Gen Thorac Cardiovasc Surg (2009) 57:488–513
DOI 10.1007/s11748-009-0460-y

ANNUAL REPORT

Thoracic and cardiovascular surgery in Japan during 2007

Annual report by the Japanese Association for Thoracic Surgery

Committee for Scientific Affairs

Yuichi Ueda, MD · Yoshitaka Fujii, MD · Hiroyuki Kuwano, MD

The Japanese Association for Thoracic Surgery has conducted annual surveys of thoracic surgery throughout Japan since 1986 to determine the statistics regarding the number of procedures according to the operative category. Here, we have summarized the results from our annual survey of thoracic surgery performed during 2007.

The incidence of hospital mortality was added to the survey to determine the nationwide status, which can be useful not only for surgeons, who can better compare their work with that of others, but also for the Association, which can gain a better understanding of present problems as well as future prospects. Thirty-day mortality (sometimes termed operative mortality) is death within 30 days of an operation regardless of the patient's geographic location and even though the patient was been discharged from the hospital within those 30 days.

Hospital mortality is death within any time interval after operation if the patient had not been discharged from the hospital. Hospital-to-hospital transfer is not considered discharge; transfer to a nursing home or a rehabilitation unit is considered hospital discharge unless the patient subsequently dies of complications of the operation. (The definitions of terms are based on the published guidelines of the Ad Hoc Liaison Committee for Standardizing Definitions of Prosthetic Heart Valve Morbidity of the Society of Thoracic Surgeons and the American Association for Thoracic Surgery (Edmunds et al. *Ann Thorac Surg* 1996;62:932–5; *J Thorac Cardiovasc Surg* 1996;112:708–11).

Thoracic surgery was classified into three categories—cardiovascular, general thoracic, and esophageal surgery—and the pertinent data were examined and analyzed for each group. Access to the computerized data is offered to all members of this Association. We honor and value your continued kind support and contributions.

Abstract of the survey

We sent out survey questionnaire forms to the departments of each category in all 1,914 institutions nationwide in early April 2008. The response rates in each category by the end of December 2008 were 95.2%, 91.1%, and 86.9% for cardiovascular, general thoracic, and esophageal surgery, respectively.

This is the annual report by The Japanese Association for Thoracic Surgery from the Committee for Scientific Affairs

Y. Ueda
Department of Cardiac Surgery, Nagoya University Graduate School of Medicine, Nagoya, Japan

Y. Fujii
Oncology, Immunology and Surgery, Nagoya City University Graduate School of Medical Sciences, Nagoya, Japan

H. Kuwano
Department of General Surgical Science (Surgery 1), Gunma University, Graduate School of Medicine, Maebashi, Japan

Questionaires sent out and received back by the end of December 2008

	Sent out	Returned	Response rate
(A) Cardiovascular surgery	586	558	95.2%
(B) General thoracic surgery	765	697	91.1%
(C) Esophageal surgery	563	489	86.9%

Categories subclassified according to the number of operations performed

No. of operations performed	Category	
	Cardiovascular surgery	General thoracic surgery
1–24	41	149
25–49	75	164
50–99	151	171
100–149	115	107
150–199	65	52
≥200	111	54
Total	558	697

No. of operations performed	Esophageal surgery
1–4	180
5–9	112
10–19	95
20–29	46
30–39	17
40–49	11
≥50	28
Total	489

2007 Final Report

(A) Cardiovascular surgery

Figure 1 shows the development of cardiovascular surgery in Japan over the last 21 years. Aneurysm surgery includes only operations for thoracic or thoracoabdominal aortic aneurysms. The number of pacemaker and assist device implantation operations is not included in the total number of surgical operations. A total of 55,754 cardiovascular operations were performed at 558 institutions during 2007 alone and included ten cardiac transplantation operations, a procedure that was restarted in Japan in 1999. In comparison with 2007, the number of operations for thoracic aortic aneurysm consistently increased, by 8.1%, and that for valvular heart disease increased by 0.8%. Surgery for congenital heart disease slightly decreased, by 1.3%. However, operations for ischemic heart disease continued to decrease, by 2.0%, which was less than that in 2006 (6.0%).

Data for individual categories are summarized in Tables 1–7. In 7,260 open-heart operations performed for congenital heart disease, the overall hospital mortality was 2.9%, which is similar to that in 2006. Mitral valve repair constituted 27.6% of all valvular heart disease operations (15,218), similar to that 2005 and 2006 (25.9%). Aortic valve replacement with a bioprosthesis was performed in 4,894 cases, with the number consistently increasing. The hospital mortality rates associated with primary single valve replacement were 2.8% and 5.7% for aortic and mitral valve replacement, respectively; that for primary mitral valve repair was 1.4%. However, hospital mortality rates for redo valve replacement were 11.4% and 10.3% for aortic and mitral procedures, respectively. Isolated coronary artery bypass grafting (CABG) was performed in 17,295 cases.

The hospital mortality associated with primary elective CABG procedures in 14,503 cases was 1.4%. Hospital mortality of primary emergency CABG in 2,487 cases was 7.9%, which was slightly lower than the 10.9% mortality in 2006. Off-pump coronary bypass grafting (OPCAB) was performed in 10,979 cases, constituting 63.4% of the total isolated CABG procedures. The per-

centage of OPCAB cases among the total isolated CABG procedures has been at the same level since 2005.

A total of 874 patients underwent surgery for complications of myocardial infarction; there were 458 operations for a left ventricular aneurysm and 400 operations for ischemic mitral regurgitation. Operations for thoracic aortic dissection were performed in 4,549 cases. For 3,016 type A acute aortic dissections, hospital mortality was 12.7%, which was similar to that in 2006 (13.3%). Operations for a nondissected thoracic aneurysm were carried out in 5,532 cases with an overall hospital mortality of 7.6%, which is similar to that for 2006 (8.8%). The hospital mortality associated with unruptured aneurysms was 5.4%, and that for ruptured aneurysms was 19.2%, which remains at a high level but was slightly improved.

The number of stent graft procedures markedly increased. A total of 264 patients with aortic dissection underwent stent graft placement: transluminal stent grafting (TEVAR) 182 cases, open stent grafting 82 cases. The hospital mortality rates associated with TEVAR for type B aortic dissection were 7.1% and 0.8% for acute and chronic cases, respectively. A total of 709 patients with a nondissected aortic aneurysm underwent stent graft placement (TEVAR 547 cases, open stent grafting156 cases). The hospital mortality rates for TEVAR were 2.8% and 21.3% for nonruptured and ruptured aneurysms, respectively.

In summary, the total cardiovascular operations increased during the year 2007, by 4.3%. They were performed with steadily improving results in almost all categories compared to those in 2006.

