III. Clinical results in patients treated with chemotherapy and/or radiotherapy in 2006

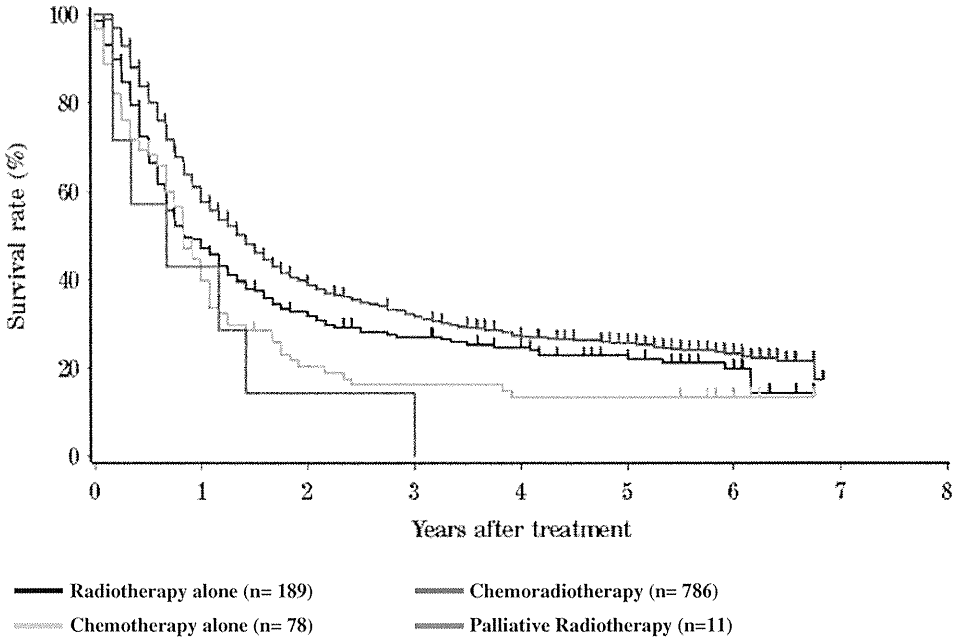
Table 33 Dose of irradiation (non-surgically treated cases)

Dose of irradiation (Gy)	Radiotherapy										
	alone (%)		with chemotherapy (%)		Palliative (%)		Recurrence (%)		Others (%)	Total (%)	
0	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	0	(0.0%)
-29	4	(1.3%)	5	(6.0%)	12	(13.2%)	4	(33.3%)	0	25	(5.1%)
30-39	5	(1.6%)	2	(2.4%)	10	(11.0%)	3	(25.0%)	0	20	(4.1%)
40-49	21	(6.9%)	5	(6.0%)	15	(16.5%)	0	(0.0%)	0	41	(8.3%)
50-59	45	(14.8%)	6	(7.1%)	19	(20.9%)	2	(16.7%)	0	72	(14.6%)
60-69	210	(68.9%)	54	(64.3%)	28	(30.8%)	2	(16.7%)	0	294	(59.8%)
70-	20	(6.6%)	12	(14.3%)	7	(7.7%)	1	(8.3%)	0	40	(8.1%)
Total	305		84		91		12		0	492	
Median (min - max)	60 (2 - 70)		61.7 (2 - 70)		50.4 (2.5 - 70)		34 (6 - 70)		-	60 (2 -70)	
Missing	12		0		3		0		0	15	

Table 34 Dose of irradiation (surgically treated cases)

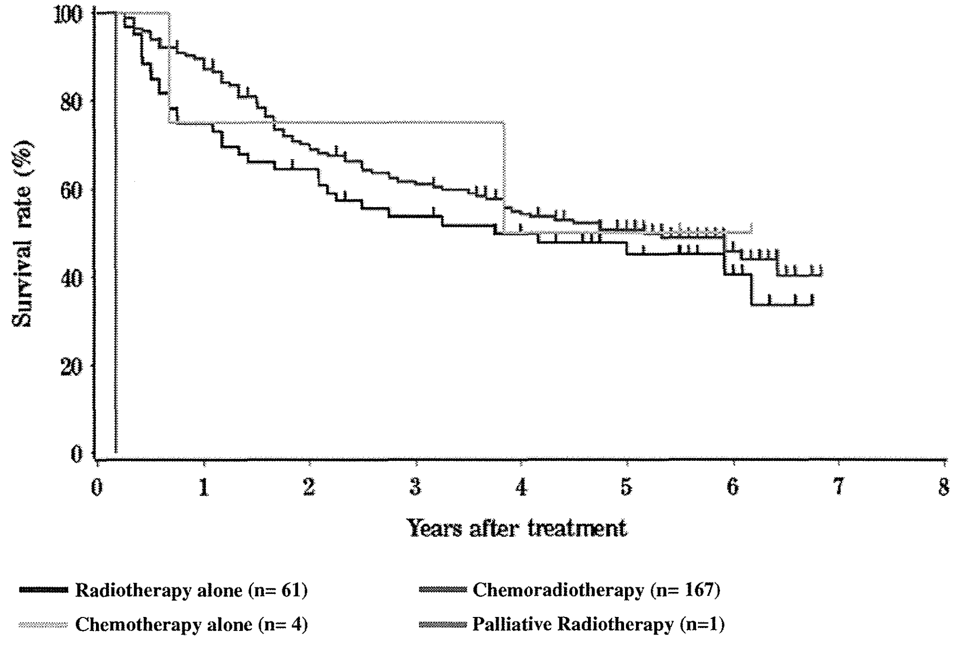
Dose of irradiation (Gy)	Preope RT (%)		Postope RT (%)	
0	0	(0.0%)	0	(0.0%)
-29	5	(2.8%)	1	(1.2%)
30-39	52	(29.1%)	10	(12.3%)
40-49	97	(54.2%)	29	(35.8%)
50-59	2	(1.1%)	21	(25.9%)
60-69	22	(12.3%)	19	(23.5%)
70-	1	(0.6%)	1	(1.2%)
Total	179		81	
Median (min - max)	40 (20 - 66)		50 (20 - 70)	
Missing	14		2	

