**Antimicrobial prophylaxis with ampicillin-sulbactam compared with cefazolin for esophagectomy: Nationwide inpatient database study**

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**Supplemental Appendix 1. Description of the background characteristics**

We examined the patient-related background factors, including sex, age, body mass index classification, smoking index, activities of daily living (Barthel index < 95), comorbidities (Charlson comorbidity index, hypertension, diabetes mellitus, chronic obstructive pulmonary disease, renal failure, and liver disease), corticosteroid use before surgery (defined as the period from the day of admission to the day before surgery), preoperative transfusion (defined as red blood cell transfusion from the day of admission to the day before surgery), and clinical cancer stage. Age was stratified into 5 groups: 18–59, 60–64, 65–69, 70–74, and ≥ 75 years. The body mass index was categorized into 5 groups based on the criteria for Asia-Pacific populations provided by the World Health Organization based on our previous study: < 16.0 kg/m2 (severe underweight), 16.0–18.4 kg/m2 (mild-to-moderate underweight), 18.5–22.9 kg/m2 (normal), 23.0–27.4 kg/m2 (overweight), and ≥ 27.5 kg/m2 (obese).1, 2 The smoking index was categorized into 5 groups: 0–5, 6–20, 21–40, ≥ 41 pack-years, and missing. Comorbidities were scored using the Charlson comorbidity index according to the protocol established by Quan et al. for the ICD-10 codes3 and classified into 3 groups: 2, 3–4, and ≥ 5. The Charlson comorbidity index is a validated method that predicts mortality by classifying and weighting comorbidities and is widely used in national studies worldwide.4, 5 The clinical cancer stage was divided into 3 categories: 0–I, II–IV, and X/missing.

We also investigated the characteristics of cancer treatment, such as preoperative treatment (chemotherapy/radiotherapy), field of lymph node dissection, thoracic approach, vessel reconstruction, epidural anesthesia, prophylactic corticosteroid use, prophylactic neutrophil elastase inhibitor use, duration of anesthesia, and transfusion on the day of surgery. Lymph node dissection was performed using either the 2-field (thoracic and abdominal) or a 3-field (cervical, thoracic, and abdominal, with or without supraclavicular lymph node dissection) approach. The thoracic approach entailed open or minimally invasive (thoracoscopic, mediastinoscopy-assisted, or robot-assisted) esophagectomy. Information on the thoracic approach was not recorded before April 2014. The database did not record whether the abdominal approach was performed using open laparotomy or laparoscopy. Prophylactic corticosteroid use was defined as the administration of intravenous methylprednisolone or hydrocortisone on the day of surgery.6 Prophylactic neutrophil elastase inhibitor use was defined as the administration of a neutrophil elastase inhibitor on the day of surgery. The perioperative use of neutrophil elastase inhibitors has been considered in clinical settings to attenuate lung injury associated with systemic inflammatory response syndrome after esophagectomy.7 The duration of anesthesia was categorized into quartiles.

Additionally, we examined the hospital-related background factors (i.e., type of hospital, hospital volume, and hospitals’ early extubation proportion) and fiscal year. The type of hospital was described as a teaching or non-teaching institution. Hospital volume was defined as the number of esophagectomies performed annually in each hospital and categorized into quartiles. We examined the proportion of patients who underwent early extubation at each hospital during the study period; early extubation was defined as removal of the endotracheal tube on the day of surgery without the need for mechanical ventilation on the day after surgery.8 Hospitals’ early extubation proportion was categorized into four groups with approximately equal numbers of patients in each group.

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**Supplemental Table 1. ICD-10 codes and procedures used to define each postoperative complication**

