International Journal of Gerontology 10 (2016) 6–10

Contents lists available at ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Original Article

Association between Hospital Volume and Outcomes of Elderly Patients with Hemorrhagic Peptic Ulcer in Japan: An Observational Study☆

Atsuhiko Murata*, Makoto Ohtani, Keiji Muramatsu, Shinya Matsuda

Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health, Kitakyushu, Fukuoka, Japan

ARTICLE INFO

Article history:
Received 7 May 2015
Received in revised form
19 November 2015
Accepted 24 November 2015
Available online 26 February 2016

Keywords:
elderly patient,
hemorrhagic peptic ulcer,
hospital volume,
national administrative database,
outcome

SUMMARY

Background: Little information is available on the relationship between case volume and the outcomes of elderly patients with bleeding peptic ulcers. This study investigated the effect of case volume on the outcomes of elderly patients with bleeding peptic ulcers, based on a national administrative database.
Methods: In total, 14,569 elderly patients (i.e., ≥ 80 years old) treated by endoscopic hemostasis for bleeding peptic ulcers were referred to 1073 hospitals from 2010 to 2012 in Japan. We compared in-hospital mortality (30-day and overall), length of hospital stay (LOS), and medical costs in relation to case volume. A hospital was categorized as a low-volume hospital (i.e., < 5 cases/y), a medium-volume hospital (i.e., 5–9 cases/y), or a high-volume hospital (HVH) (i.e., > 9 cases/y).
Results: Multiple logistic regression revealed that HVHs did not have lower in-hospital mortality rates, compared to low- or medium-volume hospitals [for 30-day mortality: the odds ratio (OR) was 0.97 with a 95% confidence interval (CI) of 0.76–1.24; $p = 0.831$; for overall mortality: OR, 0.86; 95% CI, 0.70–1.07; $p = 0.197$]. However, multiple linear regression showed that HVHs had significantly shorter LOS and lower medical costs. The coefficient for LOS was −5.02 days (95% CI, from −6.04 days to −4.01 days; $p < 0.001$), whereas the coefficient for LOS for medical costs was −1393.00 United States dollar (US$; 95% CI, from −1793.30 to −992.70 US$; $p < 0.001$).
Conclusion: This study demonstrated that a higher case volume was significantly associated with shorter LOS and lower medical costs among elderly patients with bleeding peptic ulcers. However, there was no significant effect of case volume on mortality in Japan.

1. Introduction

Hemorrhagic peptic ulcer is one of the most frequently encountered emergency conditions in daily practice[1]. The overall incidence of hemorrhagic peptic ulcers has decreased worldwide, although the overall incidence in elderly patients remains high[2,3]. Loperfido et al[2] reported that the mean age of patients with acute upper gastrointestinal bleeding had significantly increased from 1983–1985 to 2002–2004 in the United States. In a retrospective study in Norway, Bakkevold[3] reported that the incidence of hemorrhagic peptic ulcers was significantly higher in elderly patients than in younger patients. Because of the high incidence of hemorrhagic peptic ulcers in elderly patients and the rapid acceleration in the growth of the aging population, it is expected that many gastroenterologists or endoscopists will encounter more elderly patients with hemorrhagic peptic ulcers.

Hospital volume is a major factor that influences the outcomes of various endoscopic treatments such as endoscopic retrograde cholangiopancreatography or endoscopic submucosal dissection[4–6]. The presence of experienced endoscopists most strongly seems to influence this volume–outcome relationship. Some previous studies suggest that hospitals with large case volumes are more likely to have

☆ Conflict of interest: All contributing authors declare that they have no conflicts of interest.

* Correspondence to: Dr Atsuhiko Murata, University of Occupational and Environmental Health, Department of Preventive Medicine and Community Health, School of Medicine, 1-1 Iseigaoka, Yahatanishi-ku, Kitakyushu, Fukuoka 807-8555 Japan.
E-mail address: amurata@med.uoeh-u.ac.jp (A. Murata).

http://dx.doi.org/10.1016/j.ijge.2015.11.002

experienced endoscopists who are able to provide sufficient treatment, which contributes significantly to fewer complications or a shorter length of hospital stay (LOS)[4–6]. Therefore, it is reasonable to presume that higher-volume hospitals significantly contribute to the outcomes of patients who require endoscopic treatments.

However, little information is available on the relationship between hospital volume and the outcomes of hemorrhagic peptic ulcer treatment. In particular, the focus of this study on elderly patients clearly shows the effect of hospital volume because the outcomes of elderly patients have remained significantly worse than those of younger patients. In addition, the establishment of the effect of hospital volume on the outcomes of elderly patients with hemorrhagic peptic ulcers could contribute to future studies and have implications for the quality of medical care of elderly patients. Therefore, in this study, we investigated the effect of hospital volume on the clinical and medical economic outcomes of elderly patients with hemorrhagic peptic ulcers. We used the national administrative database developed in a Japanese case-mix system project called the Diagnosis Procedure Combination (DPC).

