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Epidemiology of extremity injuries in multiple trauma patients

Marc Banerjee [a,*], Bertil Bouillon [a], Sven Shafizadeh [a], Thomas Paffrath [a], Rolf Lefering [b], Arasch Wafaisade [a], the German Trauma Registry Group[c]

[a] Department of Trauma and Orthopaedic Surgery, University of Witten/Herdecke, Cologne Merheim Medical Center, Germany
[b] IFOM, Institute for Research in Operative Medicine, University of Witten/Herdecke, Cologne Merheim Medical Center, Germany

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ABSTRACT

Background: Previous studies have suggested that distinct extremity injuries are associated with worse outcome following major trauma. The aim of the present study was to determine epidemiological data of extremity injuries in multiple trauma patients with respect to prevalence, injury pattern, specific mechanisms of injury and their impact on mortality.

Methods: The Trauma Register of the German Society for Trauma Surgery anonymously documents data on critically injured patients since 1993. Trauma cases documented between 2002 and 2009, older than 16 years of age and with an ISS $\geq$ 16 were divided into those with AIS $\geq$ 2 and those without a significant extremity injury. The groups were compared with respect to injury pattern, treatment characteristics and mortality.

Results: More than half of the 24,885 patients (58.6%) had a significant extremity injury. On average patients with relevant extremity injuries sustained on average 2.1 fractures per case and 4.9% even sustained five or more extremity injuries. Fractures of the femur (16.5%), the tibia (12.6%) and the clavicle (10.4%) were the most common fractures. Patients without significant extremity injury had a significantly lower Glasgow Coma Scale at scene, a more severe brain injury and a higher 30-day- and in-hospital-mortality. In contrast, patients with significant extremity injuries had a higher rate of severe chest trauma, a higher rate of red cell blood transfusion as well a massive blood transfusion, more operative procedures and a longer ICU and in-hospital length of stay.

Conclusions: Multiple injured patients with and without significant extremity injuries can be regarded as two different populations with respect to early posttraumatic course and survival. Those without extremity injury had more severe head injuries and a higher mortality. However, significant extremity injury was associated with worse outcomes including a higher number of operative procedures, a higher rate of blood transfusion and a longer hospital length of stay.

Introduction

The injury pattern in patients sustaining multiple injuries highly influences mortality, posttraumatic course, physical and psychosocial outcome and posttraumatic quality of life. Mortality is mainly determined by severity of head injury while exsanguination represents the second leading cause of death.[1,2] Patients with head injury show an up to threefold increased mortality when compared to patients without head injury.[1] Nevertheless, additional extremity injuries mainly affect the functional outcome and quality of life after polytrauma.[2–5] Patients with lower as well as those with upper extremity injuries often continue to have severe functional restrictions. Especially those with injuries below the knee experience pain and present with an impaired ability to walk and a decreased quality of life already in the short-term.[2,4,5] In a long-term follow-up Pape et al. showed that a traumatic lower extremity amputation, the presence of two or more articular injuries, lower extremity injuries and a combination of shaft and articular injuries were predictors of a worse clinical outcome after polytrauma.[3] Furthermore, patients with extremity injuries commonly survive with good or excellent clinical outcomes if isolated injury is sustained (e.g. acromio-clavicular joint separation), however patient outcome becomes significantly poorer if the same injury is present in a polytrauma patient.[6] Although the role of extremity injuries with respect to morbidity and mortality is frequently underestimated, their therapy plays a major role in the

* Corresponding author at: Department of Trauma and Orthopedic Surgery, University of Witten/Herdecke, Cologne Merheim Medical Center, Ostmerheimerstr. 200, 51109 Cologne, Germany. Tel.: +49 221 89073276; fax: +49 221 89073085.
E-mail address: marc.banerjee@gmx.de (M. Banerjee).
[c] Committee on Emergency Medicine, Intensive and Trauma Care (Sektion NIS) of the German Society for Trauma Surgery (DGU).

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management of the multiple injured patient. However, until now little epidemiological data exist on extremity injuries in multiple trauma patients.

Thus, using a large, representative nationwide trauma registry, the aim of the present study was to describe the epidemiological patterns of extremity injuries in multiple trauma patients with respect to prevalence, injury pattern, specific mechanisms of injury and their impact on mortality.

Methods and patients

The Trauma Register of the German Society for Trauma Surgery (TR-DGU)

The TR-DGU was founded in 1993 by the German Society for Trauma Surgery (DGU, Deutsche Gesellschaft für Unfallchirurgie) for anonymous and standardised documentation of data on critically injured patients.[7] Until 2009, data from a total of 51,425 trauma patients have been entered into the registry. In 2002, an online documentation system was introduced including multiple plausibility and completeness checks. Currently, 218 hospitals are actively contributing data to the TR-DGU, mostly from Germany (a list of participating trauma centres is available at www.traumaregister.de). The data documentation is structured in four consecutive time phases following injury: A – pre-hospital phase; B – emergency room (ER) and initial therapy until intensive care unit (ICU) admission; C – ICU; and D – outcome and discharge, including a list of injuries and procedures. The registry includes detailed information on demographics, pre- and in-hospital management, outcome, injury severity and pattern by using standardised scoring systems, such as the abbreviated injury scale (AIS), the injury severity score (ISS), the new ISS (NISS) and the Glasgow Coma Scale (GCS).[8,9] For the current analysis, all injuries were coded using the AIS 1998 version.

