

(B) General thoracic surgery

The total number of operations reported in 2014 in general thoracic surgery has reached 77070, which means 1.74-fold of that in 2001, and increased by 1764 cases compared with that in 2013 (Fig. 2, Table 10).

The number of operations for primary lung cancer was 38085 in 2014 (Table 10), showing the steady increase (31,301; 2009, 32,801; 2010, 33,878; 2011, 35,667; 2012, 37,008; 2013), and 1.95-fold of the number of operations in 2001. Surgery for lung cancer consists 49.4 % of all the general thoracic surgery.

Surgery for benign pulmonary tumor was 2171 in 2014 (Table 11).

Further information of primary malignant pulmonary tumors is shown in Tables 12 and 13. Among lung cancer subtypes, adenocarcinoma comprises an overwhelming percentage of 69.2 % of the total lung cancer surgery, followed by squamous cell carcinoma of 19.3 %. Limited resection by wedge resection or segmentectomy was performed in 9581 lung cancer patients, which is 25.2 % of the entire cases. Lobectomy was performed in 27,584 patients, which is 72.4 % of the entire cases. Sleeve lobectomy was done in 471 patients. Pneumonectomy was done in 521 patients which is 1.4 % of the entire cases.

There were 103 patients who died without discharge within 30 days after lung cancer surgery, and 59 patients who were discharged from hospital but died within 30 days after lung cancer surgery, indicating that 162 patients died within 30 days after lung cancer surgery (30-day mortality rate; 0.42 %). There were 266 patients died without discharge (hospital mortality rate; 0.70 %). 30-day mortality rate in regard to procedures is 0.12 % in segmentectomy, 0.48 % in lobectomy, and 1.53 % in pneumonectomy. Interstitial pneumonia was the leading cause of death after lung cancer surgery, followed by pneumonia, respiratory failure, cardiovascular event, and bronchopleural fistula.

Surgery for metastatic pulmonary tumors is denoted in Table 14. The number of patients undergoing operations for metastatic pulmonary tumor was 8057 in 2014 with steady increase similarly to lung cancer surgery (6248; 2009, 6748; 2010, 7210; 2011, 7403; 2012, 7829; 2013). Colorectal cancer was by far the leading primary malignancy indicated for resection of metastatic tumors, which comprises 48.4 % of the entire cases.

118 tracheal tumors were operated in 2014 (Table 15). Squamous cell carcinoma and adenoid cystic carcinoma were frequent primary tracheal tumor.

673 tumors of the pleural origin were operated in 2014 (Table 16). Diffuse malignant pleural mesothelioma was the most frequent histology. Total pleurectomy was performed in 73 patients and surpassed extrapleural pneumonectomy which was the most frequently chosen

operative method in 2013. Hospital mortality rate was 4.1 % after total pleurectomy and 4.3 % after extrapleural pneumonectomy in 2014.

698 chest wall tumors were resected in 2014 (Table 17). 362 cases (51.9 %) were benign. Among 336 malignant chest wall tumors, 208 cases (61.9 %) were metastatic tumors.

Table 18 denotes surgery for mediastinal tumors. 4685 mediastinal tumors were operated in 2014. There were 2104 thymic epithelial tumors (1773 thymomas, 296 thymic carcinomas, and 35 thymic neuroendocrine carcinoma including carcinoid), followed by 932 congenital cysts, 481 neurogenic tumors, 214 lymphatic tumors, and 122 germ cell tumors.

Thymectomy for myasthenia gravis was done in 495 patients (Table 19). Among them, 307 patients were associated with thymoma, and the remaining 188 patients were not associated with thymoma.

Lung resection for inflammatory lung diseases were done in 2287 patients in 2014 (Table 20). Inflammatory pseudotumor comprised 24.7 % of the entire cases, followed by atypical mycobacterium infection (21.9 %) and fungal infections (15.1 %).

2,608 operations for empyema were reported in 2014 (Table 21). There were 1911 patients (73.3 %) with acute empyema and 698 patients with chronic empyema. Bronchopleural fistula was associated in 469 patients (24.5 %) with acute empyema and 345 patients (49.5 %) with chronic empyema. It should be noted that hospital mortality was as high as 15.1 % in patients of acute empyema with fistula.

Operation for descending necrotizing mediastinitis was done in 103 patients in 2014 (Table 22). Hospital mortality rate was 8.7 %.

Operation for bullous diseases was done in 415 patients in 2014 (Table 23). Lung volume reduction surgery was done in only 28 patients, while emphysematous bulla was the principal target of operation.

14,572 operations for pneumothorax were reported in 2014 (Table 24).

The number of operations for spontaneous pneumothorax was 11,948. Among them, 3410 patients (28.5 %) underwent bullectomy alone, while additional procedure was performed in 7625 patients (63.8 %).

The number of operations for secondary pneumothorax was 2624. COPD was by far the most prevalent associated disease (67.2 %). It should be noted that hospital mortality rate of operation for pneumothorax associated with tumorous disease was as high as 16.7 %.

217 cases of surgery for chest wall deformity were reported in 2014 survey (Table 25). This number might be underestimated compared with the real number of operations, because chest wall deformity is more likely to be

treated in the institutes which are not associated with JATS.

Diaphragmatic hernia was treated by surgery in 55 patients in 2014 (Table 26).

Chest trauma was treated by surgery in 394 patients in 2014 (Table 27).

Table 28 denotes operations for other diseases, including 77 arteriovenous malformations and 104 pulmonary sequestrations.

Table 29 denotes lung transplantation in 2014. A total of 60 lung transplantations were performed in 2014. The number of patients undergoing lung transplantation from brain-dead donors and living-related donors was 40 and 20, respectively. The number of lung transplantation is almost constant these several years, and lung transplantation is still dependent on living-related donors in Japan.

Details of tracheobronchoplasty, pediatric surgery, and combined resection of neighboring organs are denoted in Tables 30, 31, 32, and 33.

Committee for Scientific Affairs in JATS changed the method of surveying general thoracic surgery in 2014. JATS had investigated the number of diseases and

operative procedures based on questionnaires until 2013 surveys, but JATS started to collect the number of procedures in general thoracic surgery using the database in National Clinical Database (NCD) registry. There were some differences in definition in VATS procedure between surveys by JATS before 2013 and that using NCD after 2014. While the length of skin incision in definition of VATS procedure had been less than 8 cm by JATS survey before 2013 following Swanson et al's proposal [1], NCD registry did not limit the length of skin incision in VATS procedures. On the other hand, NCD required the surgeons to choose the approach among complete VATS procedure without thoracotomy, the procedure using both thoracotomy and VATS which includes hybrid approach, and conventional thoracotomy without VATS procedure. It is presumed that hybrid approach was included in VATS procedure as far as the skin incision was shorter than 8 cm in JATS survey before 2013, but this does not seem to apply to survey in 2014 based on NCD registry, suggesting possible inconsistency in comparison between JATS survey before 2013 and NCD 2014 registry. In this report, therefore, analysis with regard to VATS procedure was not conducted.