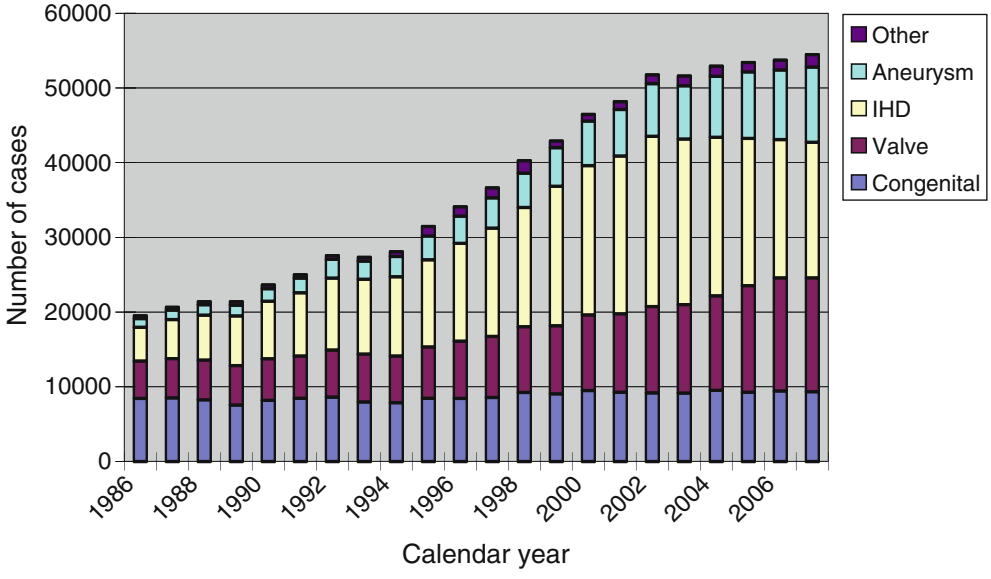

Fig. 1 General thoracic surgery. IHD, ischemic heart disease

Table 1 Congenital (total 9,346)
(1) CPB (+) (total 7,260) in 2007

		Neonate			Infant			1–17 Years			≥18 Years			Total		
		Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1	PDA	1	0	0	5	0	0	3	0	0	35	0	0	44	0	0
2	Coarctation (simple)	5	0	0	5	0	0	12	0	0	7	0	0	29	0	0
3	+VSD	36	1 (2.8)	1 (2.8)	45	0	0	5	0	0	1	0	0	87	1 (1.1)	1 (1.1)
4	+DORV	10	1 (10.0)	2 (20.0)	5	0	1 (20.0)	2	0	0	0	0	0	17	1 (5.9)	3 (17.6)
5	+AVSD	3	0	0	2	0	0	0	0	0	0	0	0	5	0	0
6	+TGA	3	0	1 (33.3)	2	0	0	0	0	0	0	0	0	5	0	1 (20.0)
7	+SV	3	0	0	4	0	0	6	1 (16.7)	0	0	0	0	13	1 (7.7)	0
8	+Others	6	1 (16.7)	1 (16.7)	6	1 (16.7)	1 (16.7)	1	0	0	2	0	0	15	2 (13.3)	2 (13.3)
9	Interrupt. of Ao (simple)	2	1 (50.0)	1 (50.0)	0	0	0	0	0	0	1	0	0	3	1 (33.3)	1 (33.3)
10	+VSD	27	1 (3.7)	2 (7.4)	20	2 (10.0)	2 (10.0)	0	0	0	0	0	0	47	3 (6.4)	4 (8.5)
11	+DORV	3	1 (33.0)	1 (33.3)	1	1 (100.0)	1 (100.0)	1	0	0	0	0	0	5	2 (40.0)	2 (40.0)
12	+Truncus	4	0	1 (25.0)	1	0	0	0	0	0	0	0	0	5	0	1 (20.0)
13	+TGA	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
14	+Others	9	1 (33.0)	1 (11.1)	9	1 (11.1)	1 (11.1)	1	0	0	0	0	0	19	2 (10.5)	2 (10.5)
15	Vascular ring	0	0	0	3	0	0	2	0	0	1	0	0	6	0	0
16	PS	1	0	0	7	0	0	13	0	0	9	0	0	30	0	0
17	PA·IVS or Critical PS	7	0	0	38	1 (2.6)	1 (2.6)	68	1 (1.5)	1 (1.5)	2	0	0	115	2 (1.7)	2 (1.7)
18	TAPVR	90	12 (13.3)	15 (16.7)	65	2 (3)	4 (6.2)	7	1 (14.3)	2 (28.6)	0	0	0	162	15 (9)	21 (13)
19	PAPVR ± ASD	8	2 (25.0)	2 (25.0)	13	0	0	65	0	0	21	0	0	107	2 (1.9)	2 (1.9)
20	ASD	7	0	0	50	0	0	749	1 (0.1)	1 (0.1)	801	6 (0.7)	7 (0.9)	1,607	7 (0.4)	8 (0.5)
21	Cor triatriatum	2	0	0	13	1 (7.7)	1 (7.7)	16	0	0	4	1 (25.0)	1 (25.0)	35	2 (5.7)	2 (5.7)
22	AVSD (partial)	0	0	0	14	0	0	59	0	0	16	0	0	89	0	0
23	AVSD (complete)	2	0	0	105	5 (4.8)	6 (5.7)	53	1 (1.9)	1 (1.9)	2	0	0	162	6 (3.7)	7 (4.3)
24	+TOF or DORV	0	0	0	7	0	0	18	1 (5.6)	2 (11.1)	3	0	0	28	1 (3.6)	2 (7.1)
25	+Others	0	0	0	4	0	0	12	0	0	1	0	0	17	0	0
26	VSD(subarterial)	1	0	0	118	0	0	247	0	0	28	0	0	394	0	0
27	VSD(perimemb./muscular)	17	0	0	784	2 (0.3)	3 (0.4)	460	1 (0.2)	1 (0.2)	81	0	0	1,342	3 (0.2)	4 (0.3)
28	VSD + PS	1	0	0	21	0	0	30	0	0	10	0	0	62	0	0
29	DCRV ± VSD	0	0	0	13	0	0	27	0	0	19	0	0	59	0	0
30	Aneurysm of sinus Valsalva	0	0	0	0	0	0	3	0	0	27	0	0	30	0	0
31	TOF	7	1 (14.3)	1 (14.3)	142	2 (1.4)	2 (1.4)	255	1 (0.4)	1 (0.4)	15	2 (13.3)	2 (13.3)	419	6 (1.4)	6 (1.4)
32	PA + VSD	7	0	0	34	1 (2.9)	2 (5.9)	112	2 (1.8)	4 (3.6)	1	0	0	154	3 (1.9)	6 (3.9)
33	DORV	14	1 (7.1)	1 (7.1)	91	4 (4.4)	4 (4.4)	96	1 (1.0)	1 (1.0)	7	0	0	208	6 (2.9)	6 (2.9)
34	TGA (simple)	99	0	3 (3.0)	5	0	0	8	0	0	1	0	0	113	0	3 (2.7)
35	+VSD	32	2 (6.3)	3 (9.4)	12	0	0	10	0	0	0	0	0	54	2 (3.7)	3 (5.6)
36	+VSD + PS	3	0	1 (33.3)	11	0	0	22	0	0	2	0	0	38	0	1 (2.6)
37	Corrected TGA	2	0	0	12	0	0	52	1 (1.9)	1 (1.9)	9	0	0	75	1 (1.3)	1 (1.3)
38	Truncus arteriosus	9	0	0	15	3 (20.0)	3 (20.0)	10	0	0	0	0	0	34	3 (8.8)	3 (8.8)
39	SV	30	4 (13.3)	8 (26.7)	160	8 (5.0)	11 (6.9)	306	6 (2.0)	6 (2.0)	20	2 (10.0)	3 (15.0)	516	20 (3.9)	28 (5.4)
40	TA	1	0	0	39	1 (2.6)	1 (2.6)	67	1 (1.5)	1 (1.5)	11	1 (9.1)	1 (9.1)	118	3 (2.5)	3 (2.5)
41	HLHS	50	16 (32.0)	21 (42.0)	88	12 (13.6)	16 (18.2)	51	1 (2.0)	1 (2.0)	0	0	0	189	29 (15.3)	38 (20.1)
42	Aortic valve lesion	5	0	0	21	1 (4.8)	2 (9.5)	91	1 (1.1)	1 (1.1)	20	0	0	137	2 (1.5)	3 (2.2)
43	Mitral valve lesion	1	1 (100.0)	1 (100.0)	62	2 (3.2)	3 (4.8)	65	0	0	16	0	0	144	3 (2.1)	4 (2.8)
44	Ebstein	8	2 (25.0)	2 (25.0)	17	0	0	21	0	0	18	1 (5.6)	2 (11.1)	64	3 (4.7)	4 (6.3)
45	Coronary disease	1	1 (100.0)	1 (100.0)	11	2 (18.2)	3 (27.3)	12	0	0	21	0	0	45	3 (6.7)	4 (8.9)
46	Others	15	3 (20.0)	3 (20.0)	29	2 (6.9)	2 (6.9)	37	2 (5.4)	2 (5.4)	8	1 (12.5)	1 (12.5)	89	8 (9.0)	8 (9.0)
47	Redo VSD	0	0	0	2	0	0	15	0	0	14	0	0	31	0	0
48	PS release	1	0	0	8	1 (12.5)	1 (12.5)	56	0	0	8	0	0	73	1 (1.4)	1 (1.4)
49	RV-PA conduit replace	0	0	0	1	0	0	41	0	0	26	1 (3.8)	1 (3.8)	68	1 (1.5)	1 (1.5)
50	Others	0	0	0	48	9 (18.8)	13 (27.1)	67	3 (4.5)	3 (4.5)	36	4 (11.1)	4 (11.1)	151	16 (10.6)	20 (13.2)
	Total	534	52 (9.7)	73 (13.7)	2,168	64 (3.0)	84 (3.9)	3,254	26 (0.8)	29 (0.9)	1,304	19 (1.5)	22 (1.7)	7,260	161 (2.2)	208 (2.9)

( ), % mortality; CPB, cardiopulmonary bypass; PDA, patent ductus arteriosus; VSD, ventricular septal defect; DORV, double outlet right ventricle; AVSD, atrioventricular septal defect; TGA, transposition of great arteries; SV, single ventricle; Interrupt. of Ao., interruption of aorta; PS, pulmonary stenosis; PA-IVS, pulmonary atresia with intact ventricular septum; TAPVR, total anomalous pulmonary venous return; PAPVR, partial anomalous pulmonary venous return; ASD, atrial septal defect; TOF, tetralogy of Fallot; DCRV, double-chambered right ventricle; TA, tricuspid atresia; HLHS, hypoplastic left heart syndrome; RV-PA, right ventricle–pulmonary artery

(2) CPB (–) (total 2,086) in 2007

		Neonate			Infant			1–17 Years			≥18 Years			Total		
		Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1	PDA	319	6 (1.9)	8 (2.5)	192	0	0	95	0	0	10	0	0	616	6 (1.0)	8 (1.3)
2	Coarctation (simple)	19	0	0	19	0	0	8	0	0	5	0	0	51	0	0
3	+VSD	30	0	0	24	0	0	3	0	0	0	0	0	57	0	0
4	+DORV	13	0	0	5	0	0	0	0	0	0	0	0	18	0	0
5	+AVSD	4	1 (25.0)	1 (25.0)	2	0	0	0	0	0	0	0	0	6	1 (16.7)	1 (16.7)
6	+TGA	4	0	0	1	0	0	0	0	0	0	0	0	5	0	0
7	+SV	14	0	0	2	0	0	0	0	0	0	0	0	16	0	0
8	+Others	5	1 (20.0)	1 (20.0)	4	0	1 (25.0)	0	0	0	0	0	0	9	1 (11.1)	2 (22.2)
9	Interrupt. of Ao (simple)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	+VSD	15	0	0	2	0	0	0	0	0	0	0	0	17	0	0
11	+DORV	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0
12	+Truncus	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
13	+TGA	1	1 (100.0)	1 (100.0)	0	0	0	0	0	0	0	0	0	1	1 (100.0)	1 (100.0)
14	+Others	8	1 (12.5)	1 (12.5)	1	0	0	0	0	0	0	0	0	9	1 (11.1)	1 (11.1)
15	Vascular ring	2	0	1 (50.0)	8	0	0	6	0	0	0	0	0	16	0	1 (6.3)
16	PS	2	0	0	2	0	0	0	0	0	0	0	0	4	0	0
17	PA·IVS or critical PS	31	1 (3.2)	1 (3.2)	26	2 (7.7)	4 (15.4)	1	0	0	0	0	0	58	3 (5.2)	5 (8.6)
18	TAPVR	2	0	0	2	0	1 (50.0)	5	0	0	0	0	0	9	0	1 (11.0)
19	PAPVR ± ASD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	ASD	0	0	0	0	0	0	0	0	0	7	1 (14.3)	1 (14.3)	7	1 (14.3)	1 (14.3)
21	Cor triatriatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	AVSD (partial)	0	0	0	2	0	0	1	0	0	0	0	0	3	0	0
23	AVSD (complete)	10	0	0	65	1 (1.5)	3 (4.6)	1	0	0	0	0	0	76	1 (1.3)	3 (3.9)
24	+TOF or DORV	7	0	0	7	0	0	1	0	0	0	0	0	15	0	0
25	+Others	4	0	0	1	1 (100.0)	1 (100.0)	1	0	0	0	0	0	6	1 (16.7)	1 (16.7)
26	VSD (subarterial)	4	0	0	11	0	0	0	0	0	0	0	0	15	0	0
27	VSD (perimemb./muscular)	24	1 (4.2)	1 (4.2)	66	1 (1.5)	2 (3.0)	2	0	0	0	0	0	92	2 (2.2)	3 (3.3)
28	VSD + PS	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
29	DCRV ± VSD	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
30	Aneurysm of sinus Valsalva	0	0	0	7	0	0	1	0	0	0	0	0	8	0	0
31	TOF	24	0	0	100	3 (3.0)	3 (3.0)	23	0	0	3	0	0	150	3 (2.0)	3 (2.0)
32	PA + VSD	22	0	1 (4.5)	68	0	0	26	1 (3.8)	1 (3.8)	2	0	0	118	1 (0.8)	2 (1.7)
33	DORV	36	1 (2.8)	2 (5.6)	69	0	0	8	0	0	0	0	0	113	1 (0.9)	2 (1.8)
34	TGA (simple)	4	0	0	5	0	0	1	0	0	0	0	0	10	0	0
35	+VSD	1	0	0	1	0	0	1	0	0	0	0	0	3	0	0
36	+VSD + PS	3	0	0	12	0	0	3	0	0	0	0	0	18	0	0
37	Corrected TGA	8	1 (12.5)	1 (12.5)	26	0	0	6	0	0	1	0	0	41	1 (2.4)	1 (2.4)
38	Truncus arteriosus	9	0	0	6	0	0	0	0	0	0	0	0	15	0	0
39	SV	65	2 (3.1)	2 (3.1)	85	1 (1.2)	1 (1.2)	24	0	0	2	1 (50.0)	1 (50.0)	176	4 (2.3)	4 (2.3)
40	TA	19	0	0	21	1 (4.8)	1 (4.8)	3	0	0	0	0	0	43	1 (2.3)	1 (2.3)
41	HLHS	61	3 (4.9)	6 (9.8)	18	1 (5.6)	1 (5.6)	6	0	0	0	0	0	85	4 (4.7)	7 (8.2)
42	Aortic valve lesion	1	0	0	2	1 (50.0)	1 (50.0)	0	0	0	0	0	0	3	1 (33.3)	1 (33.3)
43	Mitral valve lesion	0	0	0	1	0	0	2	0	0	0	0	0	3	0	0
44	Ebstein	5	2 (40.0)	2 (40.0)	8	0	0	0	0	0	0	0	0	13	2 (15.4)	2 (15.4)
45	Coronary disease	2	0	0	8	0	0	5	0	0	3	0	0	18	0	0
46	Others	10	1 (10.0)	1 (10.0)	35	0	0	53	1 (1.9)	1 (1.9)	3	0	0	101	2 (2.0)	2 (2.0)
47	Redo VSD	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
48	PS release	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
49	RV-PA conduit replace	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
50	Others	2	1 (50.0)	1 (50.0)	22	0	0	21	0	0	6	0	0	51	1 (2.0)	1 (2.0)
	Total	797	23 (2.9)	31 (3.9)	937	12 (1.3)	19 (2.0)	308	2 (0.6)	2 (0.6)	44	2 (4.5)	2 (44.0)	2,086	39 (1.9)	54 (2.6)

