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ANNUAL REPORT

Thoracic and cardiovascular surgery in Japan during 2014

Annual report by The Japanese Association for Thoracic Surgery

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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 operative category. Here, we have summarized the results from our annual survey of thoracic surgery performed during 2014.

Thoracic surgery was classified into three categories—cardiovascular, general thoracic, and esophageal surgery—and the patient 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 all member's continued kind support and contributions (Tables 1, 2).

The incidence of hospital mortality was added to the survey to determine the nationwide status, which has contributed to the Japanese surgeons to understand the present status of thoracic surgery in Japan and to make progress to improve operative results by comparing their work with those of others. The Association was able to gain a better understanding of the present problems as well as the future prospects, which has been reflected to its activity including education of its members. Thirty-day mortality (so-called "operative mortality") is defined as death within

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Table 1 Questionnaires sent out and received back by the end of December 2015

	Sent out	Returned	Response rate (%)
(A) Cardiovascular surgery	578	561	97.1
(B) General thoracic surgery	762	732	96.1
(C) Esophageal surgery	626	601	96.0

Table 2 Categories subclassified according to the number of operations performed

Number of operations performed	Category	
	Cardiovascular surgery	General thoracic surgery
0	21	30
1–24	42	81
25–49	86	108
50–99	157	202
100–149	103	137
150–199	52	80
≧200	100	94
Total	561	732
Number of operations performed	Esophageal surgery	
0	98	
1–4	145	
5–9	117	
10–19	108	
20–29	39	
30–39	27	
40–49	25	
≧50	42	
Total	601	

30 days of operation regardless of the patient's geographic location and even though the patient had been discharged from the hospital.

Hospital mortality is defined as 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 in the categories of cardiovascular surgery and esophageal surgery: transfer to a nursing home or a rehabilitation unit is considered hospital discharge unless the patient subsequently dies of complications of the operation. While hospital-to-hospital transfer after 30 days of operation is considered discharge in the categories of general thoracic surgery, because data of national clinical database (NCD) 2014 were used in this category, and hospital-to-hospital transfer after 30 days of operation is considered discharge in NCD.

Abstract of the survey

We sent out survey questionnaire forms to the departments of each category in all 1039 institutions (578 cardiovascular, 762 general thoracic, and 626 esophageal) nationwide in early April 2014. The response rates in each category by the end of December 2015 were 97.1, 96.1, and 96.0 %, respectively. This high response rate has been keep throughout recent survey, and more than 96 % response rate in all fields in 2014 survey has to be congratulated.

2014 Final report

(A) Cardiovascular surgery

First, we are very pleased with the high response rate to our survey of cardiovascular surgery (97.1 %), 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 28 years. Aneurysm surgery includes only operations for thoracic and thoracoabdominal aortic aneurysm. Pacemaker implantation includes only transthoracic implantation, and transvenous implantation is excluded. The number of pacemaker and assist device implantation operations is not included in the total number of surgical operations. A total of 66,453 cardiovascular operations were performed at 561 institutions during 2014 alone and included 30 heart transplantations, which were restarted in 1999.

The number of operations for congenital heart disease (9269 cases) decreased slightly (1.0 %) compared with that of 2013 (9366 cases), and 2.9 % decrease when compared with the data of 10 years ago (9545 cases in 2004). The number of operations for adult cardiac disease (21,939 cases in valvular heart disease, 17,498 cases in thoracic aortic aneurysm, and 2118 cases for other procedures) increased compared with those of 2013 (0.8, 11.0, and 13.2 %, respectively) except for ischemic heart disease (15,629 cases), which decreased 5.6 % of that in 2013. During the last 10 years, the numbers of operations for adult heart disease increased constantly except for that for ischemic heart disease (73.8 % increase in valvular heart disease, 26.5 % decrease in ischemic heart disease, 114.5 % increase in thoracic aortic aneurysm, and 56.5 % increase in other procedures compared those of 2004). The concomitant coronary artery bypass grafting procedure (CABG) is not included in ischemic heart disease but included in other categories, such as valvular heart disease

and thoracic aneurysm in our study, and then, the number of CABG still remained over 20,000 cases per year (20,991 cases) in 2014.

Data for individual categories are summarized in tables through 3 to 9.

In 2014, 6894 open-heart operations for congenital heart disease were performed with overall hospital mortality of 2.3 %. The number of operations for congenital heart disease was quite steady throughout these 10 years (maximum 7,386 cases in 2006), while overall hospital mortality decreased gradually from that of 3.9 % in 2004. In detail, the most common disease was atrial septal defect (1,248 cases); however, its number deceased to 64.3 % of that in 2004, which might be partially due to the recent development of catheter closure of atrial septal defect in Japan. In the last 10 years, hospital mortality for complex congenital heart disease improved in some anomalies such as, complete atrioventricular septal defect (5.4–1.7 %), tetralogy of Fallot (2.5–1.1 %), transposition of the great arteries with and without ventricular septal defect (9.8–3.9 and 7.1–6.6 %, respectively), single ventricle (8.5–4.3 %), and hypoplastic left heart syndrome (27.7–9.8 %). Right heart bypass surgery is now commonly performed (351 bidirectional Glenn procedures excluding 56 Damus–Kaye–Stansel procedures and 397 Fontan-type procedures including total cavopulmonary connection) with acceptable hospital mortality (1.2 and 1.0 %). Norwood type I procedure was performed in 125 cases with relatively low hospital mortality rate of 15.2 %.

As previously mentioned, the number of operations for valvular heart disease increased by 73.8 % in the last 10 years, and the hospital mortality associated with primary single valve replacement was 2.4 and 5.9 % for the aortic and the mitral position, while that for primary mitral valve repair was 1.1 %. However, hospital mortality rate for redo valve surgery was still high and was 9.4 and 7.8 % for aortic and mitral procedure, respectively. Finally, overall hospital mortality did not show dramatic improvement during the last 10 years (3.8 % in 2004 and 3.1 % in 2014), which might be partially due to the recent progression of age of the patients. Repair of the valve became popular procedure (397 cases in the aortic, 6527 cases in the mitral, and 5066 cases in the tricuspid), and mitral valve repair constituted 29.8 % of all valvular heart disease operation and 59.6 % of all mitral valve procedure (10,957 procedures), which are similar to those of the last 5 years and increased compared with those of 2004 (23.6 and 42.8 %, respectively). Aortic and mitral valve replacements with bioprosthesis were performed in 10,220 cases and 2,765 cases, respectively, with the number consistently increasing in the aortic position. The ratio of prostheses changed dramatically during the last 10 years and the usage of bioprosthesis is 77.5 % at the aortic position (36.7 % in 2004) and 25.2 % at the mitral position (14.8 % in 2004). CABG as a concomitant procedure performed in 17.3 % of operations for all valvular heart disease (13.3 % in 2004).