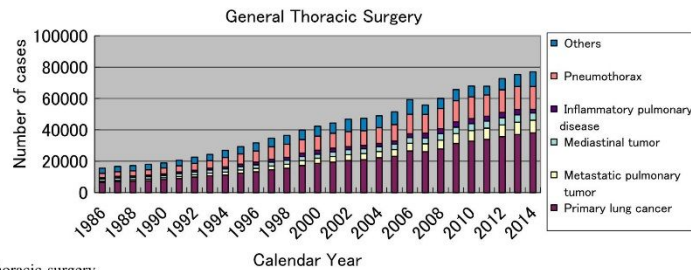


Fig. 2 General thoracic surgery

Table 10 Total entry cases of general thoracic surgery during 2014

| | Cases | % |
|---|--------|-------|
| Benign pulmonary tumor | 2171 | 2.8 |
| Primary lung cancer | 38,085 | 49.4 |
| Other primary malignant pulmonary tumor | 359 | 0.5 |
| Metastatic pulmonary tumor | 8057 | 10.5 |
| Tracheal tumor | 118 | 0.2 |
| Mesothelioma | 673 | 0.9 |
| Chest wall tumor | 698 | 0.9 |
| Mediastinal tumor | 4685 | 6.1 |
| Thymectomy for MG without thymoma | 188 | 0.2 |
| Inflammatory pulmonary disease | 2287 | 3.0 |
| Empyema | 2608 | 3.4 |
| Bullos disease excluding pneumothorax | 415 | 0.5 |
| Pneumothorax | 14,572 | 18.9 |
| Chest wall deformity | 217 | 0.3 |
| Diaphragmatic hernia including traumatic | 55 | 0.1 |
| Chest trauma excluding diaphragmatic hernia | 394 | 0.5 |
| Lung transplantation | 60 | 0.1 |
| Others | 1428 | 1.9 |
| Total | 77,070 | 100.0 |

Table 11

1. Benign pulmonary tumor

| | Cases | 30-day mortality | | Hospital mortality |
|------------------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| Hamartoma | 481 | 0 | 0 | 0 |
| Sclerosing hemangioma | 103 | 0 | 0 | 0 |
| Papilloma | 18 | 0 | 0 | 0 |
| Mucous gland adenoma bronchial | 7 | 0 | 0 | 0 |
| Fibroma | 129 | 0 | 0 | 0 |
| Lipoma | 6 | 0 | 0 | 0 |
| Neurogenic tumor | 17 | 0 | 0 | 0 |
| Clear cell tumor | 2 | 0 | 0 | 0 |
| Leiomyoma | 19 | 0 | 0 | 0 |
| Chondroma | 5 | 0 | 0 | 0 |
| Inflammatory myofibroblastic tumor | 1 | 0 | 0 | 0 |
| Pseudolymphoma | 32 | 0 | 0 | 0 |
| Histiocytosis | 23 | 0 | 0 | 0 |
| Teratoma | 0 | 0 | 0 | 0 |
| Others | 1328 | 2 (0.2) | 1 (0.1) | 6 (0.5) |
| Total | 2171 | 2 (0.1) | 1 (0.05) | 6 (0.3) |

Values in parenthesis represent mortality %

Table 12

2. Primary malignant pulmonary tumor

| | Cases | 30-day mortality | | Hospital mortality |
|---|--------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 2. Primary malignant pulmonary tumor | 38,444 | 104 (0.3) | 59 (0.2) | 269 (0.7) |
| Lung cancer | 38,085 | 103 (0.3) | 59 (0.2) | 266 (0.7) |
| Adenocarcinoma | 26,338 | 33 (0.1) | 23 (0.1) | 82 (0.3) |
| Squamous cell carcinoma | 7367 | 46 (0.6) | 22 (0.3) | 127 (1.7) |
| Large cell carcinoma | 835 | 5 (0.6) | 6 (0.7) | 10 (1.2) |
| (LCNEC) | 462 | 4 (0.9) | 1 (0.2) | 8 (1.7) |
| Small cell carcinoma | 601 | 1 (0.2) | 1 (0.2) | 9 (1.5) |
| Adenosquamous carcinoma | 548 | 7 (1.3) | 0 | 14 (2.6) |
| Carcinoma with pleomorphic, sarcomatoid or sarcomatous elements | 528 | 6 (1.1) | 2 (0.4) | 12 (2.3) |
| Carcinoid | 198 | 0 | 0 | 0 |
| Carcinomas of salivary-gland type | 45 | 0 | 0 | 0 |
| Unclassified | 55 | 2 (3.6) | 0 | 4 (7.3) |
| Multiple lung cancer | 1227 | 1 (0.1) | 3 (0.2) | 6 (0.5) |
| Others | 343 | 2 (0.6) | 2 (0.6) | 2 (0.6) |
| Wedge resection | 5438 | 4 (0.1) | 4 (0.1) | 20 (0.4) |
| Segmental excision | 4143 | 2 (0.05) | 3 (0.1) | 13 (0.3) |
| (Sleeve segmental excision) | 16 | 0 | 0 | 0 |
| Lobectomy | 27,584 | 82 (0.3) | 51 (0.2) | 198 (0.7) |
| (Sleeve lobectomy) | 471 | 5 (1.1) | 7 (1.5) | 10 (2.1) |
| Pneumonectomy | 521 | 8 (1.5) | 0 | 20 (3.8) |
| (Sleeve pneumonectomy) | 13 | 0 | 0 | 1 (7.7) |
| Other bronchoplasty | 46 | 2 (4.3) | 0 | 2 (4.3) |
| Pleuropneumonectomy | 1 | 0 | 0 | 0 |
| Others | 343 | 5 (1.5) | 1 (0.3) | 10 (2.9) |
| Sarcoma | 40 | 0 | 0 | 0 |
| AAH | 126 | 0 | 0 | 0 |
| Others | 193 | 1 (0.5) | 0 | 3 (1.6) |

Values in parenthesis represent mortality %

Table 13 Details of lung cancer operation

| | Cases |
|------------------------------|--------|
| c-Stage (TNM) | |
| Ia | 22,809 |
| Ib | 7213 |
| IIa | 2982 |
| IIb | 1780 |
| IIIa | 2505 |
| IIIb | 204 |
| IV | 481 |
| NA | 111 |
| Total | 38,085 |
| Sex | |
| Male | 23,540 |
| Female | 14,516 |
| NA | 29 |
| Total | 38,085 |
| Cause of death | |
| Cardiovascular | 23 |
| Pneumonia | 47 |
| Pyothorax | 4 |
| Bronchopleural fistula | 16 |
| Respiratory failure | 41 |
| Pulmonary embolism | 11 |
| Interstitial pneumonia | 78 |
| Brain infarction or bleeding | 14 |
| Others | 80 |
| Unknown | 11 |
| Total | 325 |
| p-Stage | |
| 0 (pCR) | 295 |
| Ia | 19,666 |
| Ib | 7601 |
| IIa | 3213 |
| IIb | 2087 |
| IIIa | 3761 |
| IIIb | 179 |
| IV | 1072 |
| NA | 211 |
| Total | 38,085 |