( ), % mortality; CPB, cardiopulmonary bypass; PDA, patent ductus arteriosus; VSD, ventricular septal defect; DORV, double outlet right ventricle; AVSD, atrioventricular septal defect; TGA, transposition of great arteries; SV, single ventricle; Interrupt. of Ao., interruption of aorta; PS, pulmonary stenosis; PA-IVS, pulmonary atresia with intact ventricular septum; TAPVR, total anomalous pulmonary venous return; PAPVR, partial anomalous pulmonary venous return; ASD, atrial septal defect; TOF, tetralogy of Fallot; DCRV, double-chambered right ventricle; TA, tricuspid atresia; HLHS, hypoplastic left heart syndrome; RV-PA, right ventricle–pulmonary artery

(3) Main procedures in 2007

		Neonate			Infant			1–17 Years		
		Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1	SP Shunt	180	3 (1.7)	4 (2.2)	420	14 (3.3)	14 (3.3)	82	2 (2.4)	2 (2.4)
2	PAB	271	12 (4.4)	18 (6.6)	235	7 (3.0)	10 (4.3)	9	0	0
3	Bidirectional Glenn or hemi-Fontan ± α	2	0	0	225	5 (2.2)	9 (4.0)	169	5 (3.0)	5 (3.0)
4	PA reconstruction/repair (including redo)	6	0	0	81	0	0	101	1 (1.0)	1 (1.0)
5	RVOT reconstruction/repair	5	0	0	105	1 (1.0)	2 (1.9)	227	0	0
6	Rastelli procedure	4	0	0	25	0	0	87	3 (3.4)	4 (4.6)
7	Arterial switch procedure	145	3 (2.1)	12 (8.3)	22	1 (4.5)	1 (4.5)	2	0	0
8	Atrial switch procedure	0	0	0	1	0	0	2	0	0
9	Double switch procedure	0	0	0	0	0	0	7	0	0
10	Repair of anomalous origin of CA	1	1 (100.0)	1 (100.0)	11	1 (9.1)	2 (18.2)	8	0	0
11	Closure of coronary AV fistula	0	0	0	7	0	0	7	0	0
12	Fontan/TCPC	0	0	0	7	0	0	387	3 (0.8)	4 (1.0)
13	Norwood procedure	51	16 (31.4)	20 (39.2)	71	7 (9.9)	12 (16.9)	4	0	0
14	Ventricular septation	1	0	1 (100.0)	0	0	0	0	0	0
15	Left side AV valve repair (including redo)	0	0	0	65	2 (3.1)	2 (3.1)	93	0	0
16	Left side AV valve replace (including redo)	1	1 (100.0)	1 (100.0)	18	1 (5.6)	2 (11.1)	33	0	0
17	Right side AV valve repair (including redo)	3	0	0	23	2 (8.7)	2 (8.7)	35	0	0
18	Right side AV valve replace (including redo)	0	0	0	0	0	0	5	0	0
19	Common AV valve repair (including redo)	5	0	1 (20.0)	22	6 (27.3)	6 (27.3)	18	0	1 (5.6)
20	Common AV valve replace (including redo)	0	0	0	2	0	0	2	0	0
21	Repair of supraaortic stenosis	0	0	0	4	1 (25.0)	1 (25.0)	8	0	0
22	Repair of subaortic stenosis (including redo)	1	0	0	11	1 (9.0)	1 (9.0)	36	2 (5.6)	2 (5.6)
23	Aortic valve plasty ± VSD closure	8	0	0	7	0	1 (14.3)	19	0	0
24	Aortic valve replacement	1	1 (100.0)	1 (100.0)	3	1 (33.3)	1 (33.3)	28	0	0
25	AVR with annular enlargement	0	0	0	3	0	0	12	0	0
26	Aortic root replace (except Ross)	1	0	0	0	0	0	4	0	0
27	Ross procedure	1	0	0	1	0	0	26	1	1
	Total	687	37 (5.4)	59 (8.6)	1,369	50 (3.7)	66 (4.8)	1,411	17 (1.2)	20 (1.4)

		≥18 Years			Total		
		Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1	SP Shunt	8	0	0	690	19 (2.8)	20 (2.9)
2	PAB	0	0	0	515	19 (3.7)	28 (5.4)
3	Bidirectional Glenn or hemi-Fontan ± α	10	0	0	406	10 (2.5)	14 (3.4)
4	PA reconstruction/repair (including redo)	11	0	0	199	1 (0.5)	1 (0.5)
5	RVOT reconstruction/repair	29	0	0	366	1 (0.3)	2 (0.5)
6	Rastelli procedure	8	0	0	124	3 (2.4)	4 (3.2)
7	Arterial switch procedure	1	0	0	170	4 (2.4)	13 (7.6)
8	Atrial switch procedure	0	0	0	3	0	0
9	Double switch procedure	0	0	0	7	0	0
10	Repair of anomalous origin of CA	7	0	0	27	2 (7.4)	3 (11.1)
11	Closure of coronary AV fistula	19	0	0	33	0	0
12	Fontan/TCPC	41	4 (9.8)	6 (14.6)	435	7 (1.6)	10 (2.3)
13	Norwood procedure	0	0	0	126	23 (18.3)	32 (25.4)
14	Ventricular septation	0	0	0	1	0	1 (100.0)
15	Left side AV valve repair (including redo)	23	0	0	181	2 (1.1)	2 (1.1)
16	Left side AV valve replace (including redo)	14	0	0	66	2 (3.0)	3 (4.5)
17	Right side AV valve repair (including redo)	34	0	0	95	2 (2.1)	2 (2.1)
18	Right side AV valve replace (including redo)	12	0	1 (8.3)	17	0	1 (5.9)
19	Common AV valve repair (including redo)	1	0	0	46	6 (13.0)	8 (17.4)
20	Common AV valve replace (including redo)	0	0	0	4	0	0
21	Repair of supraaortic stenosis	0	0	0	12	1 (8.3)	1 (8.3)
22	Repair of subaortic stenosis (including redo)	3	0	0	51	3 (5.9)	3 (5.9)
23	Aortic valve plasty ± VSD closure	3	0	0	37	0	1 (2.7)
24	Aortic valve replacement	21	1 (4.8)	1 (4.8)	53	3 (5.7)	3 (5.7)
25	AVR with annular enlargement	3	1 (33.3)	1 (33.3)	18	1 (5.6)	1 (5.6)
26	Aortic root replace (except Ross)	3	0	0	8	0	0
27	Ross procedure	3	0	0	31	1	1
	Total	254	6 (2.4)	9 (3.5)	3,721	110 (3.0)	154 (4.1)

( ), % mortality; SP, systemic–pulmonary; PAB, pulmonary artery banding; PA, pulmonary artery; RVOT, right ventricular outflow tract; CA, coronary artery; AV fistula, arteriovenous fistula; TCPC, total cavopulmonary connection; AV valve, atrioventricular valve; VSD, ventricular septal defect; AVR, aortic valve replacement

Table 2 Acquired [total (1) + (2) + (4) + (5) + (6) + (7) + isolated ope. for arrhythmia in (3): 34,907]
(1) Valvular heart disease (total 15,218) in 2007

	Valve	Cases	Operation					30-Day mortality		Hospital mortality		Redo		
			Mechanical	Bioprosthesis	Ross procedure	Repair	With CABG	Replace	Repair	Replace	Repair	Cases	30-Day mortality	Hospital mortality
Isolated	A	6,546	2,586	3,886	2	72	1,310	139 (2.1)	1 (1.4)	185 (2.9)	1 (1.4)	263	24 (9.1)	30 (11.4)
	M	4,007	1,049	589		2,369	585	62 (3.8)	17 (0.7)	94 (5.7)	34 (1.4)	312	23 (7.4)	32 (10.3)
	T	217	20	59		138	19	7 (8.9)	4 (2.9)	10 (12.7)	6 (4.3)	60	5 (8.3)	8 (13.3)
	P	3	0	3		0	0	0	0	0	0	2	0	0
A + M	A	1,182	565	590		27	165	58 (4.9)		85 (7.2)		82	4 (4.9)	5 (6.1)
	M		422	236		524								
A + T	A	184	72	109		3	25	9 (4.9)		14 (7.6)		14	1 (7.1)	2 (14.3)
	T		1	2		181								
M + T	M	2,377	776	539		1,062	229	65 (2.7)		105 (4.4)		220	11 (5.0)	20 (9.1)
	T		14	44		2,319								
A + M + T	A	657	338	309		10	58	28 (4.3)		43 (6.5)		64	6 (9.4)	6 (9.4)
	M		261	150		246								
	T		13	5		639								
Others		45	20	11		19	2	2 (4.4)		4 (8.9)		17	0	1 (5.9)
Total		15,218	6,137	6,532	2	7,609	2,393	392 (2.6)		581 (3.8)		1,034	74 (7.2)	104 (10.1)

( ), % mortality; CABG, coronary artery bypass grafting; A, aortic valve; M, mitral valve; T, tricuspid valve; P, pulmonary valve
Number of redo cases is included in the total case number of 15,218

(2) Ischemic heart disease [total (A) + (B) + (C): 18,181]
(A) Isolated CABG [total (a) + (b): 17,295]
(a) On-pump CABG (including planned on-pump beating-heart CABG at the time of incision) (total 6,316) in 2007

	Primary, elective			Primary, emergency			Redo, elective		
	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths
1VD	113	0	0	38	6 (15.8)	7 (18.4)	13	0	0
2VD	784	11 (1.4)	19 (2.4)	132	13 (9.8)	18 (13.6)	18	0	0
3VD	2,586	32 (1.2)	50 (1.9)	423	30 (7.1)	43 (10.2)	46	1 (2.2)	1 (2.2)
LMT	1,484	18 (1.2)	25 (1.7)	565	31 (5.5)	48 (8.5)	17	0	1 (5.9)
Kawasaki	5	0	0	0	0	0	1	0	0
Unspecified	42			22	3 (13.6)	3 (13.6)			
Total	5,014	61 (1.2)	94 (1.9)	1,180	83 (7.0)	119 (10.1)	95	1 (1.1)	2 (2.1)
Hemodialysis	231	7 (3.0)	13 (5.6)	77	9 (11.7)	14 (18.2)	5	0	0

	Redo, emergency			Arterial graft only	Artery graft + SVG	SVG only	Others	Uncertain
	Cases	30-Day mortality	Hospital deaths					
1VD	8	2 (25.0)	2 (25.0)	98	20	53	0	1
2VD	2	0	0	262	596	71	1	6
3VD	8	2 (25.0)	3 (37.5)	368	2,557	109	0	29
LMT	9	2 (22.2)	2 (22.2)	351	1,600	113	0	11
Kawasaki	0	0	0	5	1	0	0	0
Unspecified								64
Total	27	6 (22.2)	7 (25.9)	1,084	4,774	346	1	111
Hemodialysis	3	0	0	36	244	21	0	15

