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## Major article

## Effectiveness of an outpatient preoperative care bundle in preventing postoperative pneumonia among esophageal cancer patients

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## Key Words:

Care bundle  
Postoperative pneumonia  
Esophageal cancer  
Preoperative nursing**Background:** This historical case-control study examined the effectiveness of an outpatient preoperative care bundle on the incidence of postoperative pneumonia among patients with esophageal cancer.**Methods:** We implemented a preoperative care bundle that comprised 7 care procedures that previous studies had suggested to be effective for decreasing postoperative respiratory complications, infections, postoperative hospital stay, and mortality. The care bundle group included patients who underwent surgery after the care bundle was implemented, whereas the control group included those who underwent surgery before its implementation.**Results:** The incidence of postoperative pneumonia was 3.8% in the care bundle group (1/26) and 22.4% in the control group (48/214). A logistic regression model showed that implementation of the care bundle had a significant effect on prevention of postoperative pneumonia (odds ratio, 0.16; 95% confidence interval: 0.01-0.94) after controlling the following confounding factors: sex, blood urea nitrogen, amount of blood loss, recurrent laryngeal nerve palsy, and preoperative hospital stay.**Conclusion:** Implementation of the procedures of the preoperative care bundle was shown to be effective for preventing postoperative pneumonia in patients with esophageal cancer.

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In Japan, the annual incidence of esophageal cancer exceeds 17,000.<sup>1</sup> The incidence of elderly people among patients with esophageal cancer is increasing along with the aging of the population.<sup>2</sup> Patients aged >65 years account for more than 50% of patients.<sup>1</sup> Men account for 80%, and smoking rate of patients is high. Histologically, ≥90% of esophageal tumors are squamous cell carcinomas, and midthoracic esophageal cancer accounts for 50% of patients in Japan.<sup>3</sup> In Europe and the United States, there are more patients of adenocarcinoma in the lower thoracic esophagus and at the gastroesophageal junction.<sup>4</sup> Although the major operative procedure in the West is transhiatal esophagectomy without lymph node dissection,<sup>5</sup> thoracoabdominal esophagectomy with lymph

node dissection is commonly performed in Japan.<sup>6</sup> Because lymph node metastasis spreads from the chest and abdomen to the neck in patients of thoracic esophageal cancer, operative procedures for these tumors involve extensive lymph node dissection and are highly invasive consequently.<sup>6</sup> Therefore, the incidence of postoperative complications and postoperative hospital mortality is higher in esophageal cancer surgery than in surgeries for other gastrointestinal cancers.<sup>7</sup>

Postoperative pneumonia is a serious complication because it is associated with mortality. The mortality in patients with postoperative pneumonia is high at 20%, but this complication also affects the prognosis of patients.<sup>8</sup> It has been reported that many patients who die of sepsis after discharge have postoperative pneumonia.<sup>9</sup> Thus, postoperative pneumonia in patients with esophageal cancer is an important surgery-related morbidity that should be prevented. Breathing exercises,<sup>10</sup> oral care,<sup>11</sup> nutritional control,<sup>12</sup> and smoking cessation have been suggested as effective

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**Table 1**  
Procedures of the care bundle

Procedure	Details of procedure
1. Deep breathing	Abdominal deep breathing in the orthopneic or spine position for 3 minutes twice a day
2. Exercises using the breathing exercise device*	5-10 Reps of the 3-second exercise 1-2 times a day at the set value. <sup>†</sup> Increase the set value by 1 point, at each session, as needed
3. Respiratory muscle-stretching gymnastic exercises <sup>‡</sup>	5-10 Sessions of a performable type of stretching gymnastic exercises at least once a day
4. Professional oral cleaning	Professional oral cleaning from a dental hygienist prior to surgery
5. Clean the teeth and tongue	Brush the teeth and clean the tongue for 5 minutes at least once a day
6. Eat proper amounts of food	Eat meals satisfying the total energy expenditure (TEE) <sup>§</sup> everyday
7. Quit smoking	Quit smoking immediately

TEE, total energy expenditure.

\*InspiRx, developed by C.R. Bard, Inc, was used as the breathing exercise device.

<sup>†</sup>The set value was the inhalation volume not resulting in forced breathing.

<sup>‡</sup>"Respiratory Muscle-Stretching Gymnastics Lesson," prepared by Environmental Restoration and Conservation Agency of Japan, was used for respiratory muscle stretching gymnastics exercises.