Table 13 continued

| | Cases |
|-------|--------|
| Age | |
| <20 | 85 |
| 20–29 | 33 |
| 30–39 | 219 |
| 40–49 | 1009 |
| 50–59 | 3646 |
| 60–69 | 12,731 |
| 70–79 | 15,765 |
| 80–89 | 4532 |
| ≥90 | 58 |
| NA | 7 |
| Total | 38,085 |

Table 14
3. Metastatic pulmonary tumor

| | Cases | 30-day mortality | | Hospital mortality |
|-------------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 3. Metastatic pulmonary tumor | 8057 | 17 (0.2) | 8 (0.1) | 30 (0.4) |
| Colo-rectal | 3902 | 2 (0.1) | 0 | 5 (0.1) |
| Hepatobiliary/pancreatic | 388 | 2 (0.5) | 0 | 2 (0.5) |
| Uterine | 387 | 0 | 0 | 0 |
| Mammary | 445 | 0 | 0 | 0 |
| Ovarian | 56 | 0 | 0 | 0 |
| Testicular | 84 | 0 | 0 | 0 |
| Renal | 618 | 3 (0.5) | 2 (0.3) | 3 (0.5) |
| Skeletal | 148 | 0 | 1 (0.7) | 0 |
| Soft tissue | 235 | 0 | 1 (0.4) | 2 (0.9) |
| Otorhinolaryngological | 422 | 2 (0.5) | 1 (0.2) | 2 (0.5) |
| Pulmonary | 497 | 8 (1.6) | 1 (0.2) | 11 (2.2) |
| Others | 875 | 0 | 2 (0.2) | 5 (0.6) |

Values in parenthesis represent mortality %

Table 15
4. Tracheal tumor

| | Cases | 30-day mortality | | Hospital mortality |
|--|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 4. Tracheal tumor | 118 | 4 (3.4) | 1 (0.8) | 10 (8.5) |
| (A) Primary malignant tumor (histological classification) | | | | |
| Squamous cell carcinoma | 15 | 0 | 0 | 1 (6.7) |
| Adenoid cystic carcinoma | 9 | 0 | 0 | 0 |
| Mucoepidermoid carcinoma | 2 | 0 | 0 | 0 |
| Others | 10 | 0 | 0 | 0 |
| Total | 36 | 0 | 0 | 1 (2.8) |
| (B) Metastatic/invasive malignant tumor, e.g. invasion of thyroid cancer | 48 | 4 (8.3) | 1 (2.1) | 9 (18.8) |
| (C) Benign tracheal tumor (histological classification) | | | | |
| Papilloma | 0 | 0 | 0 | 0 |
| Adenoma | 3 | 0 | 0 | 0 |
| Neurofibroma | 1 | 0 | 0 | 0 |
| Chondroma | 0 | 0 | 0 | 0 |
| Leiomyoma | 3 | 0 | 0 | 0 |
| Others | 27 | 0 | 0 | 0 |
| Histology unknown | 0 | 0 | 0 | 0 |
| Total | 34 | 0 | 0 | 0 |
| Operation | | | | |
| Sleeve resection with reconstruction | 13 | 0 | 0 | 1 (7.7) |
| Wedge with simple closure | 0 | 0 | 0 | 0 |
| Wedge with patch closure | 0 | 0 | 0 | 0 |
| Total laryngectomy with tracheostomy | 0 | 0 | 0 | 0 |
| Others | 29 | 0 | 0 | 0 |
| Unknown | 0 | 0 | 0 | 0 |
| Total | 42 | 0 | 0 | 1 (2.4) |

Values in parenthesis represent mortality %

Table 16

5. Tumor of pleural origin

| | Cases | 30-day mortality | | Hospital mortality |
|--|------------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| Histological classification | | | | |
| Solitary fibrous tumor | 122 | 0 | 0 | 0 |
| Diffuse malignant pleural mesothelioma | 283 | 3 (1.1) | 0 | 10 (3.5) |
| Localized malignant pleural mesothelioma | 26 | 0 | 0 | 1 (3.8) |
| Others | 242 | 3 (1.2) | 2 (0.8) | 9 (3.7) |
| Total | 673 | 6 (0.9) | 2 (0.3) | 20 (3.0) |
| Operative procedure | | | | |
| Extrapleural pneumonectomy | 70 | 1 (1.4) | 0 | 3 (4.3) |
| Total pleurectomy | 73 | 1 (1.4) | 0 | 3 (4.1) |
| Others | 140 | 1 (0.7) | 0 | 4 (2.9) |
| Total | 283 | 3 (1.1) | 0 | 10 (3.5) |

Values in parenthesis represent mortality %

Table 17

6. Chest wall tumor

| | Cases | 30-day mortality | | Hospital mortality |
|----------------------------|------------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| Primary malignant tumor | 128 | 1 (0.8) | 0 | 5 (3.9) |
| Metastatic malignant tumor | 208 | 0 | 1 (0.5) | 3 (1.4) |
| Benign tumor | 362 | 0 | 0 | 0 |
| Total | 698 | 1 (0.1) | 1 (0.1) | 8 (1.1) |

Values in parenthesis represent mortality %

Table 18

7. Mediastinal tumor

| | Cases | 30-day mortality | | Hospital mortality |
|---|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 7. Mediastinal tumor | 4685 | 5 (0.1) | 2 (0.04) | 17 (0.4) |
| Thymoma* | 1773 | 5 (0.3) | 0 | 9 (0.5) |
| Thymic cancer | 296 | 0 | 0 | 1 (0.3) |
| Thymus carcinoid | 35 | 0 | 0 | 0 |
| Germ cell tumor | 122 | 0 | 0 | 0 |
| <i>Benign</i> | 87 | 0 | 0 | 0 |
| <i>Malignant</i> | 35 | 0 | 0 | 0 |
| Neurogenic tumor | 481 | 0 | 0 | 0 |
| Congenital cyst | 932 | 0 | 1 (0.1) | 5 (0.5) |
| Goiter | 75 | 0 | 0 | 1 (1.3) |
| Lymphatic tumor | 214 | 0 | 0 | 0 |
| Excision of pleural recurrence of thymoma | 43 | 0 | 0 | 0 |
| Thymolipoma | 14 | 0 | 0 | 0 |
| Others | 700 | 0 | 1 (0.1) | 1 (0.1) |

Values in parenthesis represent mortality %

* Includes those with myasthenia gravis

Table 19

8. Thymectomy for myasthenia gravis

| | Cases | 30-day mortality | | Hospital mortality |
|-------------------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 8. Thymectomy for myasthenia gravis | 495 | 1 (0.2) | 0 | 1 (0.2) |
| With thymoma | 307 | 1 (0.3) | 0 | 1 (0.3) |

