Injury, Int. J. Care Injured xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Polytrauma patients in the Netherlands and the USA: A bi-institutional comparison of processes and outcomes of care

Suzan Dijkink[a,*], Gwendolyn M. van der Wilden[a], Pieta Krijnen[a], Lisa Dol[a], Steven Rhemrev[b], David R. King[c], Marc A. DeMoya[c], George C. Velmahos[c], Inger B. Schipper[a]

[a] Department of Surgery, Leiden University Medical Center, The Netherlands
[b] Department of Surgery, Haaglanden Medical Center, The Netherlands
[c] Division of Trauma, Emergency Surgery, and Surgical Critical Care, Department of Surgery, Massachusetts General Hospital, United States

ARTICLE INFO

Article history:
Received 3 August 2017
Received in revised form 29 September 2017
Accepted 9 October 2017

Keywords:
Trauma systems
Poly trauma
Hospital mortality
Trauma outcomes
Injury severity score
The Netherlands
The United States of America

ABSTRACT

Background: Modern trauma systems differ worldwide, possibly leading to disparities in outcomes. We aim to compare characteristics and outcomes of blunt polytrauma patients admitted to two Level 1 Trauma Centers in the US (USTC) and the Netherlands (NTC).
Methods: For this retrospective study the records of 1367 adult blunt trauma patients with an Injury Severity Score (ISS) $\geq$ 16 admitted between July 1, 2011 and December 31, 2013 (640 from NTC, 727 from USTC) were analysed.
Results: The USTC group had a higher Charlson Comorbidity Index (mean [standard deviation] 1.15 [2.2] vs. 1.73 [2.8], $p < 0.0001$) and Injury Severity Score (median [interquartile range, IQR] 25 [17–29] vs. 21 [17–26], $p < 0.0001$). The in-hospital mortality was similar in both centers (11% in USTC vs. 10% NTC), also after correction for baseline differences in patient population in a multivariable analysis (adjusted odds ratio 0.95, 95% confidence interval 0.61–1.48, $p = 0.83$). USTC patients had a longer Intensive Care Unit stay (median [IQR] 4 [2–11] vs. 2 [2–7] days, $p = 0.006$) but had a shorter hospital stay (median [IQR] 6 [3–13] vs. 8 [4–16] days, $p < 0.0001$). USTC patients were discharged more often to a rehabilitation center (47% vs 10%) and less often to home (46% vs. 66%, $p < 0.0001$), and had a higher readmission rate (8% vs. 4%, $p = 0.01$).
Conclusion: Although several outcome parameters differ in two urban area trauma centers in the USA and the Netherlands, the quality of care for trauma patients, measured as survival, is equal. Other outcomes varied between both trauma centers, suggesting that differences in local policies and processes do influence the care system, but not so much the quality of care as reflected by survival.

Introduction

Despite several internationally accepted standards for trauma care, there is still significant variation among countries according to unique national demands and regulations. In the United States of America (U.S.), trauma care is organized according to the recommendations set by the American College of Surgeons Committee on Trauma (ACS-COT) [1]. With five levels for Trauma Center designation and strict criteria for the resources required at each level, trauma care in the U.S. has been regionalized and the outcomes have improved after the implementation of the trauma system [2–4].

The Dutch trauma system is comparable to the U.S. model in many ways. In 1999, the Dutch government designated 10 hospitals as trauma centers in an effort to regionalize prehospital patient triage of severely injured patients [5]. All hospitals were categorized into level 1, 2, or 3 trauma centers, based on nationally adopted trauma level criteria set by the Dutch Society for Trauma Surgery and closely resembling the ACS-COT criteria. Currently, the Dutch system is organized in eleven trauma regions, with a coordinating level 1 trauma center commanding a catchment area of minimally 1.2 million inhabitants in every region [6]. In The Netherlands, the implementation of trauma centers has reduced the overall mortality risk by 16%, and by 21% in polytrauma patients [7,8].

* Corresponding author at: Department of Surgery, post zone K6-R, P.O. Box 9600, 2300 RC Leiden, The Netherlands.
E-mail address: S.Dijkink@lumc.nl (S. Dijkink).

https://doi.org/10.1016/j.injury.2017.10.021
0020-1383/

Despite the similarities between the U.S. and the Dutch trauma systems, differences do exist, for instance regarding trauma training, patient volumes, type of injuries, prehospital care, distances travelled, and access to rehabilitation, possibly leading to differences in outcomes of care. The purpose of this study was to compare two urban Level-1 Trauma Centers, one in the U.S. and the other in the Netherlands, regarding demographics, injury characteristics, and outcomes of severely injured patients after blunt trauma.