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



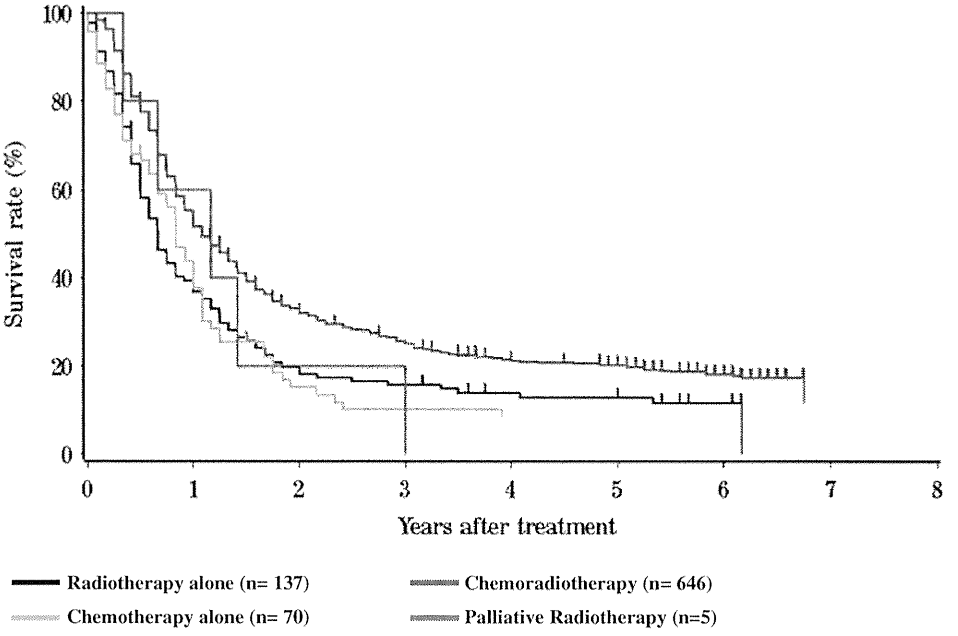
	Years after treatment							
	1	2	3	4	5	6	7	8
Radiotherapy alone	47.1%	32.8%	27.0%	24.7%	22.0%	19.9%	14.3%	-
Chemoradiotherapy	57.6%	39.7%	32.3%	27.4%	25.7%	23.2%	17.3%	-
Chemotherapy alone	28.9%	12.2%	9.1%	6.1%	3.0%	3.0%	3.0%	-
Palliative Radiotherapy	42.9%	14.3%	14.3%	-	-	-	-	-

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
Radiotherapy alone	74.8%	64.3%	53.5%	49.7%	45.0%	40.5%	33.7%	-
Chemoradiotherapy	87.2%	69.4%	61.6%	54.9%	50.6%	45.7%	40.1%	-
Chemotherapy alone	75.0%	75.0%	75.0%	50.0%	50.0%	50.0%	-	-
Palliative Radiotherapy	-	-	-	-	-	-	-	-

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
Radiotherapy alone	36.9%	19.9%	15.8%	13.9%	12.8%	11.7%	-	-
Chemoradiotherapy	51.6%	33.0%	25.7%	21.4%	20.3%	18.2%	-	-
Chemotherapy alone	37.8%	15.3%	10.2%	8.5%	8.5%	8.5%	-	-
Palliative Radiotherapy	60.0%	20.0%	0.0%	-	-	-	-	-

IV. Clinical results in patients treated with esophagectomy in 2006

Table 42 Tumor location

Locations	Cases (%)	
Cervical	81	(3.2%)
Upper thotacic	290	(11.5%)
Middle thoracic	1193	(47.2%)
Lower thoracic	734	(29.0%)
Abdominal	187	(7.4%)
EG	21	(0.8%)
EG-Junction (E=G)	18	(0.7%)
Unknown	4	(0.2%)
Total lesions	2528	
Total cases	2542	
Missing	3	

EG: esophago-gastric

Table 43 Approaches to tumor resection

Approaches	Cases (%)	
Cervical approach	113	(4.5%)
Right thoracotomy	2063	(81.3%)
Left thoracotomy	41	(1.6%)
Left thoracoabdominal approach	53	(2.1%)
Laparotomy	100	(3.9%)
Transhiatal lower esophagectomy	34	(1.3%)
Transhiatal thoracic esophagectomy	72	(2.8%)
Sternotomy	7	(0.3%)
Others	51	(2.0%)
Unknown	5	(0.2%)
Total	2539	
Missing	6	

Table 44 Endoscopic surgery

Endoscopic surgery	Cases (%)	
None	1994	(79.3%)
Thoracoscopy-assisted	234	(9.3%)
Laparoscopy-assisted	87	(3.5%)
Thoracoscopy + Laparoscopy-assisted	154	(6.1%)
Mediastinoscopy-assisted	34	(1.4%)
Thoracoscopy + Mediastinoscopy-assisted	0	
Laparoscopy + Mediastinoscopy-assisted	0	(0.0%)
Others	11	(0.4%)
Unknown	1	(0.0%)
Total	2515	
Missing	30	

Table 45 Fields of lymph node dissection according to the location of the tumor

*** Excluding pharynx and missing 16 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	13 (16.0%)	23 (8.0%)	56 (4.7%)	34 (4.7%)	7 (3.6%)	3 (7.7%)	136 (5.4%)
C	17 (21.0%)	3 (1.0%)	10 (0.8%)	2 (0.3%)	0 (0.0%)	0 (0.0%)	32 (1.3%)
C+UM	23 (28.4%)	1 (0.3%)	1 (0.1%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	26 (1.0%)
C+UM+MLM	3 (3.7%)	10 (3.5%)	26 (2.2%)	5 (0.7%)	0 (0.0%)	0 (0.0%)	44 (1.8%)
C+UM+MLM+A	16 (19.8%)	172 (59.9%)	610 (51.6%)	276 (37.8%)	20 (10.4%)	2 (5.1%)	1096 (43.6%)
C+UM+A	4 (4.9%)	1 (0.3%)	3 (0.3%)	5 (0.7%)	1 (0.5%)	0 (0.0%)	14 (0.6%)
C+MLM	17 (21.0%)	3 (1.0%)	12 (1.0%)	3 (0.4%)	1 (0.5%)	1 (2.6%)	37 (1.5%)
C+MLM+A	0 (0.0%)	1 (0.3%)	5 (0.4%)	6 (0.8%)	1 (0.5%)	0 (0.0%)	13 (0.5%)
C+A	2 (2.5%)	1 (0.3%)	2 (0.2%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	6 (0.2%)
UM	0 (0.0%)	1 (0.3%)	4 (0.3%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	6 (0.2%)
UM+MLM	0 (0.0%)	2 (0.7%)	16 (1.4%)	9 (1.2%)	2 (1.0%)	0 (0.0%)	29 (1.2%)
UM+MLM+A	2 (2.5%)	65 (22.6%)	393 (33.2%)	292 (40.0%)	42 (21.9%)	5 (12.8%)	799 (31.8%)
UM+A	1 (1.2%)	0 (0.0%)	2 (0.2%)	2 (0.3%)	1 (0.5%)	1 (2.6%)	7 (0.3%)
MLM	0 (0.0%)	0 (0.0%)	2 (0.2%)	1 (0.1%)	1 (0.5%)	1 (2.6%)	5 (0.2%)
MLM+A	0 (0.0%)	5 (1.7%)	40 (3.4%)	87 (11.9%)	88 (45.8%)	19 (48.7%)	239 (9.5%)
A	0 (0.0%)	2 (0.7%)	12 (1.0%)	7 (1.0%)	27 (14.1%)	8 (20.5%)	56 (2.2%)
Unknown	0 (0.0%)	0 (0.0%)	1 (0.1%)	2 (0.3%)	1 (0.5%)	0 (0.0%)	4 (0.2%)
Total	81	287	1183	730	192	39	2512
Missing	0	3	10	4	0	0	17