Values in parenthesis represent mortality %

Table 20
9. Operation for non-neoplastic disease
(A) Inflammatory pulmonary disease

| | Cases | 30-day mortality | | Hospital mortality |
|---|--------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 9. Operation for non-neoplastic disease | 21,976 | 197 (0.9) | 14 (0.1) | 425 (1.9) |
| (A) Inflammatory pulmonary disease | 2287 | 6 (0.3) | 2 (0.1) | 17 (0.7) |
| Tuberculous infection | 73 | 0 | 0 | 0 |
| Mycobacterial infection | 501 | 1 (0.2) | 1 (0.2) | 3 (0.6) |
| Fungal infection | 345 | 1 (0.3) | 1 (0.3) | 6 (1.7) |
| Bronchiectasis | 67 | 0 | 0 | 1 (1.5) |
| Tuberculous nodule | 133 | 0 | 0 | 0 |
| Inflammatory pseudo tumor | 566 | 0 | 0 | 0 |
| Interpulmonary lymph node | 63 | 0 | 0 | 0 |
| Others | 539 | 4 (0.7) | 0 | 7 (1.3) |

Values in parenthesis represent mortality %

Table 21
9. Operation for non-neoplastic disease
(B) Empyema

| | Cases | 30-day mortality | | Hospital mortality |
|-----------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| Acute empyema | 1911 | 52 (2.7) | 3 (0.2) | 126 (6.6) |
| With fistula | 469 | 28 (6.0) | 1 (0.2) | 71 (15.1) |
| Without fistula | 1425 | 23 (1.6) | 2 (0.1) | 52 (3.6) |
| Unknown | 17 | 1 (5.9) | 0 | 3 (17.6) |
| Chronic empyema | 697 | 14 (2.0) | 1 (0.1) | 38 (5.5) |
| With fistula | 345 | 12 (3.5) | 1 (0.3) | 27 (7.8) |
| Without fistula | 328 | 2 (0.6) | 0 | 10 (3.0) |
| Unknown | 24 | 0 | 0 | 1 (4.2) |
| Total | 2608 | 66 (2.5) | 4 (0.2) | 164 (6.3) |

Values in parenthesis represent mortality %

Table 22
9. Operation for non-neoplastic disease
(C) Descending necrotizing mediastinitis

| | Cases | 30-day mortality | | Hospital mortality |
|--|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (C) Descending necrotizing mediastinitis | 103 | 6 (5.8) | 0 | 9 (8.7) |

Values in parenthesis represent mortality %

Table 23
9. Operation for non-neoplastic disease
(D) Bullous disease

| | Cases | 30-day mortality | | Hospital mortality |
|---|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (D) Bullous disease | 415 | 1 (0.2) | 0 | 1 (0.2) |
| Emphysematous bulla | 322 | 1 (0.3) | 0 | 1 (0.3) |
| Bronchogenic cyst | 18 | 0 | 0 | 0 |
| Emphysema with volume reduction surgery | 28 | 0 | 0 | 0 |
| Others | 47 | 0 | 0 | 0 |

Values in parenthesis represent mortality %

LVRS lung volume reduction surgery

Table 24
9. Operation for non-neoplastic disease
(E) Pneumothorax

| | Cases | 30-day mortality | | Hospital mortality |
|---|--------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (E) Pneumothorax | 14,572 | 60 (0.4) | 8 (0.1) | 133 (0.9) |
| <i>Spontaneous pneumothorax</i> | | | | |
| <i>Operative procedure</i> | | | | |
| Bullectomy | 3410 | 3 (0.1) | 0 | 12 (0.4) |
| Bullectomy with additional procedure | 7625 | 2 (0.03) | 1 (0.01) | 7 (0.1) |
| Coverage with artificial material | 7241 | 2 (0.03) | 0 | 6 (0.1) |
| Parietal pleurectomy | 51 | 0 | 0 | 1 (2.0) |
| Coverage and parietal pleurectomy | 92 | 0 | 0 | 0 |
| Others | 241 | 0 | 1 (0.4) | 0 |
| Others | 905 | 8 (0.9) | 0 | 12 (1.3) |
| Unknown | 8 | 0 | 0 | 0 |
| Total | 11,948 | 13 (0.1) | 1 (0.01) | 31 (0.3) |
| <i>Secondary pneumothorax</i> | | | | |
| <i>Associated disease</i> | | | | |
| COPD | 1763 | 18 (1.0) | 2 (0.1) | 51 (2.9) |
| Tumorous disease | 84 | 7 (8.3) | 3 (3.6) | 14 (16.7) |
| Catamenial | 148 | 0 | 0 | 0 |
| LAM | 47 | 0 | 0 | 0 |
| Others (excluding pneumothorax by trauma) | 582 | 22 (3.8) | 2 (0.3) | 37 (6.4) |
| Unknown | | | | |
| <i>Operative procedure</i> | | | | |
| Bullectomy | 372 | 2 (0.5) | 1 (0.3) | 3 (0.8) |
| Bullectomy with additional procedure | 1509 | 16 (1.1) | 2 (0.1) | 37 (2.5) |
| Coverage with artificial material | 1423 | 16 (1.1) | 2 (0.1) | 37 (2.6) |
| Parietal pleurectomy | 9 | 0 | 0 | 0 |
| Coverage and parietal pleurectomy | 18 | 0 | 0 | 0 |
| Others | 59 | 0 | 0 | 0 |
| Others | 735 | 29 (3.9) | 4 (0.5) | 62 (8.4) |
| Unknown | 8 | 0 | 0 | 0 |
| Total | 2624 | 47 (1.8) | 7 (0.3) | 102 (3.9) |

Values in parenthesis represent mortality %

Table 25
9. Operation for non-neoplastic disease
(F) Chest wall deformity

| | Cases | 30-day mortality | | Hospital mortality |
|--------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (F) Chest wall deformity | 217 | 0 | 0 | 0 |
| Funnel chest | 209 | 0 | 0 | 0 |
| Others | 8 | 0 | 0 | 0 |

Table 26
9. Operation for non-neoplastic disease
(G) Diaphragmatic hernia

| | Cases | 30-day mortality | | Hospital mortality |
|--------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (G) Diaphragmatic hernia | 55 | 1 (1.8) | 0 | 1 (1.8) |
| Congenital | 22 | 0 | 0 | 0 |
| Traumatic | 9 | 0 | 0 | 0 |
| Others | 24 | 1 (4.2) | 0 | 1 (4.2) |

Values in parenthesis represent mortality %

Table 27

9. Operation for non-neoplastic disease
(H) Chest trauma
Values in parenthesis represent mortality %

| | Cases | 30-day mortality | | Hospital mortality |
|------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (H) Chest trauma | 394 | 29 (7.4) | 0 | 36 (9.1) |

Table 28

9. Operation for non-neoplastic disease
(I) Other respiratory surgery
Values in parenthesis represent mortality %

| | Cases | 30-day mortality | | Hospital mortality |
|------------------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| (I) Other respiratory surgery | 1325 | 28 (2.1) | 0 | 64 (4.8) |
| Arteriovenous malformation* | 77 | 0 | 0 | 0 |
| Pulmonary sequestration | 104 | 0 | 0 | 0 |
| Postoperative bleeding air leakage | 386 | 11 (2.8) | 0 | 30 (7.8) |
| Chylothorax | 65 | 1 (1.5) | 0 | 2 (3.1) |
| Others | 693 | 16 (2.3) | 0 | 32 (4.6) |