Isolated CABG was performed in 14,454 cases which were only 72.5 % of that of 10 years ago (2004). Among these 14,454 cases, off-pump CABG was intended in 9,006 cases (62.3 %) with a success rate of 98.3 %, so final success rate of off-pump CABG was 61.2 %. The percentage of intended off-pump CABG reached 60.3 % in 2004, and then was kept over 60 % until now. In 14,454 isolated CABG patients, 95.4 % of them received at least one arterial graft, while all arterial graft CABG was performed only 21.4 % of them.

The operative and hospital mortality rates associated with primary elective CABG procedures in 12335 cases were 0.8 and 1.3 %, respectively. Similar data analysis of CABG, including primary/redo and elective/emergency data, was begun in 2003, and the operative and hospital mortality rates associated with primary elective CABG procedures in 2003 were 1.0 and 1.5 %, respectively, so operative results of primary CABG has been stable, while hospital mortality of primary emergency CABG in 1,959 cases was still high and was 7.9 %. During these 10 years, the results of conversion from off-pump CABG improved both in conversion rate (3.1–1.7 %) and in hospital mortality (10.4–4.5 %).

A total of 1175 patients underwent surgery for complications of myocardial infarction, including 329 operations for a left ventricular aneurysm or ventricular septal perforation or cardiac rupture and 261 operations for ischemic mitral regurgitation.

Operations for arrhythmia were performed mainly as a concomitant procedure in 3855 cases with satisfactory mortality (1.6 % hospital mortality) including 3,486 MAZE procedures. MAZE procedure has become quite popular procedure when compared with that in 2004 (1837 cases).

Operations for thoracic aortic dissection were performed in 7733 cases. For 4953 Stanford type A acute aortic dissections, hospital mortality remained high and was 10.6 %. Operations for a non-dissected thoracic aneurysm were carried out in 9765 cases, with overall hospital mortality of 4.7 %. The hospital mortality associated with unruptured aneurysm was 3.3 %, and that of ruptured aneurysm was 21.2 %, which remains markedly high.

The number of stent graft procedures remarkably increased recently. A total of 1,625 patients with aortic dissection underwent stent graft placement: thoracic endovascular aortic repair (TEVAR) in 1,382 cases and open stent grafting in 243 cases. The number of TEVAR for type B chronic aortic dissections increased from 69

cases in 2004 to 835 cases in 2014. The hospital mortality rates associated with TEVAR for type B aortic dissection were 5.5 % in acute cases and 2.9 % for chronic cases, respectively.

A total of 3922 patients with non-dissected aortic aneurysm underwent stent graft placement; TEVAR in 3521 cases (12.4 % increase compared with that in 2013) and open stent grafting in 401 cases (145 % increase compared with that in 2013). The reason of dramatic increase in open stent grafting might be due to commercially availability since 2014. The hospital mortality rates for TEVAR were 2.4 and 17.1 % for non-ruptured and ruptured aneurysm, respectively.

In summary, the total cardiovascular operations increased during 2014 by 1141 cases with steadily improving results in almost all categories throughout these 10 years.

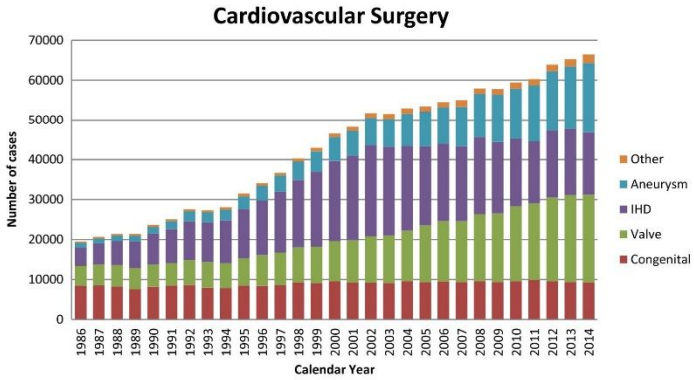

Fig. 1 Cardiovascular surgery. *IHD* ischemic heart disease

Table 3 Congenital (total; 9269)
(1) CPB (+) (total; 6894)

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
1	PDA	1	1 (100.0)	0	1 (100.0)	2	0	0	0	1	0	0	0	13	0	0	0	17	1 (5.9)	0	1 (5.9)
2	Coarctation (simple)	11	0	0	0	10	0	0	0	11	0	0	0	7	0	0	0	39	0	0	0
3	+VSD	39	0	0	0	51	0	0	0	12	0	0	0	6	0	0	0	108	0	0	0
4	+DORV	8	0	0	0	12	0	0	1 (8.3)	3	0	0	0	0	0	0	0	23	0	0	1 (4.3)
5	+AVSD	1	0	0	0	3	1 (33.3)	0	1 (33.3)	3	0	0	0	1	0	0	0	8	1 (12.5)	0	1 (12.5)
6	+TGA	9	0	0	1 (11.1)	4	0	0	0	3	0	0	0	4	0	0	0	20	0	0	1 (5.0)
7	+SV	4	1 (25.0)	0	1 (25.0)	8	0	0	0	2	0	0	0	1	0	0	0	15	1 (6.7)	0	1 (6.7)
8	+Others	3	1 (33.3)	0	1 (33.3)	8	0	0	0	3	0	0	0	1	0	0	0	15	1 (6.7)	0	1 (6.7)
9	Interrupt. of Ao (simple)	4	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	6	0	0	0
10	+VSD	33	1 (3.0)	0	3 (9.1)	23	1 (4.3)	0	2 (8.7)	9	0	0	0	5	0	0	0	70	2 (2.9)	0	5 (7.1)
11	+DORV	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
12	+Truncus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	+TGA	1	1 (100.0)	0	1 (100.0)	0	0	0	0	12	0	0	0	0	0	0	0	13	1 (7.7)	0	1 (7.7)
14	+Others	5	0	0	0	3	0	0	0	2	0	0	1 (50.0)	0	0	0	0	10	0	0	1 (10.0)
15	Vascular ring	0	0	0	0	8	0	0	0	2	0	0	0	0	0	0	0	10	0	0	0
16	PS	1	0	0	0	10	0	0	0	19	0	0	0	9	1 (11.1)	0	1 (11.1)	39	1 (2.6)	0	1 (2.6)
17	PAIVS or critical PS	18	0	0	1 (5.6)	44	1 (2.3)	0	1 (2.3)	84	0	0	0	6	0	0	0	152	1 (0.7)	0	2 (1.3)
18	TAPVR	113	8 (7.1)	0	15 (13.3)	65	4 (6.2)	0	6 (9.2)	5	0	0	0	0	0	0	0	183	12 (6.6)	0	21 (11.5)
19	PAPVR ± ASD	0	0	0	0	5	0	0	0	45	0	0	1 (2.2)	27	1 (3.7)	0	1 (3.7)	77	1 (1.3)	0	2 (2.6)
20	ASD	20	0	0	0	67	0	0	1 (1.5)	667	0	0	1 (0.1)	494	0	0	0	1248	0	0	2 (0.2)
21	Cor triatriatum	2	0	0	0	14	1 (7.1)	0	1 (7.1)	11	0	0	0	4	0	0	0	31	1 (3.2)	0	1 (3.2)
22	AVSD (partial)	1	0	0	0	7	0	0	0	33	1 (3.0)	0	1 (3.0)	24	0	0	0	65	1 (1.5)	0	1 (1.5)
23	AVSD (complete)	2	0	0	0	108	0	1 (0.9)	2 (1.9)	67	0	0	0	4	0	0	1 (25.0)	181	0	1 (0.6)	3 (1.7)
24	+TOF or DORV	1	0	0	0	11	1 (9.1)	0	1 (9.1)	15	3 (20.0)	0	3 (20.0)	0	0	0	0	27	4 (14.8)	0	4 (14.8)
25	+Others	3	0	0	0	4	0	0	1 (25.0)	6	0	0	0	9	0	0	0	22	0	0	1 (4.5)
26	VSD (subarterial)	4	1 (25.0)	0	1 (25.0)	100	0	0	0	199	0	0	0	33	0	0	0	336	1 (0.3)	0	1 (0.3)
27	VSD (perimemb./muscular)	9	0	0	0	742	3 (0.4)	0	4 (0.5)	353	2 (0.6)	1 (0.3)	2 (0.6)	71	0	0	0	1175	5 (0.4)	1 (0.1)	6 (0.5)
28	VSD + PS	0	0	0	0	15	0	0	0	20	0	0	0	3	0	0	0	38	0	0	0
29	DCRV ± VSD	1	0	0	0	16	0	0	0	28	0	0	0	20	0	0	0	65	0	0	0
30	Aneurysm of sinus valsalva	0	0	0	0	1	0	0	0	8	0	0	0	22	0	0	0	31	0	0	0
31	TOF	9	0	0	0	176	1 (0.6)	0	2 (1.1)	212	0	0	1 (0.5)	42	1 (2.4)	0	2 (4.8)	439	2 (0.5)	0	5 (1.1)
32	PA + VSD	4	0	0	0	49	1 (2.0)	0	3 (6.1)	92	0	0	1 (1.1)	7	0	0	0	152	1 (0.7)	0	4 (2.6)
33	DORV	17	0	0	0	106	3 (2.8)	0	3 (2.8)	108	0	0	2 (1.9)	11	1 (9.1)	0	1 (9.1)	242	4 (1.7)	0	6 (2.5)
34	TGA (simple)	102	8 (7.8)	1 (1.0)	8 (7.8)	13	0	0	0	5	0	0	0	1	0	0	0	121	8 (6.6)	1 (0.8)	8 (6.6)
35	+VSD	31	1 (3.2)	0	1 (3.2)	12	1 (8.3)	0	1 (8.3)	8	0	0	0	0	0	0	0	51	2 (3.9)	0	2 (3.9)