( ), % mortality; CABG, coronary artery bypass grafting; 1VD, one-vessel disease; 2VD, two-vessel disease; 3VD, three-vessel disease; LMT, left main trunk; SVG, saphenous vein graft
LMT includes LMT alone or LMT with other branch diseases

in 2007

	Primary, elective			Primary, emergency			Redo, elective			Redo, emergency		
	Cases	30-day Mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths
Arrest	3,768	46 (1.2)	66 (1.8)	693	40 (5.8)	56 (8.1)	52	1 (1.9)	1 (1.9)	8	2 (25.0)	2 (25.0)
Beating	1,148	14 (1.2)	23 (2.0)	458	43 (9.4)	63 (13.8)	39	0	1 (2.6)	17	4 (23.5)	5 (29.4)
Unspecified	56	1	5	7	3	3	4	0	0	2	0	0

(b) Off-pump CABG (total 10,979)
(The present section also includes cases of planned off-pump CABG in which, during surgery, the change is made to on-pump CABG or an on-pump beating-heart procedure) in 2007

	Primary, elective			Primary, emergency			Redo, elective		
	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths	Cases	30-Day mortality	Hospital deaths
1VD	771	4 (0.5)	7 (0.9)	94	5 (5.3)	8 (8.5)	47	1 (2.1)	1 (2.1)
2VD	1,867	8 (0.4)	14 (0.7)	207	12 (5.8)	12 (5.8)	34	2 (5.9)	2 (5.9)
3VD	4,083	28 (0.7)	50 (1.2)	419	15 (3.6)	25 (6.0)	49	1 (2.0)	1 (2.0)
LMT	2,703	25 (0.9)	39 (1.4)	577	22 (3.8)	32 (5.5)	31	1 (3.2)	2 (6.5)
Kawasaki	9	0	0	0	0	0	0	0	0
unspecified	56			10			1		
Total	9,489	65 (0.7)	110 (1.2)	1,307	54 (4.1)	77 (5.9)	162	5 (3.1)	6 (3.7)
Hemodialysis	655	8 (1.2)	24 (3.7)	103	15 (14.6)	19 (18.4)	12	3 (25.0)	3 (25.0)

	Redo, emergency			Arterial graft only	Arterial graft + SVG	SVG only	Others	Uncertain
	Cases	30-Day mortality	Hospital deaths					
1VD	2	0	0	747	71	91	2	3
2VD	5	0	1 (20.0)	1,077	956	71	0	9
3VD	5	1 (20.0)	1 (20.0)	1,448	2,995	97	0	16
LMT	9	0	2 (22.2)	1,364	1,856	91	0	9
Kawasaki	0	0	0	7	2	0	0	0
Unspecified								66
Total	21	1 (4.8)	4 (19.0)	4,643	5,880	350	2	103
Hemodialysis	2	0	0	232	495	38	0	7

( ), % mortality; CABG, coronary artery bypass grafting; 1VD, one-vessel disease; 2VD, two-vessel disease; 3VD, three-vessel disease; LMT, left main trunk; SVG, saphenous vein graft
LMT includes LMT alone or LMT with other branch diseases

(c) Includes cases of conversion, during surgery, from off-pump CABG to on-pump CABG or on-pump beating-heart CABG (total 301) in 2007

	Primary, elective			Primary, emergency			Redo, elective			Redo, emergency		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
Conversion to on-pump CABG arrest heart	44	3 (6.8)	5 (11.4)	4	1 (25.0)	2 (50.0)	1	0	1 (100.0)	0	0	0
Conversion to on-pump beating-heart CABG	195	13 (6.7)	17 (8.7)	49	5 (10.2)	6 (12.2)	7	0	0	1	0	1 (100.0)
Total	239	16 (6.7)	22 (9.2)	53	6 (11.3)	8 (15.1)	8	0	1 (12.5)	1	0	1 (100.0)
Hemodialysis	20	5 (25.0)	7 (35.0)	6	3 (50.0)	3 (50.0)	0	0	0	0	0	0

( ), % mortality; CABG, coronary artery bypass grafting

(B) Operation for complications of MI (total 874) in 2007

	Chronic			Acute			Concomitant operation		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	CABG	MVP	MVR
Infarctectomy or aneurysmectomy	440	28 (6.4)	40 (9.1)	18	5 (27.8)	5 (27.8)	334	154	23
VSP closure	37	2 (5.4)	4 (10.8)	225	58 (25.8)	75 (33.3)	84	3	5
Cardiac rupture	11	1 (9.1)	2 (18.2)	209	68 (32.5)	78 (37.3)	36	1	2
Mitral regurgitation									
1) Papillary muscle rupture	4	0	0	39	12 (30.8)	15 (38.5)	18	8	22
2) Ischemic	364	13 (3.6)	29 (8.0)	36	5 (13.9)	10 (27.8)	363	272	54
Others	18	1 (5.6)	2 (11.1)	12	4 (33.3)	4 (33.3)	9	0	0
Total	874	45 (5.1)	77 (8.8)	539	152 (28.2)	187 (34.7)	844	438	106

( ), % mortality; MI, myocardial infarction; CABG, coronary artery bypass grafting; MVP, mitral valve repair; MVR, mitral valve replacement; VSP, ventricular septal perforation
Acute, within 2 weeks from the onset of myocardial infarction

(C) TMLR (total 12) in 2007

	Cases	30-Day mortality	Hospital mortality
Isolated	1	0	0
With CABG	11	1 (9.1)	1 (11.0)
Total	12	1 (8.3)	1 (12.0)

TMLR, transmyocardial laser revascularization

(3) Operation for arrhythmia (total 3,649) in 2007

	Cases	30-day mortality	Hospital mortality	Concomitant operation						
				Isolated	Congenital	Valve	IHD	Other	Multiple combination	
									2 Categories	3 Categories
Maze	3,083	47 (1.5)	66 (2.1)	26	193	2,682	298	128	227	19
For WPW	4	0	0	0	1	1	2	0	0	0
For ventricular tachyarrhythmia	111	5 (4.5)	8 (7.2)	51	3	7	42	11	3	0
Others	451	2 (0.4)	8 (1.8)	323	10	96	27	7	12	0
Total	3,649	54 (1.5)	82 (2.2)	400	207	2,786	369	146	242	19

( ), % mortality; WPW, Wolff-Parkinson-White syndrome; IHD, ischemic heart disease
Except for 400 isolated cases, all remaining 3,249 cases are doubly allocated, one for this subgroup and the other for the subgroup corresponding to the concomitant operations

(4) Operation for constrictive pericarditis (total 139) in 2007

	CPB (+)			CPB (–)		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
Total	56	4 (7.1)	6 (10.7)	83	1 (1.2)	3 (3.6)

( ), % mortality; CPB, cardio-pulmonary Bypass

(5) Cardiac tumor (total 445) in 2007

	Cases	30-Day mortality	Hospital mortality	Concomitant operation			
				AVR	MVR	CABG	Others
Myxoma	326	2 (0.6)	4 (1.2)	4	2	16	30
Others	119	5 (4.2)	8 (6.7)	3	3	4	23
Total	445	7 (1.6)	12 (2.7)	7	5	20	53

( ), % mortality; AVR, atrial valve replacement; MVR, mitral valve replacement; CABG, coronary artery bypass grafting

(6) HOCM and DCM (total 150) in 2007

	Cases	30-Day mortality	Hospital mortality	Concomitant operation			
				AVR	MVR	MVP	CABG
Myectomy	54	2 (3.7)	2 (3.7)	20	18	6	3
Myotomy	5	0	0	1	2	1	1
No resection	46	3 (6.5)	5 (10.9)	4	11	31	7
Volume reduction surgery of the left ventricle	45	6 (13.3)	11 (24.4)	2	5	26	11
Total	150	11 (7.3)	18 (12.0)	27	36	64	22

( ), % mortality; HOCM, hypertrophic obstructive cardiomyopathy; DCM, dilated cardiomyopathy; AVR, aortic valve replacement; MVR, mitral valve replacement; MVP, mitral valve repair; CABG, coronary artery bypass grafting

(7) Other open-heart operation (total 374) in 2007

	Cases	30-Day mortality	Hospital mortality
Total	374	31 (8.3)	38 (10.2)

( ), % mortality

Table 3 Thoracic aortic aneurysm (total 10,081)

(1) Dissection (total 4,549) in 2007

Stanford type	Acute						Chronic		
	A			B			A		
Replaced site	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1. Ascending Ao	1,768	155 (8.8)	193 (10.9)	4	0	0	184	3 (1.6)	9 (4.9)
2. Aortic root	171	27	32	0	0	0	55	3	3
3. Ascending Ao + arch	894	107 (12.0)	130 (14.5)	17	2 (11.8)	2 (11.8)	243	8 (3.3)	13 (5.3)
4. Arch + descending Ao	62	4 (6.5)	4 (6.5)	17	3 (17.6)	5 (29.4)	27	4 (14.8)	5 (18.5)
5. Aortic root + ascendng Ao + arch	60	14 (23.3)	17 (28.3)	1	1 (100.0)	1 (100.0)	21	0	1 (4.8)
6. Descending Ao	10	2	3	39	6	6	49	6	8
7. Thoracoabdominal Ao	6	1 (16.7)	1 (16.7)	9	3 (33.3)	4 (44.4)	37	3 (8.1)	5 (13.5)
8. Extraanatomical bypass	5	2 (40.0)	2 (40.0)	23	2 (8.7)	3 (13.0)	1	0	0
9. Stent graft*[a]	40	2 (5.0)	2 (5.0)	35	2 (5.7)	3 (8.6)	33	2 (6.1)	4 (12.1)
1) Transluminal*[b]	12	0	0	28	1 (3.6)	2 (7.1)	15	0	1
2) Open stent: a) With total arch*[c]	2	0	0	2	1 (50.0)	1 (50.0)	1	0	0 (6.7)
b) Without total arch*[d]	26	2 (7.7)	2 (7.7)	5	0	0	17	2 (11.8)	3 (17.6)
Total	3,016	314 (10.4)	384 (12.7)	145	19 (13.1)	24 (16.6)	650	29 (4.5)	48 (7.4)

Stanford type	Chronic			Concomitant operation					Redo		
	B										
Replaced site	Cases	30-Day mortality	Hospital mortality	AVP	AVR	MVP	MVR	CABG	Cases	30-Day mortality	Hospital mortality
1. Ascending Ao	4	0	0	192	74	5	6	86	41	3 (7.3)	3 (7.3)
2. Aortic root	6	0	0	33	99	3	3	35	27	4	4
3. Ascending Ao + arch	56	2 (3.6)	4 (7.1)	59	30	4	3	66	60	10 (16.7)	11 (18.3)
4. Arch + descending Ao	103	16 (15.5)	19 (18.4)	2	4	0	0	3	20	2 (10.0)	4 (20.0)
5. Aortic root + ascendng Ao + arch	4	0	1 (25.0)	4	39	2	0	13	11	1 (9.1)	3 (27.3)
6. Descending Ao	244	5	11	0	1	0	0	5	26	3	3
7. Thoracoabdominal Ao	149	15 (10.1)	19 (12.8)	0	0	0	0	0	24	1 (4.2)	2 (8.3)
8. Extraanatomical bypass	16	0	0	0	0	0	0	0	0	0	0
9. Stent graft*[a]	156	4 (2.6)	5 (3.2)	0	1	0	0	4	39	1 (2.6)	2 (5.1)
1) Transluminal*[b]	127	1 (0.8)	1 (0.8)	0	0	0	0	0	26	0	0
2) Open stent: a) With total arch*[c]	12	1 (8.3)	1 (8.3)	0	0	0	0	0	1	0	0
b) Without total arch*[d]	17	2 (11.8)	3 (17.6)	0	1	0	0	4	12	1 (8.3)	2 (16.7)
Total	738	42 (5.7)	59 (8.0)	290	248	14	12	212	248	25 (10.1)	32 (12.9)

