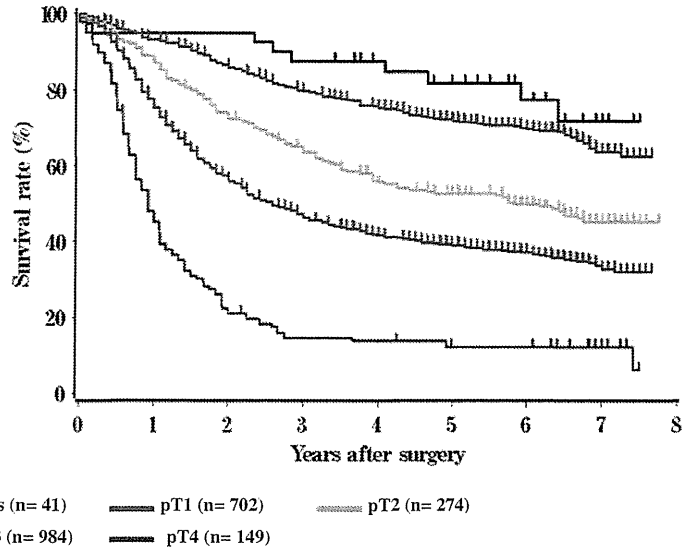

Fig. 12 Survival of patients treated by esophagectomy in relation to the depth of tumor invasion (UICC-pTNM 5th: pT)

	Years after surgery							
	1	2	3	4	5	6	7	8
pTis	95.1%	95.1%	87.6%	87.6%	81.8%	77.3%	71.7%	71.7%
pT1	93.2%	86.0%	79.6%	75.2%	71.8%	69.8%	63.7%	62.6%
pT2	87.0%	72.2%	63.8%	55.5%	52.6%	49.8%	45.2%	45.2%
pT3	75.5%	56.2%	46.3%	41.7%	39.2%	37.3%	32.9%	32.2%
pT4	45.0%	21.8%	14.6%	13.8%	12.3%	12.3%	12.3%	6.1%

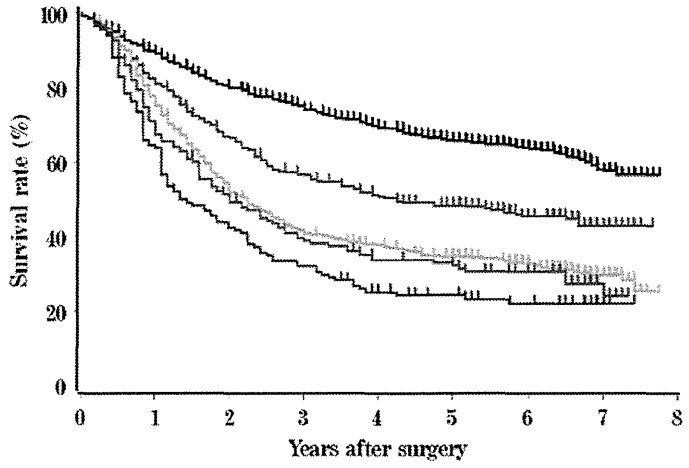

Fig. 13 Survival of patients treated by esophagectomy in relation to lymph node metastasis (JSED-pTNM 9th: pN)

	Years after surgery							
	1	2	3	4	5	6	7	8
pN0	89.2%	80.1%	74.3%	69.5%	65.9%	63.9%	57.8%	56.6%
pN1	81.5%	67.2%	56.6%	50.9%	48.6%	45.6%	43.0%	43.0%
pN2	75.2%	52.5%	41.0%	37.7%	34.8%	33.0%	29.9%	25.3%
pN3	68.3%	50.8%	38.9%	33.9%	32.3%	30.7%	24.1%	24.1%
pN4	64.0%	42.5%	32.1%	25.2%	24.3%	22.2%	22.2%	22.2%