Table 3 continued

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
36	VSD + PS	1	0	0	0	11	0	0	1 (9.1)	15	1 (6.7)	0	1 (6.7)	6	0	0	0	33	1 (3.0)	0	2 (6.1)
37	Corrected TGA	3	0	0	0	23	0	0	0	40	1 (2.5)	0	2 (5.0)	13	0	0	0	79	1 (1.3)	0	2 (2.5)
38	Truncus arteriosus	11	1 (9.1)	0	1 (9.1)	22	0	0	1 (4.5)	14	0	0	0	2	0	0	0	49	1 (2.0)	0	2 (4.1)
39	SV	22	2 (9.1)	0	7 (31.8)	202	4 (2.0)	0	6 (3.0)	263	4 (1.5)	1 (0.4)	8 (3.0)	20	1 (5.0)	0	1 (5.0)	507	11 (2.2)	1 (0.2)	22 (4.3)
40	TA	5	0	0	0	44	1 (2.3)	0	1 (2.3)	53	0	0	1 (1.9)	10	0	0	0	112	1 (0.9)	0	2 (1.8)
41	HLHS	40	2 (5.0)	0	5 (12.5)	124	9 (7.3)	0	15 (12.1)	60	1 (1.7)	0	2 (3.3)	0	0	0	0	224	12 (5.4)	0	22 (9.8)
42	Aortic valve lesion	6	0	0	0	14	1 (7.1)	0	1 (7.1)	89	1 (1.1)	0	1 (1.1)	16	1 (6.3)	0	1 (6.3)	125	3 (2.4)	0	3 (2.4)
43	Mitral valve lesion	2	0	0	0	28	1 (3.6)	0	1 (3.6)	72	1 (1.4)	0	2 (2.8)	8	0	0	0	110	2 (1.8)	0	3 (2.7)
44	Ebstein	15	0	0	3 (20.0)	14	0	0	1 (7.1)	34	0	0	0	16	2 (12.5)	0	2 (12.5)	79	2 (2.5)	0	6 (7.6)
45	Coronary disease	1	0	0	0	8	0	0	0	14	1 (7.1)	0	1 (7.1)	22	0	0	0	45	1 (2.2)	0	1 (2.2)
46	Others	21	0	0	1 (4.8)	46	1 (2.2)	0	3 (6.5)	35	0	0	0	9	0	0	1 (11.1)	111	1 (0.9)	0	5 (4.5)
47	Redo VSD	0	0	0	0	5	0	0	0	13	0	0	0	3	0	0	0	21	0	0	0
48	PS release	0	0	0	0	10	0	0	0	52	0	0	0	24	0	0	0	86	0	0	0
49	RV-PA conduit replace	0	0	0	0	4	0	0	0	54	0	0	0	37	0	0	0	95	0	0	0
50	Others	4	0	0	1 (25.0)	41	2 (4.9)	0	3 (7.3)	97	0	0	0	43	0	0	0	185	2 (1.1)	0	4 (2.2)
Total		589	28 (4.8)	1 (0.2)	52 (8.8)	2297	37 (1.6)	1 (0.04)	63 (2.7)	2.954	16 (0.5)	2 (0.1)	31 (1.0)	1054	8 (0.8)	0	11 (1.0)	6894	89 (1.3)	4 (0.1)	157 (2.3)

Values in parenthesis represent mortality %

CPB cardiopulmonary bypass, *PDA* patient ductus arteriosus, *VSD* ventricular septal defect, *DORV* double outlet right ventricle, *AVSD* atrioventricular septal defect, *TGA* transposition of great arteries, *SV* single ventricle, Interupt. 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

Table 3 continued
(2) CPB (−) (total; 2375)