( ), % mortality; Ao, aorta; AVP, aortic valve repair; AVR, aortic valve replacemnt; MVP, mitral valve repair; MVR, mitral valve replacement; CABG, coronary artery bypass grafting

Acute, within 2 weeks from the onset

*a = *b + *c + *d

(2) Nondissection (total 5,532) in 2007

Replaced site	Unruptured			Ruptured			Concomitant operation		
	Cases	30-day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	AVP	AVR	MVP
1. Ascending Ao	818	20 (2.4)	22 (2.7)	37	3 (8.1)	5 (13.5)	63	527	30
2. Aortic root	641	17	26	19	2	4	95	409	33
3. Ascending Ao + arch	1,646	63 (3.8)	102 (6.2)	214	47 (22.0)	58 (27.1)	14	94	10
4. Arch + descending Ao	196	11 (5.6)	18 (9.2)	50	11 (22.0)	15 (30.0)	0	5	0
5. Aortic root + ascendng Ao + arch	96	6 (6.3)	7 (7.3)	1	0	0	1	51	7
6. Descending Ao	509	20 (3.9)	30 (5.9)	141	27 (19.1)	33 (23.4)	0	2	0
7. Thoracoabdominal Ao	369	24	38	67	14	18	0	2	0
8. Extraanatomical bypass	15	1 (6.7)	2 (13.3)	4	1 (25.0)	1 (25.0)	0	1	0
9. Stent graft*[a]	607	14 (2.3)	21 (3.5)	102	17 (16.7)	23 (22.5)	0	5	0
1) Transluminal*[b]	467	9 (1.9)	13 (2.8)	80	12 (15.0)	17 (21.3)	0	0	0
2) Open stent: a) With total arch*[c]	39	1 (2.6)	2 (5.1)	5	0	0	0	0	0
b) Without total arch*[d]	96	4 (4.2)	6 (6.3)	16	5 (31.3)	6 (37.5)	0	5	0
Unspecified	5			1					
Total	4,897	176 (3.6)	266 (5.4)	635	122 (19.2)	157 (24.7)	173	1,096	80

Replaced site	Concomitant operation		Redo			CPB(–)		
	MVR	CABG	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1. Ascending Ao	26	105	60	8 (13.3)	11 (18.3)	4	0	0
2. Aortic root	9	85	71	5	7	1	0	0
3. Ascending Ao + arch	10	319	71	7 (9.9)	11 (15.5)	4	0	0
4. Arch + descending Ao	1	17	21	3 (14.3)	4 (19.0)	1	0	0
5. Aortic root + ascendng Ao + arch	1	9	10	4 (40.0)	4 (40.0)	1	1 (100.0)	1 (100.0)
6. Descending Ao	0	14	37	6 (16.2)	8 (21.6)	9	1 (11.1)	1 (11.1)
7. Thoracoabdominal Ao	0	4	24	3	6	4	0	0
8. Extraanatomical bypass	0	0	2	1 (50.0)	1 (50.0)	0	0	0
9. Stent graft*[a]	0	18	37	3 (8.1)	3 (8.1)	195	7 (3.6)	10 (5.1)
1) Transluminal*[b]	0	2	32	3 (9.4)	3 (9.4)	195	7 (3.6)	10 (5.1)
2) Open stent: a) With total arch*[c]	0	5	2	0	0	0	0	0
b) Without total arch*[d]	0	11	3	0	0	0	0	0
Unspecified						1		
Total	47	571	333	40 (12.0)	55 (16.5)	220	9 (4.1)	12 (5.5)

( ), % mortality; Ao, aorta; AVP, aortic valve repair; AVR, aortic valve replacement; MVP, mitral valve repair; MVR, mitral valve replacement; CABG, coronary artery bypass grafting
*a = *b + *c + *d

Table 4 Pulmonary thromboembolism (total 135) in 2007

	Cases	30-Day mortality	Hospital mortality
Acute	92	14 (15.2)	17 (18.5)
Chronic	43	4 (9.3)	4 (9.3)
Total	135	18 (13.3)	21 (15.6)

( ), % mortality

Table 5 Assisted circulation (total 1,488) in 2007

	Sites	VAD								
		Device			Results					
					Not weaned			Weaned		
		Centrifugal	VAS	Others	Ongoing	Dead	Transplant	Survived	Dead	Transplant
Postcardiotomy	Left	19	14	0	2	20 (60.6)	0	8	3 (9.1)	0
	Right	2	0	0	0	0 (0.0)	0	2	0	0
	Biventricular									
	Right	2	1	0	0	5 (100.0)	0	0	0	0
	Left	4	1	0						
Congestive heart failure	Left	7	42	9	29	20 (40.8)	2	5	2 (4.1)	0
	Right	3	0	0	0	1	0	2	0	0
	Biventricular									
	Right	11	3	0	0	11 (37.5)	1	1	0	1
	Left	0	14	0						
Respiratory failure										
Total		48	75	9	31	57 (46.3)	3	18	5 (4.1)	1

	Sites	Heart-lung assist						Unspecified
		Method		Results				
				Not weaned		Weaned		
		PCPS	Others	Dead	Transplant	Dead	Survived	
Postcardiotomy	Left							
	Right							
	Biventricular	469	34	280 (55.7)	0	72 (14.3)	151	
	Right							
	Left							
Congestive heart failure	Left							
	Right							
	Biventricular	731	47	404 (51.9)	0	110 (14.1)	263	
	Right							
	Left							
Respiratory failure		61	14	38 (50.7)	0	5 (6.7)	32	1
Total		1,261	95	722 (53.2)	0	187 (13.8)	446	

( ), % mortality; VAD, venricular assist device; VAS, verntricular assist system; PCPS, Percutaneous Cardiopulmonary Support

Table 6 Heart transplantation (total 10) in 2007

	Cases	30-Day mortality	Hospital mortality
Heart transplantation	10	0	0
Heart and lung transplantation	0	0	0
Total	10	0	0

( ), % mortality

Table 7 Pacemaker + ICD (total 17,194) in 2007

	Pacemaker			ICD	
	Univentricular	Biventricular	CRTD	CRTD	ICD
Initial	2,742	6,511	318	594	1,122
Exchange	2,141	3,300	43	65	358
Total	4,883	9,811	361	659	1,480

ICD, implantable cardioverter-defibrillator; CRTD, cardiac resynchronization therapy device with incorporated ICD device

(B) General thoracic surgery

The number of reported general thoracic surgery cases, regretfully, has decreased slightly compared with that of 2006. This is due to the new detailed questionnaire regarding operations for lung cancer. This year, we requested the patient's age in 10-year increments, how the lung cancer came to be suspected, the pathological stage, the location of the lung cancer, preoperative associated diseases, operative morbidity, and cause of death as well as the operative methods and the number of cases of each pathological entity. Although this change has prevented some thoracic surgeons from completing the questionnaire, a wealth of data were compiled; and we now understand many aspects of lung cancer surgery in more detail. We thank those who took the time to painstakingly answer all the questions.

As mentioned above, the number of reported operations for lung cancer has decreased from 26,531 in 2006 to 26,092 in 2007. In all, 63% of the patients were male (male/female ratio 1.73). The proportions of the pathological stages were as follows: Ia, 49.8%; Ib, 20.7%; IIa, 3.9%; IIb, 7.6%; IIIa, 10.4%; IIIb, 5.6%; IV, 1.9%. Among the 13,118 patients operated on in 1999, as compiled by the Japanese Joint Committee for Lung Cancer Registry, 38.1% were at stage Ia, suggesting that a shift toward diagnosing lung cancer at an earlier stage is taking place. In all, 50.5% of lung cancers were first suspected during a routine checkup and 32.6% during follow-up of another disease; only 16.8% presented with a symptom. Of note, chest XP detected 72% of those patients leading those detected by check-up CT (19%) by a large margin. Overall, 40% of patients were 70–79 years of age (the largest age group), followed by those 60–69 years of age (31.6%). In all, 2,258 patients (8.7%) 80–89 years of age and 15 patients 90 years or older were operated on for lung cancer. The percentages of each pathological subtype did not change, with adenocarcinoma (67.5%) being the most frequent, followed by squamous cell carcinoma (21.2%), large-cell carcinoma (3.1%), and small-cell carcinoma (1.9%). Most lung cancers (90.3%) occurred in the periphery of the lung.

In all, 52.5% of lung cancer patients had a history of smoking, an unexpectedly low figure compared with earlier statistics. Other associated diseases included 945 cases of interstitial pneumonia (3.6%), obstructive pulmonary disease ($FEV_1 < 40\%$) (2.3%), cardiovascular disease (3.8%), and diabetes mellitus (3.4%).

The 30-day operative and hospital mortality rates were low (0.46% and 1.0%, respectively). These figures are very low and apparently have reached a plateau, suggesting that we cannot hope for more. However, the detailed questionnaire, although discouraging some to complete the report, has shown clearly what is causing the death of our patients and what we should work on for the coming years to improve the operative results. The number one killer of postoperative lung cancer patients was exacerbation of interstitial pneumonia, killing 64 patients (0.25% of all lung cancer operations and 42% of those who had exacerbation of interstitial pneumonia). Interstitial pneumonia was exacerbated in 16.2% of those who had interstitial pneumonia preoperatively (945 patients, 3.6% of all the lung cancer patients). Other causes of death included pneumonia (46 patients), cardiovascular disease (23 patients), and bronchopleural fistula (21 patients). A total of 23 cardiac infarctions were reported; all of these patients seem to have died. Only 9 patients died of pulmonary embolism, a figure that may indicate the excellent postoperative care by our nurses, but the accuracy of diagnosis may be questioned. In all, 102 bronchopulmonary fistulas (0.4%) were reported; and 21 of these patients died. These detailed data are indispensable for our efforts to further reduce the operative mortality.

A total of 295 malignant pleural mesotheliomas were operated on in 2007, a large increase considering the decrease in the number of lung cancers reported. We asked about the operative method for this disease and found that only 139 (47%) underwent extrapleural pneumonectomy. We do not know what method was used in the other 144 patients. In all, 23 hospital deaths (7.8% of malignant mesothelioma) were reported and suggest a need for stricter selection of patients, safer operations, and possibly more intensive postoperative care.

The number of lung transplantations increased only slightly in 2007: to 19 from 13 in 2006. Ten living donor lobar transplantations were reported, a slight increase as well. Our surgeons are to be praised for the low mortality (only one death). The problem is now in the hands of the politicians.

Tracheobronchoplasty decreased by 11.4%, a significant drop considering that lung cancer cases decreased only by 1.7% from the previous year. This may reflect the decrease in the number of cancers originating in the proximal portion of the bronchus.

Now that we have many new data sets available, we will follow these data to see how the figures are going to change. In the meantime, efforts are needed to overcome the exacerbation of interstitial pneumonia in postoperative patients and define the subset of malignant mesothelioma patients who may benefit from surgery.

