

Thoracic and cardiovascular surgery in Japan during 2008

Annual report by The Japanese Association for Thoracic Surgery

Committee for Scientific Affairs

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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 2008.

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 had been discharged from the hospital within those 30 days.

Hospital mortality is death within any time interval after an 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 1,989 institutions nationwide in early April 2009. The response rates in each category by the end of December 2009 were 99.0%, 95.3%, and 95.7% 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.

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Questionnaires sent out and received back by the end of December 2009

	Sent out	Returned	Response rate
(A) Cardiovascular surgery	599	593	99.0%
(B) General thoracic surgery	785	748	95.3%
(C) Esophageal surgery	605	579	95.7%

Categories subclassified according to the number of operations performed

No. of operations performed	Category	
	Cardiovascular surgery	General thoracic surgery
0	62	33
1–24	53	136
25–49	101	143
50–99	162	202
100–149	96	118
150–199	42	55
≥200	77	61
Total	593	748

No. of operations performed	Esophageal surgery
0	78
1–4	184
5–9	121
10–19	92
20–29	36
30–39	25
40–49	11
≥50	32
Total	579

2008 Final report

(A) Cardiovascular surgery

First, we are very pleased with the high response rate to our survey of cardiovascular surgery (99%), which definitely enhances the quality of this annual report. We very much appreciate the enormous effort put into completing the survey at each participating institution.

Figure 1 shows the development of cardiovascular surgery in Japan over the last 23 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 57,941 cardiovascular operations were performed at 593 institutions during 2008 alone and included 11 cardiac transplantation operations, which were started from 1999.

The number of operations for thoracic aortic aneurysm consistently increased, by 9.1%, and that for valvular heart disease also increased, by 10%, compared with 2007. Surgery for congenital heart disease slightly increased, by 2.7%. Of great interest, the number of operations for ischemic heart disease increased by 2.8% in 2008 compared with 2007, after a consecutive decline for the last 5 years. We hope that this trend steadily continues.

Data for individual categories are summarized in Tables 1–7. In 7,328 open-heart operations performed for congenital heart disease, the overall hospital mortality was 2.6%, which has varied little since 2005. Mitral valve repair constituted 28.2% of all valvular heart disease operations (16,747), which is similar to that of the last 3 years. Aortic valve replacement with a bioprosthesis was performed in 5,417 cases, with the number consistently increasing. The hospital mortality rates associated with primary single valve replacement were

2.8% and 4.5% for aortic and mitral valve replacement, respectively, while that for primary mitral valve repair was 1.3%. However, hospital mortality rates for redo valve replacement were 7.4% and 6.4% for aortic and mitral procedures, respectively.

Isolated coronary artery bypass grafting (CABG) was performed in 17,764 cases which is an increase of 2.7% compared with 17,295 in 2007.

The operative and hospital mortality rates associated with primary elective CABG procedures in 14,943 cases were 0.7% and 1.2%, respectively. However, hospital mortality of primary emergency CABG in 2,487 cases was 7.4%, which was still high. Off-pump coronary bypass grafting (OPCAB) was performed in 11,222 cases, constituting 63.2% of the total isolated CABG procedures. The percentage of OPCAB cases among the total isolated CABG procedures has been at the same level since 2005.

A total of 1,466 patients underwent surgery for complications of myocardial infarction, including 505 operations for a left ventricular aneurysm or infarction and 386 operations for ischemic mitral regurgitation. Operations for thoracic aortic dissection were performed in 5,013 cases. For 3,283 type A acute aortic dissections,

hospital mortality was 13.0%, which was similar to that in 2007 (12.7%). Operations for a nondissected thoracic aneurysm were carried out in 5,985 cases, with an overall hospital mortality of 7.6%, which was equivalent to that in 2007 (7.6%). The hospital mortality associated with unruptured aneurysms was 5.0%, and that for ruptured aneurysms was 28.1%, which remains markedly high compared with that in 2007 (24.7%).

The number of stent graft procedures remarkably increased. A total of 331 patients with aortic dissection underwent stent graft placement: transluminal stent grafting (TEVAR) in 247 cases, open stent grafting in 82 cases. The hospital mortality rates of TEVAR for type B aortic dissection were 6.5% in acute dissection and 4.2% in chronic dissection. A total of 1,075 patients with a nondissected aortic aneurysm underwent stent graft placement (TEVAR in 823 cases; open stent grafting in 246 cases). The hospital mortality rates for TEVAR were 2.7% and 18.3% for nonruptured and ruptured aneurysms, respectively.

In summary, the total cardiovascular operations increased during the year 2008 by 5.3%. They were performed with steadily improving results in almost all categories compared with those in 2007.

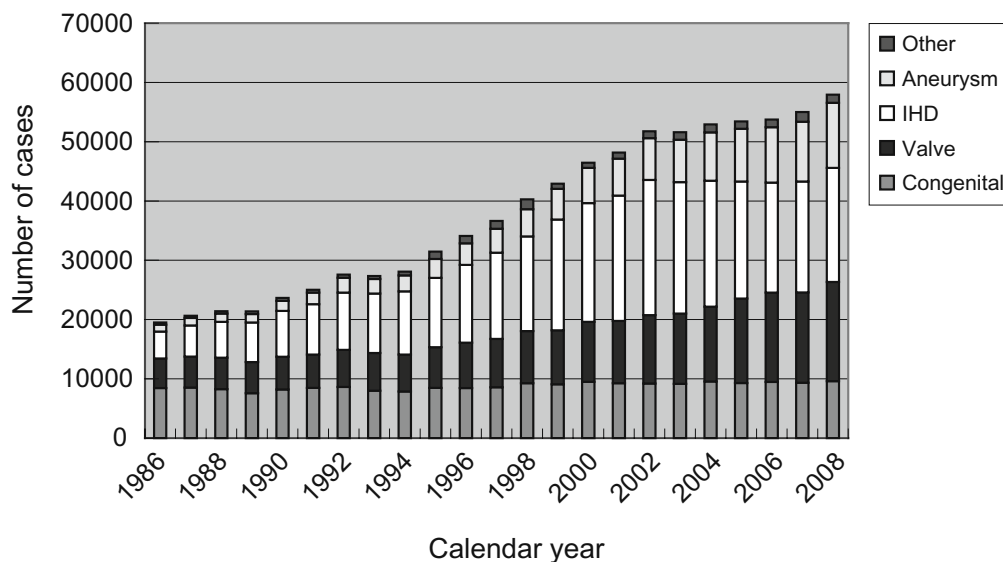


Fig. 1 General thoracic surgery. IHD, ischemic heart disease

Table 1 Congenital (total 9,595)

(1) CPB (+) (total 7,328)