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
1	PDA	430	4 (0.9)	0	5 (1.2)	230	2 (0.9)	0	4 (1.7)	40	0	0	0	2	0	0	0	702	6 (0.9)	0	9 (1.3)
2	Coarctation (simple)	21	1 (4.8)	0	1 (4.8)	27	0	0	0	4	0	0	0	0	0	0	0	52	1 (1.9)	0	1 (1.9)
3	+VSD	39	0	0	0	16	0	0	0	3	0	0	0	1	0	0	0	59	0	0	0
4	+DORV	9	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0
5	+AVSD	2	0	0	0	1	0	0	0	4	0	0	0	0	0	0	0	7	0	0	0
6	+TGA	4	0	0	0	1	0	0	0	2	0	0	0	1	0	0	0	8	0	0	0
7	+SV	12	0	0	1 (8.3)	8	0	0	0	0	0	0	0	0	0	0	0	20	0	0	1 (5.0)
8	+Others	8	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0
9	Interrupt. of Ao (simple)	2	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	5	0	0	0
10	+VSD	25	0	0	0	8	0	0	0	1	0	0	0	1	0	0	0	35	0	0	0
11	+DORV	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
12	+Truncus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
13	+TGA	1	0	0	1 (100.0)	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1 (50.0)
14	+Others	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
15	Vascular ring	5	0	0	0	8	0	0	0	7	0	0	0	0	0	0	0	20	0	0	0
16	PS	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	4	0	0	0
17	PAIVS or critical PS	25	1 (4.0)	0	1 (4.0)	20	0	0	1 (5.0)	8	1 (12.5)	0	2 (25.0)	0	0	0	0	53	2 (3.8)	0	4 (7.5)
18	TAPVR	3	0	0	0	8	2 (25.0)	0	2 (25.0)	1	0	0	0	1	0	0	0	13	2 (15.4)	0	2 (15.4)
19	PAPVR ± ASD	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0
20	ASD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Cor triatriatum	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0
22	AVSD (partial)	1	0	0	0	3	0	0	0	2	0	0	0	1	0	0	0	7	0	0	0
23	AVSD (complete)	35	0	0	1 (2.9)	72	0	0	0	3	0	0	0	0	0	0	0	110	0	0	1 (0.9)
24	+TOF or DORV	2	0	0	0	7	0	0	0	4	0	0	0	0	0	0	0	13	0	0	0
25	+Others	7	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
26	VSD (subarterial)	1	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	10	0	0	0
27	VSD (perimemb./muscular)	49	0	0	2 (4.1)	107	0	0	2 (1.9)	2	0	0	0	2	0	0	0	160	0	0	4 (2.5)
28	VSD + PS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
29	DCRV ± VSD	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0
30	Aneurysm of sinus valsalva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	TOF	28	2 (7.1)	0	2 (7.1)	88	0	0	0	7	0	0	0	1	0	0	0	124	2 (1.6)	0	2 (1.6)
32	PA + VSD	23	0	0	0	69	1 (1.4)	0	1 (1.4)	23	1 (4.3)	0	1 (4.3)	0	0	0	0	115	2 (1.7)	0	2 (1.7)
33	DORV	36	0	0	0	55	0	0	0	14	0	0	0	0	0	0	0	105	0	0	0
34	TGA (simple)	6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0

Table 3 continued
(2) CPB (−) (total; 2375)

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
35	+VSD	7	0	0	0	4	0	0	0	3	0	0	0	0	0	0	0	14	0	0	0
36	VSD + PS	12	0	0	0	14	0	0	0	1	0	0	0	13	0	0	0	40	0	0	0
37	Corrected TGA	8	0	0	0	26	0	0	0	8	0	0	0	8	0	0	0	50	0	0	0
38	Truncus arteriosus	15	1 (6.7)	0	1 (6.7)	5	0	0	0	5	0	0	0	0	0	0	0	25	1 (4.0)	0	1 (4.0)
39	SV	73	2 (2.7)	0	4 (5.5)	58	2 (3.4)	0	3 (5.2)	24	0	0	0	6	0	0	0	161	4 (2.5)	0	7 (4.3)
40	TA	25	0	0	0	13	1 (7.7)	0	1 (7.7)	9	0	0	0	0	0	0	0	47	1 (2.1)	0	1 (2.1)
41	HLHS	97	3 (3.1)	0	7 (7.2)	14	0	0	0	16	0	0	2 (12.5)	1	0	0	0	128	3 (2.3)	0	9 (7.0)
42	Aortic valve lesion	1	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0
43	Mitral valve lesion	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
44	Ebstein	6	0	0	0	1	0	0	0	3	0	0	0	1	0	0	0	11	0	0	0
45	Coronary disease	1	0	0	0	2	1 (50.0)	0	1 (50.0)	4	0	0	0	0	0	0	0	7	1 (14.3)	0	1 (14.3)
46	Others	15	1 (6.7)	0	1 (6.7)	52	0	0	0	56	0	0	0	18	0	0	0	141	1 (0.7)	0	1 (0.7)
47	Redo VSD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	PS release	1	0	0	1 (100.0)	2	0	0	0	1	0	0	0	0	0	0	0	4	0	0	1 (25.0)
49	RV-PA conduit replace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	Others	6	0	0	0	22	0	0	1 (4.5)	21	1 (4.8)	0	1 (4.8)	5	0	0	0	54	1 (1.9)	0	2 (3.7)
Total		1051	15 (1.4)	0	28 (2.7)	973	9 (0.9)	0	16 (1.6)	285	3 (1.1)	0	6 (2.1)	66	0	0	0	2375	27 (1.1)	0	50 (2.1)

Values in parenthesis represent mortality %

CPB cardiopulmonary bypass, *PDA* patient ductus arteriosus, *VSD* ventricular septal defect, *DORV* double outlet right ventricle, *AVSD* atrioventricular septal defect, *TGA* transposition of great arteries, *SV* single ventricle, Interupt. 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