Table 47 Reconstruction route

Reconstruction route	Cases (%)	
None	41	(1.7%)
Subcutaneous	285	(11.7%)
Anterior mediastinal	868	(35.6%)
Intrathoracic	369	(15.1%)
Posterior mediastinal	828	(33.9%)
Cervical	23	(0.9%)
Others	18	(0.7%)
Unknown	9	(0.4%)
Total	2441	
Missing	15	

Table 48 Organs used for reconstruction

Organs used for reconstruction	Cases (%)	
None	46	(1.8%)
Whole stomach	109	(4.3%)
Gastric tube	1989	(77.6%)
Jejunum	103	(4.0%)
Free jejunum	46	(1.8%)
Colon	112	(4.4%)
Free colon	14	(0.5%)
Skin graft	1	(0.0%)
Others	140	(5.5%)
Unknown	3	(0.1%)
Total lesions	2563	
Total cases	2541	
Missing	4	

Table 55 Histological classification

Histological classification	Cases (%)	
Not examined	2	(0.1%)
SCC	2233	(88.3%)
SCC	348	(13.8%)
Well diff.	486	(19.2%)
Moderately diff.	1013	(40.1%)
Poorly diff.	386	(15.3%)
Adenocarcinoma	80	(3.2%)
Barrett's adenocarcinoma	42	(1.7%)
Adenosquamous cell carcinoma	11	(0.4%)
(Co-existing)	2	(0.1%)
(Mucoepidermoid carcinoma)	2	(0.1%)
Adenoid cystic carcinoma	2	(0.1%)
Basaloid carcinoma	37	(1.5%)
Undiff. carcinoma (small cell)	13	(0.5%)
Undiff. carcinoma	6	(0.2%)
Other carcinoma	7	(0.3%)
Sarcoma	0	(0.0%)
Carcinosarcoma	22	(0.9%)
Malignant melanoma	8	(0.3%)
Dysplasia	3	(0.1%)
Other	20	(0.8%)
Unkown	38	(1.5%)
Total	2528	
Missing	17	

SCC: Squamous cell carcinoma

Table 56 Depth of tumor invasion

pT-category	Cases (%)	
pTX	11	(0.4%)
pT0	38	(1.5%)
pTis	29	(1.1%)
pT1a	218	(8.6%)
pT1b	614	(24.3%)
pT2	375	(14.8%)
pT3	1066	(42.2%)
pT4	145	(5.7%)
Other	0	(0.0%)
Unknown	33	(1.3%)
Total	2529	
Missing	16	

Table 58 Pathological grading of lymph node metastasis (JSED TNM 9th)

Lymph node metastasis	Cases (%)	
pN0	1272	(51.5%)
pN1	333	(13.5%)
pN2	490	(19.8%)
pN3	164	(6.6%)
pN4	177	(7.2%)
Unknown	35	(1.4%)
Total	2471	
Missing	74	

Table 59 Numbers of the metastatic nodes

Numbers of lymph node metastasis	Cases (%)	
0	1057	(42.5%)
1-2	676	(27.2%)
3-6	487	(19.6%)
7-	268	(10.8%)
Total	2488	
Missing	57	

Table 60 Pathological findings of distant organ metastasis

Distant metastasias (M)	Cases (%)	
MX	27	(1.1%)
M0	2476	(97.6%)
M1	35	(1.4%)
Total	2538	
Missing	7	

Table 61 Residual tumor

Residual tumor (R)	Cases (%)	
RX	157	(6.2%)
R0	2103	(83.6%)
R1	132	(5.2%)
R2	124	(4.9%)
Unknown	0	(0.0%)
Total	2516	
Missing	29	

Table 72 Causes of death

*** As of August 31, 2010**

Cause of death	Cases (%)	
Death due to recurrence	891	(74.1%)
Death due to other cancer	52	(4.3%)
Death due to other disease (rec+)	22	(1.8%)
Death due to other disease (rec-)	138	(11.5%)
Death due to other disease (rec?)	15	(1.2%)
Operative death*	21	(1.7%)
Postoperative hospital death**	27	(2.2%)
Unknown	36	(3.0%)
Total of death cases	1202	
Missing	15	

rec: recurrence

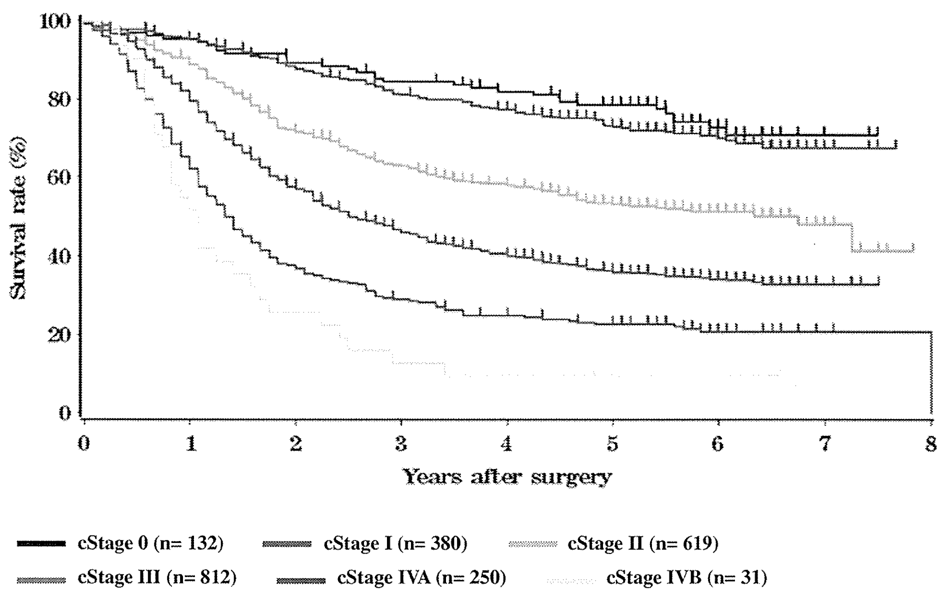
*** Death within 30 days, **Death after 30 days**

Follow-up period (years)	
Median (min - max)	2.75 (0.00 - 7.41)