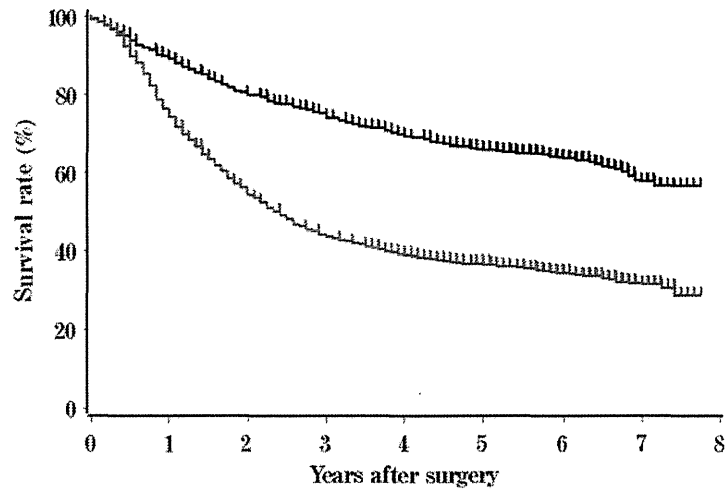

Fig. 14 Survival of patients treated by esophagectomy in relation to lymph node metastasis (UICC-pTNM 5th: pN)

	Years after surgery							
	1	2	3	4	5	6	7	8
pN0	89.2%	80.1%	74.3%	69.5%	65.9%	63.9%	57.8%	56.6%
pN1	74.5%	54.8%	43.6%	39.1%	36.7%	34.6%	31.7%	28.8%

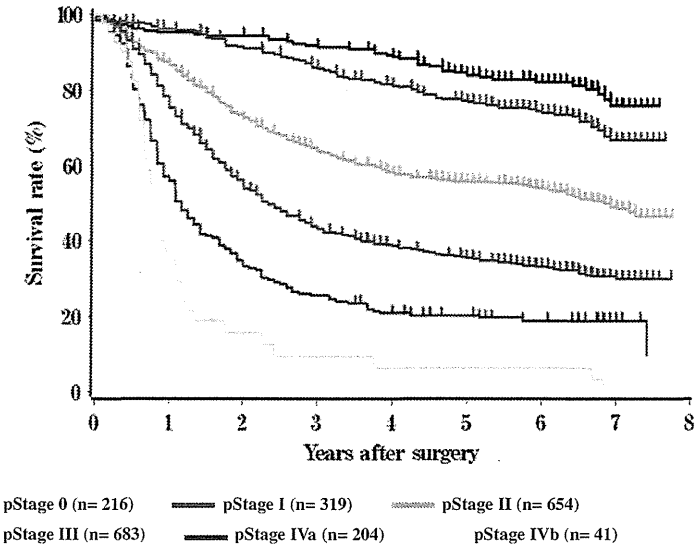

Fig. 15 Survival of patients treated by esophagectomy in relation to pathological stage (JSED-pTNM 9th)

	Years after surgery							
	1	2	3	4	5	6	7	8
pStage 0	95.2%	94.2%	91.2%	88.7%	83.9%	82.0%	75.7%	75.7%
pStage I	96.1%	91.1%	85.7%	81.2%	76.8%	73.9%	66.6%	66.6%
pStage II	86.5%	72.4%	63.5%	57.7%	55.6%	53.9%	48.4%	46.4%
pStage III	75.6%	54.3%	43.0%	38.5%	35.4%	33.1%	29.9%	29.9%
pStage IVa	55.9%	33.6%	25.5%	20.8%	20.2%	18.8%	18.8%	9.4%
pStage IVb	34.6%	15.5%	9.3%	6.2%	6.2%	6.2%	0.0%	-