Table 3 continued
(3) Main procedure

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
1	SP shunt	149	4 (2.7)	0	8 (5.4)	357	6 (1.7)	0	9 (2.5)	42	0	0	1 (2.4)	1	0	0	0	549	10 (1.8)	0	18 (3.3)
2	PAB	387	7 (1.8)	0	15 (3.9)	263	2 (0.8)	0	5 (1.9)	11	0	0	0	0	0	0	0	661	9 (1.4)	0	20 (3.0)
3	Bidirectional Glenn or hemi-Fontan ± α	1	0	0	0	240	2 (0.8)	0	2 (0.8)	106	1 (0.9)	0	1 (0.9)	4	0	0	0	351	3 (0.9)	0	3 (0.9)
4	Damus–Kaye–Stansel operation	2	0	0	0	36	1 (2.8)	0	1 (2.8)	15	0	0	0	3	0	0	1 (33.3)	56	1 (1.8)	0	2 (3.6)
5	PA reconstruction/repair (including redo)	16	0	0	1 (6.3)	106	2 (1.9)	0	3 (2.8)	140	0	0	2 (1.4)	25	0	0	0	287	2 (0.7)	0	6 (2.1)
6	RVOT reconstruction/repair	12	0	0	0	111	1 (0.9)	0	2 (1.8)	202	1 (0.5)	0	3 (1.5)	53	0	0	1 (1.9)	378	2 (0.5)	0	6 (1.6)
7	Rastelli procedure	9	0	0	0	39	0	0	1 (2.6)	94	0	0	2 (2.1)	11	0	0	0	153	0	0	3 (2.0)
8	Arterial switch procedure	134	9 (6.7)	1 (0.7)	9 (6.7)	40	1 (2.5)	0	1 (2.5)	2	1 (50.0)	0	2 (100.0)	0	0	0	0	176	11 (6.3)	1 (0.6)	12 (6.8)
9	Atrial switch procedure	2	1 (50.0)	0	1 (50.0)	4	0	0	0	1	0	0	0	0	0	0	0	7	1 (14.3)	0	1 (14.3)
10	Double switch procedure	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	15	0	0	0
11	Repair of anomalous origin of CA	1	0	0	0	4	0	0	0	8	0	0	0	4	0	0	0	17	0	0	0
12	Closure of coronary AV fistula	1	0	0	0	5	0	0	0	4	0	0	0	29	0	0	0	39	0	0	0
13	Fontan/TCPC	0	0	0	0	5	0	0	0	362	1 (0.3)	0	4 (1.1)	30	0	0	0	397	1 (0.3)	0	4 (1.0)
14	Norwood procedure	29	0	0	2 (6.9)	93	8 (8.6)	0	17 (18.3)	2	0	0	0	1	0	0	0	125	8 (6.4)	0	19 (15.2)
15	Ventricular septation	0	0	0	0	10	0	0	0	4	0	0	0	1	0	0	0	15	0	0	0
16	Left side AV valve repair (including Redo)	3	1 (33.3)	0	2 (66.7)	45	2 (4.4)	0	2 (4.4)	71	0	0	0	28	0	0	0	147	3 (2.0)	0	4 (2.7)
17	Left side AV valve replace (including Redo)	0	0	0	0	9	0	0	0	37	2 (5.4)	0	2 (5.4)	19	0	0	0	65	2 (3.1)	0	2 (3.1)
18	Right side AV valve repair (including Redo)	4	0	0	2 (50.0)	14	0	0	1 (7.1)	34	0	0	0	38	0	0	0	90	0	0	3 (3.3)
19	Right side AV valve replace (including Redo)	0	0	0	0	2	1 (50.0)	0	1 (50.0)	9	0	0	0	15	2 (13.3)	0	2 (13.3)	26	3 (11.5)	0	3 (11.5)
20	Common AV valve repair (including Redo)	2	0	0	0	33	1 (3.0)	0	3 (9.1)	34	2 (5.9)	0	2 (5.9)	1	0	0	0	70	3 (4.3)	0	5 (7.1)
21	Common AV valve replace (including Redo)	1	0	0	0	2	0	0	0	7	0	0	1 (14.3)	1	0	0	0	11	0	0	1 (9.1)
22	Repair of supra-aortic stenosis	3	0	0	0	9	0	0	0	15	0	0	0	2	0	0	0	29	0	0	0
23	Repair of subaortic stenosis (including Redo)	2	0	0	2 (100.0)	7	0	0	0	24	2 (8.3)	0	2 (8.3)	7	0	0	0	40	2 (5.0)	0	4 (10.0)
24	Aortic valve plasty ± VSD closure	4	0	0	0	8	0	0	0	31	0	0	0	2	0	0	0	45	0	0	0
25	Aortic valve replacement	0	0	0	0	0	0	0	0	19	0	0	0	23	0	0	0	42	0	0	0
26	AVR with annular enlargement	0	0	0	0	0	0	0	0	12	0	0	0	3	1 (33.3)	0	1 (33.3)	15	1 (6.7)	0	1 (6.7)

Table 3 continued
(3) Main procedure

		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
			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
27	Aortic root replace (except Ross)	0	0	0	0	1	0	0	0	10	0	0	0	5	0	0	0	16	0	0	0
28	Ross procedure	0	0	0	0	0	0	0	0	11	1 (9.1)	0	1 (9.1)	2	0	0	0	13	1 (7.7)	0	1 (7.7)
Total		762	22 (2.9)	1 (0.1)	42 (5.5)	1443	27 (1.9)	0	48 (3.3)	1322	11 (0.8)	0	23 (1.7)	308	3 (1.0)	0	5 (1.6)	3835	63 (1.6)	1 (0.03)	118 (3.1)

Values in parenthesis represent 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 4 Acquired (total, (1) + (2) + (4) + (5) + (6) + (7) + isolated ope. for arrhythmia in (3); 39,485
(1) Valvular heart disease (total; 21,939)

	Valve	Cases	Operation					30-day mortality				Hospital mortality		Redo			
			Mechanical	Bioprosthesis	Ross procedure	Repair	With CABG	Hospital		After discharge				Cases	30-day mortality		Hospital mortality
								Replace	Repair	Replace	Repair	Replace	Repair		Hospital	After discharge	
Isolated	A	10,219	1884	8037	1	297	2298	156 (1.6)	5 (1.7)	3 (0.03)	0	238 (2.4)	9 (3.0)	371	20 (5.4)	0	35 (9.4)
	M	4851	684	918		3249	716	56 (3.5)	16 (0.5)	2 (0.1)	0	95 (5.9)	35 (1.1)	344	10 (2.9)	0	27 (7.8)
	T	253	10	68		175	25	5 (6.4)	5 (2.9)	0	0	9 (11.5)	7 (4.0)	48	3 (6.3)	0	6 (12.5)
	P	13	2	9		2	0	0	0	0	0	0	0	4	0	0	0
A + M	A	1537	388	1085	0	55	238	75 (4.9)		0		112 (7.3)		91	13 (14.3)	0	16 (17.6)
	M		275	422	0	832											
A + T	A	448	96	339	1	6	63	11 (2.5)		0		23 (5.1)		42	2 (4.8)	0	4 (9.5)
	T		3	5	0	435											
M + T	M	3513	494	1044		1972	313	53 (1.5)		0		94 (2.7)		234	13 (5.6)	0	22 (9.4)
	T		12	70		3424											
A + M + T	A	1056	255	759	0	39	130	39 (3.7)		0		64 (6.1)		66	8 (12.1)	0	11 (16.7)
	M		198	381	0	474											
	T		4	17	0	1032											
Others		49	5	22	0	14	2	1 (2.0)		0		2 (0.2)		10	0	0	0
Total		21,939	4310	13,176	2	12,006	3785	422 (1.9)		5 (0.02)		688 (3.1)		1210	69 (5.7)	0	121 (10.0)

Number of redo cases is included in total case number of 21,939

Values in parenthesis represent mortality %

CABG coronary artery bypass grafting, *A* aortic valve, *M* mitral valve, *T* tricuspid valve, *P* pulmonary valve

	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge	
TAVR	877	11	1	17

Table 4 continued
(2) Ischemic heart disease (total, (A) + (B) + (C); 15,629)
(*A*) *Isolated CABG* (*total*; (*a*)+(*b*); *14,454*)
(a-1) on-pump arrest CABG (total; 3277)