|  |  |  |
| --- | --- | --- |
|  | **ICD-10 codes** | **Procedures (searched in the original Japanese codes)** |
| Any respiratory complications | J12–18, J80, J96, J690, J691, J958, J959 | Mechanical ventilation use lasting >2 days following surgery |
| Anastomotic leakage | T813 | Long-term drainage tube placement (defined as insertion of a drainage tube for ≥3 weeks after surgery) or procedures for the management of anastomotic leakage |
| Surgical site infection | J853, J860, J869, K65, L021, T813, T814 | Long-term drainage tube placement (defined as insertion of a drainage tube for ≥3 weeks after surgery) or procedures for the management of anastomotic leakage, empyema, or peritonitis |
| *Clostridioides difficile* colitis | A047 |  |
| *Noninfectious complications* |  |  |
| Pneumothorax | J93 | Procedures for the management of pneumothorax |
| Chylothorax | I898, S278, T812 | Procedures for the management of chylothorax |
| Ileus/bowel obstruction/symptomatic hernia (hiatal or diaphragmatic) | K560, K562, K565–567, K913, K440, K441, K449 | Procedures for the management of ileus/bowel obstruction or hiatal/diaphragmatic hernia |
| Pulmonary embolism | I26 | None |
| Acute coronary syndrome | I21–25 | None |
| Heart failure | I50 | None |
| Stroke | I60–66 | None |
| Acute kidney injury | N17 | None |