in 2008

	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	3	0	0	3	0	0	3	0	0	30	0	1 (3.3)	39	0	1 (2.6)
2 Coarctation (simple)	0	0	0	3	0	0	15	0	0	12	0	1 (8.3)	30	0	1 (3.3)
3 +VSD	38	1 (2.6)	3 (7.9)	33	0	1 (3.0)	6	0	0	0	0	0	77	1 (1.3)	4 (5.2)
4 +DORV	8	0	0	5	0	0	2	1 (50.0)	1 (50.0)	0	0	0	15	1 (6.7)	1 (6.7)
5 +AVSD	4	0	1 (25.0)	4	0	1 (25.0)	0	0	0	0	0	0	8	0	2 (25.0)
6 +TGA	7	2 (28.6)	2 (28.6)	2	0	0	0	0	0	0	0	0	9	2 (22.2)	2 (22.2)
7 +SV	8	1 (12.5)	1 (12.5)	5	1 (20.0)	1 (20.0)	1	0	0	0	0	0	14	2 (14.3)	2 (14.3)
8 +Others	3	0	0	3	0	0	5	0	0	3	0	0	14	0	0
9 Interrupt. of Ao (simple)	3	1 (33.3)	1 (33.3)	1	0	0	1	0	0	1	0	0	6	1 (16.7)	1 (16.7)
10 +VSD	28	3 (10.7)	4 (14.3)	19	1 (5.3)	1 (5.3)	4	0	0	0	0	0	51	4 (7.8)	5 (9.8)
11 +DORV	2	1 (50.0)	1 (50.0)	3	0	0	0	0	0	0	0	0	5	1 (20.0)	1 (20.0)
12 +Truncus	0	0	0	4	0	0	0	0	0	0	0	0	4	0	0
13 +TGA	2	0	2 (100.0)	2	0	0	1	0	0	0	0	0	5	0	2 (40.0)
14 +Others	10	0	0	3	1 (33.3)	1 (33.3)	1	1 (100.0)	1 (100.0)	1	0	0	15	2 (13.3)	2 (13.3)
15 Vascular ring	1	0	0	5	0	0	0	0	0	0	0	0	6	0	0
16 PS	1	0	0	8	0	0	21	0	0	7	0	0	37	0	0
17 PA-IVS or Critical PS	6	0	0	36	1 (2.8)	1 (2.8)	72	0	0	5	0	0	119	1 (0.8)	1 (0.8)
18 TAPVR	137	8 (5.8)	11 (8.0)	62	0	1 (1.6)	10	1 (10.0)	1 (10.0)	0	0	0	209	9 (4.0)	13 (6.0)
19 PAPVR ± ASD	0	0	0	14	0	0	60	0	0	28	1 (3.6)	1 (3.6)	102	1 (1.0)	1 (1.0)
20 ASD	5	0	0	58	0	0	784	0	0	796	3 (0.4)	3 (0.4)	1,643	3 (0.2)	3 (0.2)
21 Cor triatriatum	3	1 (33.3)	1 (33.3)	14	0	0	8	0	0	17	0	0	42	1 (2.4)	1 (2.4)
22 AVSD (partial)	1	0	0	22	0	0	50	0	0	29	0	0	102	0	0
23 AVSD (complete)	5	0	0	95	1 (1.1)	5 (5.3)	61	0	1 (1.6)	9	0	0	170	1 (0.6)	6 (3.5)
24 +TOF or DORV	0	0	0	8	2 (25.0)	2 (25.0)	19	0	0	5	0	0	32	2 (6.3)	2 (6.3)
25 +Others	2	1 (50.0)	2 (100.0)	8	0	0	7	0	0	4	0	0	21	1 (4.8)	2 (9.5)
26 VSD (subarterial)	2	0	0	117	0	0	230	0	0	45	0	0	394	0	0
27 VSD (perimemb./muscular)	6	0	0	767	5 (0.7)	6 (0.8)	437	0	0	103	0	0	1,313	5 (0.4)	6 (0.5)
28 VSD + PS	0	0	0	13	0	0	31	0	0	7	0	0	51	0	0
29 DCRV ± VSD	0	0	0	14	0	0	50	0	0	9	0	0	73	0	0
30 Aneurysm of sinus Valsalva	0	0	0	1	0	0	5	0	0	27	0	0	33	0	0
31 TOF	7	1 (14.3)	1 (14.3)	127	0	2 (1.6)	244	2 (0.8)	4 (1.6)	11	0	0	389	3 (0.8)	7 (1.8)
32 PA + VSD	5	0	0	53	0	0	90	1 (1.1)	1 (1.1)	2	0	0	150	1 (0.7)	1 (0.7)
33 DORV	10	2 (20.0)	2 (20.0)	84	2 (2.4)	4 (4.8)	109	1 (0.9)	1 (0.9)	1	0	0	204	5 (2.5)	7 (3.4)
34 TGA (simple)	109	3 (2.8)	3 (2.8)	13	1 (7.7)	2 (15.4)	7	0	0	3	0	0	132	4 (3.0)	5 (3.8)
35 +VSD	32	1 (3.1)	1 (3.1)	17	2 (11.8)	2 (11.8)	5	0	0	1	0	0	55	3 (5.5)	3 (5.5)
36 +VSD + PS	3	1 (33.3)	1 (33.3)	7	0	0	30	1 (3.3)	2 (6.7)	3	0	0	43	2 (4.7)	3 (7.0)
37 Corrected TGA	1	0	0	7	0	0	42	0	1 (2.4)	6	0	0	56	0	1 (1.8)
38 Truncus arteriosus	13	3 (23.1)	3 (23.1)	14	3 (21.4)	3 (21.4)	13	0	0	0	0	0	40	6 (15.0)	6 (15.0)
39 SV	32	5 (15.6)	6 (18.8)	166	9 (5.4)	16 (9.6)	282	3 (1.1)	3 (1.1)	29	1 (3.4)	3 (10.3)	509	18 (3.5)	28 (5.5)
40 TA	2	0	0	45	2 (4.4)	3 (6.7)	65	1 (1.5)	2 (3.1)	9	0	1 (11.1)	121	3 (2.5)	6 (5.0)
41 HLHS	48	9 (18.8)	12 (25.0)	97	12 (12.4)	12 (12.4)	57	1 (1.8)	2 (3.5)	0	0	0	202	22 (10.9)	26 (12.9)
42 Aortic valve lesion	6	2 (33.3)	2 (33.3)	19	1 (5.3)	2 (10.5)	64	0	0	18	0	0	107	3 (2.8)	4 (3.7)
43 Mitral valve lesion	1	0	0	47	1 (2.1)	2 (4.3)	72	0	2 (2.8)	20	0	0	140	1 (0.7)	4 (2.9)
44 Ebstein	9	1 (11.1)	2 (22.2)	8	1 (12.5)	1 (12.5)	25	0	0	10	0	0	52	2 (3.8)	3 (5.8)
45 Coronary disease	1	0	0	10	2 (20.0)	5 (50.0)	16	0	0	21	0	0	48	2 (4.2)	5 (10.4)
46 Others	15	1 (6.7)	1 (6.7)	38	0	2 (5.3)	39	0	2 (5.1)	13	3 (23.1)	3 (23.1)	105	4 (3.8)	8 (7.6)
47 Redo VSD	1	0	0	3	0	0	19	0	0	7	0	0	30	0	0
48 PS release	1	0	0	12	0	1 (8.3)	57	0	0	15	0	0	85	0	1 (1.2)
49 RV-PAconduit replace	0	0	0	3	0	0	42	0	0	27	1 (3.7)	2 (7.4)	72	1 (1.4)	2 (2.8)
50 Others	3	0	0	54	2 (3.7)	4 (7.4)	63	1 (1.6)	4 (6.3)	29	1 (3.4)	2 (6.9)	149	4 (2.7)	10 (6.7)
Total	584	48 (8.2)	63 (10.8)	2,156	50 (2.3)	81 (3.8)	3,225	14 (0.4)	28 (0.9)	1,363	10 (0.7)	17 (1.2)	7,328	122 (1.7)	189 (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

(2) CPB (–) (total 2,267)

in 2008

	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	375	9 (2.4)	10 (2.7)	214	2 (0.9)	2 (0.9)	85	0	0	16	0	0	690	11 (1.6)	12 (1.7)
2 Coarctation (simple)	17	1 (5.9)	1 (5.9)	17	0	0	5	0	0	4	0	0	43	1 (2.3)	1 (2.3)
3 +VSD	34	0	0	13	1 (7.7)	1 (7.7)	2	0	0	0	0	0	49	1 (2.0)	1 (2.0)
4 +DORV	13	0	1 (7.7)	0	0	0	0	0	0	0	0	0	13	0	1 (7.7)
5 +AVSD	9	0	1 (11.1)	3	0	0	0	0	0	0	0	0	12	0	1 (8.3)
6 +TGA	6	0	0	1	0	0	0	0	0	0	0	0	7	0	0
7 +SV	17	0	0	2	0	0	0	0	0	1	0	0	20	0	0
8 +Others	9	1 (11.1)	1 (11.1)	3	0	0	0	0	0	0	0	0	12	1 (8.3)	1 (8.3)
9 Interrupt. of Ao (simple)	1	0	0	1	0	0	0	0	0	0	0	0	2	0	0
10 +VSD	18	1 (5.6)	1 (5.6)	2	0	1 (50.0)	1	0	0	0	0	0	21	1 (4.8)	2 (9.5)
11 +DORV	4	0	0	1	0	0	0	0	0	0	0	0	5	0	0
12 +Truncus	2	0	0	2	0	0	0	0	0	0	0	0	4	0	0
13 +TGA	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
14 +Others	5	0	1 (20.0)	1	0	0	0	0	0	0	0	0	6	0	1 (16.7)
15 Vascular ring	1	0	0	4	0	0	7	0	0	2	0	0	14	0	0
16 PS	4	0	0	1	0	0	0	0	0	0	0	0	5	0	0
17 PA-IVS or Critical PS	40	2 (5.0)	3 (7.5)	30	5 (16.7)	5 (16.7)	5	0	0	0	0	0	75	7 (9.3)	8 (10.7)
18 TAPVR	2	0	0	7	0	0	0	0	0	0	0	0	9	0	0
19 PAPVR ± ASD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 ASD	4	0	0	2	0	0	2	0	0	8	0	0	16	0	0
21 Cor triatriatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22 AVSD (partial)	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
23 AVSD (complete)	21	0	0	57	1 (1.8)	1 (1.8)	2	0	0	1	0	0	81	1 (1.2)	1 (1.2)
24 +TOF or DORV	3	0	0	3	0	0	1	0	0	0	0	0	7	0	0
25 +Others	1	0	0	1	0	0	1	0	0	0	0	0	3	0	0
26 VSD(subarterial)	1	0	0	7	0	1 (14.3)	0	0	0	1	0	0	9	0	1 (11.1)
27 VSD(perimemb./muscular)	27	0	0	74	1 (1.4)	1 (1.4)	7	0	1 (14.3)	4	0	0	112	1 (0.9)	2 (1.8)
28 VSD + PS	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0
29 DCRV ± VSD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30 Aneurysm of sinus Valsalva	0	0	0	3	0	0	0	0	0	1	0	0	4	0	0
31 TOF	25	0	0	114	2 (1.8)	2 (1.8)	17	0	0	3	0	0	159	2 (1.3)	2 (1.3)
32 PA + VSD	19	0	0	59	0	0	33	0	1 (3.0)	2	0	0	113	0	1 (0.9)
33 DORV	36	1 (2.8)	1 (2.8)	58	0	0	12	0	0	2	0	0	108	1 (0.9)	1 (0.9)
34 TGA (simple)	3	0	0	1	0	0	1	0	0	2	0	0	7	0	0
35 +VSD	2	0	0	4	0	0	0	0	0	0	0	0	6	0	0
36 +VSD + PS	7	0	0	5	0	0	1	0	0	0	0	0	13	0	0
37 Corrected TGA	3	0	0	9	0	0	8	0	0	0	0	0	20	0	0
38 Truncus arteriosus	12	1 (8.3)	2 (16.7)	2	0	0	1	0	0	0	0	0	15	1 (6.7)	2 (13.3)
39 SV	63	2 (3.2)	2 (3.2)	64	1 (1.6)	2 (3.1)	10	0	0	2	0	0	139	3 (2.2)	4 (2.9)
40 TA	17	0	0	34	1 (2.9)	2 (5.9)	5	0	0	2	0	0	58	1 (1.7)	2 (3.4)
41 HLHS	68	10 (14.7)	16 (23.5)	8	0	0	4	0	0	0	0	0	80	10 (12.5)	16 (20.0)
42 Aortic valve lesion	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
43 Mitral valve lesion	0	0	0	1	0	0	1	0	0	0	0	0	2	0	0
44 Ebstein	3	1 (33.3)	1 (33.3)	4	1 (25.0)	1 (25.0)	1	0	0	0	0	0	8	2 (25.0)	2 (25.0)
45 Coronary disease	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46 Others	41	2 (4.9)	2 (4.9)	110	1 (0.9)	2 (1.8)	77	0	0	11	0	0	239	3 (1.3)	4 (1.7)
47 Redo VSD	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0
48 PS release	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49 RV-PA conduit replace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 Others	13	0	0	32	0	0	21	0	0	5	0	0	71	0	0
Total	930	31 (3.3)	43 (4.6)	957	16 (1.7)	21 (2.2)	313	0	2 (0.6)	67	0	0	2,267	47 (2.1)	66 (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