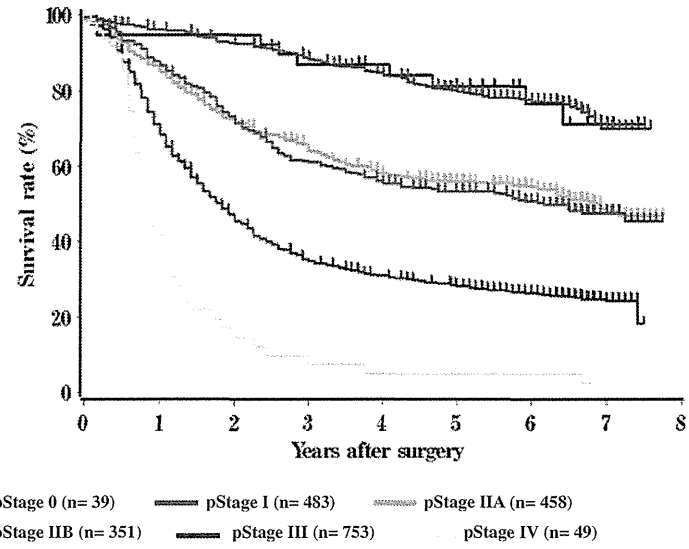

Fig. 16 Survival of patients treated by esophagectomy in relation to pathological stage (UICC-pTNM 5th)

	Years after surgery							
	1	2	3	4	5	6	7	8
pStage 0	94.8%	94.8%	86.9%	86.9%	81.0%	76.5%	71.0%	71.0%
pStage I	96.1%	92.4%	88.3%	84.2%	79.6%	77.2%	70.0%	70.0%
pStage IIA	85.2%	71.6%	64.1%	57.9%	55.9%	54.6%	48.0%	46.8%
pStage IIB	86.7%	71.4%	61.1%	55.4%	53.2%	50.6%	47.5%	45.4%
pStage III	68.6%	46.0%	34.9%	31.0%	28.3%	26.4%	24.3%	18.2%
pStage IV	41.6%	17.0%	9.7%	4.9%	4.9%	4.9%	0.0%	-

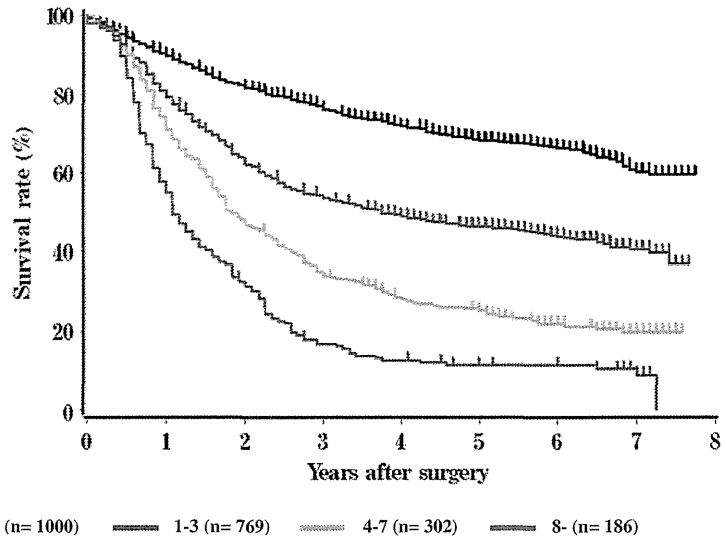

Fig. 17 Survival of patients treated by esophagectomy in relation to number of metastatic node

	Years after surgery							
	1	2	3	4	5	6	7	8
0	89.7%	81.5%	75.9%	71.7%	68.2%	66.3%	60.3%	59.5%
1-3	79.4%	62.3%	53.6%	48.8%	46.4%	44.0%	40.6%	36.9%
4-7	71.3%	47.1%	33.9%	28.0%	25.2%	21.7%	19.7%	19.7%
8-	54.9%	31.8%	16.7%	12.5%	11.2%	11.2%	8.8%	0.0%

