Assessment of Progress in Early Trauma Care in Japan over the Past Decade: Achievements and Areas for Future Improvement

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BACKGROUND: Strategies to optimize early trauma care have been introduced in Japan; however, detailed evaluation of the progress achieved has not been reported.

STUDY DESIGN: In this retrospective observational study, patients registered in the Japanese nationwide trauma registry were stratified according to probability of survival (Ps) > 0.5 or ≤ 0.5, respectively. Mortality rates during the first 2 days and in-hospital mortality rates were compared between early (2004 to 2009) and late cohorts (2010 to 2014) in each group, using mixed effects logistic regression analysis. Improvement in mortality rates during the first 2 days among subgroups were also assessed.

RESULTS: We analyzed 80,949 patients with Ps > 0.5 (early, 25,917; late, 55,032) and 8,898 patients with Ps ≤ 0.5 (early, 3,511; late, 5,387). Mortality rates during the first 2 days in both groups were significantly reduced (adjusted odds ratio [AOR; 95% CI] 0.61 [0.53 to 0.69] in the Ps > 0.5 group and 0.67 [0.60 to 0.76] in the Ps ≤ 0.5 group). In-hospital mortality rates in both groups were also significantly reduced (AOR [95% CI] 0.70 [0.64 to 0.76] and 0.73 [0.64 to 0.82], respectively). Significant improvements were observed in patients with a Revised Trauma Score ≥ 7 on arrival or an Abbreviated Injury Scale (AIS) of the abdomen ≥ 3. Limited improvements were observed in patients with head AIS ≥ 3 and in patients who underwent thoracotomy.

CONCLUSIONS: Although early trauma care has generally improved, specific progress was variable. Focused panel review of patients with severe head injury or undergoing thoracotomy may be an efficient strategy for further improvement. (J Am Coll Surg 2017;224:191−198. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Traumatic death is a major public health issue, and remains a leading cause of death for persons of working age and for young persons in many developed countries.[1-3] The total costs of medical care and work loss associated with all trauma-related injuries in the United States were reported as $671 billion in 2013.[4]

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Although preventable trauma deaths (PTDs) have been frequently used as a parameter to monitor the quality of trauma care,[5,6] a standardized definition to identify PTD does not exist. Most studies have evaluated PTD by multidisciplinary panel review, by using a statistical approach based on a scoring system, such as the probability of survival (Ps), or by using a mixed approach, based on both methods.[7-9] However, the panel review approach requires significant time and manpower, so it would be impractical and ineffective to use peer review to evaluate PTD for individual cases within a large-scale database, such as a nationwide registry.

Shanti and colleagues[10] showed that evaluation of PTD by a statistical approach, using the Revised Trauma Score (RTS) and the Trauma and Injury Severity Score (TRISS), was consistent with the panel review approach. In a systematic review, Kwon and associates[11] demonstrated that the PTD rate was not affected by the approach used, although the statistical approach potentially had the risk of broader

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Abbreviations and Acronyms

AIS = Abbreviated Injury Scale
AOR = adjusted odds ratio
ED = emergency department
GCS = Glasgow Coma Scale
ISS = Injury Severity Score
JTDB = Japan Trauma Data Bank
Ps = probability of survival
PTD = preventable trauma death
RTS = Revised Trauma Score
TAE = transcatheter arterial embolization
TRISS = Trauma and Injury Severity Score

dispersion compared with the panel review approach. Moreover, in terms of objectivity and large numbers, population-based studies have been recommended to identify PTD, replacing the panel review approach.[12]

In Japan, a national survey showed that 38% of traumatic deaths were potentially preventable in 2000, and the frequency of PTDs varied according to the region and institution assessed.[13] To improve the quality of trauma care in Japan, various efforts have been introduced. For initial patient management in the emergency department (ED), the Japan Advanced Trauma Evaluation and Care course was introduced in 2002. This is a standardized off-the-job training course for emergency physicians, adapting the Advanced Trauma Life Support course to Japanese trauma care situations. In 2003, establishment of a nationwide trauma registry enabled monitoring of the quality of trauma care. Furthermore, in 2006, the Japanese Society for the Acute Care Surgery was established for initial management, surgery, and surgical critical care for trauma.

Although these strategies have been implemented across Japan, nationwide verification of progress and detailed assessment have not been reported. The aim of this study was to evaluate changes in the quality of early trauma care, largely in terms of PTDs, as a result of these strategies, and to identify areas in which improvement has occurred and areas requiring further improvement by the statistical approach, using a nationwide trauma registry.

METHODS

Design and settings

This was a retrospective observational study to assess improvements in early trauma care by comparing changes in mortality rates. Data were obtained from the Japan Trauma Data Bank (JTDB). The JTDB is a nationwide trauma registry established in 2003, which is authorized and maintained by the Japanese Association for the Surgery of Trauma and Japanese Association for Acute Medicine. Trauma patients with Abbreviated Injury Scale (AIS) ≥ 3 are registered in the JTDB. During the study period, the JTDB received records from 244 hospitals, and of these, 95% were government-approved tertiary emergency medical centers. The observation period of all subjects registered in the JTDB was from the time of injury to hospital discharge. The ethics committee of Tokyo Medical and Dental University approved this study (#2192).

Study population

We included trauma patients transferred directly from the scene of injury to the hospital and registered in the JTDB from January 2004 to December 2014. We excluded patients with a score of 6 points on an AIS (ie unsalvageable injury) or with a missing AIS score in any anatomic region. We also excluded patients with missing data relating to the year of injury, mechanism of injury, outcome at discharge, duration of hospital stay, and variables used to calculate probability of survival (systolic blood pressure, respiratory rate, and Glasgow coma scale [GCS] on arrival at the ED). Further, patients treated at hospitals not participating in the JTDB in the years 2000 and 2010 were also excluded. Patients were divided into 2 groups according to $Ps > 0.5$ or $Ps \leq 0.5$. Selected patients were further divided into an early and a late cohort.

Data collection

We collected the following patient information from the JTDB: age, mechanism of injury, year of injury, vital signs on arrival at the ED (systolic blood pressure and respiratory rate), GCS on arrival at the ED, AIS of each anatomic region, Injury Severity Score (ISS), unique identification number of the treating hospital (hospital ID), duration of hospital stay, and status at discharge (alive or dead). The RTS was calculated with these data. The Ps was calculated based on TRISS.[14] Furthermore, we collected information regarding the procedure performed: craniotomy, thoracotomy, laparotomy, and/or transcatheter arterial embolization (TAE).

Definition and outcomes

The early cohort was defined as patients injured between 2004 and 2009, and the late cohort was defined as patients injured between 2010 and 2014. Unexpected death was defined as death in patients with $Ps > 0.5$. In this study, PTD was defined as unexpected death during the first 2 days, because the term was generally used for the death of victims due to inadequate practice in the early phase of trauma care.