(3) Main procedure

in 2008

		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	248	5 (2.0)	6 (2.4)	409	15 (3.7)	16 (3.9)	76	1 (1.3)	1 (1.3)
2	PAB	323	14 (4.3)	25 (7.7)	213	2 (0.9)	5 (2.3)	11	0	0
3	Bidirectional Glenn or hemi-Fontan ± α	3	0	0	266	4 (1.5)	10 (3.8)	162	2 (1.2)	3 (1.9)
4	PA reconstruction/repair (including redo)	14	0	0	104	1 (1.0)	3 (2.9)	86	0	1 (1.2)
5	RVOT reconstruction/repair	15	2 (13.3)	2 (13.3)	100	1 (1.0)	1 (1.0)	205	2 (1.0)	3 (1.5)
6	Rastelli procedure	10	1 (10.0)	1 (10.0)	28	0	0	89	1 (1.1)	2 (2.2)
7	Arterial switch procedure	145	6 (4.1)	7 (4.8)	37	3 (8.1)	5 (13.5)	3	1 (33.3)	1 (33.3)
8	Atrial switch procedure	3	0	0	3	0	0	3	0	0
9	Double switch procedure	0	0	0	0	0	0	8	0	0
10	Repair of anomalous origin of CA	0	0	0	7	1 (14.3)	3 (42.9)	12	0	0
11	Closure of coronary AV fistula	1	0	0	1	0	0	17	0	0
12	Fontan/TCPC	1	0	0	40	4 (10.0)	5 (12.5)	351	2 (0.6)	3 (0.9)
13	Norwood procedure	49	7 (14.3)	9 (18.4)	64	13 (20.3)	15 (23.4)	11	0	0
14	Ventricular septation	0	0	0	8	0	0	9	0	0
15	Left side AV valve repair (including redo)	1	0	0	62	3 (4.8)	4 (6.5)	70	0	0
16	Left side AV valve replace (including redo)	0	0	0	18	1 (5.6)	2 (11.1)	39	0	1 (2.6)
17	Right side AV valve repair (including redo)	3	1 (33.3)	1 (33.3)	18	1 (5.6)	1 (5.6)	30	0	0
18	Right side AV valve replace (including redo)	0	0	0	0	0	0	5	1 (20.0)	1 (20.0)
19	Common AV valve repair (including redo)	7	2 (28.6)	2 (28.6)	28	1 (3.6)	1 (3.6)	22	0	2 (9.1)
20	Common AV valve replace (including redo)	1	1 (100.0)	1 (100.0)	2	0	0	9	0	1 (11.1)
21	Repair of supraaortic stenosis	0	0	0	3	0	0	8	0	0
22	Repair of subaortic stenosis (including redo)	2	0	0	13	0	0	30	0	2 (6.7)
23	Aortic valve plasty ± VSD closure	5	1 (20.0)	1 (20.0)	12	0	0	14	0	0
24	Aortic valve replacement	0	0	0	6	0	0	24	0	0
25	AVR with annular enlargement	0	0	0	1	0	0	8	0	0
26	Aortic root replace (except ross)	0	0	0	1	0	0	6	0	0
27	Ross procedure	2	1 (50.0)	1 (50.0)	6	0	1 (16.7)	9	0	0
	Total	833	41 (4.9)	56 (6.7)	1,450	50 (3.4)	71 (4.9)	1,317	10 (0.8)	21 (1.6)

		≥18 years			Total		
		Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1	SP Shunt	3	0	0	736	21 (2.9)	23 (3.1)
2	PAB	0	0	0	547	16 (2.9)	30 (5.5)
3	Bidirectional Glenn or hemi-Fontan ± α	6	0	1 (16.7)	437	6 (1.4)	14 (3.2)
4	PA reconstruction/repair (including redo)	16	0	0	220	1 (0.5)	4 (1.8)
5	RVOT reconstruction/repair	26	1 (3.8)	1 (3.8)	346	6 (1.7)	7 (2.0)
6	Rastelli procedure	12	1 (8.3)	2 (16.7)	139	3 (2.2)	5 (3.6)
7	Arterial switch procedure	0	0	0	185	10 (5.4)	13 (7.0)
8	Atrial switch procedure	2	0	0	11	0	0
9	Double switch procedure	0	0	0	8	0	0
10	Repair of anomalous origin of CA	4	0	0	23	1 (4.3)	3 (13.0)
11	Closure of coronary AV fistula	27	0	0	46	0	0
12	Fontan/TCPC	24	1 (4.2)	2 (8.3)	416	7 (1.7)	10 (2.4)
13	Norwood procedure	2	0	0	126	20 (15.9)	24 (19.0)
14	Ventricular septation	0	0	0	17	0	0
15	Left side AV valve repair (including redo)	25	0	0	158	3 (1.9)	4 (2.5)
16	Left side AV valve replace (including redo)	22	0	0	79	1 (1.3)	3 (3.8)
17	Right side AV valve repair (including redo)	30	0	0	81	2 (2.5)	2 (2.5)
18	Right side AV valve replace (including redo)	16	1 (6.3)	1 (6.3)	21	2 (9.5)	2 (9.5)
19	Common AV valve repair (including redo)	4	0	0	61	3 (4.9)	5 (8.2)
20	Common AV valve replace (including redo)	1	0	0	13	1 (7.7)	2 (15.4)
21	Repair of supraaortic stenosis	0	0	0	11	0	0
22	Repair of subaortic stenosis (including redo)	5	1 (20.0)	1 (20.0)	50	1 (2.0)	3 (6.0)
23	Aortic valve plasty ± VSD closure	1	0	0	32	1 (3.1)	1 (3.1)
24	Aortic valve replacement	18	0	0	48	0	0
25	AVR with annular enlargement	0	0	0	9	0	0
26	Aortic root replace (except ross)	4	0	0	11	0	0
27	Ross procedure	0	0	0	17	1 (5.9)	2 (11.8)
	Total	248	5 (2.0)	8 (3.2)	3,848	106 (2.8)	157 (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): 37,257]

(1) Valvular heart disease (total 16,747)

in 2008

	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	7,050	2,653	4,308	1	88	1,502	130 (1.9)	1 (1.1)	198 (2.8)	2 (2.3)	270	12 (4.4)	20 (7.4)
	M	4,406	1,096	706		2,604	710	51 (2.8)	23 (0.9)	81 (4.5)	35 (1.3)	390	13 (3.3)	25 (6.4)
	T	271	22	60		189	35	4 (4.9)	3 (1.6)	6 (7.3)	4 (2.1)	56	1 (1.8)	2 (3.6)
	P	10	2	6		2	1	0	0	0	0	6	0	0
A + M	A	1,190	560	597	3	30	159	43 (3.6)		70 (5.9)		78	5 (6.4)	10 (12.8)
M	407		248	3	532									
A + T	A	237	97	124		16	27	9 (3.8)		12 (5.1)		38	4 (10.5)	4 (10.5)
T	2		5		230									
M + T	M	2,708	821	594		1,293	264	51 (1.9)		93 (3.4)		242	5 (2.1)	10 (4.1)
T	6		50		2,652									
A + M + T	A	800	394	388		18	93	29 (3.6)		43 (5.4)		51	6 (11.8)	7 (13.7)
M	309		197		294									
T	2		6		792									
Others		75	19	27	1	28	3	10 (13.3)		14 (18.7)		19	2 (10.5)	4 (21.1)
Total		16,747	6,390	7,316	8	8,768	2,794	354 (2.1)		558 (3.3)		1,150	48 (4.2)	82 (7.1)

(), % 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 total case number of 16,747

(2) Ischemic heart disease [total (A) + (B) + (C): 19,237]

(A) Isolated CABG [total (a) + (b): 17,764]

(a-1) On-pump arrest CABG (total 4,743)

in 2008

	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	101	0	0	16	2 (12.5)	2 (12.5)	4	0	0
2VD	642	5 (0.8)	7 (1.1)	78	10 (12.8)	15 (19.2)	8	1 (12.5)	1 (12.5)
3VD	2,078	20 (1.0)	28 (1.3)	235	9 (3.8)	14 (6.0)	28	2 (7.1)	2 (7.1)
LMT	1,160	9 (0.8)	14 (1.2)	369	16 (4.3)	20 (5.4)	17	0	2 (11.8)
Total	3,981	34 (0.9)	49 (1.2)	698	37 (5.3)	51 (7.3)	57	3 (5.3)	5 (8.8)
Kawasaki	11	0	0	2	1 (50.0)	1 (50.0)	0	0	0
Hemodialysis	195	9 (4.6)	11 (5.6)	48	6 (12.5)	6 (12.5)	2	0	0

	Redo, emergency			Arterial graft only	Artery graft + SVG	SVG only	Others	Uncertain
	Cases	30-Day mortality	Hospital deaths					
1VD	0	0	0	69	14	37	1	0
2VD	0	0	0	181	492	49	3	3
3VD	3	2 (66.7)	2 (66.7)	193	2,032	113	0	6
LMT	4	0	0	230	1,218	87	7	8
Total	7	2 (28.6)	2 (28.6)	673	3,756	286	11	17
Kawasaki	0	0	0	8	3	1	1	0
Hemodialysis	0	0	0	22	200	20	0	3

(), % 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

(a-2) On-pump beating CABG (total 1,799)

in 2008

	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	29	1 (3.4)	1 (3.4)	15	1 (6.7)	2 (13.3)	4	0	0
2VD	194	4 (2.1)	7 (3.6)	71	12 (16.9)	13 (18.3)	12	1 (8.3)	1 (8.3)
3VD	623	8 (1.3)	15 (2.4)	163	21 (12.9)	32 (19.6)	13	0	0
LMT	417	3 (0.7)	9 (2.2)	230	26 (11.3)	28 (12.2)	10	1 (10.0)	1 (10.0)
Total	1,263	16 (1.3)	32 (2.5)	479	60 (12.5)	75 (15.7)	39	2 (5.1)	2 (5.1)
Kawasaki	4	0	0	0	0	0	1	0	0
Hemodialysis	85	1 (1.2)	3 (3.5)	38	7 (18.4)	8 (21.1)	3	1 (33.3)	1 (33.3)

	Redo, emergency			Arterial graft only	Artery graft + SVG	SVG only	Others	Uncertain
	Cases	30-Day mortality	Hospital deaths					
1VD	7	0	0	28	4	22	1	0
2VD	2	0	0	92	149	37	0	1
3VD	4	1 (25.0)	1 (25.0)	123	646	32	0	2
LMT	5	1 (20.0)	2 (40.0)	157	453	49	2	1
Total	18	2 (11.1)	3 (16.7)	400	1,252	140	3	4
Kawasaki	0	0	0	5	0	0	0	0
Hemodialysis	0	0	0	14	98	10	0	4

(), % 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

(b) Off-pump CABG (total 11,222)

(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 2008

	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	818	4 (0.5)	7 (0.9)	76	1 (1.3)	3 (3.9)	59	1 (1.7)	3 (5.1)
2VD	1,921	11 (0.6)	15 (0.8)	177	4 (2.3)	7 (4.0)	33	1 (3.0)	2 (6.1)
3VD	4,255	20 (0.5)	47 (1.1)	452	16 (3.5)	20 (4.4)	49	1 (2.0)	2 (4.1)
LMT	2,705	19 (0.7)	32 (1.2)	626	24 (3.8)	30 (4.8)	32	0	2 (6.3)
Total	9,699	54 (0.6)	101 (1.0)	1,331	45 (3.4)	60 (4.5)	173	3 (1.7)	9 (5.2)
Kawasaki	8	0	0	0	0	0	0	0	0
Hemodialysis	640	12 (1.9)	24 (3.8)	114	15 (13.2)	19 (16.7)	18	1 (5.6)	2 (11.1)