Table 29

10. Lung transplantation
Values in parenthesis represent mortality %

| | Cases | 30-day mortality | | Hospital mortality |
|--|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| Single lung transplantation from brain dead donor | 23 | 0 | 0 | 0 |
| Bilateral lung transplantation from brain dead donor | 17 | 0 | 0 | 0 |
| Lung transplantation from living donor | 20 | 0 | 0 | 2 (10.0) |
| Total of lung transplantation | 60 | 0 | 0 | 2 (3.3) |
| Donor of living donor lung transplantation | 37 | 0 | 0 | 0 |

Table 30

11. Tracheobronchoplasty
Values in parenthesis represent mortality %

| | Cases | 30-day mortality | | Hospital mortality |
|--------------------------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 11. Tracheobronchoplasty | 649 | 9 (1.4) | 7 (1.1) | 16 (2.5) |
| Trachea | 27 | 0 | 0 | 1 (3.7) |
| Sleeve resection with reconstruction | 20 | 0 | 0 | 1 (5.0) |
| Wedge with simple closure | 0 | 0 | 0 | 0 |
| Wedge with patch closure | 0 | 0 | 0 | 0 |
| Total laryngectomy with tracheostomy | 0 | 0 | 0 | 0 |
| Others | 7 | 0 | 0 | 0 |
| Carinal reconstruction | 28 | 2 (7.1) | 0 | 2 (7.1) |
| Sleeve pneumonectomy | 15 | 0 | 0 | 1 (6.7) |
| Sleeve lobectomy | 476 | 5 (1.1) | 7 (1.5) | 10 (2.1) |
| Sleeve segmental excision | 22 | 0 | 0 | 0 |
| Bronchoplasty without lung resection | 13 | 1 (7.7) | 0 | 1 (7.7) |
| Others | 68 | 1 (1.5) | 0 | 1 (1.5) |

Table 31

12. Pediatric surgery
Values in parenthesis represent mortality %

| | Cases | 30-day mortality | | Hospital mortality |
|-----------------------|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 12. Pediatric surgery | 580 | 3 (0.5) | 0 | 7 (1.2) |

Table 32
13. Combined resection of neighboring organ(s)

| Organ resected | Cases | 30-day mortality | | Hospital mortality |
|--|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 13. Combined resection of neighboring organ(s) | 1408 | 7 (0.5) | 3 (0.2) | 25 (1.8) |
| (A) Primary lung cancer (organ resected) | | | | |
| Aorta | 16 | 0 | 0 | 1 (6.3) |
| Superior vena cava | 26 | 0 | 0 | 2 (7.7) |
| Brachiocephalic vein | 13 | 1 (7.7) | 0 | 1 (7.7) |
| Pericardium | 143 | 1 (0.7) | 1 (0.7) | 4 (2.8) |
| Pulmonary artery | 158 | 1 (0.6) | 0 | 2 (1.3) |
| Left atrium | 30 | 0 | 0 | 0 |
| Diaphragm | 51 | 0 | 0 | 0 |
| Chest wall (including ribs) | 360 | 3 (0.8) | 2 (0.6) | 17 (4.7) |
| Vertebra | 16 | 1 (6.3) | 0 | 2 (12.5) |
| Esophagus | 9 | 0 | 0 | 0 |
| Total | 822 | 7 (0.9) | 3 (0.4) | 29 (3.5) |
| (B) Mediastinal tumor (organ resected) | | | | |
| Aorta | 2 | 0 | 0 | 1 (50.0) |
| Superior vena cava | 59 | 0 | 0 | 1 (1.7) |
| Brachiocephalic vein | 89 | 0 | 0 | 0 |
| Pericardium | 340 | 2 (0.6) | 0 | 3 (0.9) |
| Pulmonary artery | 3 | 0 | 0 | 0 |
| Left atrium | 0 | 0 | 0 | 0 |
| Diaphragm | 34 | 0 | 0 | 1 (2.9) |
| Chest wall (including ribs) | 9 | 0 | 0 | 0 |
| Vertebra | 13 | 0 | 0 | 0 |
| Esophagus | 4 | 0 | 0 | 0 |
| Lung | 461 | 0 | 0 | 0 |
| Total | 1014 | 2 (0.2) | 0 | 6 (0.6) |

Values in parenthesis represent mortality %

Table 33
14. Operation of lung cancer invading the chest wall of the apex

| | Cases | 30-day mortality | | Hospital mortality |
|--|-------|------------------|-----------------|--------------------|
| | | Hospital | After discharge | |
| 14. Operation of lung cancer invading the chest wall of the apex | 737 | 2 (0.3) | 5 (0.7) | 15 (2.0) |

Values in parenthesis represent 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 2014 alone, a total of 13,958 patients with esophageal diseases were registered from 601 institutions (response rate: 96.0 %) which affiliated to the Japanese Association for Thoracic Surgery and/or to the Japan Esophageal Society. Among these institutions, those where 20 or more patients underwent esophageal surgeries within the year of 2014 were 133 institutions (22.1 %), which shows no definite shift of esophageal operations to high volume institutions when compared to the data of 2013 (33.3 %) (Table 34) Of 3,956 patients with a benign esophageal disease, 1660 (42.0 %) patients underwent surgery,

and 57 (1.4 %) patients underwent endoscopic resection, while 2239 (56.6 %) patients did not undergo any surgical treatment. (Table 35) Of 10,638 patients with a malignant esophageal tumor, 8135 (76.5 %) patients underwent resection, esophagectomy for 6247 (59.0 %) and endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD) for 1851 (17.5 %), while 2492 (23.5 %) patients did not undergo any resection. (Tables 36, 37) The patients registered, particularly those undergoing ESD or EMR for a malignant esophageal disease, have been increasing since 1990 (Fig. 3).

Among benign esophageal diseases (Table 35), hiatal hernia, esophageal varices, esophagitis (including reflux

esophagitis) and achalasia were the most common conditions in Japan. On the other hand, spontaneous rupture of the esophagus, benign esophageal tumors and congenital esophageal atresia were common diseases which were surgically treated as well as the above-mentioned diseases. The 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 1072 patients with a benign esophageal disease, with 30-day mortality in 14 (1.3 %), while thoracoscopic and/or laparoscopic surgery was performed for 588 patients, with 1(0.2 %) of the 30-day mortality. The difference in these death rates between open and scopic surgery seems to be related the conditions requiring open surgery.

The majority of malignant diseases were carcinomas (Table 36). Among esophageal carcinomas, the incidence of squamous cell carcinoma was 90.5 %, while that of adenocarcinomas including Barrett cancer was 7.1 %. The resection rate for patients with a squamous cell carcinoma was 76.4 %, while that for patients with an adenocarcinoma was 88.3 %.

According to location, cancer in the thoracic esophagus was the most common (Table 37). Of the 3950 patients (37.3 % of total esophageal malignancies) having superficial esophageal cancers within mucosal and submucosal layers, 1892 (47.9 %) patients underwent esophagectomy, while 1848 (46.8 %) patients underwent EMR or ESD. The 30-day mortality rate and hospital mortality rate after esophagectomy for patients with a superficial cancer were 0.5 and 1.2 % respectively. Advanced esophageal cancer invading deeper than the submucosal layer was observed in 6628 (62.6 %) patients. Of the 6628 patients with advanced esophageal cancer, 4344 (65.5 %) underwent esophagectomy, with 0.9 % of the 30-day mortality rate, and with 2.4 % of the hospital mortality rate.