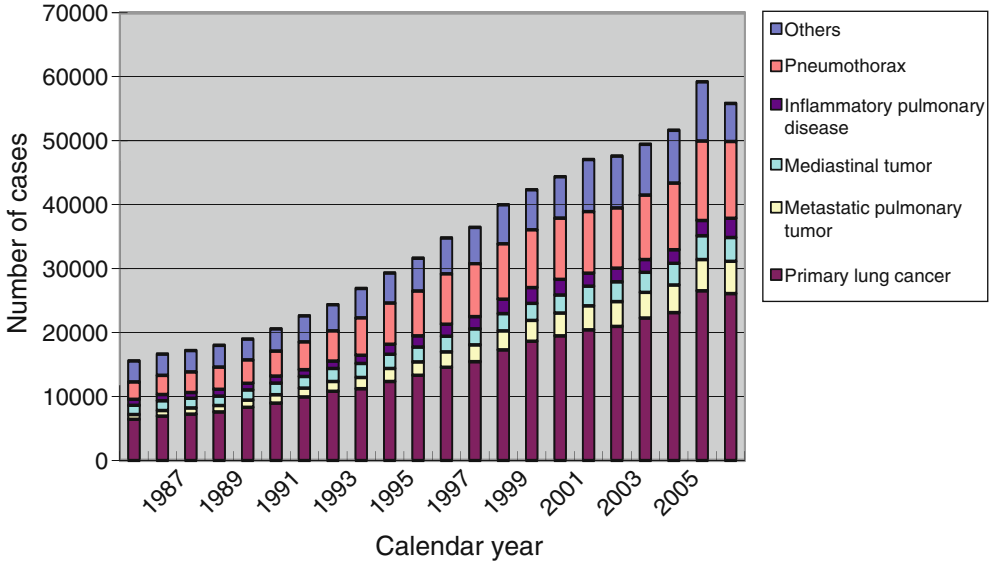

Fig. 1 General thoracic surgery

Table 1 Total entry cases of general thoracic surgery during 2007 in 2007

	Cases	%
Benign pulmonary tumor	648	1.2
Primary lung cancer	26,092	46.7
Other primary malignant pulmonary tumor	255	0.5
Metastatic pulmonary tumor	5,047	9.0
Tracheal tumor	139	0.2
Mesothelioma	431	0.8
Chest wall tumor	628	1.1
Mediastinal tumor	3,731	6.7
Thymectomy for MG without thymoma	309	0.6
Inflammatory pulmonary disease	3,021	5.4
Empyema	1,425	2.6
Bullous disease excluding pneumothorax	681	1.2
Pneumothorax	11,982	21.5
Chest wall deformity	337	0.6
Diaphragmatic hernia including traumatic	113	0.2
Chest trauma excluding diaphragmatic hernia	346	0.6
Lung transplantation	19	0.0
Others	628	1.1
Total	55,832	100.0

Table 2 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
1. Benign pulmonary tumor	648	1 (0.2)	1 (0.2)	484
Hamartoma	408	0 (0.0)	0 (0.0)	313
Sclerosing hemangioma	86	0		66
Others	154	1 (0.6)	1 (0.6)	105

( ), % mortality

Table 3 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
2. Primary malignant pulmonary tumor	26,347	119 (0.5)	261 (1.0)	
Lung cancer	26,092	117 (0.4)	258 (1.0)	12,079
Adenocarcinoma	17,616	44 (0.2)	98 (0.6)	
Squamous cell carcinoma	5,533	51 (0.9)	110 (2.0)	
Large-cell carcinoma	810	5 (0.6)	10 (1.2)	
(LCNEC)	(344)	(2) (0.6)	(3) (0.9)	
Small-cell carcinoma	488	6 (1.2)	7 (1.4)	
Adenosquamous carcinoma	451	4 (0.9)	9 (2.0)	
Carcinoma with plemorphic, sarcomatoid or sarcomatous elements	267	2 (0.7)	10 (3.7)	
Carcinoid	173	0 (0.0)	0 (0.0)	
Carcinomas of salivary gland type	34	0 (0.0)	0 (0.0)	
Unclassified	69	0 (0.0)	0 (0.0)	
Multiple lung cancer	504	1 (0.2)	9 (1.8)	
Others	150	1 (0.7)	1 (0.7)	
Unknown	5	1 (20.0)	1 (20.0)	
Wedge resection	3,279	6 (0.2)	12 (0.4)	2,402
Segmental excision	2,041	3 (0.1)	11 (0.5)	1,129
Sleeve segmental excision	65	1 (1.5)	1 (1.5)	41
Lobectomy	19,406	83 (0.4)	184 (0.9)	8,348
Sleeve lobectomy	421	4 (1.0)	12 (2.9)	40
Pneumonectomy	580	16 (2.8)	26 (4.5)	33
Sleeve pneumonectomy	15	0 (0.0)	1 (6.7)	0
Pleuropneumonectomy	16	0 (0.0)	1 (6.3)	1
Others	259	2 (0.8)	4 (1.5)	83
Unclassified	10	2	6	2
Sarcoma	44	2 (4.5)	2 (4.5)	
AAH	141	(0.0)	(0.0)	
Others	70	(0.0)	1 (1.4)	35

( ), % mortality

Table 4 Details of lung cancer operation in 2007

Age (years)	Cases
<20	9
20–29	23
30–39	185
40–49	847
50–59	4,022
60–69	8,199
70–79	10,373
80–89	2,258
≥90	15
NA	161
Total	26,092

NA, not available

Sex	Cases
Male	16,518
Female	9,570
NA	4
Total	26,092

Stage	Cases
Ia	12,764
Ib	5,308
IIa	1,003
IIb	1,953
IIIa	2,656
IIIb	1,440
IV	491
Others	103
NA	374
Total	26,092

Associated disease	Cases
Smoking history	13,722
BMI ≥ 30	643
Brain and cerebrovascular disease	984
$FEV_{1.0\%} < 40\%$	589
Ischemic heart disease	982
Interstitial pneumonia	945
Cr ≥ 2	269
Liver cirrhosis	85
Hb A1c ≥ 8	898
Hb ≤ 8	111
Autoimmune disease	295

Postoperative morbidity	Cases
Wound infection	230
Bleeding >500 ml/h	379
Air leak >2 weeks	385
Chylothorax	238
Bronchopleural fistula	102
Pulmonary embolism	36
Pyothorax	197
Pneumonia	484
Respiration support >3 days	138
Interstitial pneumonia exacerbation	153
Cardiac infarction	23
Arrhythmia	932
Brain infarction, bleeding	78
Others	314

Cause of death	Cases
Cardiovascular	23
Pneumonia	46
Pyothorax	10
Bronchopleural fistula	21
Respiratory failure	18
Pulmonary embolism	9
Interstitial pneumonia	64
Brain infarction or bleeding	13
Lung cancer	32
Others	25
Unknown	7
Unclassifiable	10
Total	268

Diagnosis	Cases
Symptom	3,755
Medical checkup	11,285
Chest XP	8,082
CT	2,161
Sputum cytology	87
Others	117
Follow-up of other disease	7,274
Others	310

Location	Cases
Peripheral	19,776
Central	2,114
Multiple	687
Unclassified	193
Others	33

Table 5 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
3. Metastatic pulmonary tumor	5,047	8 (0.2)	12 (0.2)	3,288
Colorectal	2,461	4 (0.2)	7 (0.3)	1,580
Hepatobiliary/pancreatic	183	1 (0.5)	1 (0.5)	128
Uterine	218	0 (0.0)	0 (0.0)	164
Mammary	332	1 (0.3)	1 (0.3)	239
Ovarian	36	0 (0.0)	1 (2.8)	25
Testicular	67	0 (0.0)	0 (0.0)	36
Renal	414	1 (0.2)	1 (0.2)	278
Skeletal	121	0 (0.0)	0 (0.0)	80
Soft tissue	184	0 (0.0)	0 (0.0)	122
Otorhinolaryngological	272	0 (0.0)	0 (0.0)	178
Pulmonary	292	1 (0.3)	1 (0.3)	153
Others	467	0 (0.0)	0 (0.0)	305

( ), % mortality

Table 6 in 2007

	Cases	30-Day mortality	Hospital mortality
4. Tracheal tumor	139	1 (0.7)	2 (1.4)
Primary malignancy	93	0 (0.0)	1 (1.1)
Metastatic	34	1 (2.9)	1 (2.9)
Benign	12	0 (0.0)	0 (0.0)

( ), % mortality

Table 7 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
5. Tumor of pleural origin	431	8 (1.9)	24 (5.6)	
Solitary fibrous tumor	112	0 (0.0)	1 (0.9)	
Malignant pleural mesothelioma	295	9 (3.1)	23 (7.8)	
Others	24	0 (0.0)	0 (0.0)	

( ), % mortality

Table 8 in 2007

	Cases	30-Day mortality	Hospital mortality
6. Chest wall tumor	628	1 (0.2)	1 (0.2)

( ), % mortality

Table 9 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
7. Mediastinal tumor	3,731	2 (0.1)	7 (0.2)	1,378
Thymoma	1,525	1 (0.1)	1 (0.1)	332
Thymic cancer	195	0 (0.0)	3 (1.5)	16
Germ cell tumor	200	0 (0.0)	1 (0.5)	45
Benign	149	0 (0.0)	0 (0.0)	44
Malignant	50	0 (0.0)	1 (2.0)	1
Unclassified	1	0	0 (0.0)	0
Neurogenic tumor	461	0 (0.0)	0 (0.0)	289
Congenital cyst	598	0 (0.0)	0 (0.0)	406
Goiter	121	0 (0.0)	0 (0.0)	8
Lymphatic tumor	251	1 (0.4)	2 (0.8)	132
Others	380	0 (0.0)	0 (0.0)	150

( ), % mortality

Table 10 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
8. Thymectomy for myasthenia gravis	568	3 (0.5)	3 (0.5)	124
With thymoma	259	2 (0.8)	2 (0.8)	

( ), % mortality

Table 11 in 2007

	Cases	30-Day mortality	Hospital mortality
9. Operation for nonneoplastic disease	18,530	77 (0.4)	151 (0.8)

in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
A. Inflammatory pulmonary disease	3,021	3 (0.1)	7 (0.2)	1,973
Tuberculous infection	161	0 (0.0)	0 (0.0)	66
Fungal infection	316	2 (0.6)	5 (1.6)	135
Bronchiectasis	86	1 (1.2)	2 (2.3)	30
Tuberculous nodule	546	0 (0.0)	0 (0.0)	414
Infection	1,344	0 (0.0)	0 (0.0)	923
Interpulmonary lymph node	179	0 (0.0)	0 (0.0)	163
Others	389	0 (0.0)	0 (0.0)	242

( ), % mortality

Table 12 in 2007

	Cases	30-Day mortality	Hospital mortality	Radical surgery
B. Empyema	1,425	20 (1.4)	59 (4.1)	984

( ), % mortality

Table 13 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
C. Descending necrotizing mediastinitis	77	2 (2.6)	4 (5.2)	29

( ), % mortality

Table 14 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
D. Bullous disease	681	2 (0.3)	4 (0.6)	457
Emphysematous bulla	511	0 (0.0)	1 (0.2)	352
Bronchogenic cyst	117	0 (0.0)	0 (0.0)	74
Emphysema with volume reduction surgery	32	1 (3.1)	2 (6.3)	22
Others	21	1 (4.8)	1 (4.8)	9

( ), % mortality

Table 15 in 2007

	Cases	30-Day mortality	Hospital mortality	By VATS
E. Pneumothorax	11,982	16 (0.1)	33 (0.3)	10,896
Primary spontaneous	11,072	5 (0.0)	10 (0.1)	10,173
Secondary	910	11 (1.2)	23 (2.5)	723

( ), % mortality

Table 16 in 2007

	Cases	30-Day mortality	Hospital mortality
F. Chest wall deformity	337	0 (0.0)	5 (1.5)
Funnel chest	285	0 (0.0)	4 (1.4)
Others	52	0 (0.0)	1 (1.9)