	Redo, emergency			Arterial graft only	Artery graft + SVG	SVG only	Others	Uncertain
	Cases	30-Day mortality	Hospital deaths					
1VD	6	0	1 (16.7)	818	55	82	0	4
2VD	3	0	0	1,004	1,054	67	0	9
3VD	6	0	1 (16.7)	1,259	3,414	73	4	12
LMT	4	0	0	1,240	2,030	95	1	1
Total	19	0	2 (10.5)	4,321	6,553	317	5	26
Kawasaki	0	0	0	3	4	1	0	0
Hemodialysis	2	0	0	204	523	36	1	10

(), % 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 215) in 2008

	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	40	2 (5.0)	2 (5.0)	5	0	1 (20.0)	2	1 (50.0)	1 (50.0)	0	0	0
Conversion to on-pump beating-heart CABG	136	6 (4.4)	9 (6.6)	27	3 (11.1)	3 (11.1)	5	0	0	0	0	0
Total	176	8 (4.5)	11 (6.3)	32	3 (9.4)	4 (12.5)	7	1 (14.3)	1 (14.3)	0	0	0
Hemodialysis	16	0	1 (6.3)	4	0	0	2	1 (50.0)	1 (50.0)	0	0	0

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

(B) Operation for complications of MI (total 1,466) in 2008

	Chronic			Acute			Concomitant operation		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	CABG	MVP	MVR
Infarctectomy or aneurysmectomy	482	23 (4.8)	36 (7.5)	23	5 (21.7)	7 (30.4)	364	180	12
VSP closure	56	3 (5.4)	6 (10.7)	252	68 (27.0)	88 (34.9)	104	10	6
Cardiac rupture	10	2 (20.0)	2 (20.0)	194	68 (35.1)	72 (37.1)	32	1	1
Mitral regurgitation									
1) Papillary muscle rupture	5	1 (20.0)	1 (20.0)	35	4 (11.4)	6 (17.1)	17	2	27
2) Ischemic	360	10 (2.8)	23 (6.4)	26	7 (26.9)	8 (30.8)	311	286	48
Others	17	5 (29.4)	5 (29.4)	6	0	2 (33.3)	9	4	1
Total	930	44 (4.7)	73 (7.8)	536	152 (28.4)	183 (34.1)	837	483	95

(), % 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 7) in 2008

	Cases	30-Day mortality	Hospital mortality
Isolated	1	0	0
With CABG	6	0	0
Total	7	0	0

TMLR, transmyocardial laser revascularization

(3) Operation for arrhythmia (total 3,512) in 2008

	Cases	30-Day mortality	Hospital mortality	Concomitant operation						
				Isolated	Congenital	Valve	IHD	Others	Multiple combination	
									2 Categories	3 Categories
Maze	3,277	44 (1.3)	62 (1.9)	18	165	2,888	408	146	326	22
For WPW	3	0	0	0	0	3	0	0	0	0
For ventricular tachyarrhythmia	97	4 (4.1)	8 (8.2)	31	2	9	56	5	6	1
Others	135	1 (0.7)	1 (0.7)	0	8	90	44	7	12	1
Total	3,512	49 (1.4)	71 (2.0)	49	175	2,990	508	158	344	24

(), % mortality; WPW, Wolff-Parkinson-White syndrome; IHD, ischemic heart disease

Except for 49 isolated cases, all remaining 3,643 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 122)

in 2008

	CPB (+)			CPB (-)		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
Total	57	6 (10.5)	8 (14.0)	65	2 (3.1)	2 (3.1)

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

(5) Cardiac tumor (total 502)

in 2008

	Cases	30-Day mortality	Hospital mortality	Concomitant operation			
				AVR	MVR	CABG	Others
Myxoma	358	1 (0.3)	1 (0.3)	3	5	16	29
Others	144	2 (1.4)	5 (3.5)	5	6	10	15
Total	502	3 (0.6)	6 (1.2)	8	11	26	44

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

(6) HOCM and DCM (total 186)

in 2008

	Cases	30-Day mortality	Hospital mortality	Concomitant operation			
				AVR	MVR	MVP	CABG
Myectomy	78	1 (1.3)	3 (3.8)	41	19	5	11
Myotomy	7	2 (28.6)	2 (28.6)	2	1	4	0
No resection	40	1 (2.5)	3 (7.5)	3	8	26	3
Volume reduction surgery of the left ventricle	61	3 (4.9)	8 (13.1)	2	7	36	8
Total	186	7 (3.8)	16 (8.6)	48	35	71	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 414)

in 2008

	Cases	30-Day mortality	Hospital mortality
Total	414	29 (7.0)	30 (7.2)

(), % mortality

Table 3 Thoracic aortic aneurysm (total 10,998)

(1) Dissection (total 5,013)

in 2008

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	1,951	189 (9.7)	222 (11.4)	3	1 (33.3)	1 (33.3)	244	5 (2.0)	6 (2.5)
2. Aortic root	166	27 (16.3)	30 (18.1)	1	1 (100.0)	1 (100.0)	66	9 (13.6)	11 (16.7)
3. Ascending Ao + arch	1,016	119 (11.7)	144 (14.2)	19	5 (26.3)	6 (31.6)	240	7 (2.9)	10 (4.2)
4. Arch + descending Ao	21	4 (19.0)	4 (19.0)	23	5 (21.7)	5 (21.7)	27	3 (11.1)	5 (18.5)
5. Aortic root + ascending Ao + arch	73	16 (21.9)	17 (23.3)	6	2 (33.3)	2 (33.3)	30	4 (13.3)	5 (16.7)
6. Descending Ao	11	1 (9.1)	2 (18.2)	60	9 (15.0)	13 (21.7)	78	4 (5.1)	4 (5.1)
7. Thoracoabdominal Ao	1	0	0	5	0	2 (40.0)	21	1 (4.8)	1 (4.8)
8. Extraanatomical bypass	14	6 (42.9)	6 (42.9)	27	6 (22.2)	6 (22.2)	0	0	0
9. Stent graft ^{*a}	30	3 (10.0)	3 (10.0)	36	4 (11.1)	5 (13.9)	36	0	5 (13.9)
1) Transluminal ^{*b}	8	0	0	31	2 (6.5)	2 (6.5)	18	0	4 (22.2)
2) Open stent: a) With total arch ^{*c}	3	0	0	3	1 (33.3)	1 (33.3)	4	0	0
b) Without total arch ^{*d}	19	3 (15.8)	3 (15.8)	2	1 (50.0)	2 (100.0)	14	0	1 (7.1)
3) Unspecified	0	0	0	0	0	0	0	0	0
10. Unspecified	0	0	0	0	0	0	2	1	1
Total	3,283	365 (11.1)	428 (13.0)	180	33 (18.3)	41 (22.8)	744	34 (4.6)	48 (6.5)

Stanford type	Chronic			Concomitant operation					Redo		
	B			AVP	AVR	MVP	MVR	CABG	Cases	30-Day mortality	Hospital mortality
Replaced site	Cases	30-Day mortality	Hospital mortality								
1. Ascending Ao	8	0	1 (12.5)	228	72	9	11	135	52	11 (21.2)	13 (25.0)
2. Aortic root	5	0	0	20	134	5	0	51	44	12 (27.3)	13 (29.5)
3. Ascending Ao + arch	56	3 (5.4)	3 (5.4)	89	32	5	3	72	50	8 (16.0)	9 (18.0)
4. Arch + descending Ao	80	7 (8.8)	12 (15.0)	2	8	0	0	10	34	3 (8.8)	6 (17.6)
5. Aortic root + ascending Ao + arch	8	2 (25.0)	3 (37.5)	16	30	1	1	13	13	1 (7.7)	1 (7.7)
6. Descending Ao	290	17 (5.9)	23 (7.9)	11	1	0	0	5	54	2 (3.7)	4 (7.4)
7. Thoracoabdominal Ao	122	13 (10.7)	17 (13.9)	2	0	0	0	0	37	3 (8.1)	5 (13.5)
8. Extraanatomical bypass	8	2 (25.0)	2 (25.0)	0	0	0	2	0	2	1 (50.0)	1 (50.0)
9. Stent graft ^{*a}	229	6 (2.6)	9 (3.9)	5	0	1	0	5	38	0	5 (13.2)
1) Transluminal ^{*b}	190	5 (2.6)	8 (4.2)	2	0	0	0	0	34	0	5 (14.7)
2) Open stent: a) With total arch ^{*c}	22	0	0	0	0	0	0	0	0	0	0
b) Without total arch ^{*d}	15	1 (6.7)	1 (6.7)	3	0	1	0	5	4	0	0
3) Unspecified	2	0	0	0	0	0	0	0	0	0	0
10. Unspecified	0	0	0	0	0	0	0	0	0	0	0
Total	806	50 (6.2)	70 (8.7)	373	277	21	17	291	324	41 (12.7)	57 (17.6)

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

Acute, within 2 weeks from the onset

*a = *b + *c + *d + unspecified

(2) Non-dissection (total 5,985)

in 2008

Replaced site	Unruptured			Ruptured			Concomitant operation		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality	AVP	AVR	MVP
1. Ascending Ao	836	15 (1.8)	20 (2.4)	43	10 (23.3)	10 (23.3)	46	522	31
2. Aortic root	677	18 (2.7)	22 (3.2)	15	2 (13.3)	3 (20.0)	100	442	30
3. Ascending Ao + arch	1,790	74 (4.1)	113 (6.3)	218	55 (25.2)	68 (31.2)	28	124	16
4. Arch + descending Ao	165	10 (6.1)	13 (7.9)	38	11 (28.9)	12 (31.6)	2	1	4
5. Aortic root + ascending Ao + arch	86	6 (7.0)	6 (7.0)	4	3 (75.0)	3 (75.0)	7	50	5
6. Descending Ao	452	18 (4.0)	22 (4.9)	157	32 (20.4)	39 (24.8)	1	6	0
7. Thoracoabdominal Ao	348	24 (6.9)	35 (10.1)	64	18 (28.1)	25 (39.1)	0	0	0
8. Extraanatomical bypass	11	0	0	6	3 (50.0)	3 (50.0)	0	0	0
9. Stent graft* ^a	952	22 (2.3)	33 (3.5)	123	20 (16.3)	25 (20.3)	2	6	4
1) Transluminal* ^b	730	12 (1.6)	20 (2.7)	93	14 (15.1)	17 (18.3)	0	0	0
2) Open stent: a) With total arch* ^c	74	0	0	2	0	0	0	1	0
b) Without total arch* ^d	142	10 (7.0)	13 (9.2)	28	6 (21.4)	8 (28.6)	2	5	4
3) Unspecified	6			0					
Total	5,317	187 (3.5)	264 (5.0)	668	154 (23.1)	188 (28.1)	186	1,151	90