Multiple primary cancers were observed in 1908 (18.0 %) of all the 10,584 patients with esophageal cancer. Synchronous cancer was found in 982 (51.5 %) patients, while metachronous cancer (found before esophageal cancer) was observed in 926 (48.5 %) patients. The

stomach is the commonest site for both synchronous and metachronous malignancy followed by head and neck cancer (Table 37).

Among esophagectomy procedures, transthoracic esophagectomy through right thoracotomy was the most commonly adopted for patients with a superficial cancer as well as for those with an advanced cancer (Table 38). Transhiatal esophagectomy commonly performed in Western countries was adopted in only 2.8 % of patients having a superficial cancer who underwent esophagectomy and in 1.6 % of those having an advanced cancer in Japan. The thoracoscopic and/or laparoscopic esophagectomy were adopted for 1134 patients (59.9 %) with a superficial cancer, and for 1666 patients (38.3 %) with an advanced cancer. The number of cases of thoracoscopic and/or laparoscopic surgery for superficial or advanced cancer has been increasing for these several years (Fig. 4).

Combined resection of the neighboring organs during resection of an esophageal cancer was performed in 330 patients (Tables 38, 39). Resection of the aorta together with the esophagectomy was performed in 2 cases. Tracheal and/or bronchial resection combined with esophagectomy was performed in 24 patients, with the 30-day mortality rate at 0 % and the hospital mortality rate at 4.2 %. Lung resection combined with esophagectomy was performed in 77 patients, with the 30-day mortality rate at 3.9 % and the hospital mortality rate at 7.8 %.

Salvage surgery after definitive (chemo-) radiotherapy was performed in 262 patients, with the 30-day mortality rate at 1.5 % and with the hospital mortality rate at 3.8 % (Table 38).

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

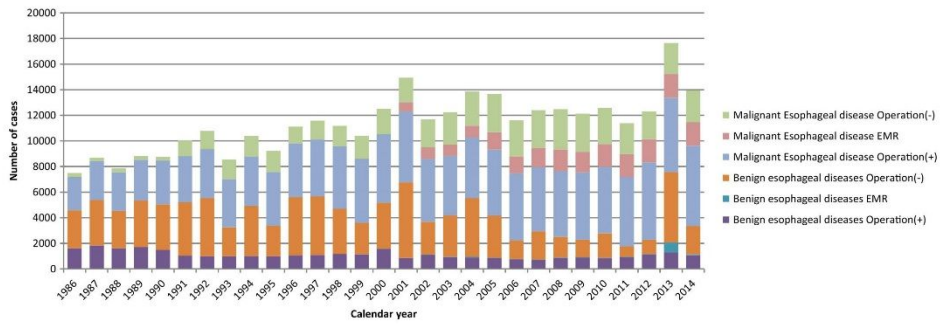


Fig. 3 Annual trend of in-patients with esophageal diseases. *EMR* endoscopic mucosal resection (including endoscopic submucosal)

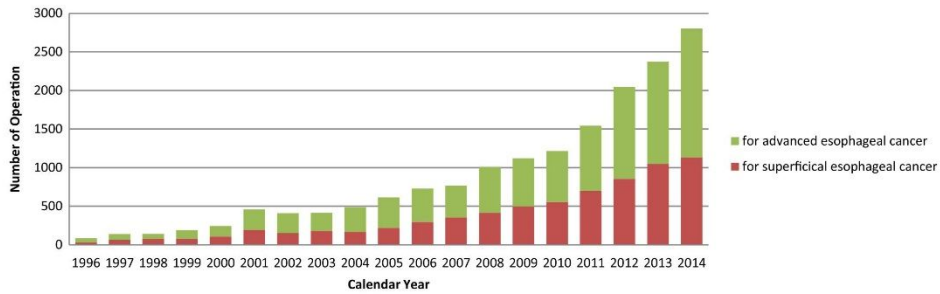


Fig. 4 Annual trend of video-assisted esophagectomy for esophageal malignancy

Table 34 Distribution of number of esophageal operations in 2014 in each institution

| Esophageal surgery | | | |
|------------------------------|----------------------------|------------------------------|--------------------|
| Number of operations in 2014 | Benign esophageal diseases | Malignant esophageal disease | Benign + malignant |
| 0 | 289 | 136 | 98 |
| 1–4 | 245 | 148 | 145 |
| 5–9 | 45 | 120 | 117 |
| 10–19 | 17 | 81 | 108 |
| 20–29 | 3 | 36 | 39 |
| 30–39 | 1 | 23 | 27 |
| 40–49 | 0 | 20 | 25 |
| ≥50 | 1 | 37 | 42 |
| Total | 601 | 601 | 601 |

Table 35 Benign esophageal diseases

| | Operation (+) | | | | | | | | | Endoscopic resection | Operation (–) | Total | |
|---|--------------------|------|-------|--------------------|------------|---|----------|------------|---|----------------------|---------------|-------|-------|
| | Number of patients | | | Hospital mortality | | | | | | | | | |
| | Total | Open | T/L*3 | Open Surgery | | | T/L*3 | | | | | | Total |
| | | | | ~30 days | 31–90 days | Total (including after 91 days mortality) | ~30 days | 31–90 days | Total (including after 91 days mortality) | | | | |
| 1. Achalasia | 338 | 179 | 159 | 1 (0.6) | 0 | 1 (0.6) | 0 | 0 | 0 | 1 (0.3) | 52 | 390 | |
| 2. Benign tumor | 111 | 73 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 43 | 18 | 172 | |
| (1) Leiomyoma | 70 | 43 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 9 | 96 | |
| (2) Cyst | 12 | 7 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | |
| (3) Others | 29 | 23 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 6 | 61 | |
| (4) Not specified | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | |
| 3. Diverticulum | 55 | 39 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 72 | |
| 4. Hiatal hernia | 739 | 423 | 316 | 2 (0.5) | 2 (0.5) | 4 (0.9) | 1 (0.3) | 1 (0.3) | 2 (0.6) | 6 (0.8) | 193 | 932 | |
| 5. Spontaneous rupture of the esophagus | 95 | 87 | 8 | 4 (4.6) | 1 (1.1) | 5 (5.7) | 0 | 0 | 0 | 5 (5.3) | 13 | 108 | |
| 6. Esophago-tracheal fistula | 18 | 17 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 30 | |
| 7. Congenital esophageal atresia | 51 | 47 | 4 | 0 | 1 (2.1) | 1 (2.1) | 0 | 0 | 0 | 1 (2.0) | 1 | 52 | |
| 8. Congenital esophageal stenosis | 10 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 14 | |
| 9. Corrosive stricture of the esophagus | 11 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 21 | |
| 10. Esophagitis, esophageal ulcer | 87 | 61 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1199 | 1286 | |
| 11. Esophageal varices | 70 | 67 | 3 | 2 (3.0) | 0 | 2 (3.0) | 0 | 0 | 0 | 2 (2.9) | 685 | 755 | |
| (1) Laparotomy | 9 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 9 | |
| (2) Sclerotherapy | | | | | | | | | | | 201 | 201 | |
| (3) EVL | | | | | | | | | | | 344 | 344 | |
| 12. Others | 75 | 62 | 13 | 5 (8.1) | 0 | 5 (8.1) | 0 | 0 | 0 | 5 (6.7) | 14 | 124 | |
| Total | 1660 | 1072 | 588 | 14 (1.3) | 4 (0.4) | 18 (1.7) | 1 (0.2) | 1 (0.2) | 2 (0.3) | 20 (1.2) | 57 | 2239 | |