Fig. 8 Survival of patients treated by esophagectomy

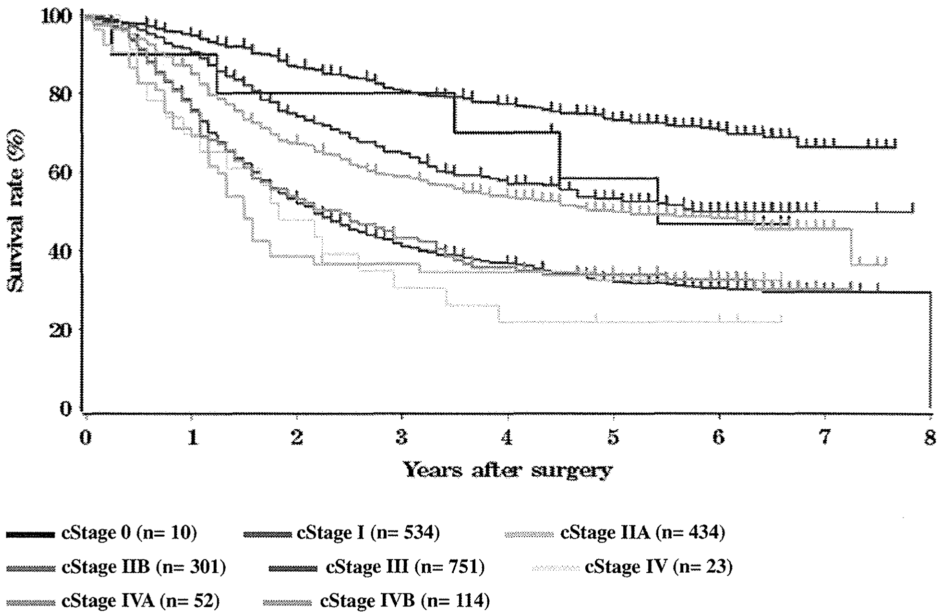
	Years after surgery							
	1	2	3	4	5	6	7	8
Esophagectomy	83.3%	66.1%	57.2%	52.2%	48.0%	45.9%	44.0%	41.9%

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



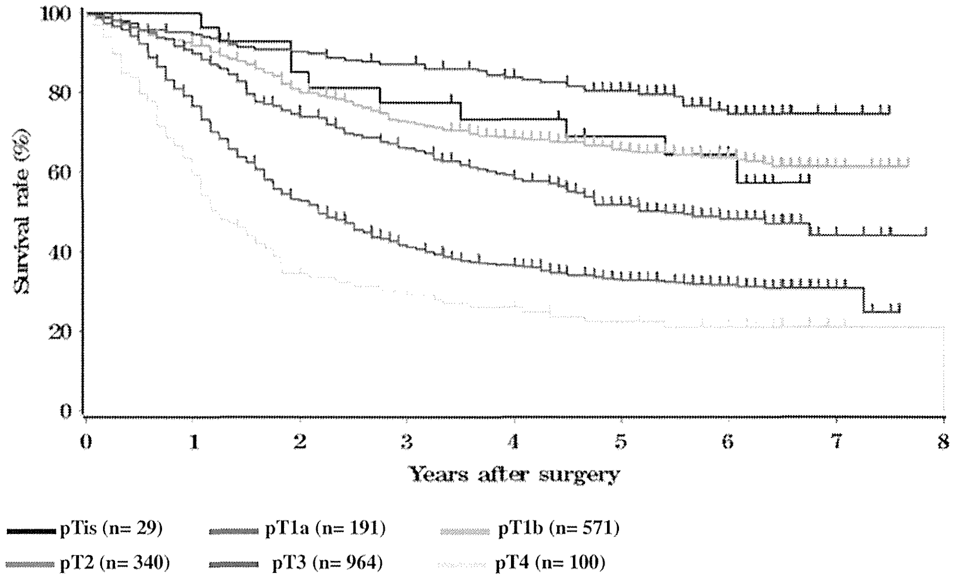
	Years after surgery							
	1	2	3	4	5	6	7	8
cStage 0	95.4%	89.3%	84.5%	82.1%	78.7%	72.9%	70.9%	-
cStage I	95.2%	88.2%	81.5%	77.5%	73.1%	70.3%	67.5%	-
cStage II	89.0%	72.3%	63.2%	58.6%	53.4%	51.4%	48.1%	41.2%
cStage III	79.7%	57.7%	46.9%	40.6%	36.1%	34.3%	32.9%	-
cStage IVA	62.2%	37.7%	29.1%	24.9%	22.6%	20.8%	20.8%	20.8%
cStage IVB	51.6%	25.8%	12.9%	9.7%	9.7%	9.7%	-	-

Fig. 10 Survival of patients treated by esophagectomy in relation to clinical stage (UICC TNM 6th)



	Years after surgery							
	1	2	3	4	5	6	7	8
cStage 0	90.0%	80.0%	80.0%	70.0%	58.3%	46.7%	46.7%	-
cStage I	94.7%	86.8%	80.9%	77.2%	73.0%	70.5%	66.2%	-
cStage IIA	85.1%	67.4%	58.8%	54.0%	49.9%	48.1%	45.5%	36.4%
cStage IIB	90.6%	74.8%	65.1%	58.0%	53.1%	49.9%	49.9%	49.9%
cStage III	75.6%	52.9%	41.7%	37.0%	32.0%	30.4%	29.5%	29.5%
cStage IV	69.6%	47.8%	30.4%	21.7%	21.7%	21.7%	-	-
cStage IVA	69.2%	38.5%	36.5%	34.5%	32.5%	32.5%	-	-
cStage IVB	75.3%	53.8%	43.0%	35.7%	33.8%	32.6%	30.1%	-

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



	Years after surgery							
	1	2	3	4	5	6	7	8
pTis	100.0%	85.1%	77.4%	73.3%	69.0%	64.4%	-	-
pT1a	94.7%	90.4%	87.1%	83.8%	80.4%	74.7%	74.7%	-
pT1b	92.0%	80.8%	72.9%	68.7%	65.6%	63.6%	61.4%	61.4%
pT2	89.9%	74.6%	66.3%	59.3%	51.7%	48.2%	44.0%	44.0%
pT3	76.6%	53.1%	41.7%	36.6%	32.8%	31.5%	30.8%	-
pT4	59.5%	34.6%	30.3%	26.0%	22.5%	21.2%	21.2%	21.2%