Replaced site	Concomitant operation		Redo			CPB(-)		
	MVR	CABG	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
1. Ascending Ao	27	100	70	8 (11.4)	10 (14.3)	2	0	0
2. Aortic root	14	73	92	9 (9.8)	12 (13.0)	2	0	0
3. Ascending Ao + arch	6	340	60	9 (15.0)	11 (18.3)	0	0	0
4. Arch + descending Ao	0	26	13	3 (23.1)	3 (23.1)	2	1 (50.0)	1 (50.0)
5. Aortic root + ascending Ao + arch	1	7	11	1 (9.1)	1 (9.1)	0	0	0
6. Descending Ao	0	19	41	7 (17.1)	7 (17.1)	9	0	1 (11.1)
7. Thoracoabdominal Ao	0	6	26	5 (19.2)	6 (23.1)	5	2 (40.0)	3 (60.0)
8. Extraanatomical bypass	0	1	2	2 (100.0)	2 (100.0)	9	3 (33.3)	3 (33.3)
9. Stent graft* ^a	19	29	76	2 (2.6)	4 (5.3)	302	10 (3.3)	12 (4.0)
1) Transluminal* ^b	19	2	69	2 (2.9)	3 (4.3)	290	7 (2.4)	9 (3.1)
2) Open stent: a) With total arch* ^c	0	4	2	0	0	4	0	0
b) Without total arch* ^d	0	23	5	0	1 (20.0)	8	3 (37.5)	3 (37.5)
3) Unspecified						0		
Total	67	601	391	46 (11.8)	60 (15.3)	331	16 (4.8)	20 (6.0)

(), % 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 + unspecified

Table 4. Pulmonary thromboembolism (total 80)

in 2008

	Cases	30-Day mortality	Hospital mortality
Acute	54	15 (27.8)	15 (27.8)
Chronic	26	3 (11.5)	5 (19.2)
Total	80	18 (22.5)	20 (25.0)

(), % mortality

Table 5 Assisted circulation (total 1,655)

in 2008

	Sites	VAD								
		Device			Results					
		Centrifugal	VAS	Others	Not weaned			Weaned		
					Ongoing	Dead	Transplant	Survived	Dead	Transplant
Postcardiotomy	Left	16	11	0	2	14 (51.9)	0	8	3 (11.1)	0
	Right	3	0	0	0	1 (33.3)	0	2	0	0
	Biventricular									
Congestive heart failure	Right	1	4	0	0	1 (20.0)	0	2	2 (40.0)	0
	Left	1	4	0						
	Biventricular									
Respiratory failure	Left	10	36	17	36	18 (28.6)	2	4	2 (3.2)	1
	Right	1	0	0	0	1 (100.0)	0	0	0	0
	Biventricular									
Respiratory failure	Right	8	10	0	2	12 (66.7)	0	2	1 (5.6)	1
	Left	2	16	0						
Total		42	81	17	40	47 (33.6)	2	18	8 (5.7)	2

	Sites	Heart-lung assist						Unspecified
		Method		Results				
		PCPS	Others	Not weaned		Weaned		
				Dead	Transplant	Dead	Survived	
Postcardiotomy	Left	439	53	257 (52.2)	0	88 (17.9)	146	1
	Right							
	Biventricular							
Congestive heart failure	Right	878	43	479 (52.0)	1	137 (14.9)	303	1
	Left							
	Biventricular							
Respiratory failure	Right	81	21	32 (31.4)	1	16 (15.7)	53	0
	Left							
Total		1,398	117	768 (50.7)	2	241 (15.9)	502	2

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

Table 6 Heart transplantation (total 3)

in 2008

	Cases	30-Day mortality	Hospital mortality
Heart Transplantation	11	0	0
Heart and lung transplantation	0	0	0
Total	11	0	0

(), % mortality

Table 7 Pacemaker + ICD (total 17,358)

in 2008

	Pacemaker			ICD	
	Univentricular	Biventricular	CRTD	CRTD	ICD
Initial	2,281	6,994	200	689	1,171
Exchange	1,881	3,636	51	72	383
Total	4,162	10,630	251	761	1,554

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

(B) General thoracic surgery

We are pleased to report that after a slight dip in 2007, the number of reported cases of general thoracic surgery is now back on its steady trend of increase. The total number of general thoracic surgery cases performed in 2008 was 61,315 including 27,881 primary lung cancers, 4,142 mediastinal tumors, and 12,776 pneumothoraces. Last year's decline in reported cases was due to the newly implemented complex questionnaire.

Primary lung cancer still accounts for the largest and most formidable population of patients that we deal with. Among the 27,881 cases of lung cancer, the proportion of adenocarcinoma increased only slightly, to 67.7%, compared with 67.5% in 2007 and 2006. It appears that the increase in adenocarcinoma has now plateaued. The male:female ratio was 1.7. The number of adenocarcinomas was more than three times that of squamous cell carcinomas (21.4%), which is also reflected by the predominance of peripherally located tumors (84.7%). Because this survey is of cases that were operated on, small cell lung cancer accounts for only 1.6%. We asked for reports of the clinical and pathological stage according to the new 7th edition of lung cancer staging. Clinical stage Ia cancers comprised 52.4% of the cases operated on (a slight increase from 48.9% in 2007) followed by 20.2% of stage Ib (20.3% in 2007); stage I cancers comprised 72.6% of the total. These data indicate that more small cancers are found and operated on. Pathological stage I disease accounted for 66.1% of the total, indicating underestimation of the clinical staging.

The 30-day mortality of lung cancer patients was as low as 0.4%. This is a figure that we should be proud of and is the result of the continued efforts of surgeons, nurses, and the thoracic surgery ward team. Even pneumonectomy (608 cases) boasts the very low 30-day mortality of 2.8%. On the other hand, a small fraction of patients who underwent wedge (0.3% of 3,489) or segmental (0.3% of 2,368) resection died, which underlies the importance of patient selection and control of postoperative complications.

Thanks to the detailed questionnaire that has been implemented since 2007, we now have a clear view of the causes of postoperative death, which evade the efforts of thoracic surgery teams in postoperative patient care. Among the 237 deaths reported after pulmonary resection for lung cancer, exacerbation of interstitial pneumonia caused 63 deaths, followed by pneumonia, which caused 40 deaths. How we are going to prevent and cope with the unexpected worsening of preexisting interstitial pneumonia will be discussed in the forthcoming meetings of thoracic surgeons. We lost 29 lung cancer patients

from bronchopleural fistula, a figure that represents mainly the technical failure of the operation; these may be preventable and they continue to be one of our biggest tasks in thoracic surgery. The same number (29) of patients died from respiratory failure after lung cancer surgery; these may indicate inadequate assessment of pulmonary function or patient selection.

The majority of the lung cancer patients operated on were asymptomatic; 45.9% and 31.5% of the patients were diagnosed after a medical checkup and during follow-up for other diseases, respectively, and only 15.3% were diagnosed with symptoms. Chest XP still detects 73.8% of patients, far outperforming CT. The role of screening remains controversial, and we are faced with the difficult decision of whether to operate on very slow-growing and potentially harmless lung cancers.

In 2008, 51.9% of the operations for lung cancer were performed using video-assisted thoracic surgery (VATS). In reality, this includes a wide variety of procedures, from "pure VATS" to those using VATS as a source of light. As less invasive surgery will remain the mainstream of thoracic surgery, VATS will be used in more patients each year. However, we have to define VATS more clearly and make VATS operations safer and comparable to open thoracotomy as a means of cancer treatment. Associations of thoracic surgeons must continue in their efforts to establish a VATS training system for young thoracic surgeons.

A total of 5,546 operations for metastatic pulmonary tumor were performed in 2008; 68.4% of these were performed using VATS. About half of these cases (48.5%) were metastases of colorectal cancer. Malignant pleural mesothelioma poses a great challenge to thoracic surgeons: 17 of the 294 patients operated on with malignant pleural mesotheliomas died in the hospital. To improve the outcome of surgical treatment of this disease, we need to select patients carefully, combine other modalities, and improve our technique for the relatively rare procedure of extrapleural pneumonectomy.

Of 4,142 mediastinal tumors operated on in 2008, thymoma was the most frequent (41.3%), followed by congenital cyst (16.1%), neurogenic tumor (11.6%), lymphoma (6.4%), and germ cell tumor (5.6%). Thymectomy for myasthenia gravis was performed in 577 patients; 272 of those cases were associated with thymoma. An increasing number of thymectomies are now performed using VATS and mediastinoscopy, which together comprised 23% of the thymectomies for myasthenia gravis.

A total of 12,776 patients underwent surgery for pneumothorax; 90.6% of that surgery was performed under VATS. The record shows 19 deaths among these

patients. The cause of death is unclear, but many deaths were in patients with secondary pneumothorax.

Only 25 lung transplantations were performed in 2008 with two in-hospital fatalities. We hope that the revision of the regulations on transplantation may help increase the availability of brain-dead donors in 2010.

The statistics presented here clearly show that our efforts have paid off in the form of excellent results in lung cancer surgery. However, readers are encouraged to carefully examine the figures themselves, as these may indicate the field toward which we need to direct our future efforts.