ICD-10, International Classification of Diseases, Tenth Revision

**Supplemental Table 2.** **Background characteristics of patients before and after overlap weighting**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Before overlap weighting** | | | **After overlap weightinga** | | |
| **CEZ** | **ABPC/SBT** | **ASD** | **CEZ** | **ABPC/SBT** | **ASD** |
| **(*n* = 16,077)** | **(*n* = 1695)** |  | **(*n* = 8886)** | **(*n* = 8886)** |  |
| **Sex,** male | 13,387 (83.3) | 1451 (85.6) | 6.4 | (85.4) | (85.4) | 0.0 |
| **Age,** years |  |  |  |  |  |  |
| 18–59 | 2952 (18.4) | 328 (19.4) | 2.5 | (19.1) | (19.1) | 0.0 |
| 60–64 | 2847 (17.7) | 316 (18.6) | 2.4 | (18.3) | (18.3) | 0.0 |
| 65–69 | 3830 (23.8) | 387 (22.8) | 2.3 | (23.1) | (23.1) | 0.0 |
| 70–74 | 3465 (21.6) | 364 (21005) | 0.2 | (21.6) | (21.6) | 0.0 |
| ≥ 75 | 2983 (18.6) | 300 (17.7) | 2.2 | (18.0) | (18.0) | 0.0 |
| **Body mass index,** kg/m2 |  |  |  |  |  |  |
| <16.0 | 493 (3.1) | 49 (2.9) | 1.0 | (3.0) | (3.0) | 0.0 |
| 16.0–18.4 | 2305 (14.3) | 254 (15.0) | 1.8 | (14.9) | (14.9) | 0.0 |
| 18.5–22.9 | 8423 (52.4) | 852 (50.3) | 4.3 | (50.3) | (50.3) | 0.0 |
| 23.0–27.4 | 4272 (26.6) | 464 (27.4) | 1.8 | (27.4) | (27.4) | 0.0 |
| ≥27.5 | 584 (3.6) | 76 (4.5) | 4.3 | (4.4) | (4.4) | 0.0 |
| **Smoking index**, pack-years |  |  |  |  |  |  |
| 0–5 | 4909 (30.5) | 387 (22.8) | 17.5 | (24.1) | (24.1) | 0.0 |
| 6–20 | 1729 (10.8) | 177 (10.4) | 1.0 | (10.6) | (10.6) | 0.0 |
| 21–40 | 3533 (22.0) | 389 (22.9) | 2.3 | (22.9) | (22.9) | 0.0 |
| ≥41 | 3871 (24.1) | 445 (26.3) | 5.0 | (26.1) | (26.1) | 0.0 |
| Missing | 2035 (12.7) | 297 (17.5) | 13.6 | (16.3) | (16.3) | 0.0 |
| **Barthel index <95** | 525 (3.3) | 30 (1.8) | 9.6 | (1.9) | (1.9) | 0.0 |
| **Comorbidities** |  |  |  |  |  |  |
| Charlson comorbidity index |  |  |  |  |  |  |
| 2 | 12,706 (79.0) | 1330 (78.5) | 1.3 | (78.5) | (78.5) | 0.0 |
| 3–4 | 2273 (14.1) | 255 (15.0) | 2.6 | (15.0) | (15.0) | 0.0 |
| ≥5 | 1101 (6.8) | 110 (6.5) | 1.4 | (6.5) | (6.5) | 0.0 |
| Hypertension | 3587 (22.3) | 406 (24.0) | 3.9 | (23.5) | (23.5) | 0.0 |
| Diabetes mellitus | 2096 (13.0) | 237 (14.0) | 2.8 | (14.0) | (14.0) | 0.0 |
| Chronic obstructive pulmonary disease | 339 (2.1) | 33 (1.9 | 1.1 | (1.9) | (1.9) | 0.0 |
| Renal failure | 142 (0.9) | 13 (0.8) | 1.3 | (0.8) | (0.8) | 0.0 |
| Liver disease | 798 (5.0) | 97 (5.7) | 3.4 | (5.7) | (5.7) | 0.0 |
| **Corticosteroid use before surgery** | 71 (0.4) | 6 (0.4) | 1.4 | (0.4) | (0.4) | 0.0 |
| **Preoperative transfusion** | 248 (1.5) | 28 (1.7) | 0.9 | (1.6) | (1.6) | 0.0 |
| **Clinical stage** |  |  |  |  |  |  |