<sup>§</sup>"TEE" is multiplied by the basal energy expenditure, activity factor, and stress factors.

preventive measures against postoperative pulmonary complications in patients with esophageal cancer.<sup>13</sup> However, there are no reports demonstrating that these measures significantly decrease postoperative pneumonia in patients with esophageal cancer.

Care bundles have recently come into widespread use and are expected to provide greater effects by allowing the performance of 3 to 5 types of evidence-based care simultaneously rather than a single type of care.<sup>14</sup> In earlier studies, care bundles were shown to reduce the incidence of health care-associated infection<sup>15</sup> and were also associated with decreases in mortality, length of hospital stay, and medical costs.<sup>16</sup> However, the reported care bundles for the prevention of pneumonia have been designed to prevent ventilator-associated pneumonia.<sup>17</sup> It has been suggested that a care bundle for the prevention of postoperative pneumonia may have a significant effect on overall outcomes,<sup>18</sup> but the content of such a bundle has not been studied. This study aimed to elucidate the effects of a preoperative care bundle in the outpatient clinic on the prevention of postoperative pneumonia in patients undergoing surgery for esophageal cancer.

## METHODS

### Subjects and design

This historical case-control study included 268 patients who underwent subtotal esophagectomy between February 2007 and August 2009 at the cancer hospital, which performs the largest number of cancer surgeries in Japan. The care bundle group included patients who underwent surgery after the introduction of the preoperative care bundle in February 2009, whereas the control group included those who underwent surgery before the its introduction. The exclusion criteria for subjects were as follows: preoperative intravenous or enteral nutrition, preoperative complications specific to esophageal cancer (eg, esophageal stricture or esophagobronchial fistula), preoperative pneumonia, postoperative complications occurring before pneumonia onset, reoperation, delayed emergence from anesthesia, postoperative mechanical ventilation, and refusal of consent to join the care bundle group.

A total of 28 patients who met the exclusion criteria was excluded. Six patients were excluded from the care bundle group because of preoperative esophagobronchial fistula (2 patients), reoperation (2 patients), postoperative mechanical ventilation after pyothorax (1 patient), or refusal of consent (1 patient). Twenty-two patients were excluded from the control group because of preoperative intravenous or enteral nutrition (16 patients), preoperative pneumonia (1 patient), preoperative deep venous thrombosis (1 patient), reoperation because of chylothorax (1 patient), postoperative mechanical ventilation because of delayed emergence from anesthesia (2 patients), or mechanical ventilation after

pyothorax (1 patient). This study was approved by the concerned Institutional Review Board.

### Assessment factors

The assessment factors were the patient characteristics and treatment factors that had been suggested to be associated with postoperative pneumonia in earlier studies. In total, there were 33 assessment factors. The patient characteristics included age, sex, tumor staging, comorbidities (chronic respiratory disease, diabetes mellitus, cerebrovascular disorder, and other diseases), activities of daily living, results of blood tests (serum albumin, serum hemoglobin, and blood urea nitrogen [BUN]) and pulmonary function tests (forced expiratory volume in 1 second and percent vital capacity), smoking history, Brinkman index, prognostic nutritional index, body mass index, and the Physical Status Classification System of the American Society of Anesthesiologists. The preoperative treatment factors included type of admitted department before surgery, preoperative treatment (chemotherapy or chemoradiotherapy), duration of waiting for hospitalization, and length of preoperative hospital stay. The surgical factors included operative approach, reconstruction route, organ for reconstruction, fields of lymphadenectomy, operative time, blood loss, intraoperative steroid use, and postoperative recurrent laryngeal nerve palsy.

### Care bundle

The preoperative care bundle consisted of 7 care procedures, including 3 procedures of breathing exercise, 2 procedures of oral care, a procedure of nutritional control and smoking cessation, which were suggested in previous studies to be effective for decreasing postoperative respiratory complications, infections, postoperative hospital stay, and mortality (Table 1).

After assessment of the patients' condition, infection control nurses individually instructed patients of the care bundle group on the contents of the care bundle. These instructions were given in a session lasting 30 to 60 minutes at the outpatient unit. The patients performed the 7 care procedures of the care bundle from the day of individual instruction until the day of admission and kept a performance record.

### Definition of postoperative pneumonia

The criteria for the diagnosis of postoperative pneumonia were based on the definition of pneumonia developed by the Centers for Disease Control and Prevention.<sup>19</sup> The follow-up period was 30 days after surgery. The date of the occurrence of postoperative pneumonia and bacteria detected from airway secretions aseptically collected by bronchoscope were assessed.

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