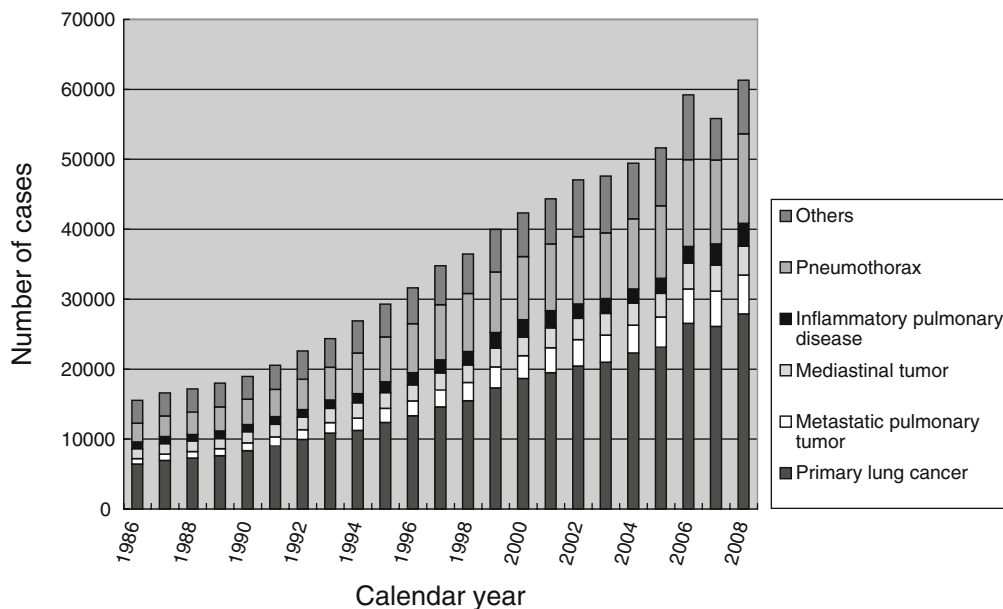


Fig. 1 General thoracic surgery

Table 1 Total entry cases of General Thoracic Surgery during 2008 in 2008

	Cases	%
Benign pulmonary tumor	700	1.1
Primary lung cancer	27,881	45.5
Other primary malignant pulmonary tumor	1,381	2.3
Metastatic pulmonary tumor	5,546	9.0
Tracheal tumor	127	0.2
Mesothelioma	469	0.8
Chest wall tumor	656	1.1
Mediastinal tumor	4,142	6.8
Thymectomy for MG without thymoma	577	0.9
Inflammatory pulmonary disease	3,274	5.3
Empyema	1,544	2.5
Bullous disease excluding pneumothorax	727	1.2
Pneumothorax	12,776	20.8
Chest wall deformity	352	0.6
Diaphragmatic hernia including traumatic	141	0.2
Chest trauma excluding diaphragmatic hernia	374	0.6
Lung transplantation	25	0.0
Others	623	1.0
Total	61,315	100.0

Table 2

in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
1. Benign pulmonary tumor	700	0 (0.0)	0 (0.0)	542
Hamartoma	400	0 (0.0)	0 (0.0)	314
Sclerosing hemangioma	103	0 (0.0)	0 (0.0)	82
Others	197	0 (0.0)	0 (0.0)	146

(), % mortality

Table 3

in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
2. Primary malignant pulmonary tumor	28,194	118 (0.4)	250 (0.9)	
Lung cancer	27,881	117 (0.4)	248 (0.9)	14,460
Adenocarcinoma	18,864	59 (0.3)	104 (0.6)	
Squamous cell carcinoma	5,941	43 (0.7)	112 (1.9)	
Large-cell carcinoma (LCNEC)	908 (294)	4 (0.4)	4 (0.4)	
Small-cell carcinoma	440	0 (0.0)	0 (0.0)	
Adenosquamous carcinoma	440	4 (0.9)	4 (0.9)	
Carcinoma with plemorphic, sarcomatoid or sarcomatous elements	509	4 (0.8)	6 (1.2)	
Carcinoid	313	1 (0.3)	7 (2.2)	
Carcinomas of salivary gland type	177	0 (0.0)	0 (0.0)	
Unclassified	30	0 (0.0)	0 (0.0)	
Multiple lung cancer	67	1 (1.5)	1 (1.5)	
Others	413	0 (0.0)	2 (0.5)	
Unknown	136	1 (0.7)	2 (1.5)	
Unknown	83			
Wedge resection	3,489	9 (0.3)	20 (0.6)	2,660
Segmental excision	2,368	6 (0.3)	10 (0.4)	1,321
Sleeve segmental excision	15	0 (0.0)	0 (0.0)	2
Lobectomy	20,647	75 (0.4)	169 (0.8)	10,327
Sleeve lobectomy	446	7 (1.6)	12 (2.7)	25
Pneumonectomy	608	17 (2.8)	31 (5.1)	34
Sleeve pneumonectomy	16	2 (12.5)	4 (25.0)	0
Pleuropneumonectomy	12	0 (0.0)	1 (8.3)	0
Others	276	1 (0.4)	1 (0.4)	91
Unclassified	4			
Sarcoma	46	1 (2.2)	2 (4.3)	
AAH	149	(0.0)	(0.0)	
Others	118	(0.0)	(0.0)	66

(), % mortality

Table 4 Details of lung cancer operation

in 2008

c-Stage	Cases
I a	14,605
I b	5,635
II a	1,789
II b	1,619
III a	2,114
III b	478
IV	350
NA	1,291
Total	27,881

NA, not available

p-Stage	Cases
0 (pCR)	62
I a	13,451
I b	4,985
II a	2,143
II b	1,798
III a	3,203
III b	768
IV	667
NA	866
Total	27,881

Age (years)	Cases
<20	8
20–29	36
30–39	209
40–49	892
50–59	4,113
60–69	9,096
70–79	10,922
80–89	2,538
≥90	27
NA	40
Total	27,881

Sex	Cases
Male	17,556
Female	10,285
NA	40
Total	27,881

Associated disease	Cases
Smoking history	15,109
BMI ≥ 30	666
Brain and cerebrovascular disease	1,178
FEV _{1.0%} < 40%	736
Ischemic heart disease	1,124
Interstitial pneumonia	1,036
Cr ≥ 2	295
Liver cirrhosis	99
Hb A1c ≥ 8	1,022
Hb ≤ 8	93
Autoimmune disease	313

Postoperative morbidity	Cases
Wound infection	302
Bleeding >500 ml/h	102
Air leak >2 weeks	433
Chylothorax	215
Bronchopleural fistula	119
Pulmonary embolism	44
Pyothorax	177
Pneumonia	521
Respiration support >3 days	146
Interstitial pneumonia exacerbation	157
Cardiac infarction	27
Arrhythmia	998
Brain infarction, bleeding	62
Others	440

Cause of death	Cases
Cardiovascular	26
Pneumonia	40
Pyothorax	6
Bronchopleural fistula	29
Respiratory failure	29
Pulmonary embolism	10
Interstitial pneumonia	63
Brain infarction or bleeding	6
Lung cancer	16
Others	18
Unknown	4
Unclassifiable	1
Total	248

Diagnosis	Cases
Symptom	4,259
Medical checkup	12,804
Chest xp	9,443
CT	2,728
Sputum cytology	83
Others	182
Followup of other disease	8,786
Others	461

Location	Cases
Peripheral	23,626
Central	2,296
Multiple	234
Unclassified	414
Others	70

Table 5

in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
3. Metastatic pulmonary tumor	5,546	5 (0.1)	17 (0.3)	3,791
Colorectal	2,688	3 (0.1)	7 (0.3)	1,874
Hepatobiliary/pancreatic	206	0 (0.0)	2 (1.0)	149
Uterine	244	0 (0.0)	0 (0.0)	178
Mammary	335	0 (0.0)	0 (0.0)	236
Ovarian	54	0 (0.0)	0 (0.0)	37
Testicular	49	0 (0.0)	0 (0.0)	36
Renal	452	0 (0.0)	0 (0.0)	327
Skeletal	116	0 (0.0)	0 (0.0)	72
Soft tissue	243	0 (0.0)	1 (0.4)	152
Otorhinolaryngological	308	0 (0.0)	1 (0.3)	236
Pulmonary	340	1 (0.3)	3 (0.9)	156
Others	494	1 (0.2)	3 (0.6)	338
Unknown	17	0	0	

(), % mortality

Table 6

in 2008

	Cases	30-Day mortality	Hospital mortality
4. Tracheal tumor	127	0 (0.0)	0 (0.0)
Primary malignant	84	0 (0.0)	0 (0.0)
Metastatic	25	0 (0.0)	0 (0.0)
Benign	18	0 (0.0)	0 (0.0)

(), % mortality

Table 7

in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS	Operation		
					Extrapleural pneumonectomy	Pan-pleurectomy	Others
5. Tumor of pleural origin	469	7 (1.5)	18 (3.8)				
Solitary fibrous tumor	142	0 (0.0)	0 (0.0)				
Malignant pleural mesothelioma	294	7 (2.4)	17 (5.8)		127	17	146
Others	33	0 (0.0)	1 (3.0)		0	0	33

(), % mortality

Table 8

in 2008

	Cases	30-Day mortality	Hospital mortality
6. Chest wall tumor	656	0 (0.0)	2 (0.3)

(), % mortality

Table 9 in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
7. Mediastinal tumor	4,142	5 (0.1)	13 (0.3)	1,836
Thymoma*	1,712	2 (0.1)	5 (0.3)	381
Thymic cancer	240	0 (0.0)	2 (0.8)	24
Germ cell tumor	234	0 (0.0)	0 (0.0)	63
Benign	166	0 (0.0)	0 (0.0)	53
Malignant	67	0 (0.0)	0 (0.0)	9
unclassified	1	0	0	1
Neurogenic tumor	479	0 (0.0)	1 (0.2)	321
Congenital cyst	669	0 (0.0)	0 (0.0)	428
Goiter	128	0 (0.0)	0 (0.0)	18
Lymphatic tumor	266	1 (0.4)	1 (0.4)	148
Others	403	2 (0.5)	4 (1.0)	453
Unknown	11			

(), % mortality

* Includes those with myasthenia gravis

Table 10 in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
8. Thymectomy for myasthenia gravis	577	2 (0.3)	4 (0.7)	133
With thymoma	272	0 (0.0)	2 (0.7)	

(), % mortality

Table 11 in 2008

	Cases	30-Day mortality	Hospital mortality
9. Operation for nonneoplastic disease	19,882	95 (0.5)	172 (0.9)

in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
A. Inflammatory pulmonary disease	3,274	10 (0.3)	15 (0.5)	2,196
Tuberculous infection	145	1 (0.7)	0 (0.0)	86
Mycobacterial infection	292	1 (0.3)	2 (0.7)	174
Fungal infection	397	3 (0.8)	6 (1.5)	184
Bronchiectasis	96	2 (2.1)	2 (2.1)	38
Tuberculous nodule	386	0 (0.0)	0 (0.0)	284
Infection	1,262	2 (0.2)	4 (0.3)	916
Interpulmonary lymph node	190	0 (0.0)	0 (0.0)	176
Others	506	1 (0.2)	1 (0.2)	338