| 0–I | 5177 (32.2) | 496 (29.3) | 6.4 | (30.1) | (30.1) | 0.0 |
| II–IV | 10,556 (65.7) | 1076 (63.5) | 4.6 | (64.2) | (64.2) | 0.0 |
| Missing | 344 (2.1) | 123 (7.3) | 24.4 | (5.7) | (5.7) | 0.0 |
| **Preoperative treatment** |  |  |  |  |  |  |
| Chemotherapy | 7414 (46.1) | 795 (46.9) | 1.6 | (47.0) | (47.0) | 0.0 |
| Radiotherapy | 1074 (6.7) | 142 (8.4) | 6.4 | (7.9) | (7.9) | 0.0 |
| **Three-field lymph node dissection** | 12,629 (78.6) | 1467 (86.5) | 21.2 | (85.6) | (85.6) | 0.0 |
| **Thoracic approach** |  |  |  |  |  |  |
| Unspecified (to March 2014) | 6223 (38.7) | 685 (40.4) | 3.5 | (39.9) | (39.9) | 0.0 |
| Open | 4237 (26.4) | 429 (25.3) | 2.4 | (25.1) | (25.1) | 0.0 |
| Minimally invasive | 5617 (34.9) | 581 (34.3) | 1.4 | (35.0) | (35.0) | 0.0 |
| **Vessel reconstruction** | 28 (0.2) | 5 (0.3) | 2.5 | (0.3) | (0.3) | 0.0 |
| **Epidural anesthesia** | 13,287 (82.6) | 1312 (77.4) | 13.1 | (78.2) | (78.2) | 0.0 |
| **Prophylactic corticosteroids** | 10,276 (63.9) | 1297 (76.5) | 27.8 | (75.2) | (75.2) | 0.0 |
| **Prophylactic neutrophil elastase inhibitor** | 4175 (26.0) | 364 (21.5) | 10.6 | (22.3) | (22.3) | 0.0 |
| **Duration of anesthesia,** min |  |  |  |  |  |  |
| <499 | 3972 (24.7) | 421 (24.8) | 0.3 | (24.6) | (24.6) | 0.0 |
| 500–590 | 4113 (25.6) | 358 (21.1) | 10.6 | (21.4) | (21.4) | 0.0 |
| 591–689 | 4045 (25.2) | 389 (22.9) | 5.2 | (23.4) | (23.4) | 0.0 |
| ≥690 | 3947 (24.6) | 527 (31.1) | 14.6 | (30.7) | (30.7) | 0.0 |
| **Transfusion on the day of surgery** | 2884 (17.9) | 375 (22.1) | 10.5 | (21.4) | (21.4) | 0.0 |
| **Teaching hospital** | 10,203 (63.5) | 1081 (63.8) | 0.6 | (63.6) | (63.6) | 0.0 |
| **Hospital volume**, cases/year |  |  |  |  |  |  |
| <7.2 | 4025 (25.0) | 391 (23.1) | 4.6 | (24.4) | (24.4) | 0.0 |
| 7.2–19.9 | 3830 (23.8) | 530 (31.3) | 16.7 | (31.4) | (31.4) | 0.0 |
| 20.0–34.7 | 3906 (24.3) | 413 (24.4) | 0.2 | (24.0) | (24.0) | 0.0 |
| ≥34.8 | 4316 (26.8) | 361 (21.3) | 13.0 | (20.3) | (20.3) | 0.0 |
| **Hospitals’ early extubation proportion** |  |  |  |  |  |  |
| <8% | 3804 (23.7) | 256 (15.1) | 21.8 | (16.2) | (16.2) | 0.0 |
| 8–22% | 4161 (25.9) | 636 (37.5) | 25.2 | (36.3) | (36.3) | 0.0 |
| 23–79% | 3848 (23.9) | 594 (35.0) | 24.5 | (33.8) | (33.8) | 0.0 |
| ≥80% | 4264 (26.5) | 209 (12.3) | 36.5 | (13.7) | (13.7) | 0.0 |
| **Fiscal year** |  |  |  |  |  |  |
| 2010–2011 | 2451 (15.2) | 219 (12.9) | 6.7 | (13.6) | (13.6) | 0.0 |
| 2012–2013 | 3772 (23.5) | 466 (27.5) | 9.3 | (26.3) | (26.3) | 0.0 |
| 2014–2015 | 4070 (25.3) | 477 (28.1) | 6.4 | (27.4) | (27.4) | 0.0 |
| 2016–2018 | 5784 (36.0) | 533 (31.4) | 9.6 | (32.7) | (32.7) | 0.0 |