Values in parenthesis represent mortality %

T/L thoracoscopic and/or laparoscopic

Table 36 Malignant esophageal diseases (histologic classification)

| | Resection (+) | Resection (–) | Total |
|--|---------------|---------------|--------|
| Carcinomas | 8100 | 2495 | 10,595 |
| 1. Squamous cell carcinoma | 7233 | 2355 | 9588 |
| 2. Basaloid (-squamous) carcinoma | 79 | 2 | 81 |
| 3. Carcinosarcoma | 43 | 3 | 46 |
| 4. Adenocarcinoma in the Barrett's esophagus | 319 | 21 | 340 |
| 5. Other adenocarcinoma | 350 | 67 | 417 |
| 6. Adenosquamous carcinoma | 22 | 5 | 27 |
| 7. Mucoepidermoid carcinoma | 2 | 0 | 2 |
| 8. Adenoid cystic carcinoma | 1 | 1 | 2 |
| 9. Enderine cell carcinoma | 34 | 24 | 58 |
| 10. Undifferentiated carcinoma | 7 | 4 | 11 |
| 11. Others | 10 | 13 | 23 |
| Other malignancies | 35 | 8 | 43 |
| 1. Malignant non-epithelial tumors | 8 | 2 | 10 |
| 2. Malignant melanoma | 20 | 5 | 25 |
| 3. Other malignant tumors | 7 | 1 | 8 |
| Not specified | 0 | 0 | 0 |
| Total | 8135 | 2503 | 10,638 |

Resection: including endoscopic resection

Table 37 Malignant esophageal disease (clinical characteristics)

| | Operation (+) | | | | EMR or ESD | Operation (-) | Total |
|-----------------------------|---------------|--------------------|------------|---|------------|---------------|--------|
| | Cases | Hospital mortality | | | | | |
| | | ~ 30 days | 31–90 days | Total (including after 91 days mortality) | | | |
| 1. Esophageal cancer | 6247 | 47 (0.8) | 46 (0.7) | 128 (2.0) | 1851 | 2492 | 10,584 |
| Location | | | | | | | |
| (1) Cervical esophagus | 258 | 0 | 1 (0.4) | 3 (1.2) | 76 | 178 | 512 |
| (2) Thoracic esophagus | 5041 | 45 (0.9) | 39 (0.8) | 112 (2.2) | 1501 | 2133 | 8675 |
| (3) Abdominal esophagus | 644 | 2 (0.3) | 3 (0.5) | 7 (1.1) | 100 | 117 | 861 |
| (4) Multiple cancers | 301 | 0 | 3 (1.0) | 6 (2.0) | 174 | 61 | 536 |
| (5) Others/not described | 3 | 0 | 0 | 0 | 0 | 3 | 0 |
| Tumor depth | | | | | | | |
| (A) Superficial cancer (T1) | 1892 | 9 (0.5) | 9 (0.5) | 22 (1.2) | 1848 | 210 | 3950 |
| <i>Mucosal cancer (T1a)</i> | 415 | 0 | 2 (0.5) | 2 (0.5) | 1514 | 49 | 1978 |
| (B) Advanced cancer (T2–T4) | 4344 | 37 (0.9) | 37 (0.9) | 105 (2.4) | 2 | 2282 | 6628 |
| (C) Not specified | 11 | 1 (9.1) | 0 | 1 (9.1) | 1 | 0 | 12 |
| 2. Multiple primary cancers | 1050 | 7 (0.7) | 7 (0.7) | 21 (2.0) | 520 | 338 | 1908 |
| 1) Synchronous | 587 | 4 (0.7) | 2 (0.3) | 10 (1.7) | 210 | 185 | 982 |
| (1) Head and neck | 184 | 0 | 0 | 1 (0.5) | 84 | 59 | 327 |
| (2) Stomach | 226 | 2 (0.9) | 0 | 4 (1.8) | 72 | 65 | 363 |
| (3) Others | 144 | 1 (0.7) | 2 (1.4) | 4 (2.8) | 41 | 42 | 227 |
| (4) Triple cancers | 33 | 1 (3.0) | 0 | 1 (3.0) | 13 | 19 | 65 |
| (5) Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Metachronous | 463 | 3 (0.6) | 5 (1.1) | 11 (2.4) | 310 | 153 | 926 |
| (1) Head and neck | 102 | 0 | 1 (1.0) | 2 (2.0) | 107 | 38 | 247 |
| (2) Stomach | 114 | 2 (1.8) | 1 (0.9) | 3 (2.6) | 75 | 36 | 225 |
| (3) Others | 221 | 1 (0.5) | 2 (0.9) | 5 (2.3) | 86 | 60 | 367 |
| (4) Triple cancers | 26 | 0 | 1 (3.8) | 1 (3.8) | 42 | 19 | 87 |
| (5) Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Unknown | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Values in parenthesis represent mortality %

EMR endoscopic mucosal resection (including endoscopic submucosal dissection)

Table 38 Malignant esophageal disease (surgical procedures)