Table 1
Basic parameters of the study population ($n = 24{,}885$).

N	24,885
Age (years; mean, SD)	46.1 (SD 20.2)
Male (%)	73.3
Blunt trauma (%)	96.0
ISS (points; mean, SD)	29 (SD 12)
NISS (points; mean, SD)	35 (SD 14)
GCS at scene ≤ 8 (%)	35.1
Bloodtransfusion[a] (%)	26.9
Operative procedures (*n*; mean, SD)	3.0 (SD 3.9)
Multiple organ failure (%)	32.0
In-hospital mortality (%)	18.3

GCS: Glasgow Coma Scale; ISS: injury severity score; NISS: new injury severity score; pRBC: packed red blood cells; SD: standard deviation.
[a] Transfusion of blood products between ER arrival and ICU admission.

Documentation of extremity injuries

The data report form for phase D (see above) contains a detailed documentation of injuries and surgical procedures. For the current analysis, the database was screened for injuries of the upper (UE) and lower extremities (LE) as coded according to AIS scores.[8] An AIS ≥ 2 was considered as a significant injury to the limb. Extremity injuries with AIS severity grade 1 such as uncomplicated finger or toe fractures are not included in this evaluation. Fractures to the spine and pelvis are also not considered as extremity injuries here.

Study population

We reviewed datasets from the TR-DGU database documented between the years 2002 and 2009. The database was retrospectively analysed for patients $\geq$16 years of age with a relevant injury load, defined as ISS $\geq$ 16. Patients were eligible if the

Table 2
Basic demographic/clinical characteristics upon admission and outcome of multiple trauma patients with and without extremity injuries ($n = 24{,}885$). The small *p* values are based on the large sample size, and interpretation has to consider the clinical importance of the observed difference.

	Multiple trauma without extremity injury	Multiple trauma with extremity injuries	*p*-Value
N	10,302	14,583	
Age (years, mean, SD)	49.2 (SD 21.0)	43.9 (SD 19.3)	<0.0001
Male (%)	73.0	73.5	0.43
Blunt trauma (%)	95.3	96.6	<0.0001
Traffic accident (%)	45.9	69.2	<0.0001
ISS (points; mean, SD)	28 (SD 13)	29 (SD12)	<0.0001
NISS (points; mean, SD)	36 (SD 16)	34 (SD 13)	<0.0001
AIS head ≥ 3 (%)	71.4	49.9	<0.0001
AIS thorax ≥ 3 (%)	43.5	63.9	<0.0001
AIS abdomen ≥ 3 (%)	18.4	22.5	<0.0001
SBP at scene (mmHg; mean, SD)	122 (SD 40)	115 (SD 33)	<0.0001
GCS at scene ≤ 8 (%)	43.3	29.7	<0.0001
i.v. fluids pre-hospital (ml; mean, SD)	1048 (SD 887)	1377 (SD 1049)	<0.0001
SBP at ER (mmHg; mean, SD)	124 (SD 33)	119 (SD 30)	<0.0001
Haemoglobin (g/dl; mean, SD)	12.1 (SD 2.7)	11.2 (SD 2.9)	<0.0001
Prothrombin time (Quick%; mean, SD)	80.0 (SD 23.9)	76.0 (SD 23.2)	<0.0001
Base excess (mmol/l; mean, SD)	−3.4 (SD 5.3)	−3.7 (SD5.0)	<0.0001
i.v. fluids ER to ICU (ml; mean, SD)	1814 (SD 1736)	2667 (SD 2451)	<0.0001
pRBC transfusion[a] (%)	17.3	33.6	<0.0001
Massive transfusion[a] ($\geq$10 pRBC) (%)	3.4	9.3	<0.0001
pRBC units[a] (*n*; mean; SD)	1.2 (SD 4.2)	2.7 (SD 6.2)	<0.0001
Operative procedures (*n*; mean, SD)	1.6 (SD 2.1)	4.0 (SD 4.5)	<0.0001
Multiple organ failure (%)	31.6	32.3	0.24
ICU LOS (days; mean; SD)	10.1 (SD 12.9)	12.6 (SD 14.8)	<0.0001
In-hospital LOS (days; mean; SD)	22.2 (SD 30.6)	29.8 (SD 29.2)	<0.0001
Ventilator days (days; mean; SD)	6.7 (SD 11.1)	7.9(SD 12.4)	<0.0001
30-days mortality (%)	24.4	14.1	<0.0001
In-hospital mortality overall (%)	25.2	14.9	<0.0001

AIS: abbreviated injury scale; ER: emergency room; FFP: fresh frozen plasma; GCS: Glasgow Coma Scale; ICU: intensive care unit; ISS: injury severity score; LOS: length of stay; NISS: new injury severity score; pRBC: packed red blood cells; SBP: systolic blood pressure; SD: standard deviation.
[a] Blood products transfused between ER arrival and ICU admission.