Data are presented as *n* (%).

CEZ, cefazolin; ABPC/SBT, ampicillin-sulbactam; ASD, absolute standardized difference

aAfter overlap weighting, one individual no longer represents one data entity and thus, the raw counts are not reported after overlap weighting.

**Supplemental Table 3.** **Background characteristics of patients after propensity score matching**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Propensity score matching** | | |
| **CEZ** | **ABPC/SBT** | **ASD** |
| **(*n* = 1686)** | **(*n* = 1686)** |  |
| **Sex,** male | 1457 (86.4) | 1442 (85.5) | 2.6 |
| **Age,** years |  |  |  |
| 18–59 | 313 (18.6) | 324 (19.2) | 1.7 |
| 60–64 | 284 (16.8) | 315 (18.7) | 4.8 |
| 65–69 | 403 (23.9) | 386 (22.9) | 2.4 |
| 70–74 | 374 (22.2) | 363 (21.5) | 1.6 |
| ≥ 75 | 312 (18.5) | 298 (17.7) | 2.2 |
| **Body mass index,** kg/m2 |  |  |  |
| <16.0 | 51 (3.0) | 49 (2.9) | 0.7 |
| 16.0–18.4 | 244 (14.5) | 251 (14.9) | 1.2 |
| 18.5–22.9 | 824 (48.9) | 846 (50.2) | 2.6 |
| 23.0–27.4 | 466 (27.6) | 464 (27.5) | 0.3 |
| ≥27.5 | 101 (6.0) | 76 (4.5) | 6.7 |
| **Smoking index**, pack-years |  |  |  |
| 0–5 | 396 (23.5) | 387 (23.0) | 1.3 |
| 6–20 | 189 (11.2) | 177 (10.5) | 2.3 |
| 21–40 | 375 (22.2) | 387 (23.0) | 1.7 |
| ≥41 | 445 (26.4) | 444 (26.3) | 0.1 |
| Missing | 281 (16.7) | 291 (17.3) | 1.6 |
| **Barthel index <95** | 27 (1.6) | 30 (1.8) | 1.4 |
| **Comorbidities** |  |  |  |
| Charlson comorbidity index |  |  |  |
| 2 | 1308 (77.6) | 1325 (78.6) | 2.4 |
| 3–4 | 267 (15.8) | 252 (14.9) | 2.5 |
| ≥5 | 111 (6.6) | 109 (6.5) | 0.5 |
| Hypertension | 412 (24.4) | 403 (23.9) | 1.2 |
| Diabetes mellitus | 223 (13.2) | 236 (14.0) | 2.2 |
| Chronic obstructive pulmonary disease | 36 (2.1) | 33 (2.0) | 1.3 |
| Renal failure | 14 (0.8) | 13 (0.8) | 0.7 |
| Liver disease | 104 (6.2) | 95 (5.6) | 2.3 |
| **Corticosteroid use before surgery** | 5 (0.3) | 6 (0.4) | 1.0 |
| **Preoperative transfusion** | 30 (1.8) | 28 (1.7) | 0.9 |
| **Clinical stage** |  |  |  |
| 0–I | 489 (29.0) | 496 (29.4) | 0.9 |
| II–IV | 1065 (63.2) | 1076 (63.8) | 1.4 |
| Missing | 132 (7.8) | 114 (6.8) | 4.1 |
| **Preoperative treatment** |  |  |  |
| Chemotherapy | 778 (46.1) | 794 (47.1) | 1.9 |
| Radiotherapy | 112 (6.6) | 142 (8.4) | 6.7 |
| **Three-field lymph node dissection** | 14234 (85.1) | 1458 (86.5) | 4.1 |
| **Thoracic approach** |  |  |  |
| Unspecified (to March 2014) | 682 (40.5) | 680 (40.3) | 0.2 |
| Open | 404 (24.0) | 425 (25.2) | 2.9 |
| Minimally invasive | 600 (35.6) | 581 (34.5) | 2.4 |
| **Vessel reconstruction** | 3 (0.2) | 5 (0.3) | 2.4 |
| **Epidural anesthesia** | 1297 (76.9) | 1309 (77.6) | 1.7 |
| **Prophylactic corticosteroids** | 1246 (73.9) | 1288 (76.4) | 5.8 |
| **Prophylactic neutrophil elastase inhibitor** | 369 (21.9) | 364 (21.6) | 0.7 |
| **Duration of anesthesia,** min |  |  |  |
| <499 | 396 (23.5) | 414 (24.6) | 2.5 |
| 500–590 | 355 (21.1) | 357 (21.2) | 0.3 |
| 591–689 | 380 (22.5) | 388 (23.0) | 1.1 |
| ≥690 | 555 (32.9) | 527 (31.3) | 3.6 |
| **Transfusion on the day of surgery** | 354 (21.0) | 373 (22.1) | 2.7 |
| **Teaching hospital** | 1088 (64.5) | 1073 (63.6) | 1.9 |
| **Hospital volume**, cases/year |  |  |  |
| <7.2 | 425 (25.2) | 391 (23.2) | 4.7 |
| 7.2–19.9 | 563 (33.4) | 530 (31.4) | 4.2 |
| 20.0–34.7 | 395 (23.4) | 404 (24.0) | 1.3 |
| ≥34.8 | 303 (18.0) | 361 (21.4) | 8.7 |
| **Hospitals’ early extubation proportion** |  |  |  |
| <8% | 229 (13.6) | 256 (15.2) | 4.6 |
| 8–22% | 638 (37.8) | 627 (37.2) | 1.3 |
| 23–79% | 605 (35.9) | 594 (35.2) | 1.4 |
| ≥80% | 214 (12.7) | 209 (12.4) | 0.9 |
| **Fiscal year** |  |  |  |
| 2010–2011 | 242 (14.4) | 219 (13.0) | 4.0 |
| 2012–2013 | 440 (26.1) | 461 (27.3) | 2.8 |
| 2014–2015 | 471 (27.9) | 473 (28.1) | 0.3 |
| 2016–2018 | 533 (31.6) | 533 (31.6) | 0.0 |

Data are presented as *n* (%).

CEZ, cefazolin; ABPC/SBT, ampicillin-sulbactam; ASD, absolute standardized difference