Material and methods

Trauma centers

This retrospective cohort study was performed at the Level 1 Trauma Center of the Massachusetts General Hospital in Boston, USA (USTC) and two Level 1 locations of Trauma Center West Netherlands (NTC), the Haaglanden Medical Center Westeinde and Leiden University Medical Center. The same trauma protocols apply for both Dutch trauma center locations and a previous study demonstrated that the characteristics of the polytrauma patients were similar. No differences were found in in-hospital mortality adjusted for clinical predictors between both Dutch trauma center locations (unpublished data).

The basic characteristics of trauma organization and management of USTC and NTC are summarized in Table 1. Differences were noted in the catchment area, the number of patients admitted annually, and the composition of the trauma team.

The Institutional Review Boards of both trauma centers granted permission for this study.

Patients and data collection

All trauma patients admitted to the NTC or USTC following a blunt trauma between July 1, 2011 and December 31, 2013, older than 16 years of age, and with an Injury Severity Score (ISS) of 16 or higher, were included for analysis. Patients who died before arrival or in the emergency department were excluded from the analysis. Also, patients who were first managed in another hospital before arriving at the NTC or USTC were excluded.

Patients were identified in the trauma registries of the two trauma centers [9,10]. Data obtained from the trauma registries were supplemented in identical databases in each TC by information acquired from the electronic medical records.

Data

Demographic data, type and severity of injuries classified according to the Abbreviated Injury Scale (AIS update 1998) [11], Injury Severity Score (ISS) [12], and vital signs and Revised Trauma Score (RTS) on admission were obtained from the trauma registries [13]. Missing data for the RTS were determined based on vital signs documented in the hospital records in 16.3% of all the cases in both trauma centers. Injuries with AIS code >2 were considered serious injuries. Data on comorbidity, intubation, and complications was collected from the medical charts. To describe the pre-trauma condition of the patients, the age-adjusted Charlson Comorbidity Index (CCI) was calculated by using a Microsoft Excel Macro [14,15]. The APACHE II score was used to assess the severity of illness of the patients admitted to the Intensive Care Unit (ICU) [16].

The primary outcome was in-hospital mortality. Secondary outcomes included length of stay in the hospital (HOS-LOS) and the ICU (ICU–LOS), ventilator-free days, complications (surgical complications including superficial and deep surgical site infections and rebleeding, pneumonia, urinary tract infections (UTI), deep venous thrombosis (DVT) and pulmonary embolism), readmission, and discharge disposition.

Statistical analysis

After data collection, the two TC databases were merged for statistical analysis. The demographic and clinical characteristics of

Table 1
Characteristics of trauma systems.

	NTC	USTC
Level trauma center	1	1
Number of locations	2	1
Hospital catchment area	Urban area 2.0 million inhabitants	Urban area 6.0 million inhabitants
Total number of trauma patients/year	2270	2500
Polytrauma patients/year	400	600
ATLS training	Yes	Yes
Protocol 'Management of polytrauma patients' available	Yes	No
Specific criteria for activation of the trauma team	Yes	Yes
24/7 in house coverage	Yes (junior surgical resident, under close supervision of an attending surgeon)	Yes (attending surgeon)
CT-scan available at ED	in 1 of 2 locations	Yes
X-ray/ultrasound available at ED	Yes	Yes
Operating room available 24/7	Yes	Yes
OR-team available 24/7	Yes, on call	Yes
ICU bed available	Yes	Yes
Trauma team members	Attending surgeon, surgical resident, emergency physician, an anesthesiologist, intensive care doctor, radiologist, ICU-nurse, two emergency department nurses and an OR-nurse.	Attending surgeon, fellow in trauma surgery (junior attending), senior resident, intern, ED senior resident, ED junior resident, nurse practitioner
Other specialties available for consultation	Yes	Yes

Please cite this article in press as: S. Dijkink, et al., Polytrauma patients in the Netherlands and the USA: A bi-institutional comparison of processes and outcomes of care, Injury (2017), https://doi.org/10.1016/j.injury.2017.10.021