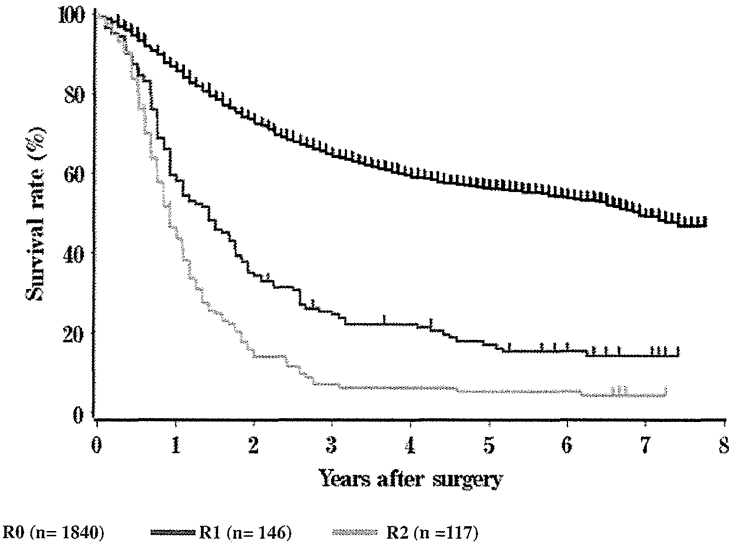

Fig. 18 Survival of patients treated by esophagectomy in relation to residual tumor (R)

	Years after surgery							
	1	2	3	4	5	6	7	8
R0	85.8%	72.7%	64.2%	59.1%	56.1%	53.8%	49.0%	46.8%
R1	58.1%	34.4%	24.6%	22.3%	17.2%	15.4%	14.3%	14.3%
R2	43.5%	14.2%	7.1%	6.2%	5.3%	5.3%	4.4%	-

Int. J. Radiation Oncology Biol. Phys., Vol. 82, No. 1, pp. e111–e117, 2012

0360-3016/$ - see front matter

ELSEVIER

doi:10.1016/j.ijrobp.2011.01.029

CLINICAL INVESTIGATION **Education and Training**

NATIONAL MEDICAL CARE SYSTEM MAY IMPEDE FOSTERING OF TRUE SPECIALIZATION OF RADIATION ONCOLOGISTS: STUDY BASED ON STRUCTURE SURVEY IN JAPAN

HODAKA NUMASAKI, PH.D.,* HITOSHI SHIBUYA, M.D.,† MASAMICHI NISHIO, M.D.,‡ HIROSHI IKEDA, M.D.,§ KENJI SEKIGUCHI, M.D.,‖ NORIHIKO KAMIKONYA, M.D.,¶ MASAHIKO KOIZUMI, M.D.,# MASAO TAGO, M.D.,** YUTAKA ANDO, M.D.,†† NOBUHIRO TSUKAMOTO, M.D.,‡‡ ATSURO TERAHARA, M.D.,§§ KATSUMASA NAKAMURA, M.D.,‖‖ MICHIHIDE MITSUMORI, M.D.,¶¶ TETSUO NISHIMURA, M.D.,## MASATO HAREYAMA, M.D.,*** TERUKI TESHIMA, M.D.*, AND JAPANESE SOCIETY OF THERAPEUTIC RADIOLOGY AND ONCOLOGY DATABASE COMMITTEE

*Department of Medical Physics and Engineering, Osaka University Graduate School of Medicine, Suita, Osaka, Japan; †Department of Radiology, Tokyo Medical and Dental University, Tokyo, Japan; ‡Department of Radiology, National Hospital Organization Hokkaido Cancer Center, Sapporo, Hokkaido, Japan; §Department of Radiology, Sakai Municipal Hospital, Sakai, Osaka, Japan; ‖Department of Radiation Oncology, St. Luke's International Hospital, Tokyo, Japan; ¶Department of Radiology, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan; #Oncology Center, Osaka University Hospital, Suita, Osaka, Japan; **Department of Radiology, Teikyo University School of Medicine University Hospital, Mizonokuchi, Kawasaki, Kanagawa, Japan; ††Department of Medical Informatics, Heavy Ion Medical Center, National Institute of Radiological Sciences, Chiba, Japan; ‡‡Department of Radiation Oncology, Saitama Medical University International Medical Center, Saitama, Japan; §§Department of Radiology, Toho University Omori Medical Center, Tokyo, Japan; ‖‖Department of Radiology, Kyushu University Hospital at Beppu, Oita, Japan; ¶¶Department of Radiation Oncology and Image-applied Therapy, Graduate School of Medicine Kyoto University, Kyoto, Japan; ##Division of Radiation Oncology, Shizuoka Cancer Center, Shizuoka, Japan; and ***Department of Radiology, Sapporo Medical University, Hokkaido, Japan

Purpose: To evaluate the actual work environment of radiation oncologists (ROs) in Japan in terms of working pattern, patient load, and quality of cancer care based on the relative time spent on patient care.