**Supplemental Table 4.** **Background characteristics of patients before and after overlap weighting using the redefined model (including patients who did not continue CEZ or ABPC/SBT on the day after surgery)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Before overlap weighting** | | | **After overlap weightinga** | | |
| **CEZ** | **ABPC/SBT** | **ASD** | **CEZ** | **ABPC/SBT** | **ASD** |
| **(*n* = 20,424)** | **(*n* = 1934)** |  | **(*n* = 11,179)** | **(*n* = 11,179)** |  |
| **Sex,** male | 16,989 (83.2) | 1639 (84.8) | 4.3 | (84.8) | (84.8) | 0.0 |
| **Age,** years |  |  |  |  |  |  |
| 18–59 | 3796 (18.6) | 366 (18.9) | 0.9 | (18.8) | (18.8) | 0.0 |
| 60–64 | 3576 (17.5) | 353 (18.3) | 1.9 | (18.0) | (18.0) | 0.0 |
| 65–69 | 4877 (23.9) | 443 (22.9) | 2.3 | (23.0) | (23.0) | 0.0 |
| 70–74 | 4386 (21.5) | 418 (21.6) | 0.3 | (21.7) | (21.7) | 0.0 |
| ≥ 75 | 3789 (18.6) | 354 (18.3) | 0.6 | (18.5) | (18.5) | 0.0 |
| **Body mass index,** kg/m2 |  |  |  |  |  |  |
| <16.0 | 641 (3.1) | 54 (2.8) | 2.0 | (2.9) | (2.9) | 0.0 |
| 16.0–18.4 | 2921 (14.3) | 282 (14.6) | 0.8 | (14.7) | (14.7) | 0.0 |
| 18.5–22.9 | 10,690 (52.3) | 978 (50.6) | 3.5 | (50.8) | (50.8) | 0.0 |
| 23.0–27.4 | 5447 (26.7) | 533 (27.6) | 2.0 | (27.4) | (27.4) | 0.0 |
| ≥27.5 | 725 (3.5) | 87 (4.5) | 4.8 | (4.3) | (4.3) | 0.0 |
| **Smoking index**, pack-years |  |  |  |  |  |  |
| 0–5 | 6053 (29.6) | 416 (21.5) | 18.7 | (23.2) | (23.2) | 0.0 |
| 6–20 | 2275 (11.1) | 217 (11.2) | 0.3 | (11.2) | (11.2) | 0.0 |
| 21–40 | 4591 (22.5) | 446 (23.1) | 1.4 | (22.9) | (22.9) | 0.0 |
| ≥41 | 5050 (24.7) | 504 (26.1) | 3.1 | (26.1) | (26.1) | 0.0 |
| Missing | 2455 (12.0) | 351 (18.1) | 17.2 | (16.7) | (16.7) | 0.0 |
| **Barthel index <95** | 754 (3.7) | 35 (1.8) | 11.5 | (2.0) | (2.0) | 0.0 |
| **Comorbidities** |  |  |  |  |  |  |
| Charlson comorbidity index |  |  |  |  |  |  |
| 2 | 16,146 (79.1) | 1527 (79.0) | 0.2 | (78.7) | (78.7) | 0.0 |
| 3–4 | 2858 (14.0) | 290 (15.0) | 2.8 | (15.0) | (15.0) | 0.0 |
| ≥5 | 1420 (7.0) | 117 (6.0) | 3.7 | (6.3) | (6.3) | 0.0 |
| Hypertension | 4662 (22.8) | 450 (23.3) | 1.0 | (22.7) | (22.7) | 0.0 |
| Diabetes mellitus | 2661 (13.0) | 267 (13.8) | 2.3 | (13.9) | (13.9) | 0.0 |
| Chronic obstructive pulmonary disease | 427 (2.1) | 42 (2.2) | 0.6 | (2.1) | (2.1) | 0.0 |
| Renal failure | 184 (0.9) | 16 (0.8) | 0.8 | (0.9) | (0.9) | 0.0 |
| Liver disease | 993 (4.9) | 100 (5.2) | 1.4 | (5.3) | (5.3) | 0.0 |
| **Corticosteroid use before surgery** | 94 (0.5) | 7 (0.4) | 1.5 | (0.4) | (0.4) | 0.0 |
| **Preoperative transfusion** | 346 (1.7) | 33 (1.7) | 0.1 | (1.6) | (1.6) | 0.0 |
| **Clinical stage** |  |  |  |  |  |  |
| 0–I | 6509 (31.9) | 565 (29.2) | 5.8 | (30.0) | (30.0) | 0.0 |
| II–IV | 13,503 (66.1) | 1244 (64.3) | 3.8 | (64.6) | (64.6) | 0.0 |