(), % mortality

Table 12 in 2008

	Cases	30-Day mortality	Hospital mortality	Radical surgery
B. Empyema	1,544	17 (1.1)	58 (3.8)	1,107

(), % mortality

Table 13 in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
C. Descending necrotizing mediasinitis	72	1 (1.4)	2 (2.8)	35

(), % mortality

Table 14 in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
D. Bullous disease	727	1 (0.1)	3 (0.4)	463
Emphysematous bulla	554	1 (0.2)	2 (0.4)	358
Bronchogenic cyst	103	0 (0.0)	0 (0.0)	65
Emphysema with volume reduction surgery	30	0 (0.0)	1 (3.3)	23
Others	39	0 (0.0)	0 (0.0)	17
Unknown	1			

(), % mortality

Table 15 in 2008

	Cases	30-Day mortality	Hospital mortality	By VATS
E. Pneumothorax	12,776	19 (0.1)	44 (0.3)	11,573
Primary spontaneous	11,584	5 (0.0)	7 (0.1)	10,681
Secondary	1,183	14 (1.2)	37 (3.1)	892
Unknown	9	0	0	

(), % mortality

Table 16 in 2008

	Cases	30-Day mortality	Hospital mortality
F. Chest wall deformity	352	1 (0.3)	1 (0.3)
Funnel chest	329	0 (0.0)	0 (0.0)
Others	23	1 (4.3)	1 (4.3)

(), % mortality

Table 17 in 2008

	Cases	30-Day mortality	Hospital mortality	Traumatic
G. Diaphragmatic hernia	141	2 (1.4)	2 (1.4)	37

(), % mortality

Table 18 in 2008

	Cases	30-Day mortality	Hospital mortality
H. Chest trauma	374	39 (10.4)	40 (10.7)

(), % mortality

Table 19 in 2008

	Cases	30-Day mortality	Hospital mortality	Sympatectomy
I. Other respiratory surgery	623	5 (0.8)	7 (1.1)	22
Arteriovenous malformation*	102	1 (1.0)	1 (1.0)	9
Pulmonary sequestration	122	1 (0.8)	1 (0.8)	2
Others	399	3 (0.8)	5 (1.3)	11

(), % mortality

* Includes those with myasthenia gravis

Table 20 in 2008

	Cases	30-Day mortality	Hospital mortality
10. Lung transplantation	25	0 (0.0)	2 (8.0)
Single lung	9	0 (0.0)	0 (0.0)
Bilateral	5	0 (0.0)	1 (20.0)
Living donor	11	0 (0.0)	1 (9.1)
Donor	25		

(), % mortality

Table 21 in 2008

	Cases	30-Day mortality	Hospital mortality
11. Video-assisted thoracic surgery	37,733	52 (0.1)	85 (0.2)

(), % mortality

Including thoracic sympathectomy (244)

Table 22 in 2008

	Cases	30-Day mortality	Hospital mortality
12. Tracheobronchoplasty	576	11 (1.9)	15 (2.6)
Trachea	48	2 (4.2)	2 (4.2)
Carinal reconstruction	14	1 (7.1)	2 (14.3)
Sleeve pneumonectomy	73	1 (1.4)	2 (2.7)
Bronchus	391	7 (1.8)	9 (2.3)
Others	50	0 (0.0)	0 (0.0)

(), % mortality

Table 23 in 2008

	Cases	30-Day mortality	Hospital mortality
13. Pediatric surgery	519	3 (0.6)	3 (0.6)

(), % mortality

Table 24

in 2008

	Cases		30-Day mortality	%	Hospital mortality	%
14. Combined resection of neighboring organ(s)	1,478		8	0.54	19	1.29
Organ resected	Primary lung cancer			Mediastinal tumor		
	Cases	30-Day mortality	Hospital mortality	Cases	30-Day mortality	Hospital mortality
Aorta	11	1 (9.1)	1 (9.1)	1	0 (0.0)	0 (0.0)
Superior vena cava	25	1 (4.0)	1 (4.0)	34	0 (0.0)	1 (2.9)
Brachiocephalic vein	11	0 (0.0)	0 (0.0)	73	0 (0.0)	2 (2.7)
Pericardium	190	1 (0.5)	5 (2.6)	175	0 (0.0)	1 (0.6)
Pulmonary artery	175	0 (0.0)	0 (0.0)	4	0 (0.0)	0 (0.0)
Left atrium	38	2 (5.3)	2 (5.3)	2	0 (0.0)	0 (0.0)
Diaphragm	141	0 (0.0)	0 (0.0)	13	0 (0.0)	0 (0.0)
Chest wall (including ribs)	512	2 (0.4)	6 (1.2)	15	0 (0.0)	0 (0.0)
Vertebra	22	1 (4.5)	1 (4.5)	5	0 (0.0)	0 (0.0)
Esophagus	5	0 (0.0)	0 (0.0)	3	0 (0.0)	0 (0.0)
Lung				157	0 (0.0)	2 (1.3)

(), % mortality

Table 25

in 2008

	Cases	30-Day mortality	Hospital mortality
15. Operation of lung cancer invading the chest wall of the apex	141	0 (0.0)	1 (0.7)

(), % 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 2008 alone, a total of 12,488 patients with esophageal diseases were registered from 501 institutions (response rate 95.1%) that are affiliated with The Japanese Association for Thoracic Surgery and/or the Japan Esophageal Society. Among these institutions, 104 (20.8%) had 20 or more patients who underwent esophageal surgery during the year 2008, which shows the same tendency of esophageal operations in higher volume institutions when compared with the data of 2007 (20.9%) [1] (Table 1). Of 2,515 patients with a benign esophageal disease, 872 (34.7%) patients underwent surgery, and 29 (1.2%) patients underwent endoscopic resection, while 1,614 (64.2%) patients did not undergo any surgical treatment (Table 2). Of 9,973 patients with a malignant esophageal tumor, 6,831 (68.5%) patients underwent resection—esophagectomy in 5,124 (51.4%) and endoscopic mucosal resection (EMR) including endoscopic submucosal dissection (ESD) in 1,705 (17.1%), while 3,144 (31.5%) patients did not undergo any resection (Tables 3, 4). The decrease in registered patients with surgically treated benign esophageal diseases is obvious, and 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 esophageal disease, particularly those undergoing nonsurgical therapy for a malignant esophageal disease, has been increasing since 1990 (Fig. 1).

Among benign esophageal diseases (Table 2), esophageal varices, hiatal hernia, and esophagitis (including reflux esophagitis) were the most common conditions in Japan. On the other hand, achalasia, benign esophageal tumors, spontaneous rupture of the esophagus, and congenital esophageal atresia were common diseases that were treated surgically, 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 504 patients who had a benign esophageal disease, with 30-day mortality in 8 (1.6%) patients and with hospital mortality, including 30-day mortality, in 14 (2.8%), while thoracoscopic and/or laparoscopic surgery was performed in 368 patients, with no patient deaths registered in the 30-day mortality category and 1 (0.3%) death in the hospital mortality category. The difference in these death rates between open and scopic surgery seems to be related to the conditions requiring open surgery. Most of the deaths occurred in patients with spontaneous esophageal rupture, which required open surgery.

The majority of malignant diseases were carcinomas (Table 3). Among esophageal carcinomas, the incidence of squamous cell carcinoma was 92.5%, and that of adenocarcinomas including Barrett's cancer was 4.0%. The resection rate for patients with a squamous cell carcinoma was 66.9%, and for patients with an adenocarcinoma it was 88.1%.

Regarding location, the thoracic esophagus was the most common site of the cancer (Table 4). Of the 3,456 patients (34.6% of total esophageal malignancies) with superficial esophageal cancers in the mucosal and submucosal layers, 1,398 (40.5%) underwent esophagectomy, and 1,705 (49.3%) underwent EMR. The 30-day mortality and hospital mortality rates after esophagectomy for patients with a superficial cancer were 0.6% and 1.5%, respectively. There were no EMR-related deaths. Advanced esophageal cancer invading deeper than the submucosal layer was observed in 6,403 (64.2%) patients. Of the 6,403 patients with advanced esophageal cancer, 3,723 (58.1%) underwent esophagectomy, with a 1.5% 30-day mortality rate and a 3.2% hospital mortality rate.

Multiple primary cancers were observed in 1,088 (10.9%) of all the 9,973 patients with esophageal cancer. Synchronous cancer was found in 611 (6.1%) patients, and metachronous cancer (found before esophageal cancer) was observed in 477 (4.8%). The stomach is the most common site for synchronous and other malignancies, followed by head and neck cancer, and both stomach and head and neck cancers are common sites in the metachronous occurrence of other malignancies (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 4.9% of patients having a superficial cancer who underwent esophagectomy and in 1.9% of those having an advanced cancer. Thoracoscopic and/or laparoscopic esophagectomy was adopted for 416 patients (29.8%) with a superficial cancer and for 593 patients (15.9%) 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 247 patients (Tables 5, 6). Resection of the aorta with concomitant esophagectomy was not performed in 2008. Tracheal and/or bronchial resection combined with esophagectomy was performed in 17 patients, with a 30-day mortality rate of 5.9% and a hospital mortality

rate of 11.8%. Lung resection combined with esophagectomy was performed in 48 patients, with a 30-day mortality rate of 2.1% and a hospital mortality rate of 6.3%.

Salvage surgery after definitive (chemo) radiotherapy was performed in 203 patients, with a 30-day mortality rate of 0.5% and a hospital mortality rate of 3.9% (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.