Methods and Materials: In 2008, the Japanese Society of Therapeutic Radiology and Oncology produced a questionnaire for a national structure survey of radiation oncology in 2007. Data for full-time ROs were crosschecked with data for part-time ROs by using their identification data. Data of 954 ROs were analyzed. The relative practice index for patients was calculated as the relative value of care time per patient on the basis of Japanese Blue Book guidelines (200 patients per RO).

Results: The working patterns of RO varied widely among facility categories. ROs working mainly at university hospitals treated 189.2 patients per year on average, with those working in university hospitals and their affiliated facilities treating 249.1 and those working in university hospitals only treating 144.0 patients per year on average. The corresponding data were 256.6 for cancer centers and 176.6 for other facilities. Geographically, the mean annual number of patients per RO per quarter was significantly associated with population size, varying from 143.1 to 203.4 ($p < 0.0001$). There were also significant differences in the average practice index for patients by ROs working mainly in university hospitals between those in main and affiliated facilities (1.07 vs 0.71: $p < 0.0001$).

Conclusions: ROs working in university hospitals and their affiliated facilities treated more patients than the other ROs. In terms of patient care time only, the quality of cancer care in affiliated facilities might be worse than that in university hospitals. Under the current national medical system, working patterns of ROs of academic facilities in Japan appear to be problematic for fostering true specialization of radiation oncologists. © 2012 Elsevier Inc.

Structure survey, Working pattern, Patient load, Quality of cancer care, Medical care system.

Reprint requests to: Teruki Teshima, M.D., 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

Supported by the Japanese Society of Therapeutic Radiology and Oncology (JASTRO) and Grants-in-Aid for Cancer Research (No. 18-4, 20S-5, and H19-3rd Term Cancer Control General-038) from the Ministry of Health, Labor and Welfare of Japan and by a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Sciences (No. 19390320 and 20591495).

Conflict of interest: none

Acknowledgments—We thank all radiation oncologists throughout Japan who participated in this survey for their efforts in providing us with valuable information to make this study possible.

Received Oct 15, 2010, and in revised form Dec 8, 2010. Accepted for publication Jan 12, 2011.

INTRODUCTION

The medical care systems of the United States and Japan are very different, which influences the personnel cost of medical staff. In radiation oncology, too, there is thus a major difference in personnel distribution between the United States and Japan. Most radiotherapy facilities in the United States are supported by full-time radiation oncologists (ROs), whereas the majority of radiotherapy facilities in Japan still rely on part-time ROs. Radiotherapy facilities with less than one full-time equivalent (FTE) RO on their staff still account for 56% nationwide (1). The Cancer Control Act was implemented in Japan in 2007 in response to patients' urgent petitions to the government (2). This act strongly advocates the promotion of radiotherapy (RT) and an increase in the number of ROs and medical physicists. However, a shortage of ROs still remains a major concern in Japan and will remain so for the foreseeable future.

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, 3). The structure of radiation oncology in Japan has improved in terms of equipment and its functions in response to the increasing number of cancer patients who require RT.

In this study, we used the data of the JASTRO structure survey of 2007 to evaluate the actual work environment of radiation oncologists in Japan in terms of working pattern, patient load, and the quality of cancer care based on the relative time spent on patient care.

MATERIALS AND METHODS

Between March and December 2008, JASTRO carried out a national structure survey of radiation oncology in the form of a questionnaire in 2007 (1). The questionnaire consisted of questions about the number of treatment machines and modality by type, the number of personnel by job category, the number of patients by type, and the site. The response rate was 721 of 765 (94.2%) from all actual RT facilities in Japan.