| | Operation (+) | | | | Thoracoscopic and/or laparoscopic procedure | | | | EMR or ESD |
|--|---------------|--------------------|------------|---|---|--------------------|------------|---|------------|
| | Cases | Hospital mortality | | | Cases | Hospital mortality | | | |
| | | ~ 30 days | 31–90 days | Total (including after 91 days mortality) | | ~ 30 days | 31–90 days | Total (including after 91 days mortality) | |
| Superficial cancer (T1) | 1892 | 9 (0.5) | 9 (0.5) | 22 (1.2) | 1134 | 3 (0.3) | 7 (0.6) | 14 (1.2) | 1848 |
| <i>Mucosal cancer (T1a)</i> | 415 | 0 | 2 (0.5) | 2 (0.5) | 223 | 0 | 0 | 0 | 1514 |
| Esophagectomy | 1892 | 9 (0.5) | 9 (0.5) | 22 (1.2) | 1134 | 3 (0.3) | 7 (0.6) | 14 (1.2) | 1848 |
| (1) Transhiatal esophagectomy | 53 | 1 (1.9) | 1 (1.9) | 2 (3.8) | 4 | 0 | 0 | 0 | |
| (2) Transthoracic (rt.) esophagectomy and reconstruction | 1579 | 5 (0.3) | 8 (0.5) | 17 (1.1) | 1037 | 2 (0.2) | 7 (0.7) | 13 (1.3) | |
| (3) Transthoracic (lt.) esophagectomy and reconstruction | 43 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | |
| (4) Cervical esophageal resection and reconstruction | 35 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | |
| (5) Two-stage operation | 27 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | |
| (6) Others | 155 | 3 (1.9) | 0 | 3 (1.9) | 57 | 1 (1.8) | 0 | 1 (1.8) | |
| (7) Not specified | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Advanced cancer (T2–T4) | | | | | | | | | |
| Esophagectomy | 4344 | 37 (0.9) | 37 (0.9) | 105 (2.4) | 1666 | 11 (0.7) | 11 (0.7) | 32 (1.9) | 2 |
| (1) Transhiatal esophagectomy | 68 | 0 | 1 (1.5) | 1 (1.5) | 7 | 0 | 0 | 0 | |
| (2) Transthoracic (rt.) esophagectomy and reconstruction | 3661 | 31 (0.8) | 26 (0.7) | 78 (2.1) | 1522 | 9 (0.6) | 10 (0.7) | 27 (1.8) | |
| (3) Transthoracic (lt.) esophagectomy and reconstruction | 137 | 1 (0.7) | 2 (1.5) | 3 (2.2) | 14 | 0 | 0 | 0 | |
| (4) Cervical esophageal resection and reconstruction | 171 | 1 (0.6) | 2 (1.2) | 8 (4.7) | 35 | 1 (2.9) | 0 | 2 (5.7) | |
| (5) Two-stage operation | 84 | 1 (1.2) | 1 (1.2) | 4 (4.8) | 25 | 0 | 0 | 0 | |
| (6) Others/not specified | 223 | 3 (1.3) | 5 (2.2) | 11 (4.9) | 63 | 1 (1.6) | 1 (1.6) | 3 (4.8) | |
| (7) Not specified | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| (Depth not specified) | 11 | 1 (9.1) | 0 | 1 (9.1) | 0 | 0 | 0 | 0 | 1 |
| Combined resection of other organs | 330 | 6 (1.8) | 4 (1.2) | 13 (3.9) | | | | | |
| (1) Aorta | 2 | 0 | 0 | 0 | | | | | |
| (2) Trachea, bronchus | 24 | 0 | 0 | 1 (4.2) | | | | | |
| (3) Lung | 77 | 3 (3.9) | 2 (2.6) | 6 (7.8) | | | | | |
| (4) Others | 227 | 3 (1.3) | 2 (0.9) | 6 (2.6) | | | | | |
| Unknown | 0 | 0 | 0 | 0 | | | | | |
| Salvage surgery | 262 | 4 (1.5) | 4 (1.5) | 10 (3.8) | 55 | 0 | 2 (3.6) | 2 (3.6) | 26 |

Values in parenthesis represent mortality %

Table 39 Mortality after combined resection of the neighboring organs

| Year | Esophagectomy | | | Combined resection | | | | | | | | | | | |
|-------|---------------|------|-------|--------------------|---|-------|-----------------|----|-------|------|----|-------|--------|----|-------|
| | | | | Aorta | | | Tracheobronchus | | | Lung | | | Others | | |
| | a | b | c (%) | a | b | c (%) | a | b | c (%) | a | b | c (%) | a | b | c (%) |
| 1996 | 4194 | 120 | 2.86 | 7 | 3 | 42.86 | 24 | 0 | 0.00 | 50 | 2 | 4.00 | 78 | 4 | 5.13 |
| 1997 | 4441 | 127 | 2.86 | 1 | 0 | 0.00 | 34 | 5 | 14.71 | 56 | 1 | 1.79 | 94 | 3 | 3.19 |
| 1998 | 4878 | 136 | 2.79 | 4 | 0 | 0.00 | 29 | 0 | 0.00 | 74 | 1 | 1.35 | 128 | 2 | 1.56 |
| 1999 | 5015 | 116 | 2.31 | 5 | 0 | 0.00 | 23 | 2 | 8.70 | 68 | 0 | 0.00 | 122 | 1 | 0.82 |
| 2000 | 5350 | 81 | 1.51 | 2 | 0 | 0.00 | 23 | 2 | 8.70 | 69 | 0 | 0.00 | 96 | 1 | 1.04 |
| 2001 | 5521 | 110 | 1.99 | 1 | 0 | 0.00 | 26 | 1 | 3.85 | 83 | 3 | 3.61 | 99 | 2 | 2.02 |
| 2002 | 4904 | 66 | 1.35 | 3 | 1 | 33.33 | 20 | 2 | 10.00 | 63 | 0 | 0.00 | 63 | 1 | 1.59 |
| 2003 | 4639 | 45 | 0.97 | 0 | 0 | 0.00 | 24 | 2 | 8.33 | 58 | 0 | 0.00 | 88 | 1 | 1.14 |
| 2004 | 4739 | 64 | 1.35 | 2 | 0 | 0.00 | 17 | 0 | 0.00 | 59 | 5 | 8.47 | 119 | 2 | 1.68 |
| 2005 | 5163 | 52 | 1.01 | 1 | 0 | 0.00 | 11 | 1 | 9.09 | 67 | 1 | 1.49 | 73 | 1 | 1.37 |
| 2006 | 5236 | 63 | 1.20 | 0 | 0 | 0.00 | 17 | 0 | 0.00 | 62 | 2 | 3.23 | 122 | 3 | 2.46 |
| 2007 | 4990 | 60 | 1.20 | 0 | 0 | 0.00 | 25 | 1 | 4.00 | 44 | 1 | 2.27 | 138 | 2 | 1.45 |
| 2008 | 5124 | 63 | 1.23 | 0 | 0 | 0.00 | 17 | 1 | 5.88 | 48 | 1 | 2.08 | 185 | 0 | 0.00 |
| 2009 | 5260 | 63 | 1.20 | 0 | 0 | 0.00 | 19 | 2 | 10.53 | 58 | 2 | 3.45 | 211 | 3 | 1.42 |
| 2010 | 5180 | 45 | 0.87 | 2 | 0 | 0.00 | 33 | 0 | 0.00 | 58 | 0 | 0.00 | 245 | 5 | 2.04 |
| 2011 | 5430 | 38 | 0.70 | 4 | 0 | 0.00 | 26 | 0 | 0.00 | 41 | 0 | 0.00 | 179 | 5 | 2.79 |
| 2012 | 6055 | 47 | 0.78 | 2 | 0 | 0.00 | 23 | 1 | 4.35 | 69 | 0 | 0.00 | 240 | 1 | 0.42 |
| 2013 | 5824 | 41 | 0.70 | 2 | 0 | 0.00 | 44 | 0 | 0.00 | 77 | 1 | 1.30 | 156 | 3 | 1.92 |
| 2014 | 6247 | 47 | 0.75 | 2 | 0 | 0.00 | 24 | 0 | 0.00 | 77 | 3 | 3.90 | 227 | 3 | 1.32 |
| Total | 98,190 | 1384 | 1.41 | 38 | 4 | 10.53 | 273 | 20 | 7.33 | 1181 | 23 | 1.95 | 2663 | 43 | 1.61 |

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

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