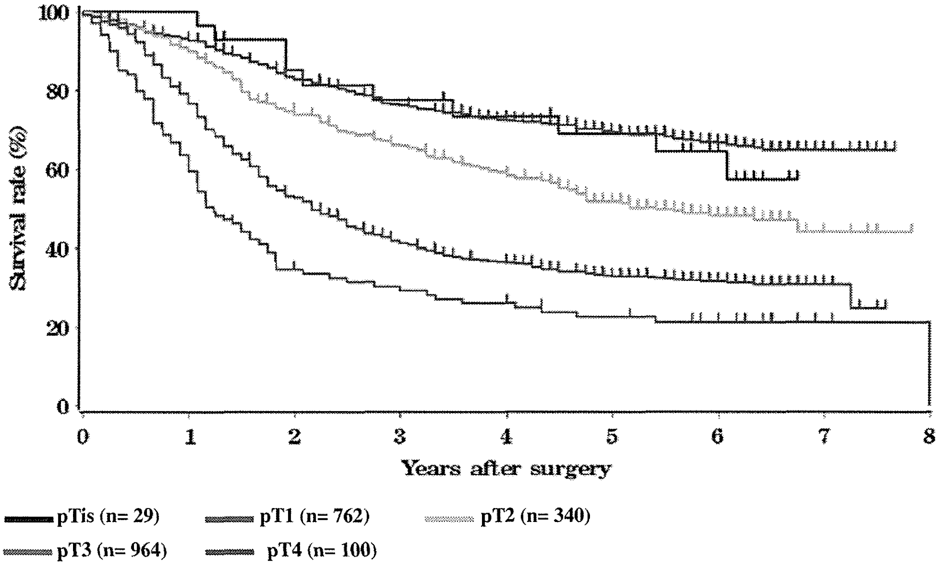
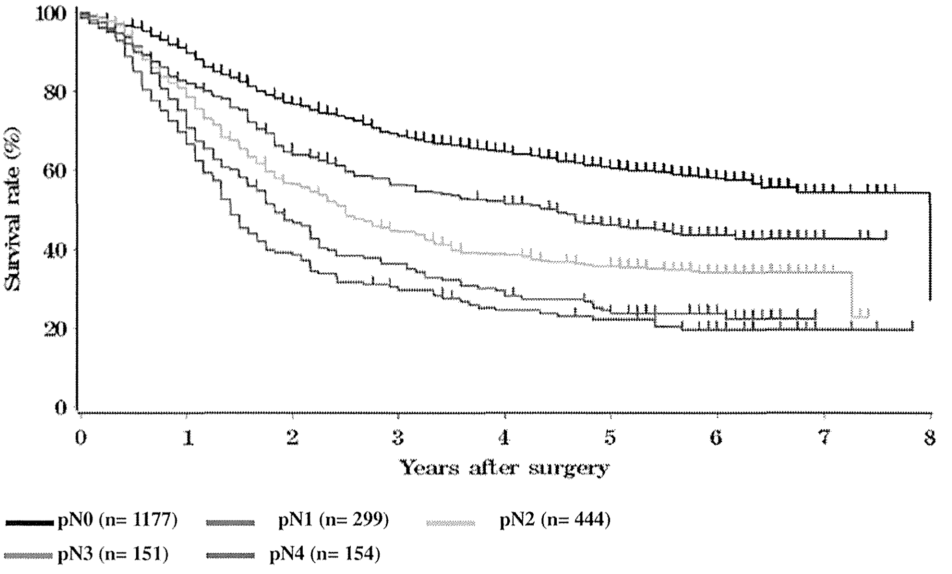


Fig. 12 Survival of patients treated by esophagectomy in relation to the depth of tumor invasion: pT (UICC TNM 6th)

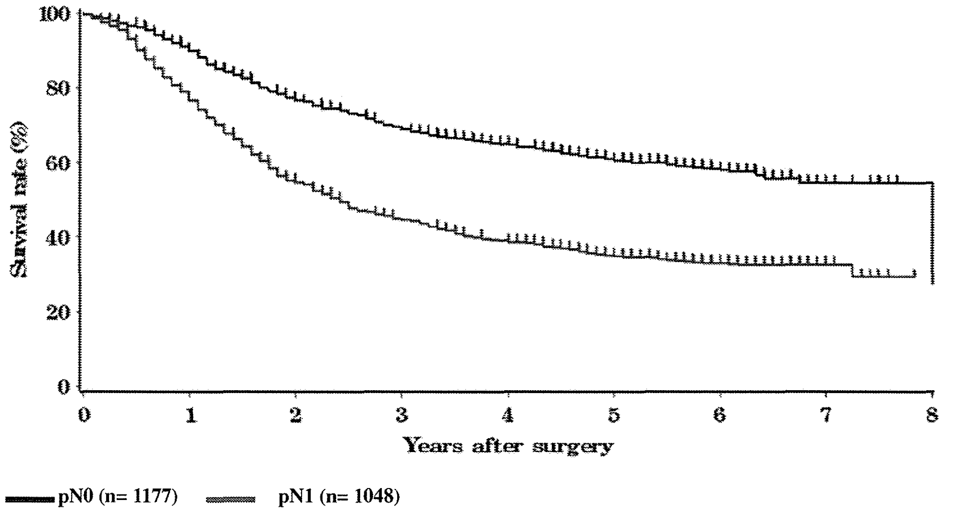
	Years after surgery							
	1	2	3	4	5	6	7	8
pTis	100.0%	85.1%	77.4%	73.3%	69.0%	64.4%	-	-
pT1	92.7%	83.3%	76.5%	72.6%	69.3%	66.5%	64.7%	64.7%
pT2	89.9%	74.6%	66.3%	59.3%	51.7%	48.2%	44.0%	44.0%
pT3	76.6%	53.1%	41.7%	36.6%	32.8%	31.5%	30.8%	-
pT4	59.5%	34.6%	30.3%	26.0%	22.5%	21.2%	21.2%	21.2%