Table 1 shows the overview of radiation oncology in Japan. University hospitals accounted for 15.8% of all RT facilities and had 40.0% of the total full-time ROs and treated 29.5% of all patients. The corresponding data were 4.0%, 7.8%, and 10.2% for cancer centers, and 80.2%, 52.2%, and 60.3% for other RT hospitals, respectively. "Full-time/part-time" indicates the employment pattern of RO. In Japan, even full-time ROs must work part-time in smaller facilities such as other RT hospitals. We considered these numbers to be inappropriate for accurate assessment of personnel. For this survey, we therefore collected FTE (40 h/week for radiation oncology services only) data depending on hours worked in clinical RT of each RO. For example, if an RO works 3 days at a university hospital and 2 days at an affiliated hospital each week, FTE of the RO at the university hospital is 0.6 and at an affiliated hospital it is 0.4. The FTE of a facility that has three ROs with 0.8, 0.4, and 0.6 is calculated as 1.8 in total.

This survey collected the work situation data of a total of 1,007 full-time ROs and 534 part-time ROs. The data of full-time ROs were crosschecked with those of part-time ROs by using their identification data. Table 2 shows the result of crosschecking between data of full-time ROs and data of part-time ROs. In this study, data of 954 ROs were analyzed. Table 3 shows an overview of the analyzed data. In ROs working mainly in university hospitals, there are two ROs who worked at a maximum of six facilities (main facilities and five affiliated facilities) SAS 8.02 (SAS Institute Inc., Cary, NC) (4) was used for the statistical analysis, and the statistical significance was tested by means of the Student's *t*-test or analysis of variance.

The Japanese Blue Book guidelines (5, 6) for structure of radiation oncology in Japan based on Patterns of Care Study (PCS) data were used as the standard for comparison with the results of this study. PCS in Japan have been used since 1996 and have disclosed significant differences in the quality of RT by the type of facilities and their caseloads (7, 8). The standard guidelines for annual patient load per FTE RO have been set at 200 (warning level 300).

To evaluate quality of cancer care provided by ROs, the relative practice index for patients was calculated by the following expression.

$$\frac{\sum_{k=1}^{n} f_k}{\sum_{k=1}^{n} a_k} \times 200$$

in which n is the number of facilities that the RO works in ($n = 1, 2, 3, \ldots, k$), f_k is the FTE of the RO in facility k, and a_k is the annual number of patients per RO in facility k

Calculation method of coefficient "200:"

1) Number of weeks per year = (365–15)/7 = 50 weeks
   ※ Japan has 15 national holidays a year
2) 1.0 FTE = 40 h/week
3) Annual working hours of FTE 1.0 = 50 × 40 h = 2,000 h
4) Relative practice index for patients was normalized using the Blue Book guideline of 200 patients/FTE RO. For this guideline, care time per patient was set at 10 hours (2,000 h/200 patients).
5) Coefficient was 200 (2000/10).

RESULTS

Working patterns

Figure 1 shows working patterns of ROs working mainly in (a) university hospitals, (b) cancer centers, and (c) other

Table 1. Categorization of radiotherapy facilities in Japan

Facility category	Number of facilities	New patients	Total patients (new + repeat)	Full-time ROs		Part-time ROs	
				n	FTE	*n*	FTE
University hospital	114	50,351	60,555	403	293.0	70	21.6
Cancer center	29	16,794	20,968	78	73.7	14	2.5
Other radiotherapy hospital	578	103,084	123,564	526	351.8	450	83.7
Total	721	170,229	205,087	1,007	718.5	534	107.8

Abbreviations: RO = radiation oncologist; FTE = full-time equivalent (40 hours per week for radiation oncology services only).