	Primary, elective				Primary, emergency				Redo, elective				Redo, emergency				Arterial graft only	Artery graft + SVG	SVG only	Others	Unclear
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality					
		Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge						
1VD	93	1 (1.1)	0	1 (1.1)	19	2 (10.5)	0	3 (15.8)	5	0	0	1 (20.0)	2	1 (50.0)	0	2 (100.0)	55	18	46	0	0
2VD	461	3 (0.7)	0	6 (1.3)	47	2 (4.3)	0	2 (4.3)	7	0	0	0	0	0	0	0	95	392	27	0	1
3VD	1512	10 (0.7)	0	12 (0.8)	161	15 (9.3)	0	19 (11.8)	15	1 (6.7)	0	2 (13.3)	1	1 (100.0)	0	1 (100.0)	92	1569	19	0	9
LMT	761	8 (1.1)	0	12 (1.6)	190	11 (5.8)	0	15 (7.9)	3	1 (33.3)	0	1 (33.3)	0	0	0	0	107	814	33	1	1
Total	2827	22 (0.8)	0	31 (1.1)	417	30 (7.2)	0	39 (9.4)	30	2 (6.7)	0	4 (13.3)	3	2 (66.7)	0	3 (100.0)	349	2793	125	1	11
Kawasaki	7	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	7	2	0	0	0
Hemodialysis	172	6 (3.5)	0	8 (4.7)	28	3 (10.7)	0	5 (17.9)	1	0	0	1 (100.0)	0	0	0	0	10	173	10	0	8

Values in parenthesis represent 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; 2171)

	Primary, elective				Primary, emergency				Redo, elective				Redo, emergency				Arterial graft only	Artery graft + SVG	SVG only	Others	Unclear
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality					
		Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge						
1VD	35	2 (5.7)	0	2 (5.7)	31	2 (6.5)	0	5 (16.1)	4	0	0	1 (25.0)	3	1 (33.3)	0	1 (33.3)	40	6	25	0	2
2VD	255	4 (1.6)	0	6 (2.4)	51	4 (7.8)	0	6 (11.8)	11	1 (9.1)	0	1 (9.1)	6	2 (33.3)	0	4 (66.7)	74	224	18	0	7
3VD	894	15 (1.7)	0	28 (3.1)	170	15 (8.8)	0	18 (10.6)	7	0	0	0	1	1 (100.0)	0	1 (100.0)	118	918	24	0	12
LMT	479	6 (1.3)	0	8 (1.7)	216	24 (11.1)	0	33 (15.3)	6	0	0	0	2	1 (50.0)	0	1 (50.0)	103	564	31	0	5
Total	1663	27 (1.6)	0	44 (2.6)	468	45 (9.6)	0	62 (13.2)	28	1 (3.6)	0	2 (7.1)	12	5 (41.7)	0	7 (58.3)	335	1712	98	0	26
Kawasaki	2	0	0	0	1	1 (100.0)	0	1 (100.0)	0	0	0	0	1	0	0	0	1	1	0	0	2
Hemodialysis	139	4 (2.9)	0	11 (7.9)	30	3 (10.0)	0	4 (13.3)	6	0	0	0	2	0	0	1 (50.0)	17	142	10	0	8

Values in parenthesis represent 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; 9006)
(The present section also includes cases of planned off-pump CABG in which, during surgery, the change is made to an on-pump CABG or on-pump beating-heart procedure)

	Primary, elective				Primary, emergency				Redo, elective				Redo, emergency				Arterial graft only	Artery graft + SVG	SVG only	Others	Unclear
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality					
		Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge						
1VD	556	3 (0.5)	0	6 (1.1)	70	4 (5.7)	0	5 (7.1)	27	1 (3.7)	0	2 (7.4)	2	1 (50.0)	0	1 (50.0)	531	36	64	0	24
2VD	1446	10 (0.7)	1 (0.07)	13 (0.9)	144	8 (5.6)	0	9 (6.3)	12	0	0	0	2	0	0	0	521	977	56	0	50
3VD	3679	27 (0.7)	0	43 (1.2)	386	13 (3.4)	0	16 (4.1)	22	0	0	0	3	0	0	0	708	3237	41	0	104
LMT	2164	14 (0.6)	0	23 (1.1)	474	18 (3.8)	0	23 (4.9)	14	0	0	0	5	0	0	0	654	1934	45	0	24
Total	7845	54 (0.7)	1 (0.01)	85 (1.1)	1074	43 (4.0)	0	53 (4.9)	75	1 (1.3)	0	2 (2.7)	12	1 (8.3)	0	1 (8.3)	2414	6184	206	0	202
Kawasaki	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	2	1	0	0
Hemodialysis	524	4 (0.8)	0	9 (1.7)	79	4 (5.1)	0	4 (5.1)	7	0	0	0	1	0	0	0	99	453	13	0	46

Values in parenthesis represent 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; 156)

	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
		Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge	
A conversion to on-pump CABG arrest heart	27	1 (3.7)	0	0	3	0	0	0	0	0	0	0	0	0	0	0
A conversion to on-pump beating-heart CABG	100	4 (4.0)	0	4 (4.0)	26	3 (11.5)	0	3 (11.5)	0	0	0	0	0	0	0	0
Total	127	5 (3.9)	0	4 (3.1)	29	3 (10.3)	0	3 (10.3)	0	0	0	0	0	0	0	0
Hemodialysis	15	1 (6.7)	0	1 (6.7)	1	0	0	0	0	0	0	0	0	0	0	0

Values in parenthesis represent mortality %

CABG coronary artery bypass grafting

(*B*) *Operation for complications of MI* (*total*; *1175*)

	Chronic				Acute				Concomitant operation		
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality			
		Hospital	After discharge			Hospital	After discharge		CABG	MVP	MVR
Infarctectomy or aneurysmectomy	257	6 (2.3)	0	13 (5.1)	38	6 (15.8)	0	7 (18.4)	164	59	19
VSP closure	51	4 (7.8)	0	5 (9.8)	245	70 (28.6)	0	82 (33.5)	77	1	7
Cardiac rupture	21	1 (4.8)	0	5 (23.8)	199	73 (36.7)	0	78 (39.2)	23	1	1
Mitral regurgitation											
1) Papillary muscle rupture	10	1 (10.0)	0	1 (10.0)	46	10 (21.7)	1 (2.2)	12 (26.1)	18	11	46
2) Ischemic	251	7 (2.8)	0	17 (6.8)	27	7 (25.9)	0	7 (25.9)	221	174	53
Others	19	0	0	0	11	1 (9.1)	0	3 (27.3)	3	4	0
Total	609	19 (3.1)	0	41 (6.7)	566	167 (29.5)	1 (0.2)	189 (33.4)	506	250	126

Values in parenthesis represent mortality %

Acute, within 2 weeks from the onset of myocardial infarction

MI myocardial infarction, *CABG* coronary artery bypass grafting, *MVP* mitral valve repair, *MVR* mitral valve replacement, *VSP* ventricular septal perforation

(*C*) *TMLR* (*total*; *0*)

	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge	
Isolated	0	0	0	0
With CABG	0	0	0	0
Total	0	0	0	0

TMLR transmyocardial laser revascularization

(3) Operation for arrhythmia (total; 3855)