2. Materials and methods

2.1. Administrative database associated with the DPC system

The DPC database has been described in detail elsewhere[4–6]. This database collects important information during a patient's hospitalization. It includes the patient's financial data, claim information, and discharge summary (e.g., the principal diagnosis, complications, and comorbidities). The data are coded using the International Classification of Diseases and Injuries, 10th revision (ICD-10) code. In addition, the DPC database contains comprehensive medical information such as all interventional or surgical procedures, the amount of daily care delivered, and medications that have been indexed in the original Japanese code.[4–6] All codes are assigned by the Ministry of Health, Labour and Welfare of Japan (Tokyo, Japan)[4,6].

2.2. Study setting

Information from 120,242 patients with peptic ulcers (i.e., ICD-10 codes K25 and K26) was collected using the DPC administrative database for 2010, 2011, and 2012. We excluded 60,497 patients who did not undergo endoscopic hemostasis for hemorrhagic peptic ulcers. We also excluded 45,176 patients younger than 80 years because this study aimed to investigate the effect of hospital volume on the treatment outcomes of elderly patients with hemorrhagic peptic ulcers. (Elderly patients have been defined as individuals 80 years or older in previous studies[7,8].) Therefore, 14,569 elderly Japanese patients who had undergone endoscopic hemostasis for hemorrhagic peptic ulcers were allocated for analysis. The 14,569 patients were referred to 1073 DPC-participating hospitals (83 academic hospitals and 990 community hospitals). These hospitals are dispersed throughout Japan and have leading roles in providing acute care medicine, advancing medical research, and educating students and medical residents[4,6].

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

Study variables were the type of hemorrhagic peptic ulcer; age; sex; chronic comorbid conditions; use of ambulance transportation and the intensive care unit; other treatments for hemorrhagic peptic ulcers such as transfusions or surgery; hospital type, size, and region; proportion of hospitals with an emergency center; in-hospital mortality; LOS; and medical costs during hospitalization.

Age was stratified as follows: 80–89 years and $\geq$ 90 years. The severity of chronic comorbid conditions was assessed using the Charlson Comorbidity Index (CCI), which is widely used to record comorbidities and has been validated in various studies[4,6]. The CCI was calculated for each patient as in previous studies, which showed an association between the CCI and the ICD-10 code. The CCI was expressed as the score of all comorbid conditions and was initially evaluated as a continuous variable. However, categorical variables, which constituted four severity categories of chronic comorbid conditions, were created to simplify the presentation of the results: 0, “none”; 1, “mild”; 2, “moderate”; and $\geq$ 3, “severe.” Hospital type was classified as “academic” or “community.” Hospital size was categorized into three groups, according to the number of hospital beds: small (i.e., < 200 beds), medium (i.e., 200–600 beds), and large (i.e., > 600 beds). The analysis of medical costs incurred during hospitalization was based on the exchange rate (in December 2014) of approximately 100 yen to 1 United States dollar (US$).

2.4. Main outcome measures and statistical analysis

The main measure of interest in this investigation was hospital volume. Hospital volume was expressed as the number of cases during the study period, and was initially evaluated as a continuous variable. However, categorical variables that defined the three hospital volume categories were created to simplify the presentation of the results: low-volume hospitals (LVHs) had fewer than five cases per year (n = 4526), medium-volume hospitals (MVHs) had from five to nine cases per year (n = 5062), and high-volume hospitals (HVHs) had more than nine cases per year (n = 4981). The range of the volume categories seems to be more closely set than in previous reports because of the small sample size and the numerous participating hospitals. However, the volume categories were based on cutoffs that yielded roughly equivalent numbers of patients in each volume category, as described in previous studies[4,6]. Therefore, the validity and reliability of this prospective cohort study has been reasonably assured.

To evaluate statistical significance, we used the Chi-square test for categorical data and one-way factorial analysis of variance for continuous variables. We used multiple logistic regression models to estimate the odds ratios (ORs) and their 95% confidence intervals (CIs) for in-hospital mortality (i.e., 30-day and overall). The LVH group was the reference group. To control for selection bias with regard to the baseline characteristics of the patients among the hospital volumes, we performed generalized propensity score analysis to estimate the dose–response function for each hospital volume. We used a multinomial logistic regression model with logit as the link function to obtain generalized propensity scores using the data of patient characteristics. We developed two propensity score models between hospital volumes: LVHs versus MVHs and LVHs versus HVHs. The propensity scores were categorized into deciles, as reported previously in the literature[9]. Multiple linear regression models were also used to identify the impact of the effect of hospital volume on LOS and medical costs during hospitalization with regard to the hospital characteristics and propensity scores.

All statistical analyses were performed using the STATA statistical software package, version 11.0 (Stata Corporation, College Station, TX, USA). A p value < 0.05 was considered statistically significant.