Table 2. Connection between full-time and part-time RO data

Data of full-time ROs	
Total number	1,007
Number of full-time ROs excluded from this analysis*	53
Number of full-time ROs analyzed	954
Breakdown	
Number of ROs who worked as full-time staff at main facilities and as part-time staff at affiliated facilities	199
Number of ROs who conducted only radiotherapy-related work as full-time staff at individual facilities (FTE of the RO was 1.0)	275
Number of ROs who conducted radiotherapy-related and other work as full-time staff at individual facilities (FTE of the RO was less than 1.0)	480
Data of part-time ROs including duplicate ROs	
Total number	534
Number of ROs who worked as full-time staff at main facilities and as part-time staff at affiliated facilities (number of part-time ROs analyzed)	280
Number of ROs who worked as only part-time staff at the facilities (Number of part-time ROs excluded from this analysis)	254

Abbreviations: RO = radiation oncologist; FTE = full-time equivalent (40 hours per week for radiation oncology service only).
* Data of full-time ROs who worked at facilities with few patients were excluded, as were duplicated data of full-time ROs.

RT hospitals. The percentages of white parts in Figures 1 (a-c) were 17.4%, 5.0%, and 32.0%.

In university hospitals, the mean FTE RO for main facilities was 0.73 and for affiliated facilities it was 0.10. The corresponding figures were 0.94 and 0.01 for cancer centers, and 0.67 and 0.01 for other RT hospitals. For university hospitals, the ratio of ROs working only in main facilities was 16.4%, and the corresponding figures for cancer centers and other RT hospitals were 79.5% and 31.7%, respectively. The ratio of ROs working mainly in university hospitals and part-time in affiliated facilities was 44.5%. The corresponding data were 6.5% of ROs working primarily in cancer centers and 7.5% of ROs working mainly in other RT hospitals.

Patient loads

Figure 2(a) shows the patient load per RO working mainly in university hospitals, cancer centers, and other RT hospitals. Of ROs working primarily in university hospitals, 40.1% treated more than 200 patients per year. The corresponding ratios were 74.4% of ROs working primarily in cancer centers and 36.5% of those working mainly in other RT hospitals. The average number of patients treated by ROs working primarily in university hospitals was 189.2, with the corresponding figures being 256.6 patients in cancer centers and 176.6 in other RT hospitals. Figure 2(b) shows the patient load per RO working primarily in university hospitals. Of ROs working in university hospitals and affiliated facilities, 65.9% treated more than 200 patients per year, and the percentage was 19.3% of ROs working only in university hospitals. The former treated an average of 249.1 patients and the latter 144.0 patients per year.

The geographic patterns

Figure 3 shows the geographic distribution for 47 prefectures of the mean annual number of patients (new plus repeat) per RO arranged in order of increasing population by all prefectures in Japan (9). The average annual number of patients per RO per quarter ranged from 143.1 to 203.4, with significant differences among quarters ($p < 0.0001$). Figure 4 shows the top 10 prefectures with ROs who treated more than 200 patients per year in descending order: Tokyo, Osaka, Kanagawa, Hokkaido, Chiba, Aichi, Fukuoka, Hyogo, Miyagi, and Hiroshima.

Relative practice index for patients of ROs

Figure 5(a) shows the average relative practice index for patients of ROs in university hospitals and affiliated facilities (ROs working mainly in university hospitals). The average practice index of RO for patients was 1.07 at university hospitals and 0.71 at affiliated facilities for a statistically significant difference ($p < 0.0001$). Figure 5(b) shows the average relative practice index for patients of ROs working only in university hospitals, only in cancer centers, and only in other RT hospitals. The respective indices for the three categories were 1.26, 1.02, and 1.01. There were significant differences in the indices between university hospitals and cancer centers ($p = 0.0278$) and between university hospitals and other RT hospitals ($p < 0.0001$). The difference between cancer

Table 3. Overview of analyzed data

Main facility category	Number of full-time ROs working at main facilities	Number of part-time ROs working at affiliated facilities					
		First*	Second*	Third*	Fourth*	Fifth*	Subtotal
University hospital	372	160	59	14	4	2	239
Cancer center	78	5	0	0	0	0	5
Other radiotherapy hospital	504	34	2	0	0	0	36
Total	954	199	61	14	4	2	280

Abbreviation: RO = radiation oncologist.
* First: first affiliated facilities; second: second affiliated facilities; third: third affiliated facilities; fourth: fourth affiliated facilities; fifth: fifth affiliated facilities.