



ORIGINAL ARTICLE

# Influence of hospital volume on outcomes of laparoscopic gastrectomy for gastric cancer in patients with comorbidity in Japan



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## KEYWORDS

comorbidity;  
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outcomes

**Summary Objective:** Little information is available on the relationship between hospital volume and the outcomes of laparoscopic gastrectomy for gastric cancer in patients with comorbidity. This study aimed to investigate the influence of hospital volume on patient outcomes of laparoscopic gastrectomy for gastric cancer in patients with comorbidity using a national administrative database.

**Methods:** A total of 5941 comorbid patients treated with laparoscopic gastrectomy for gastric cancer were referred to 741 hospitals in Japan. We collected patients' data from the administrative database to compare laparoscopy-related complications, in-hospital mortality, length of stay (LOS), and medical costs during hospitalization in relation to hospital volume. Hospital volume was categorized into two groups: low (<40 cases in 3 years;  $n = 4111$ ) and high ( $\geq 40$  cases;  $n = 1830$ ).

**Results:** There were no significant differences between the groups in laparoscopy-related complications and in-hospital mortality ( $p = 0.684$  and  $p = 0.200$ , respectively). However, significant variations in mean LOS and medical costs were observed between hospital volume categories (26.1 days vs. 20.2 days and 16,163.9 US dollars vs. 14,345.9 US dollars, respectively;  $p < 0.001$ ). Multiple linear regressions revealed that higher hospital volume was significantly associated with shorter LOS and lower medical costs during hospitalization. The unstandardized coefficient for LOS was  $-4.62$  days (95% confidence interval =  $-5.63$ – $-3.60$ ,  $p < 0.001$ ), whereas that for medical costs was  $-1424.1$  US dollars (95% confidence interval =  $-1962.5$ – $-885.6$ ,  $p < 0.001$ ).

Conflicts of interest: All authors have no conflicts of interest to declare.

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*Conclusion:* Hospital volume was significantly associated with a decrease of LOS and medical costs of comorbid patients undergoing laparoscopic gastrectomy for gastric cancer.

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## 1. Introduction

Gastric cancer is one of the leading causes of cancer death in the world.<sup>1,2</sup> According to the vital statistics released by the Ministry of Health, Welfare, and Labour in Japan, approximately 50,000 Japanese people die from gastric cancer annually, representing approximately 15% of annual cancer-related deaths over the past 4 decades.<sup>3</sup> Recently, endoscopic resection, such as endoscopic mucosal resection or endoscopic submucosal dissection, has been frequently performed because of the early detection or diagnosis of gastric cancer.<sup>4</sup> However, the number of surgical resections for gastric cancer remains high in Japan.<sup>5</sup>

Recent advances in surgical techniques have enabled more effective and safe operations for gastric cancer. Laparoscopic gastrectomy is a less-invasive operation for gastric cancer compared with open gastrectomy, and some previous reports suggest that laparoscopic gastrectomy can be performed safely with lower morbidity and mortality.<sup>6–8</sup> In addition, this procedure has a favorable effect with regard to the length of hospitalization and the medical costs of patients.<sup>9,10</sup> Currently, laparoscopic gastrectomy is a widely accepted procedure for treating gastric cancer, and the number of patients undergoing laparoscopic gastrectomy has been increasing in Japan.<sup>11</sup>

Since Luft et al<sup>12</sup> reported a correlation between hospital volume and patient outcomes, health policy measures advocating high hospital volume have been predicated on the overwhelming empirical evidence of the hospital volume–outcome relationship. Many studies, especially over the past decade, have shown significant associations between the volume of hospital services provided and patient outcomes, particularly for a wide variety of surgical procedures.<sup>13,14</sup> Although the reasons for such relationships have not been fully explained, these results suggest that hospital volume is a significant independent indicator of patient outcome.

However, little information is available on the relationship between hospital volume and patient outcomes of laparoscopic gastrectomy for gastric cancer. In addition, there have been no reports that have focused on the volume effect for outcomes of patients with comorbidity. Clarification of the relationship between hospital volume and the outcomes of laparoscopic gastrectomy in patients with comorbidity could contribute to studies of the quality of patient medical care, which could in turn have significant implications for health care policy decision making.

In this study, we investigated the influence of hospital volume on outcomes of laparoscopic gastrectomy for gastric cancer in patients with comorbidity. This was achieved using the national administrative database developed in the Japanese case-mix system project named the Diagnosis Procedure Combination (DPC) system, which is a

unique insurance reimbursement scheme for incentive payments.

## 2. Materials and methods

### 2.1. DPC system and database

The health care system of Japan has severe financial problems because of the expense of new medical technology, a rapidly aging society, and extended patient hospitalizations.<sup>15,16</sup> To address these issues, the Ministry of Health, Labour, and Welfare and its affiliated research institute have begun investigating whether the Japanese case-mix classification system can be used to standardize medical profiling and payment.<sup>13–16</sup> As a result, Japanese case-mix projects based on the DPC system were introduced to 82 academic hospitals (National Cancer Center, National Cardiovascular Center, and 80 university hospitals) in 2003.<sup>13–16</sup> 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. Enormous amounts of inpatient data have been collected annually, covering approximately 90% of the total acute care inpatient hospitalizations.<sup>13–16</sup>

Each patient's financial data, claim information, and discharge summary, which includes principal diagnosis, comorbidity at the time of admission, and complications during hospitalization, are recorded in the administrative database of the DPC system. These data are coded using the International Classification of Diseases and Injuries, 10<sup>th</sup> Revision (ICD-10) code. Additionally, this administrative database also contains comprehensive medical information, including all interventional or surgical procedures, medications, and devices that have been indexed in the original Japanese code. The Ministry of Health, Labour, and Welfare of Japan assigns these codes.<sup>13–16</sup> The date and amount of care delivered each day are also recorded in the DPC administrative database.<sup>13–16</sup>

### 2.2. Study setting

We selected 12,522 patients treated with laparoscopic gastrectomy for gastric cancer at 741 DPC participation hospitals (83 academic and 658 community hospitals) between 2009 and 2011 in Japan. The hospitals involved are dispersed throughout Japan and play leading roles in providing acute care medicine, advancing medical research, and educating students and medical residents.

We calculated the number of laparoscopic gastrectomies performed for gastric cancer in each hospital, and hospital volume was expressed as the number of cases during the

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