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



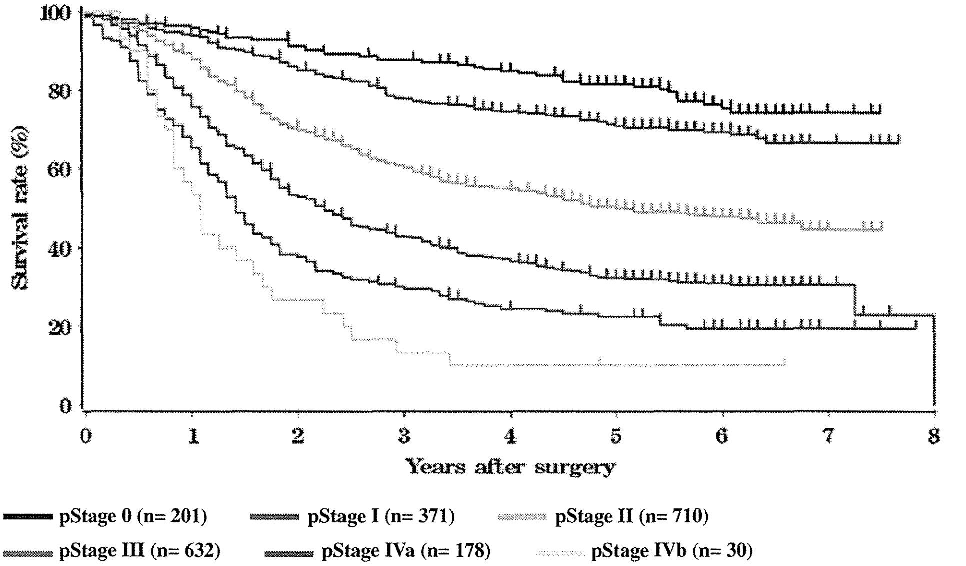
	Years after surgery							
	1	2	3	4	5	6	7	8
pN0	89.8%	77.1%	69.4%	64.9%	60.4%	57.9%	54.3%	54.3%
pN1	82.1%	64.5%	56.4%	52.1%	46.1%	43.4%	42.5%	42.5%
pN2	78.7%	56.5%	44.7%	38.7%	35.7%	34.0%	34.0%	22.7%
pN3	70.7%	47.2%	36.3%	29.4%	23.7%	23.7%	22.4%	-
pN4	66.5%	39.1%	30.3%	24.4%	22.1%	19.5%	19.5%	19.5%

Fig. 14 Survival of patients treated by esophagectomy in relation to lymph node metastasis: pN (UICC TNM 6th)



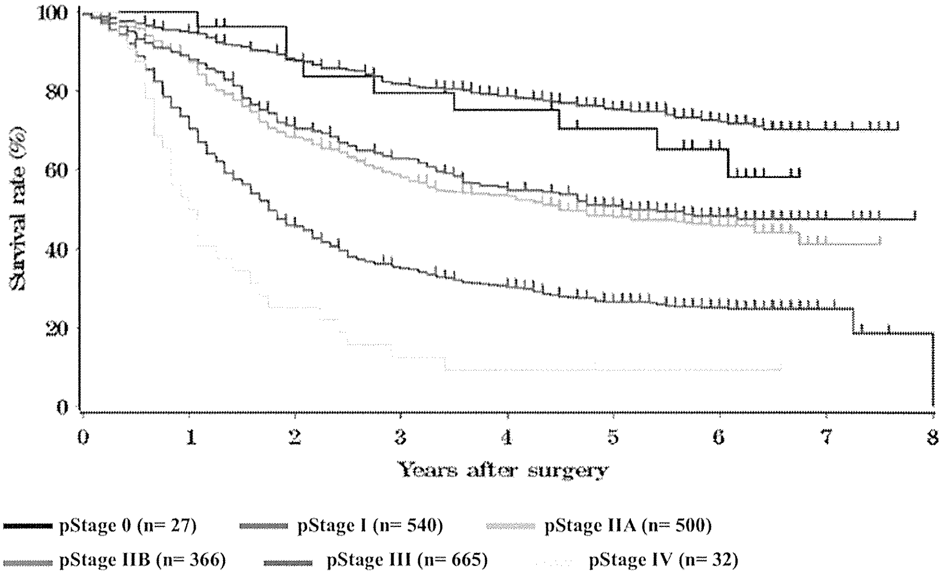
	Years after surgery							
	1	2	3	4	5	6	7	8
pN0	89.8%	77.1%	69.4%	64.9%	60.4%	57.9%	54.3%	54.3%
pN1	76.7%	54.9%	44.7%	39.1%	34.9%	33.0%	32.5%	29.3%

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



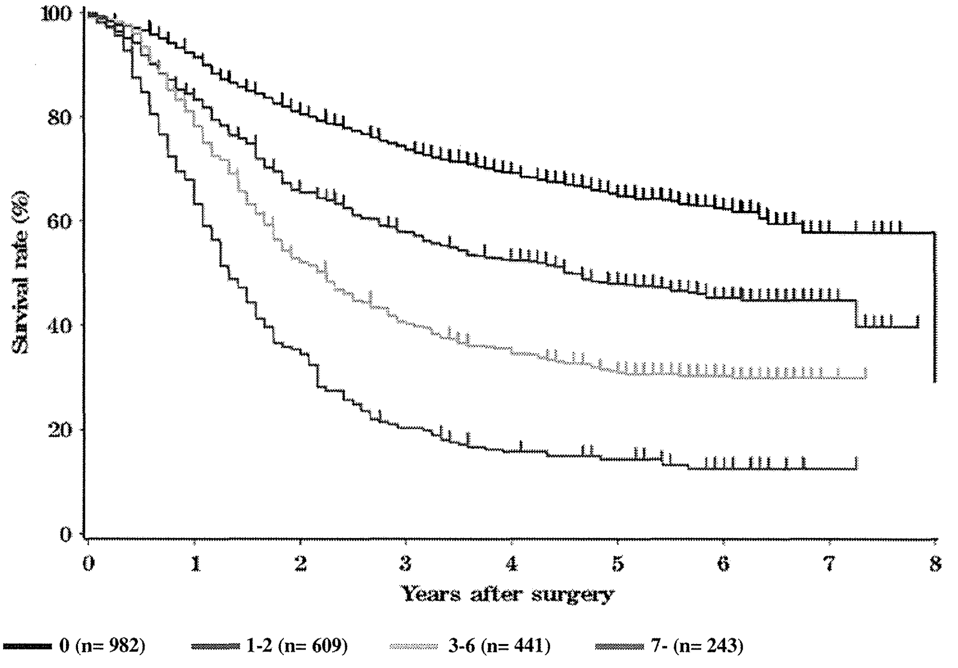
	Years after surgery							
	1	2	3	4	5	6	7	8
pStage 0	96.0%	91.3%	87.7%	85.0%	81.6%	75.5%	74.3%	74.3%
pStage I	94.0%	85.8%	78.1%	74.6%	71.0%	69.5%	66.5%	66.5%
pStage II	88.0%	70.3%	60.8%	55.2%	50.0%	47.8%	44.4%	44.4%
pStage III	75.8%	53.2%	42.9%	37.3%	32.4%	31.1%	30.7%	23.0%
pStage IVa	65.4%	38.3%	30.2%	24.6%	22.5%	19.6%	19.6%	19.6%
pStage IVb	53.3%	26.7%	17.1%	13.3%	10.0%	10.0%	10.0%	-

Fig. 16 Survival of patients treated by esophagectomy in relation to pathological stage (UICC TNM 6th)