	Cases	30-day mortality		Hospital mortality	Concomitant operation						
					Isolated	Congenital	Valve	IHD	Others	Multiple combination	
		Hospital	After discharge							2 categories	3 categories
Maze	3486	34 (1.0)	0	55 (1.6)	15	127	3,162	375	216	440	32
For WPW	2	0	0	0	0	1	1	0	0	0	0
For ventricular tachyarrhythmia	35	2 (5.7)	0	3 (8.6)	2	3	14	13	5	2	0
Others	332	3 (0.9)	0	4 (1.2)	89	7	193	57	25	34	3
Total	3855	39 (1.0)	0	62 (1.6)	106	138	3370	445	246	476	35

Values in parenthesis represent mortality %. Except for 106 isolated cases, all remaining 3749 cases are doubly allocated, one for this subgroup and the other for the subgroup corresponding to the concomitant operations

WPW Wolff–Parkinson–White syndrome, *IHD* ischemic heart disease

(4) Operation for constrictive pericarditis (total; 178)

	CPB (+)				CPB (−)			
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge			Hospital	After discharge	
Total	102	12 (11.8)	0	15 (14.7)	76	0	0	5 (6.6)

Values in parenthesis represent mortality %

CPB cardiopulmonary bypass

(5) Cardiac tumor (total; 602)

	Cases	30-day mortality		Hospital mortality	Concomitant operation			
		Hospital	After discharge		AVR	MVR	CABG	Others
Benign tumor	530	4 (0.8)	0	7 (1.3)	10	11	25	70
Cardiac myxoma	419	2 (0.5)	0	2 (0.5)	4	8	20	59
Papillary fibroelastoma	46	0	0	2 (4.3)	4	2	1	7
Rhabdomyoma	4	1 (25.0)	0	1 (25.0)	0	0	0	0
Others	61	1 (1.6)	0	2 (3.3)	2	1	4	4
Malignant tumor	72	4 (5.6)	1 (1.4)	11 (15.3)	2	3	2	11
Primary	45	2 (4.4)	0	3 (6.7)	2	3	1	7
Metastatic	27	2 (7.4)	1 (3.7)	8 (29.6)	0	0	1	4

Values in parenthesis represent mortality %

AVR aortic valve replacement, *MVR* mitral valve replacement, *CABG* coronary artery bypass grafting

(6) HOCM and DCM (total; 211)

	Cases	30-day mortality		Hospital mortality	Concomitant operation			
		Hospital	After discharge		AVR	MVR	MVP	CABG
Myectomy	171	5 (2.9)	0	8 (4.7)	110	19	23	13
Myotomy	5	0	0	0	1	2	0	0
No-resection	14	1 (7.1)	0	1 (7.1)	2	5	16	0
Volume reduction surgery of the left ventricle	21	3 (14.3)	0	4 (19.0)	0	6	6	4
Total	211	9 (4.3)	0	13 (6.2)	113	32	45	17

Values in parenthesis represent mortality %

HOCM hypertrophic obstructive cardiomyopathy, *DCM* dilated cardiomyopathy, *AVR* aortic valve replacement, *MVR* mitral valve replacement, *MVP* mitral alve repair, *CABG* coronary artery bypass grafting

(7) Other open-heart operation (total; 820)

	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge	
Total	820	36 (4.4)	0	42 (5.1)

Values in parenthesis represent mortality %

Table 5 Thoracic aortic aneurysm (total; 17,498)
(1) Dissection (total; 7,733)

Replaced site	Stanford type																								
	Acute								Chronic								Concomitant operation					Redo			
	A				B				A				B												
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	AVP	AVR	MVP	MVR	CABG	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge			Hospital	After discharge			Hospital	After discharge			Hospital	After discharge								Hospital	After discharge	
1. Ascending Ao.	2787	220 (7.9)	1 (0.04)	267 (9.6)	1	0	0	0	234	7 (3.0)	0	13 (5.6)	7	2 (28.6)	0	2 (28.6)	182	143	5	7	137	71	10 (14.1)	0	14 (19.7)
2. Aortic Root	197	42 (21.3)	0	48 (24.4)	1	0	0	0	60	5 (8.3)	0	8 (13.3)	1	0	0	0	39	181	3	2	52	34	6 (17.6)	0	8 (23.5)
3. Ascending Ao. + Arch	1525	129 (8.5)	0	156 (10.2)	41	5 (12.2)	0	8 (19.5)	295	3 (1.0)	0	10 (3.4)	109	2 (1.8)	0	5 (4.6)	104	52	10	2	75	76	5 (6.6)	0	8 (10.5)
4. Arch + descending Ao.	57	2 (3.5)	0	5 (8.8)	16	5 (31.3)	0	6 (37.5)	24	1 (4.2)	0	2 (8.3)	62	5 (8.1)	0	7 (11.3)	0	0	0	0	5	19	1 (5.3)	0	2 (10.5)
5. Aortic root + Asc. Ao. + Arch	129	21 (16.3)	0	23 (17.8)	0	0	0	0	29	3 (10.3)	0	8 (27.6)	5	0	0	0	24	109	1	1	28	17	1 (5.9)	0	1 (5.9)
6. Descending Ao.	16	1 (6.3)	0	1 (6.3)	41	4 (9.8)	0	7 (17.1)	63	2 (3.2)	0	3 (4.8)	208	11 (5.3)	0	14 (5.7)	0	1	0	0	1	24	4 (16.7)	0	6 (25.0)
7. Thoracoabdominal Ao.	2	0	0	1 (50.0)	11	3 (27.3)	0	4 (36.4)	27	2 (7.4)	0	3 (11.1)	138	7 (5.1)	0	12 (8.7)	0	0	0	0	1	31	4 (12.9)	0	5 (16.1)
8. Extra-anatomical bypass	7	1 (14.3)	0	1 (14.3)	8	0	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
9. Stent graft*a	233	18 (7.7)	0	25 (10.7)	277	11 (4.0)	0	16 (5.8)	232	4 (1.7)	0	8 (3.4)	883	18 (2.0)	1 (0.1)	26 (2.9)	8	5	3	0	7	94	4 (4.3)	0	4 (4.3)
1) TEVARI*b	105	8 (7.6)	0	11 (10.5)	272	11 (4.0)	0	15 (5.5)	170	1 (0.6)	0	3 (1.8)	835	16 (1.9)	1 (0.1)	24 (2.9)	0	0	0	0	0	77	2 (2.6)	0	2 (2.6)
2) Open stent	128	10 (7.8)	0	14 (10.9)	5	0	0	1 (20.0)	62	3 (4.8)	0	5 (8.1)	48	2 (4.2)	0	2 (4.2)	8	5	3	0	7	17	2 (11.8)	0	2 (11.8)
a) With total arch*c	127	10 (7.9)	0	14 (11.0)	4	0	0	1 (25.0)	54	3 (5.6)	0	5 (9.3)	43	2 (4.7)	0	2 (4.7)	8	5	3	0	7	16	2 (12.5)	0	2 (12.5)
b) Without total arch*d	1	0	0	0	1	0	0	0	8	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	0
3) Unspecified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	4953	434 (8.8)	1 (0.02)	527 (10.6)	396	28 (7.1)	0	41 (10.4)	967	27 (2.8)	0	55 (5.7)	1,417	45 (3.2)	1 (0.1)	66 (4.7)	357	491	22	12	306	366	35 (9.6)	0	48 (13.1)