( ), % mortality

Table 17 in 2007

	Cases	30-Day mortality	Hospital mortality	Traumatic
G. Diaphragmatic hernia	113	5 (4.4)	6 (5.3)	37

( ), % mortality

Table 18 in 2007

	Cases	30-Day mortality	Hospital mortality
H. Chest trauma	346	23 (6.6)	26 (7.5)

( ), % mortality

Table 19 in 2007

	Cases	30-Day mortality	Hospital mortality	Sympathectomy
I. Other respiratory surgery	551	7 (1.3)	8 (1.5)	
Arteriovenous malformation*	90	0 (0.0)	0 (0.0)	1
Pulmonary sequestration	100	0 (0.0)	0 (0.0)	1
Others	360	7 (1.9)	8 (2.2)	5
Unknown	1			1

( ), % mortality

Table 20 in 2007

	Cases	30-Day mortality	Hospital mortality
10. Lung transplantation	10	1 (10.0)	1 (10.0)
Single lung	6	0 (0.0)	0 (0.0)
Bilateral	3	1 (33.3)	1 (33.3)
Living donor	10	0 (0.0)	0 (0.0)

( ), % mortality

Table 21 in 2007

	Cases	30-Day mortality	Hospital mortality
11. Video-assisted thoracic surgery	33,696	39 (0.1)	70 (0.2)

( ), % mortality
Including thoracic sympathectomy (385)

Table 22 in 2007

	Cases	30-Day mortality	Hospital mortality
12. Tracheobronchoplasty	538	6 (1.1)	12 (2.2)
Trachea	64	0 (0.0)	0 (0.0)
Carinal reconstruction	16	0 (0.0)	0 (0.0)
Sleeve pneumonectomy	58	0 (0.0)	1 (1.7)
Bronchus	378	5 (1.3)	10 (2.6)
Others	19	1 (5.3)	1 (5.3)
Unclassified	3		

( ), % mortality

Table 23 in 2007

	Cases	30-Day mortality	Hospital mortality
13. Pediatric surgery	406	5 (1.2)	5 (1.2)

( ), % mortality

Table 24 in 2007

	Cases		30-Day mortality	%	Hospital mortality	%
14. Combined resection of neighboring organ(s)	1,197		8	0.67	22	1.84
Organ resected	Primary lung cancer			Mediastinal tumor		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
Aorta	12	0 (0.0)	1 (8.3)	4	0 (0.0)	0 (0.0)
Superior vena cava	35	0 (0.0)	0 (0.0)	108	1 (0.9)	3 (2.8)
Pulmonary artery	188	2 (1.1)	4 (2.1)	6	0 (0.0)	0 (0.0)
Left atrium	39	0 (0.0)	1 (2.6)	2	0 (0.0)	0 (0.0)
Diaphragm	118	0 (0.0)	1 (0.8)	7	0 (0.0)	0 (0.0)
Chest wall (including ribs)	492	4 (0.8)	9 (1.8)	10	0 (0.0)	0 (0.0)
Vertebra	35	1 (2.9)	2 (5.7)	4	0 (0.0)	0 (0.0)
Esophagus	10	0 (0.0)	0 (0.0)	0	0	0
Lung				170	0 (0.0)	1 (0.6)

( ), % mortality

Table 25 in 2007

	Cases	30-Day mortality	Hospital mortality
15. Operation for lung cancer invading the apical chest wall	127	2 (1.6)	3 (2.4)

( ), % mortality
Includes tumors invading the anterior apical chest wall and posterior apical chest wall (superior sulcus tumor, so-called Pancoast type)

(C) Esophageal surgery

During 2007 alone, 12,396 patients with esophageal diseases were registered from 489 institutions (response rate 86.9%) that are affiliated with the Japanese Association for Thoracic Surgery and/or the Japan Esophageal Society. Among these institutions, 102 (20.9%) had 20 or more patients who underwent esophageal surgery during the year 2007, which shows a slight shift of esophageal operations to higher-volume institutions when compared to the data of 2006 (18.3%)[1] (Table 1). Of 2,952 patients with a benign esophageal disease, 701 (23.7%) underwent surgery, and 30 (1.0%) underwent endoscopic resection; 2,221 (75.2%) patients did not undergo any surgical treatment (Table 2). Of 9,444 patients with a malignant esophageal tumor, 6,516 (69.0%) patients underwent resection—esophagectomy for 4,990 (52.8%) and endoscopic mucosal resection (EMR) including endoscopic submucosal dissection (ESD) for 1,526 (16.2%); 2,928 (31.0%) patients did not undergo any resection (Tables 3, 4). The decrease in registered patients with surgically treated benign esophageal diseases is obvious, especially in the category esophageal varices.[1] This decrease in registered benign esophageal diseases with operation for these few years may show that a larger number of such patients are treated in medical departments. Moreover, the number of registered patients with malignant esophageal disease, particularly those undergoing nonsurgical therapy have been increasing since 1990 (Fig. 1).

Among benign esophageal diseases (Table 2), esophageal varices, esophagitis (including reflux esophagitis), and hiatal hernia were the most common conditions. Achalasia, benign esophageal tumors, spontaneous rupture of the esophagus, and congenital esophageal atresia were common diseases that were treated surgically treated, as were the above-mentioned diseases. Thoracoscopic and/or laparoscopic procedures have been widely adopted for benign esophageal diseases, in particular achalasia, hiatal hernia, and benign tumors. Open surgery was performed in 388 patients who had a benign esophageal disease, with 30-day mortality in 7 (1.8%) patients and hospital mortality including 30-day mortality in 12 (3.1%). Thoracoscopic and/or laparoscopic surgery was performed in 313 patients, with no patient deaths registered in the 30-day mortality category and one (0.3%) death in the hospital mortality category. The difference in these death rates between open and thoracoscopic surgery seems to be related the conditions requiring open surgery. Most of the deaths were found in patients with spontaneous esophageal rupture or congenital esophageal stenosis that required open surgery.

Most of the malignant diseases were carcinomas (Table 3). Among esophageal carcinomas, the incidence of squamous cell carcinoma was 93.9%, and that of adenocarcinomas including Barrett's cancer was 3.7%. The resection rate for patients with a squamous cell carcinoma was 68.2%, and for patients with an adenocarcinoma it was 85.4%.

Regarding location, the thoracic esophagus was the most common site of the cancer (Table 4). Of the 3,110 patients (32.9% of total esophageal malignancies) with superficial esophageal cancers in the mucosal and submucosal layers, 1,284 (41.3%) underwent esophagectomy, and 1,526 (49.1%) underwent EMR. Advanced esophageal cancer invading deeper than the submucosal layer was observed in 6,334 (67.1%) patients. The 30-day mortality and hospital mortality rates after esophagectomy for patients with a superficial cancer were 1.2% and 2.4%, respectively. There were no EMR-related deaths. Of the 6,334 patients with advanced esophageal cancer, 3,706 (58.5%) underwent esophagectomy, with a 1.2% 30-day mortality rate and a 3.8% hospital mortality rate.

Multiple primary cancers were observed in 1,216 (12.9%) of all the 9,444 patients with esophageal cancer. Synchronous cancer was found in 702 (7.4%) patients, and metachronous cancer (found before esophageal cancer) was observed in 514 (5.4%). The stomach is the commonest site for both synchronous and metachronous other malignancies, followed by head and neck cancer (Table 4).

Among esophagectomy procedures, transthoracic esophagectomy through a right thoracotomy was most commonly adopted for patients with a superficial cancer as well as for those with an advanced cancer (Table 5). Whereas transhiatal esophagectomy is commonly performed in Western countries, in Japan it was adopted in only 5.2% of patients having a superficial cancer who underwent esophagectomy and in 2.1% of those having an advanced cancer. Thoracoscopic and/or laparoscopic esophagectomy was adopted for 354 patients (27.5%) with a superficial cancer and for 415 patients (11.2%) with an advanced cancer. The number of cases of thoracoscopic and/or laparoscopic surgery for superficial or advanced cancer has been increasing for several years (Fig. 2).

Combined resection of the neighboring organs during resection of an esophageal cancer was performed in 207 patients (Tables 5, 6). Resection of the aorta with concomitant esophagectomy was not performed in 2007. Tracheal and/or bronchial resection combined with esophagectomy was performed in 25 patients, with no hospital mortality. Lung resection combined with esophagectomy was performed in 44 patients, with a 30-day

mortality rate of 2.3% and a hospital mortality rate of 9.1%.

Salvage surgery after definitive (chemo)radiotherapy was performed in 168 patients, with a 30-day mortality rate of 3.0% and a hospital mortality rate of 7.1% (Table 5).

Lastly, despite the efforts of the Committee to cover wider patient populations for this annual survey, most of the institutions that responded to the questionnaire were the departments of thoracic or esophageal surgery. It should be noted that a larger number of patients with esophageal diseases may have been treated medically and endoscopically. We should continue our efforts for a complete survey through more active collaboration with the Japan Esophageal Society and other related societies.

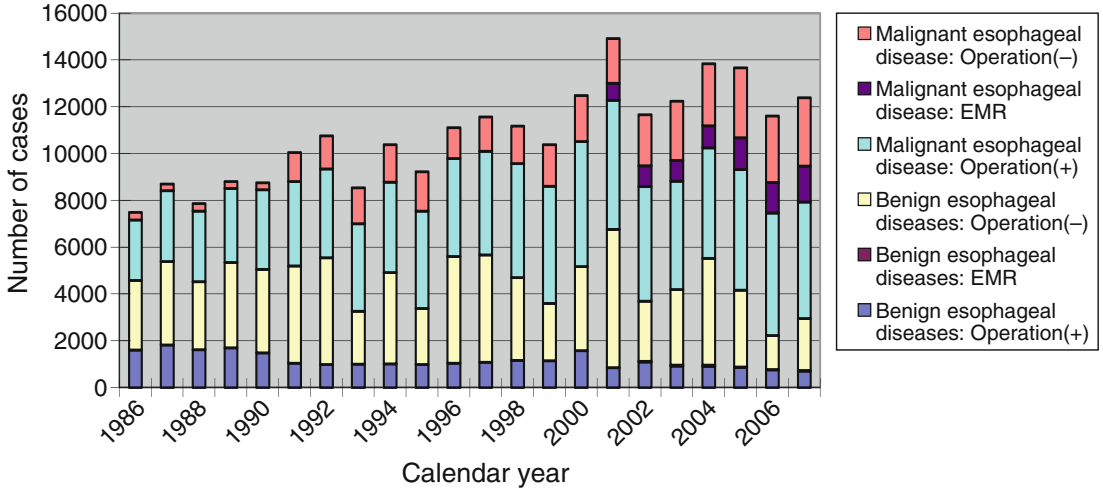

Fig. 1 Annual trend of in-patients with esophageal diseases. *EMR*, endoscopic mucosal resection (including endoscopic submucosal dissection)