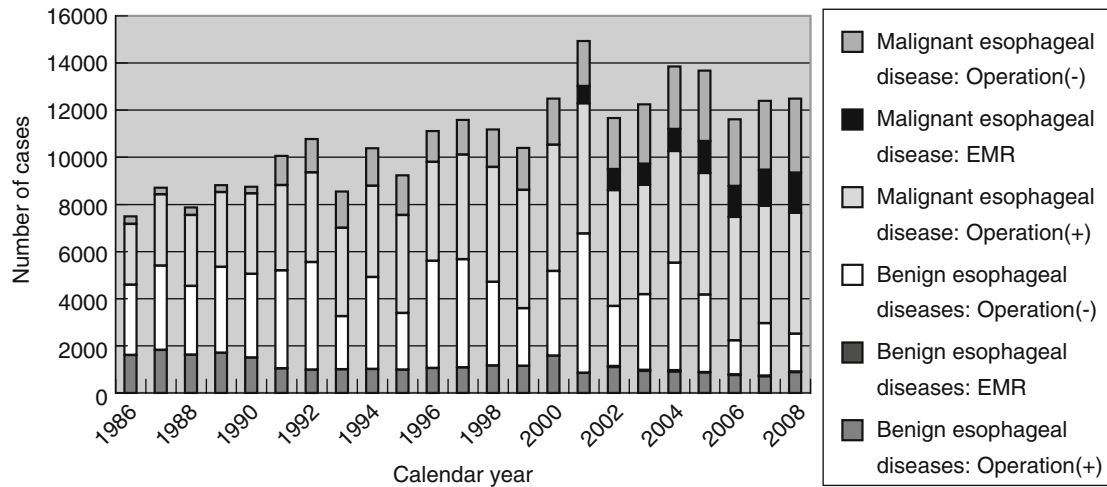


Fig. 1 Annual trend of in-patients with esophageal diseases. *EMR*, endoscopic mucosal resection (including endoscopic submucosal dissection)

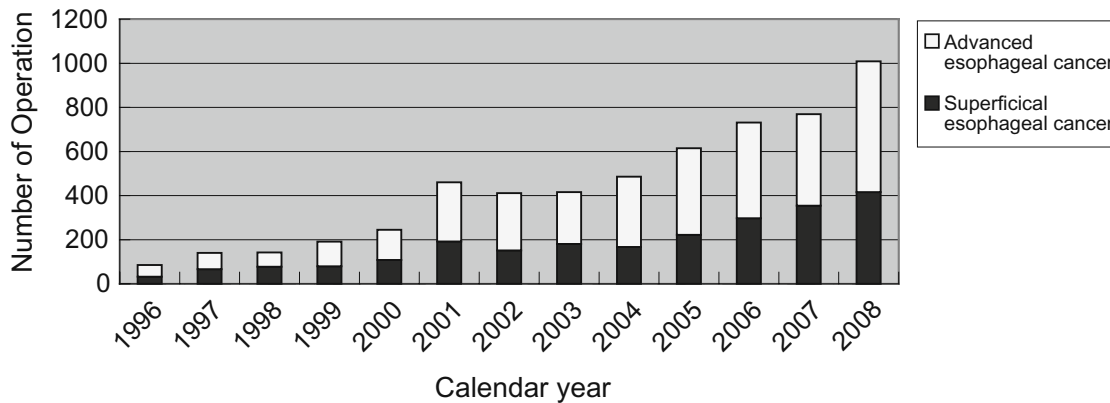


Fig. 2 Annual trend of video-assisted esophagectomy for esophageal malignancy

Table 1 Distribution of the number of esophageal operations in 2008 at the institutions

in 2008

Esophageal surgery			
No. of operations in 2007	Benign esophageal disease	Malignant esophageal disease	Benign + malignant disease
1–4	196	195	184
5–9	34	108	121
10–19	15	86	92
20–29	1	28	36
30–39	1	22	25
40–49	0	10	11
≥50	2	27	32
Total	249	476	501

Table 2 Benign esophageal diseases

in 2008

	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	164	28	136	0	0 (0.0)	0	3	3 (10.7)	0		52	216
2. Benign tumor	60	32	28	0	0 (0.0)	0	0	0 (0.0)	0	29	74	163
(1) Leiomyoma	38	18	20	0	0 (0.0)	0	0	0 (0.0)	0	15	64	117
(2) Cyst	4	3	1	0	0 (0.0)	0	0	0 (0.0)	0	1	4	9
(3) Others	18	11	7	0	0 (0.0)	0	0	0 (0.0)	0	13	5	36
(4) Not specified			0	0	0	0	0	0	0	0	1	1
3. Diverticulum	20	12	8	0	0 (0.0)	0	0	0 (0.0)	0		24	44
4. Hiatal hernia	233	85	148	0	0 (0.0)	0	0	0 (0.0)	0		150	383
5. Spontaneous rupture of the esophagus	71	69	2	3	3 (4.3)	0	5	5 (7.2)	0		12	83
6. Esophagotracheal fistula	12	12	0	0	0 (0.0)	0	1	1 (8.3)	0		11	23
7. Congenital esophageal atresia	56	54	2	0	0 (0.0)	0	0	0 (0.0)	0		16	72
8. Congenital esophageal stenosis	5	4	1	0	0 (0.0)	0	0	0 (0.0)	0		4	9
9. Corrosive stricture of the esophagus	5	3	2	0	0 (0.0)	0	0	0 (0.0)	0		8	13
10. Esophagitis, Esophageal ulcer	58	31	27	0	0 (0.0)	0	0	0 (0.0)	0		304	362
11. Esophageal varices	145	141	4	2	2 (1.4)	0	2	2 (1.4)	0		871	1,016
(1) Laparotomy	25	21	4	2	2 (9.5)		2	2 (9.5)	0			25
(2) Others				0			0					0
(3) Sclerotherapy				0			0				608	608
12. Others	43	33	10	3	3 (9.1)	0	4	3 (9.1)	1		88	131
Total	872	504	368	8	8 (1.6)	0	15	14 (2.8)	1	29	1,614	2,515

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

Table 3 Malignant esophageal diseases (histological classification) in 2008

	Resection(+)	Resection(-)	Total
Carcinomas	6,654	3,121	9,775
1. Squamous cell carcinoma	6,053	2,989	9,042
2. Basaloid(-squamous) carcinoma	100	4	104
3. Carcinosarcoma	40	6	46
4. Adenocarcinoma in the Barrett's esophagus	229	20	249
5. Other adenocarcinoma	112	26	138
6. Adenosquamous carcinoma	23	3	26
7. Mucoepidermoid carcinoma	3	1	4
8. Adenoid cystic carcinoma	0	0	0
9. Endocrine cell carcinoma	17	18	35
10. Undifferentiated carcinoma	27	26	53
11. Others	9	28	37
12. Redundant	(1)		
13. Unknown	41	0	
Other malignancies	35	11	46
1. Malignant nonepithelial tumors	8	0	8
2. Malignant melanoma	18	8	26
3. Other malignant tumors	9	3	12
Not specified	141	11	152
Total	6,830	3,143	9,973

Resection includes endoscopic resection

Table 4 Malignant esophageal disease (clinical characteristics) in 2008

	Operation(+)			EMR	Operation(-)	Total
	Cases	30-Day mortality	Hospital mortality			
1. Esophageal cancer	5,124	63 (1.2)	144 (2.8)	1,705	3,144	9,973
A. Location						0
(1) Cervical esophagus	208	0 (0.0)	5 (2.4)	49	271	528
(2) Thoracic esophagus	4,231	57 (1.3)	130 (3.1)	1,426	2,611	8,268
(3) Abdominal esophagus	424	3 (0.7)	6 (1.4)	81	84	589
(4) Multiple cancers	249	3 (1.2)	3 (1.2)	148	120	517
(5) Others/not described	12	0	0	1	58	71
B. Tumor depth						
(1) Superficial cancer	1,398	8 (0.6)	21 (1.5)	1,705	353	3,456
(2) Advanced cancer	3,723	54 (1.5)	119 (3.2)		2,680	6,403
(3) Not specified	3	1	4		111	114
2. Multiple primary cancers	719	6 (0.8)	17 (2.4)	369		1,088
A. Synchronous	473	3 (0.6)	10 (2.1)	138		611
(1) Head and neck	147	0 (0.0)	0 (0.0)	66		213
(2) Stomach	195	2 (1.0)	7 (3.6)	48		243
(3) Others	11	1 (9.1)	2 (18.2)	11		22
(4) Triple cancers	30	0 (0.0)	1 (3.3)	9		39
(5) Not specified				4		
B. Metachronous	246	3 (1.2)	7 (2.8)	231		477
(1) Head and neck	62	1 (1.6)	2 (3.2)	82		144
(2) Stomach	69	2 (2.9)	3 (4.3)	73		142
(3) Others	103	0 (0.0)	2 (1.9)	55		158
(4) Triple cancers	12	0 (0.0)	0 (0.0)	27		39

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

Table 5 Malignant esophageal disease (surgical procedures)

in 2008

	Cases	30-Day mortality	Hospital mortality
Superficial cancer			
1. Endoscopic mucosal resection	1,705	0 (0.0)	0 (0.0)
2. Esophagectomy	1,398	8 (0.6)	21 (1.5)
(1) Transhiatal esophagectomy	68	0 (0.0)	1 (1.5)
(2) Thoracoscopic and/or laparoscopic procedure	416	1 (0.2)	4 (1.0)
(3) Transthoracic (rt.) esophagectomy and reconstruction	824	3 (0.4)	11 (1.3)
(4) Transthoracic (lt.) esophagectomy and reconstruction	25	0 (0.0)	0 (0.0)
(5) Cervical esophageal resection and reconstruction	7	0 (0.0)	0 (0.0)
(6) Two-stage operation	15	1 (6.7)	1 (6.7)
(7) Others/not specified	43	3 (7.0)	4 (9.3)
Advanced cancer			
1. Endoscopic mucosal resection	0		
2. Esophagectomy	3,723	54 (1.5)	119 (3.2)
(1) Transhiatal esophagectomy	71	2 (2.8)	5 (7.0)
(2) Thoracoscopic and/or laparoscopic procedure	593	10 (1.7)	19 (3.2)
(3) Transthoracic (rt.) esophagectomy and reconstruction	2,693	39 (1.4)	84 (3.1)
(4) Transthoracic (lt.) esophagectomy and reconstruction	143	2 (1.4)	3 (2.1)
(5) Cervical esophageal resection and reconstruction	95	0 (0.0)	1 (1.1)
(6) Two-stage operation	50	1 (2.0)	6 (12.0)
(7) Others/not specified	79	0 (0.0)	1 (1.3)
(Depth not specified)	3	1	4
Combined resection of other organs	250	2 (0.8)	6 (2.4)
1. Aorta	0	0 (0.0)	0 (0.0)
2. Trachea, bronchus	17	1 (5.9)	2 (11.8)
3. Lung	48	1 (2.1)	3 (6.3)
4. Others	185	0 (0.0)	1 (0.5)
Salvage surgery	203	1 (0.5)	8 (3.9)

Table 6 Mortality after combined resection of the neighbouring organs

in 2008

Year	Esophagectomy			Combined resection											
				Aorta			Tracheobronchus			Lung			Others		
	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%
2008	5,124	63	1.23%	0	0	0.00%	17	1	5.88%	48	1	2.08%	185	0	0.00%
Total	64,194	1,103	1.76%	26	4	15.38%	290	17	5.86%	801	17	2.12%	1,405	23	1.64%

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)

Acknowledgements 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.

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