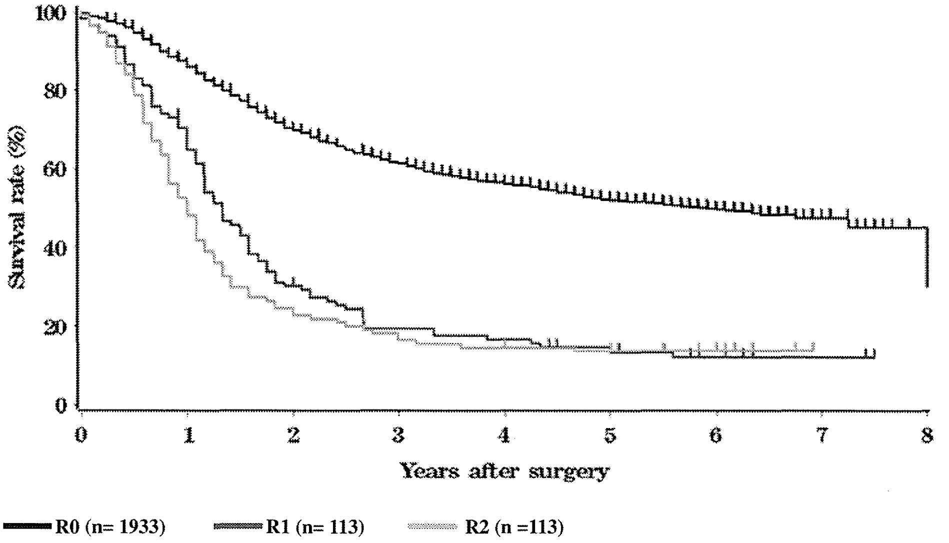
	Years after surgery							
	1	2	3	4	5	6	7	8
pStage 0	96.2%	87.8%	79.4%	75.0%	70.3%	65.3%	58.1%	-
pStage I	94.7%	88.0%	81.8%	78.6%	75.3%	72.2%	70.1%	70.1%
pStage IIA	87.3%	68.5%	58.9%	53.5%	47.9%	45.9%	41.1%	41.1%
pStage IIB	87.8%	71.2%	62.9%	55.6%	50.7%	48.2%	47.5%	47.5%
pStage III	70.3%	45.7%	35.3%	30.6%	26.5%	25.0%	24.7%	18.5%
pStage IV	50.0%	25.0%	12.5%	9.4%	9.4%	9.4%	-	-

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	91.4%	81.0%	74.4%	69.4%	64.8%	62.2%	57.8%	57.8%
1-2	83.3%	65.7%	57.9%	52.6%	47.9%	45.2%	44.8%	39.8%
3-6	78.3%	52.6%	40.7%	35.5%	30.9%	30.3%	29.8%	29.8%
7-	63.1%	35.4%	20.2%	15.7%	14.3%	12.5%	12.5%	12.5%

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	86.1%	70.3%	61.6%	56.5%	52.0%	49.6%	47.5%	45.0%
R1	64.9%	30.2%	19.5%	16.5%	13.5%	12.1%	12.1%	12.1%
R2	48.0%	24.5%	18.1%	14.5%	13.5%	13.5%	13.5%	-

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Japanese Structure Survey of High-precision Radiotherapy in 2012 Based on Institutional Questionnaire about the Patterns of Care

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Objective: The purpose of this study was to clarify operational situations, treatment planning and processes, quality assurance and quality control with relevance to stereotactic radiotherapy, intensity-modulated radiotherapy and image-guided radiotherapy in Japan.
Methods: We adopted 109 items as the quality indicators of high-precision radiotherapy to prepare a questionnaire. In April 2012, we started to publicly open the questionnaire on the website, requesting every institution with radiotherapy machines for response. The response ratio was 62.1% (490 out of 789 institutions responded).
Results: Two or more radiotherapy technologists per linear accelerator managed linear accelerator operation in ~90% of the responded institutions while medical physicists/radiotherapy quality managers were engaged in the operation in only 64.9% of the institutions. Radiotherapy certified nurses also worked in only 18.4% of the institutions. The ratios of the institutions equipped for stereotactic radiotherapy of lung tumor, intensity-modulated radiotherapy and image-guided radiotherapy were 43.3, 32.6 and 46.8%, respectively. In intensity-modulated radiotherapy planning, radiation oncologists were usually responsible for delineation while medical physicists/radiotherapy quality managers or radiotherapy technologists set up beam in 33.3% of the institutions. The median time required for quality assurance of intensity-modulated radiotherapy at any site of brain, head and neck and prostate was 4 h. Intensity-modulated radiotherapy quality assurance activity had to be started after clinical hours in >60% of the institutions.
Conclusions: This study clarified one major issue in the current high-precision radiotherapy in Japan. A manpower shortage should be corrected for high-precision radiotherapy, especially in the area relevant to quality assurance/quality control.

Key words: structure survey – SRT – IMRT – IGRT – QA/QC

INTRODUCTION

A greater number of cancer patients have been treated with radiotherapy (RT) in clinical practice in Japan (1). One of the factors for this trend is considered to be the approval of the Cancer Control Act in 2006, which strongly advocated the promotion of RT. A second factor may be due to various advanced new RT technologies in a rapid recent development. As new high-precision RT techniques can provide greater tumor coverage while sparing normal tissues, risks of adverse effects and cancer recurrence are overall expected to decrease compared with conventional RT. For example, stereotactic radiotherapy (SRT) has shown a clinical benefit for patients with early stage lung cancer (2). High-dose external beam RT with intensity-modulated radiation therapy (IMRT) also has been reported to improve disease-free survival and decrease rectal toxicity in patients with localized prostate cancer over the past decade (3,4). Image-guided radiation therapy (IGRT) available immediately before treatment for setup, registration, and repositioning, is often used in combination with SRT and IMRT. Thus, IGRT has an important role in the accuracy enhancement of these treatments. In Japan, SRT, IMRT and IGRT were listed as eligible for public health insurance reimbursement in 2004, 2008 and 2010, respectively.

In this manner, the Japanese structure of the clinical practice of RT is gradually changing. However, the current situation in Japan regarding the operation of these high-precision RT techniques has not yet been fully defined. Therefore, we conducted a questionnaire-based survey that would clarify the operational situation, treatment planning and treatment processes of SRT, IMRT and IGRT. The aim of this report is to clarify the recent structure of high-precision RT in Japan to suggest an area for improvement.

PATIENTS AND METHODS

We adopted 109 items as the quality indicators of high-precision RT to prepare a questionnaire about personnel, treatment planning and processes, quality assurance (QA) and quality control (QC) with relevance to SRT, IMRT and IGRT in 2012. The questionnaire in this survey as represented on the graphical user interface of the web access can be reused in a future survey. We carried out a nationwide survey on permission by the board meeting of the Japanese Society for Therapeutic Radiology and Oncology (JASTRO). In April 2012, we publicly opened the questionnaire on the website to request every institution with RT machines for response. Replies to the questionnaire could be recovered on the web access from most of the institutions and partly in mail. Four hundred and ninety out of 789 active institutions (62.1%) replied.