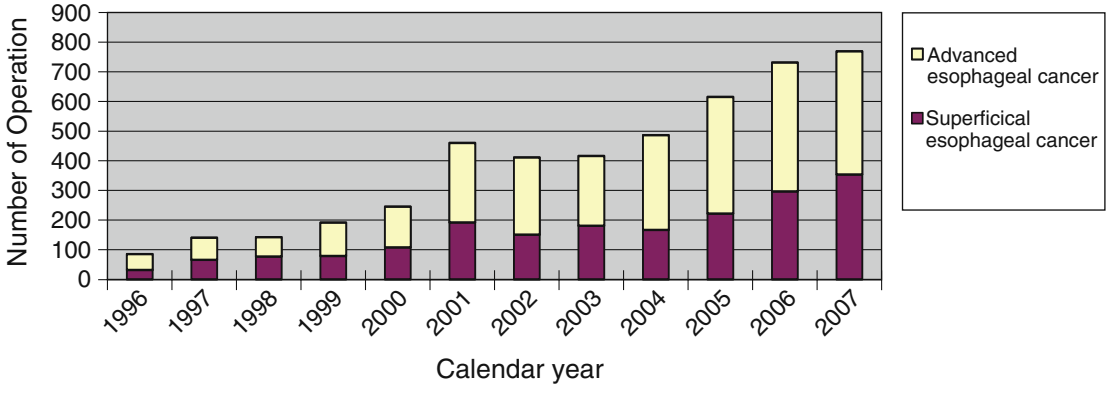

Fig. 2 Annual trend of video-assisted esophagectomy for esophageal malignancy

Table 1 Distribution of the number of esophageal operations in 2007 at the institutions in 2007

Esophageal surgery			
No. of operations in 2007	Benign esophageal disease	Malignant esophageal disease	Benign + malignant disease
1–4	188	182	180
5–9	32	115	112
10–19	12	82	95
20–29	2	39	46
30–39	0	16	17
40–49	0	7	11
≥50	0	26	28
Total	234	467	489

Table 2 Benign esophageal diseases in 2007

	Operation(+)									Endoscopic resection	Operation (–)	Total
	No. of patients			30-Day mortality			Hospital mortality					
	Total	Open	T/L	Total	Open surgery	T/L	Total	Open surgery	T/L			
1. Achalasia	140	26	114	0	0 (0.0)	0	0	0 (0.0)	0		46	186
2. Benign tumor	53	30	23	0	0 (0.0)	0	0	0 (0.0)	0	30	34	117
(1) Leiomyoma	37	18	19	0	0 (0.0)	0	0	0 (0.0)	0	10	25	72
(2) Cyst	5	2	3	0	0 (0.0)	0	0	0 (0.0)	0	1	6	12
(3) Others	11	10	1	0	0 (0.0)	0	0	0 (0.0)	0	15	2	28
(4) Not specified				0	0	0	0	0	0	4	1	1
3. Diverticulum	21	16	5	0	0 (0.0)	0	0	0 (0.0)	0		67	88
4. Hiatal hernia	226	84	142	1	1 (1.2)	0	2	1 (1.2)	1		638	864
5. Spontaneous rupture of the esophagus	76	72	4	3	3 (4.2)	0	7	7 (9.7)	0		12	88
6. Esophagotracheal fistula	16	16	0	0	0 (0.0)	0	0	0 (0.0)	0		16	32
7. Congenital esophageal atresia	52	52	0	0	0 (0.0)	0	0	0 (0.0)	0		7	59
8. Congenital esophageal stenosis	4	4	0	1	1 (25.0)	0	1	1 (25.0)	0		6	10
9. Corrosive stricture of the esophagus	8	8	0	0	0 (0.0)	0	0	0 (0.0)	0		14	22
10. Esophagitis, esophageal ulcer	30	11	19	0	0 (0.0)	0	0	0 (0.0)	0		474	504
11. Esophageal varices	33	33		1	1 (3.0)	0	1	1 (3.0)	0		885	918
(1) Laparotomy	29	29		1	1 (3.4)		1	1 (3.4)				29
(2) Others				0			0					0
(3) Sclerotherapy				0			0				601	601
12. Others	42	36	6	1	1 (2.8)	0	2	2 (5.6)	0		22	64
Total	701	388	313	7	7 (1.8)	0	13	12 (3.1)	1	30	2,221	2,952

( ), % mortality; T/L, thoracoscopic and/or laparoscopic resection

Table 3 Malignant esophageal diseases (histological classification) in 2007

	Resection(+)	Resection(–)	Total
Carcinomas	6,471	2,919	9,390
1. Squamous cell carcinoma	6,018	2,803	8,821
2. Basaloid(-squamous) carcinoma	58	8	66
3. Carcinosarcoma	39	8	47
4. Adenocarcinoma in Barrett's esophagus	167	21	188
5. Other adenocarcinoma	126	29	155
6. Adenosquamous carcinoma	21	5	26
7. Mucoepidermoid carcinoma	5	2	7
8. Adenoid cystic carcinoma	2	0	2
9. Endcrine cell carcinoma	11	2	13
10. Undifferentiated carcinoma	13	21	34
11. Others	11	20	31
Other malignancies	40	9	49
1. Malignant nonepithelial tumors	9	2	11
2. Malignant melanoma	20	5	25
3. Other malignant tumors	11	2	13
Not specified	5	0	5
Total	6,516	2,928	9,444

Resection includes endoscopic resection

Table 4 Malignant esophageal disease (clinical characteristics) in 2007

	Operation(+)			EMR	Operation(−)	Total
	Cases	30-Day mortality	Hospital mortality			
1. Esophageal cancer	4,990	60 (1.2)	170 (3.4)	1,526	2,928	9,444
A. Location						0
(1) Cervical esophagus	175	3 (1.7)	8 (4.6)	22	223	420
(2) Thoracic esophagus	4,154	51 (1.2)	147 (3.5)	1,286	2,361	7,801
(3) Abdominal esophagus	419	5 (1.2)	10 (2.4)	79	187	685
(4) Multiple cancers	242	1 (0.4)	3 (1.2)	91	79	412
(5) Others/not described	0	0	2	48	78	126
B. Tumor depth						
(1) Superficial cancer	1,284	15 (1.2)	31 (2.4)	1,526	300	3,110
(2) Advanced cancer	3,706	45 (1.2)	139 (3.8)		2,628	6,334
(3) Not specified	775	4 (0.5)	18 (2.3)		441	1,216
2. Multiple primary cancers	775	4 (0.5)	18 (2.3)		441	1,216
A. Synchronous	472	4 (0.8)	14 (3.0)		230	702
(1) Head and neck	151	0 (0.0)	1 (0.7)		70	221
(2) Stomach	210	0 (0.0)	5 (2.4)		87	297
(3) Others	89	3 (3.4)	5 (5.6)		57	146
(4) Triple cancers	22	1 (4.5)	3 (13.6)		14	36
(5) Not specified					2	2
B. Metachronous	303	0 (0.0)	4 (1.3)		211	514
(1) Head and neck	71	0 (0.0)	1 (1.4)		50	121
(2) Stomach	89	0 (0.0)	1 (1.1)		70	159
(3) Others	119	0 (0.0)	2 (1.7)		68	187
(4) Triple cancers	24	0 (0.0)	0 (0.0)		23	47

( ), % mortality; EMR, endoscopic mucosal resection (including endoscopic submucosal dissection)

Table 5 Malignant esophageal disease (surgical procedures) in 2007

	Cases	30-Day mortality	Hospital mortality
Superficial cancer			
1. Endoscopic mucosal resection	1,526	0 (0.0)	0 (0.0)
2. Esophagectomy	1,284	15 (1.2)	31 (2.4)
(1) Transhiatal esophagectomy	67	1 (1.5)	2 (3.0)
(2) Thoracoscopic and/or laparoscopic procedure	354	3 (0.8)	9 (2.5)
(3) Transthoracic (rt.) esophagectomy and reconstruction	777	8 (1.0)	17 (2.2)
(4) Transthoracic (lt.) esophagectomy and reconstruction	39	2 (5.1)	2 (5.1)
(5) Cervical esophageal resection and reconstruction	13	0 (0.0)	0 (0.0)
(6) Two-stage operation	5	0 (0.0)	0 (0.0)
(7) Others/not specified	29	1 (3.4)	1 (3.4)
Advanced cancer			
1. Endoscopic mucosal resection	0		
2. Esophagectomy	3,706	45 (1.2)	139 (3.8)
(1) Transhiatal esophagectomy	77	0 (0.0)	4 (5.2)
(2) Thoracoscopic and/or laparoscopic procedure	415	5 (1.2)	10 (2.4)
(3) Transthoracic (rt.) esophagectomy and reconstruction	2,789	34 (1.2)	102 (3.7)
(4) Transthoracic (lt.) esophagectomy and reconstruction	152	0 (0.0)	6 (3.9)
(5) Cervical esophageal resection and reconstruction	126	2 (1.6)	10 (7.9)
(6) Two-stage operation	50	0 (0.0)	2 (4.0)
(7) Others/not specified	97	4 (4.1)	5 (5.2)
(Depth not specified)			(18.8)
Combined resection of other organs	207	4 (1.9)	12 (5.8)
1. Aorta	0	0 (0.0)	0 (0.0)
2. Trachea, bronchus	25	1 (4.0)	1 (4.0)
3. Lung	44	1 (2.3)	4 (9.1)
4. Others	138	2 (1.4)	7 (5.1)
Salvage surgery	168	5 (3.0)	12 (7.1)

Table 6 Mortality after combined resection of neighboring organs in 2007

	Esophagectomy			Combined resection											
				Aorta			Tracheobronchus			Lung			Others		
Year	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
1996	4,194	120	2.86%	7	3	42.86%	24	0	0.00%	50	2	4.00%	78	4	5.13%
1997	4,441	127	2.86%	1	0	0.00%	34	5	14.71%	56	1	1.79%	94	3	3.19%
1998	4,878	136	2.79%	4	0	0.00%	29	0	0.00%	74	1	1.35%	128	2	1.56%
1999	5,015	116	2.31%	5	0	0.00%	23	2	8.70%	68	0	0.00%	122	1	0.82%
2000	5,350	81	1.51%	2	0	0.00%	23	2	8.70%	69	0	0.00%	96	1	1.04%
2001	5,521	110	1.99%	1	0	0.00%	26	1	3.85%	83	3	3.61%	99	2	2.02%
2002	4,904	66	1.35%	3	1	33.33%	20	2	10.00%	63	0	0.00%	63	1	1.59%
2003	4,639	45	0.97%	0	0	0.00%	24	2	8.33%	58	0	0.00%	88	1	1.14%
2004	4,739	64	1.35%	2	0	0.00%	17	0	0.00%	59	5	8.47%	119	2	1.68%
2005	5,163	52	1.01%	1	0	0.00%	11	1	9.09%	67	1	1.49%	73	1	1.37%
2006	5,236	63	1.20%	0	0	0.00%	17	0	0.00%	62	2	3.23%	122	3	2.46%
2007	4,990	60	1.20%	0	0	0.00%	25	1	4.00%	44	1	2.27%	138	2	1.45%
Total	59,070	1,040	1.76%	26	4	15.38%	273	16	5.86%	753	16	2.12%	1,220	23	1.89%

a, number of patients who underwent the operation
b, number of patients who died within 30 days after the operation
c, % ratio of b/a (i.e., direct operative mortality)

Acknowledgments On behalf of The Japanese Association for Thoracic Surgery, the authors thank the heads of the Affiliate and Satellite Institutes of Thoracic Surgery for their cooperation and the Councilors of the Japan Esophageal Society.

Members of the Committee for Scientific Affairs

Yuichi Ueda, MD, Yoshitaka Fujii, MD, Tomoyuki Goya, MD, Hiroyuki Kuwano, MD, Arata Murakami, MD, Kiyoharu Nakano, MD, Hiroshi Nishida, MD, Yutaka Okita, MD, Soji Ozawa, MD, Yuzuru Sakakibara, MD, Kisaburou Sakamoto, MD, Kosei Yasumoto, MD