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## Effects of additional laparoscopic cholecystectomy on outcomes of laparoscopic gastrectomy in patients with gastric cancer based on a national administrative database

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### ABSTRACT

**Background:** Little information is available on the effects of adding laparoscopic cholecystectomy to laparoscopic gastrectomy on outcomes of patients with gastric cancer. The aim of this study is to investigate the effects of adding laparoscopic cholecystectomy to laparoscopic gastrectomy on outcomes in patients with gastric cancer using a national administrative database.

**Methods:** A total of 14,006 patients treated with laparoscopic gastrectomy for gastric cancer were referred to 744 hospitals in Japan between 2009 and 2011. Patients were divided into two groups, those who also underwent simultaneous laparoscopic cholecystectomy for gallbladder stones ( $n = 1484$ ) and those who underwent laparoscopic gastrectomy alone ( $n = 12,522$ ). Laparoscopy-related complications, in-hospital mortality, length of stay, and medical costs during hospitalization were compared in the patient groups.

**Results:** Multiple logistic regression analysis revealed that adding laparoscopic cholecystectomy did not affect laparoscopy-related complications (odds ratio, 1.02; 95% confidence interval [CI], 0.84–1.24;  $P = 0.788$ ) or in-hospital mortality (odds ratio, 1.16; 95% CI, 0.49–2.76;  $P = 0.727$ ). Multiple linear regression analysis also showed that adding laparoscopic cholecystectomy did not affect the length of stay (unstandardized coefficient, 0.37 d; 95% CI, –0.47 to 1.22 d;  $P = 0.389$ ). However, adding laparoscopic cholecystectomy was associated with significantly increased medical costs during hospitalization (unstandardized coefficient, \$1256.0 (95% CI, \$806.2–\$1705.9;  $P < 0.001$ ).

**Conclusions:** This study demonstrated that adding laparoscopic cholecystectomy did not affect outcomes of patients undergoing laparoscopic gastrectomy for gastric cancer, although medical costs during hospitalization were significantly increased.

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## 1. Introduction

Gastric cancer is one of the leading causes of cancer deaths in the world [1,2]. Although its incidence has declined, gastric cancer still represents a tremendous health care burden in Japan [3]. According to vital statistics released by the Ministry of Health, Labour and Welfare in Japan, approximately 50,000 Japanese people die from gastric cancer annually, representing approximately 15% of annual cancer-related deaths over the past four decades [3,4]. Although early gastric cancers can be resected endoscopically, by endoscopic mucosal resection or endoscopic submucosal dissection, the number of patients requiring surgical resection for gastric cancer still remains high in Japan [5].

Recent advances in surgical techniques have enabled more effective and safe operations for gastric cancer. Laparoscopic gastrectomy is less invasive than open gastrectomy, with lower morbidity and mortality rates [6–8]. In addition, this procedure decreases the length of hospitalization and medical costs [9,10]. Laparoscopic gastrectomy has become widely accepted for treating gastric cancer, with the number of patients undergoing this procedure increasing in Japan and other developed countries [11,12].

The incidence of gallbladder stones has been reported to be higher in patients who have undergone gastrectomy than in the general population, with 15%–25% of patients having gallbladder stones within 5 y of a gastrectomy [13,14]. The increased incidence of gallbladder stones is thought to be related to surgical dissection of the vagus nerve branches and anatomic gastrointestinal reconstruction [13,14]. Simultaneous laparoscopic gastrectomy and cholecystectomy have therefore been recommended in patients with both gastric cancer and gallbladder stones [15,16].

However, little information is available on the effects of adding laparoscopic cholecystectomy to laparoscopic gastrectomy on outcomes of patients with gastric cancer. In addition, there have been no reports whether adding laparoscopic cholecystectomy may influence on medical costs of patients with laparoscopic gastrectomy. Clarification of the effect of adding laparoscopic cholecystectomy could contribute to studies of quality management of medical care for patients with gastric cancer. This, in turn, may have significant implications for health care policy decision making. We therefore used data from a national administrative database, developed in the Japanese case-mix system project and called the Diagnosis Procedure Combination (DPC), to analyze the effects of adding laparoscopic cholecystectomy on outcomes in patients undergoing laparoscopic gastrectomy for gastric cancer.

## 2. Methods

### 2.1. The DPC system and database

The health care system of Japan has severe financial problems because of the expenses of new medical technologies, the rapidly aging society, and extended patient hospitalizations [17]. To address these issues, the Ministry of Health, Labour

and Welfare of Japan and its affiliated research institute have begun investigating whether the Japanese case-mix classification system can be used to standardize medical profiling and payment [18]. Because of this, Japanese case-mix projects based on the DPC system were introduced to 82 academic hospitals (the National Cancer Center, the National Cardiovascular Center, and 80 university hospitals) in 2003 [19,20]. Reimbursement from health insurance using the DPC system is common practice in Japan. According to the administrative database of the DPC system, the number of acute care hospitals has increased. Data on inpatients are collected annually, with the DPC system currently covering approximately 90% of the total acute care inpatient hospitalizations [17–20].

Each patient's financial data, claim information, and discharge summary, including principal diagnosis, complications, and comorbidities during hospitalization, are recorded in the administrative database of the DPC system. These data are coded using International Classification of Diseases, 10th Revision (ICD-10) codes. Additionally, this administrative database also contains comprehensive medical information, including all interventional and surgical procedures, medications, and devices that have been indexed in the original Japanese code assigned by the Ministry of Health, Labour and Welfare of Japan [17–20]. The date and amount of care delivered each day are also recorded in the DPC administrative database [17–20].

### 2.2. Study setting

We selected 14,006 patients who underwent laparoscopic gastrectomy for gastric cancer in 744 hospitals participating in the DPC between 2009 and 2011. These hospitals are dispersed throughout Japan and play leading roles in providing acute care medicine, advancing medical research, and educating students and medical residents [17–20]. Using the data on diseases and surgical procedures in the administrative database, patients were categorized into two groups, based on whether they also underwent simultaneous laparoscopic cholecystectomy for gallbladder stones: patients who underwent laparoscopic gastrectomy and cholecystectomy ( $n = 1484$ ) and patients who underwent laparoscopic gastrectomy alone ( $n = 12,522$ ).

The use of DPC data was permitted by all institutions and hospitals that provided detailed data. The research protocol of the study was approved by the ethics committee of medical care and research of the University of Occupational and Environmental Health, Kitakyushu, Japan.

### 2.3. Study variables

Patient characteristics included the location of the gastric cancer, type of gastrectomy, age, sex, presence of chronic comorbid conditions, laparoscopy-related complications, in-hospital mortality, length of stay (LOS), and medical costs during hospitalization. Hospital characteristics included hospital type, size, and region.

The location of gastric cancer was defined by ICD-10 codes: C16.0 (cardia), C16.1 (fundus), C16.2 (body), C16.3 (antrum), C16.4 (pylorus), and C16.5, C16.6, C16.8, and C16.9

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