| Missing | 412 (2.0) | 125 (6.5) | 22.2 | (5.4) | (5.4) | 0.0 |
| **Preoperative treatment** |  |  |  |  |  |  |
| Chemotherapy | 9630 (47.2) | 914 (47.3) | 0.2 | (47.2) | (47.2) | 0.0 |
| Radiotherapy | 1369 (6.7) | 162 (8.4) | 6.3 | (7.5) | (7.5) | 0.0 |
| **Three-field lymph node dissection** | 16,287 (79.7) | 1696 (87.7) | 21.7 | (86.6) | (86.6) | 0.0 |
| **Thoracic approach** |  |  |  |  |  |  |
| Unspecified (to March 2014) | 7478 (36.6) | 717 (37.1) | 1.0 | (23.4) | (23.4) | 0.0 |
| Open | 5353 (26.2) | 440 (22.8) | 8.1 | (39.3) | (39.3) | 0.0 |
| Minimally invasive | 7593 (37.2) | 777 (40.2) | 6.2 | (37.3) | (37.3) | 0.0 |
| **Vessel reconstruction** | 34 (0.2) | 5 (0.3) | 2.0 | (0.3) | (0.3) | 0.0 |
| **Epidural anesthesia** | 16,718 (81.9) | 1496 (77.4) | 11.2 | (78.2) | (78.2) | 0.0 |
| **Prophylactic corticosteroids** | 12,445 (60.9) | 1508 (78.0) | 37.6 | (75.8) | (75.8) | 0.0 |
| **Prophylactic neutrophil elastase inhibitor** | 4873 (23.9) | 416 (21.5) | 5.6 | (22.9) | (22.9) | 0.0 |
| **Duration of anesthesia,** min |  |  |  |  |  |  |
| <502 | 5139 (25.2) | 447 (23.1) | 4.8 | (23.8) | (23.8) | 0.0 |
| 502–592 | 5158 (25.3) | 384 (19.9) | 12.9 | (20.6) | (20.6) | 0.0 |
| 593–692 | 5177 (25.3) | 453 (23.4) | 4.5 | (23.7) | (23.7) | 0.0 |
| ≥693 | 4950 (24.2) | 650 (33.6) | 20.8 | (31.9) | (31.9) | 0.0 |
| **Transfusion on the day of surgery** | 3502 (17.1) | 404 (20.9) | 9.5 | (20.3) | (20.3) | 0.0 |
| **Teaching hospital** | 12,461 (61.0) | 1210 (62.6) | 3.2 | (62.7) | (62.7) | 0.0 |
| **Hospital volume**, cases/year |  |  |  |  |  |  |
| <7.9 | 5109 (25.0) | 433 (22.4) | 6.2 | (24.4) | (24.4) | 0.0 |
| 7.9–19.9 | 5008 (24.5) | 535 (27.7) | 7.2 | (29.2) | (29.2) | 0.0 |
| 20.0–39.0 | 5190 (25.4) | 424 (21.9) | 8.2 | (22.5) | (22.5) | 0.0 |
| ≥39.1 | 5117 (25.1) | 542 (28.0) | 6.7 | (23.8) | (23.8) | 0.0 |
| **Hospitals’ early extubation proportion** |  |  |  |  |  |  |
| <8% | 5211 (25.5) | 300 (15.5) | 25.0 | (17.4) | (17.4) | 0.0 |
| 8–29% | 4906 (24.0) | 696 (36.0) | 26.3 | (36.2) | (36.2) | 0.0 |
| 30–82% | 4899 (24.0) | 748 (38.7) | 32.1 | (35.0) | (35.0) | 0.0 |
| ≥83% | 5408 (26.5) | 190 (9.8) | 44.3 | (11.4) | (11.4) | 0.0 |
| **Fiscal year** |  |  |  |  |  |  |
| 2010–2011 | 2977 (14.6) | 232 (12.0) | 7.6 | (13.0) | (13.0) | 0.0 |
| 2012–2013 | 4501 (22.0) | 485 (25.1) | 7.2 | (24.2) | (24.2) | 0.0 |
| 2014–2015 | 5205 (25.5) | 525 (27.1) | 3.8 | (26.4) | (26.4) | 0.0 |
| 2016–2018 | 7741 (37.9) | 692 (35.8) | 4.4 | (36.3) | (36.3) | 0.0 |

Data are presented as *n* (%).

CEZ, cefazolin; ABPC/SBT, ampicillin-sulbactam; ASD, absolute standardized difference

aAfter overlap weighting, one individual no longer represents one data entity and thus, the raw counts are not reported after overlap weighting.