RESULTS

Personnel Situation for High-precision and Conventional RT

Table 1 shows radiation oncologists (ROs) engaged in high-precision and conventional RT. ROs managed patients on hospital wards in 28.1% of the institutions. Institutions with ROs responsible for chemotherapy were at a ratio as low as 17.4%. Table 1 also shows the actual conditions of radiotherapy technologists (RTTs), medical physicists (MPs), radiotherapy quality managers (RQMs) and nurses engaged in high-precision and conventional RT. Two or more RTTs per linear accelerator managed linear accelerator operation in more than three quarters of the institutions. MPs and/or RQMs worked in 64.9% of the institutions. They had to work in part as RTTs (the workload reaching ~20% of the workload as MPs/RQMs along the rule of Japanese public health insurance reimbursement) in 90.8% of the institutions. Nurses assigned to linear accelerator operation were at 73.2% of the institutions, although RT nursing certified staffs (i.e. nurses certified by the Japanese nursing association as having expertise in the prevention, relief and self-care support of the side-effects conditions following RT) were assigned in only 18.4% of the institutions. Safe management, operational issues and all cases were discussed regularly between RT staffs in two-third of the institutions. In most of the institutions, all RT staffs including ROs, RTTs, nurses and MPs/RQMs participated in conferences.

SRT Situation

Figure 1 and Table 2 show the actual conditions of SRT for lung tumor. Institutions equipped for SRT of lung tumor were at a ratio of 43.3%. Some types of body immobilization systems such as vacuum cushion and thermoplastic shell were used in most of the institutions. Various methods were used for managing respiratory motions in RT planning computed tomography (CT) such as long-time scan CT, four-dimensional CT (4DCT) and respiratory phase fusion. Respiratory motions were controlled during irradiation in most of the institutions. The method most presently available for the control of respiratory motions was respiratory depression, while chest and abdomen were both depressed during irradiation in more than half of the institutions. Visual or audio feedback was still less fashionable as a respiration monitoring approach during irradiation.

IMRT Situation

Table 3 shows the actual conditions of IMRT. Institutions equipped for IMRT were at a ratio of 32.6%. Most common site treated with IMRT was the prostate. Median intervals between the initial consultation with RT departments and the IMRT start were 10 days for brain tumor, 14 days for head and neck tumor and 21 days for prostate tumor in the case without neoadjuvant hormonal therapy and 90 days for prostate tumor in the case with neoadjuvant hormonal therapy. Figure 2 shows assigned tasks of IMRT planning among ROs, MPs/RQMs and RTTs. ROs were responsible for the delineation of targets and organs at risk (OAR) in most of the institutions while MPs/RQMs or RTTs set up beam in 33.3% of the institutions. Monitor units (MU) calculation of bed absorption was corrected in only a half of the institutions.

Table 1 Situation of ROs, RTTs, MPs, RQMs and nurses in high-precision and conventional RT

	Responding institution (*n*)	Classification	*n*	Ratio (%)
Institutions with ROs responsible for chemotherapy	489		85	17.4
Institutions with ROs responsible for admission	484		136	28.1
Institutions with RTTs				
Number of RTTs per linear accelerator engaged in linear accelerator operation	485	One	49	10.1
		Two	380	78.4
		Three	44	9.1
		Others	12	2.5
Institutions with MPs and/or RQMs	485		315	64.9
Institutions with MPs and/or RQMs responsible for RTTs operation	315		286	90.8
Institutions with nurses engaged in linear accelerator operation	485	Ordinarily	302	62.3
		Sometimes	53	10.9
		None	127	26.2
		Others	3	0.6
Institutions with RT nursing certified staffs	483		89	18.4
Regular conference in RT staffs	488		326	66.8
Members of regular conference	326	ROs	306	93.9
		RTTs	314	96.3
		MPs/RQMs	212	65.0
		nurse	251	77.0
Repetition of regular conference	326	Every day	48	14.7
		Every week	202	62.0
		Every month	50	15.3
		Others	26	8.0

ROs, radiation oncologists; RTTs, radiotherapy technologists; MPs, medical physicists; RQMs, radiotherapy quality managers, RT, radiotherapy.

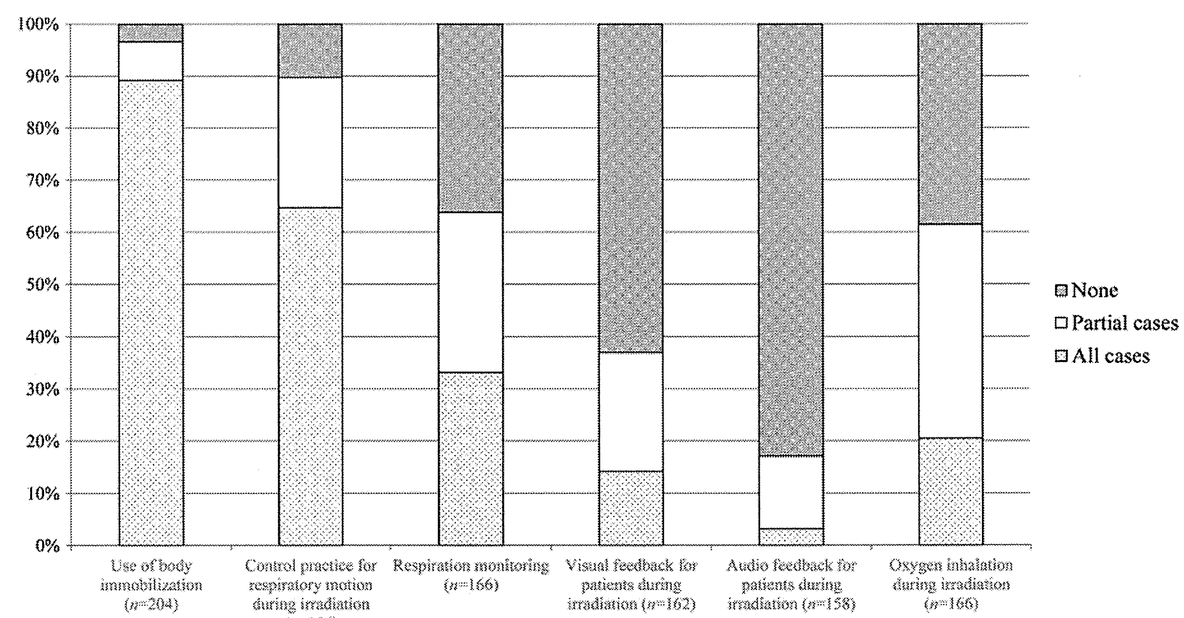

Figure 1. Difference of methods in stereotactic radiotherapy (SRT) for lung tumor.