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Impact of hospital volume on mortality in patients with severe torso injury



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ABSTRACT

Background: Whether a positive volume-outcome relationship exists in the context of trauma remains controversial. Heterogeneity in the definition of hospital volume in previous studies is one of the main reasons for this inconclusiveness. We investigated whether hospital volume is associated with mortality in patients with severe torso injury using two different definitions of hospital volume.

Materials and methods: This retrospective cohort study used the Diagnosis Procedure Combination database in Japan. Patients who were admitted to tertiary emergency centers with severe torso injury and underwent emergency surgery or interventional radiology treatment for the torso injury upon admission from April 1, 2010 to March 31, 2014 were included. Hospital volume was defined as the annual number of admissions with severe torso injury (HV-torso) or the annual number of total trauma admissions (HV-all). The main outcome was 28-d mortality. Multivariable logistic regression models fitted with generalized estimating equations were used to evaluate relationships between hospital volume and 28-d mortality.

Results: Overall, 7725 patients were included. The 28-d mortality rate was 15.3%. The HV-torso was significantly associated with reduced 28-d mortality (adjusted odds ratio = 0.59; 95% confidence interval = 0.44-0.79). However, there was no significant association between the HV-all and mortality (adjusted odds ratio = 1.02; 95% confidence interval = 0.72-1.46).

Conclusions: The HV-torso was significantly associated with reduced mortality in patients with severe torso injury. In contrast, the HV-all had no significant relationship with their mortality. Regionalization of trauma care for severe torso injury may be beneficial for patients with severe torso injury.

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Introduction

Hospital volume–patient outcome relationships in various medical and surgical conditions have been investigated for decades. Patients with pancreatic cancer, esophageal cancer, and aortic aneurysm requiring surgery are more likely to achieve better outcomes when treated at high-volume than low-volume hospitals.¹ Volume-outcome relationships have also been well investigated in patients with trauma.² However, whether trauma patients should be centralized in high-volume hospitals remains controversial. Some studies have supported a positive volume-outcome relationship,^{3,4} while others have refuted it.^{5,6}

Heterogeneity in the methodology of previous studies is a predominant reason for this inconclusiveness of the volume-outcome relationship in trauma care delivery.² Definitions of hospital volume used in previous studies have included the number of patients with almost all types and severity of injury,^{4,6} the number of patients with severe injury,^{3,7} and the number of patients with specific injuries.^{8,9} The injury type and severity in the included patients have also varied among previous studies. Because required resources and practices for patients with trauma depend on the type and severity of injuries, the number of admissions with a specific injury may be more strongly associated with outcomes in patients with the injury, compared with the total number of trauma admissions.

The aim of the present study was to investigate the volume-outcome relationship in patients with severe torso injury requiring emergency surgery or interventional radiology treatment using two different definitions of hospital volume. We hypothesized that 1-d and 28-d mortality are reduced at hospitals with a higher volume of severe torso injury, but not associated with the annual number of total trauma admissions.

Materials and methods

This was a retrospective observational study using the Diagnosis Procedure Combination (DPC) database, a national inpatient database in Japan. A detailed profile of the DPC database is described elsewhere.¹⁰ Briefly, approximately 1000 hospitals in Japan, including all 82 academic hospitals, participate in the DPC database. The annual number of admissions recorded is 7 million, which accounts for 50% of all hospital admissions in Japan. Diagnoses recorded in the database include four main diagnoses (including one primary diagnosis on admission), four concurrent diagnoses that represent preexisting comorbidities or concomitant diagnoses for admission, and four postadmission complications. These diagnoses are separately recorded using the International Statistical Classification of Diseases and Related Health Problems, tenth revision (ICD-10) coding system and text data in the Japanese language. Other information recorded in the database include patient demographics, hospital identifiers, types of hospital admission (urgent or scheduled), drugs administered and procedures implemented, several clinical data including the Japan Coma Scale (JCS) score on

admission,^{11,12} and discharge outcomes. Drugs and procedures are recorded with the dates they were implemented. Procedures are coded with Japanese original codes. Physicians in charge record patient data on diagnoses and clinical features, including the JCS scores.

The present study was approved by the Institutional Review Boards and Ethics Committee of The University of Tokyo. Informed consent was waived because of the anonymous nature of the data.

Certified tertiary emergency centers in Japan

As of February 2014, 266 tertiary emergency centers had been certified by the Japanese government. Requisites for tertiary emergency centers include availability of designated operation rooms and intensive care units for severely ill or injured patients. Availability of specialists including internists, cardiologists, general surgeons, neurosurgeons, orthopedic surgeons, pediatricians, anesthesiologists, and psychiatrists is also required. Emergency medical personnel triage patients in the field based on their vital signs, physical findings, and brief history and selectively transfer patients in severe condition possibly requiring urgent evaluation or treatment to the nearest tertiary emergency center.¹³ As of March 2014, the end of the present study period, no official verification for trauma centers had been established in Japan. Thus, during the study period, patients with severe trauma were generally transferred to the nearest tertiary emergency center along with patients without trauma while receiving brief prehospital care including oxygen inhalation, spinal immobilization, and pressure hemostasis if required. No subclassification of trauma care was used among the tertiary emergency centers. More than 90% of all tertiary emergency centers participated in the DPC at the time of this study.

Patient selection

The inclusion criteria of the present study were urgent admission to a tertiary emergency center for treatment of trauma from April 1, 2010 to March 31, 2014 and the presence of severe torso injury. Patients admitted to hospitals for the treatment of trauma were identified by the ICD-10 codes S00.0 to T14.9, recorded as a primary diagnosis on admission. Patients with severe torso injuries were defined as those undergoing emergency surgery or interventional radiology treatment for intrathoracic injuries, intraabdominal injuries, or pelvic fractures on admission. The exclusion criteria were an age of <15 y, transfer to another hospital or discharge alive on the day of hospital admission, and missing data.

Variables

The main independent variable of interest was hospital volume. Two definitions of hospital volume were used in this study. The first definition was the average annual number of admissions of patients with severe torso injuries during the study period in individual hospitals. The second definition was the average annual number of total trauma admissions during the study period. These hospital volumes were

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