Values in parenthesis represent mortality %

Ao aorta, *AVP* aortic valve repair, *AVR* aortic valve replacement, *MVP* mitral valve repair, *MVR* mitral valve replacement, *CABG* coronary artery bypass grafting, *TEVAR* thoracic endovascular aortic (aneurysm) repair

Acute, within 2 weeks from the onset

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

Table 5 continued
(2) Non-dissection (total; 9765)

Replaced site	Unruptured				Ruptured				Concomitant operation					Redo				CPB (−)			
	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality	AVP	AVR	MVP	MVR	CABG	Cases	30-day mortality		Hospital mortality	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge			Hospital	After discharge								Hospital	After discharge			Hospital	After discharge	
1. Ascending Ao.	1369	24 (1.8)	0	38 (2.8)	36	4 (11.1)	0	7 (19.4)	82	872	67	50	171	122	5 (4.1)	0	9 (7.4)	–	–	–	–
2. Aortic Root	1022	27 (2.6)	0	32 (3.1)	35	8 (22.9)	0	10 (28.6)	250	698	71	19	121	129	17 (13.2)	0	22 (17.1)	–	–	–	–
3. Ascending Ao. + Arch	2139	43 (2.0)	0	75 (3.5)	162	29 (17.9)	4 (2.5)	38 (23.5)	44	181	21	8	351	90	5 (5.6)	0	6 (6.7)	–	–	–	–
4. Arch + descending Ao.	137	10 (7.3)	0	14 (10.2)	22	2 (9.1)	0	4 (18.2)	0	11	0	0	9	7	1 (14.3)	0	2 (28.6)	–	–	–	–
5. Aortic root – Asc. Ao. + Arch	120	2 (1.7)	0	3 (2.5)	2	0	0	0	26	90	3	1	12	10	0	0	1 (10.0)	–	–	–	–
6. Descending Ao.	255	8 (3.1)	0	12 (4.7)	64	11 (17.2)	0	17 (26.6)	0	0	0	0	5	16	4 (25.0)	0	6 (37.5)	8	1 (12.5)	0	1 (12.5)
7. Thoracoabdominal Ao.	390	21 (5.4)	0	28 (7.2)	65	14 (21.5)	0	20 (30.8)	0	0	0	0	0	24	3 (12.5)	0	4 (16.7)	9	0	0	0
8. Extra-anatomical bypass	25	0	1 (4.0)	0	0	0	0	0	0	1	0	0	2	3	0	0	1 (33.3)	10	0	0	1 (10.0)
9. Stent graft*a	3528	55 (1.6)	3 (0.1)	95 (2.7)	394	46 (11.7)	0	69 (17.5)	12	14	2	1	50	159	11 (6.9)	0	25 (15.7)	1100	23 (2.1)	1 (0.1)	35 (3.2)
1) TEVAR*b	3158	43 (1.4)	3 (0.1)	75 (2.4)	363	42 (11.6)	0	62 (17.1)	6	1	1	0	11	148	8 (5.4)	0	22 (14.9)	1100	23 (2.1)	1 (0.1)	35 (3.2)
2) Open stent	370	12 (3.2)	0	20 (5.4)	31	4 (12.9)	0	7 (22.6)	6	13	1	1	39	11	3 (27.3)	0	3 (27.3)	–	–	–	–
a) With total arch*c	285	8 (2.8)	0	16 (5.6)	23	1 (4.3)	0	4 (17.4)	6	13	1	1	35	8	2 (25.0)	0	2 (25.0)	–	–	–	–
b) Without total arch*d	85	4 (4.7)	0	4 (4.7)	8	3 (37.5)	0	3 (37.5)	0	0	0	0	4	3	1 (33.3)	0	1 (33.3)	–	–	–	–
3) Unspecified	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8985	190 (2.1)	4 (0.04)	297 (3.3)	780	114 (14.6)	4 (0.5)	165 (21.2)	414	1867	164	79	721	560	46 (8.2)	0	76 (13.6)	1,127	24 (2.1)	1 (0.1)	37 (3.3)

Values in parenthesis represent mortality %

Ao aorta, *AVP* aortic valve repair, *AVR* aortic valve replacement, *MVP* mitral valve repair, *MVR* mitral valve replacement, *CABG* coronary artery bypass grafting, *TEVAR* thoracic endovascular aortic (aneurysm) repair

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

Table 6 Pulmonary thromboembolism (total; 171)

	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge	
Acute	110	15 (13.6)	6 (5.5)	19 (17.3)
Chronic	61	6 (9.8)	0	6 (9.8)
Total	171	21 (12.3)	6 (3.5)	25 (14.6)

Values in parenthesis represent mortality %

Table 7 Assisted circulation (total; 1679)

Sites	VAD									Heart–lung assist					
	Device			Results						Method		Results			
	Centrifugal	VAS (extra)	VAS (implant)	Not weaned			Weaned			PCPS	Others	Not weaned		Weaned	
				On going	Death	Transplant	Alive	Deaths	Transplant			Deaths	Transplant	Deaths	Alive
Post cardiotomy															
Left	23	5	5	5	13 (39.4)	0	12	3 (9.1)	0						
Right	2	0	0	0	1 (50.0)	0	1	0	0						
Biventricle															
Right	8	0	0	0	6 (75.0)	0	2	1 (12.5)	0	432	78	259 (50.8)	0	79 (15.5)	157
Left	7	3	0												
Congestive heart failure															
Left	52	41	99	101	56 (29.2)	6	18	7 (3.6)	1						
Right	6	1	0	0	2 (28.6)	0	3	2 (28.6)	0						
Biventricle															
Right	24	6	0	3	16 (53.3)	0	8	2 (6.7)	1	676	61	332 (45.0)	1	111 (15.1)	281
Left	10	16	4												
Respiratory failure										80	40	35 (29.2)	0	15 (12.5)	70
Total	132	72	108	109	94 (30.1)	6	44	15 (4.8)	2	1188	179	626 (45.8)	1	205 (15.0)	508

Values in parenthesis represent mortality %

VAD ventricular assist devise, *VAS* ventricular assist system, extra Extracorporeal VAS, implant Implantable VAS, *PCPS* percutaneous cardiopulmonary support

Table 8 Heart transplantation (total; 30)

	Cases	30-day mortality		Hospital mortality
		Hospital	After discharge	
Heart transplantation	30	1 (3.3)	0	2 (6.7)
Heart and lung transplantation	0	0	0	0
Total	30	1 (3.3)	0	2 (6.7)

Values in parenthesis represent mortality %

Table 9 Pacemaker + ICD (total; 4923)

	Pacemaker			ICD	
	V	A-V	CRT	CRTD	ICD
Initial	570	1,971	94	245	383
Exchange	454	807	29	116	254
Unclear	0	0	0	0	0
Total	1024	2778	123	361	637

ICD implantable cardioverter-defibrillator, *CRTD* cardiac resynchronization therapy devise with incorporated ICD devise