



30 years of polytrauma care: An analysis of the change in strategies and results of 4849 cases treated at a single institution

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ABSTRACT

The quality and progress of treatment of 4849 multiple trauma patients treated at one institution was reviewed retrospectively. Three periods, 1975–1984 (decade I; $n = 1469$) and 1985–1994 (decade II; $n = 1937$) and 1995–2004 (decade III; $n = 1443$) were compared.

65% of multiple trauma patients had cerebral injuries, 58% thoracic trauma and 81% extremity fractures (37% open injuries). Injury combinations decreased during all decades with head/extremity injuries being the most common combination. Throughout the three decades pre-hospital care became more aggressive with an increase of intravenous fluid resuscitation (I: 80%, II: 97%, III: 98%). Chest tube insertion decreased after an initial increase (I: 41%, II: 83%, III: 27%) as well as intubation (I: 82%, II: 94%, III: 59%). Rescue times were progressively shortened. For initial clinical diagnosis of massive abdominal haemorrhage ultrasound (I: 17%, II: 92%, III: 97%) replaced peritoneal lavage (I: 44%, II: 28%, III: 0%). CT-scans were used more frequently for the initial diagnosis of head injuries and other injuries to the trunk throughout the observation time. With regard to complications, acute renal failure decreased by half (I: 8.4%; II: 3.7%; III: 3.9%), ARDS initially decreased but increased again in the last decade (I: 18.1%, II: 13.4%, III: 15.3%), whereas the rate of multiple organ dysfunction syndrome (MODS) increased continuously (I: 14.2%, II: 18.9%, III: 19.8%) probably due to a decline of the mortality rate from 37% in the first to 22% in the second and 18% in the third decade and parallel increase of the time of death.

These treatment results summarise the enormous clinical effort as well as medical progress in polytrauma management over the past 30 years. Further reduction of mortality is desirable, but probably only possible when immediate causal therapy of later posttraumatic organ failure can be established.

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Introduction

The management of patients with multiple injuries continues to be a challenging process. A critical evaluation of treatment results is impeded by a heterogeneous patient population, low number of cases and different therapy regimens over the past years.²⁹

Recently, in an attempt to address these problems, several multi-centre databases of multiple trauma patients have been established and contributed to improvements in trauma care.^{8,36,46} Only rarely have studies been published from a single institution to

review the changes over time in outcome of multiple trauma/intensive care patients.^{33,44}

Back in 1995, our group reported on 3406 multiple trauma patients treated at a single institution comparing two 10-year treatment periods. Epidemiological and demographic characteristics were described in detail as well as changes of the patient population and the effect of new achievements.²⁹ This study showed a considerable reduction of mortality as well as success in volume and ventilator therapy.²⁹ It was then suggested that an effort should be made to decrease rescue and resuscitation time for fast and effective therapy of traumatic shock. We also recommended early definitive stabilisation of long bone fractures and radical debridement of necrotic tissues to allow early restoration of physiological functions. We concluded that a further reduction of

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mortality will depend on causal therapy of posttraumatic organ failure immediately after injury.

Since this publication, another 1450 multiple trauma patients were treated at our institution. Thus, we felt that there is a unique opportunity to design a follow-up study in order to assess if changes in diagnostics and therapy led to further improvements. Subsequently, a comparison of three treatment periods (1975–1984, 1985–1994, and 1995–2004) of the treatment of multiple trauma patients was carried out. Specifically, we asked the following questions:

1. How did the characteristics of patients with multiple trauma change throughout the observation period?
2. Were recommendations to improve care of multiply traumatised patients from our 1995 analysis established effectively?
3. Was there further improvement of outcome from multiple trauma compared to the 1995 data?

Patients and methods

Study population and study design

This study includes multiple blunt trauma patients treated at our level I trauma centre from 1 January 1975 to 31 December 2004. In order to create three comparable time periods the decades published by Regel et al. in 1995 were slightly changed.²⁹ The previously published results were recalculated and included in this study. Data were recorded retrospectively from patient files from 1975 to 1987 and inserted into our multiple trauma database. From 1988 to 2004 data were collected prospectively and entered in our trauma database on a daily basis. Data were complete – i.e. not missing a single information in the whole data set – in 89.5% of cases. The overall completeness – i.e. rate of missing information in relation to the total information required – is 95.8%. The information and data analysed in this paper was present in the database or extracted from the patient files to establish a complete set of data for analysis. Furthermore, all data were evaluated for completeness and reliability before entry into the database by specially trained study nurses and surgeons. During the input of the data into the computer system automatic reliability checks were carried out. A second reliability test was undertaken after the data had been digitised. Yearly random sampling for reliability checks of 10% of patients entered into the database was performed. Finally, once a year data are subjected to in-hospital audit checks by specially trained personnel from the controlling department. Since 1993, data also are part of the reliability and audit checks by the German Trauma Registry of the German Association of Trauma Surgeons (Deutsche Gesellschaft für Unfallchirurgie, DGU).

In order to clarify changes over this 30-year phase, the whole period was divided into three decades (I: 1975–1984, II: 1985–1994, III: 1995–2004) and the three decades were compared.

Inclusion criteria were blunt multiple trauma according to current recommendations^{1,8} and guidelines of the German Association of Trauma Surgeons (<http://www.dgu-online.de/de/leitlinien/polytrauma.jsp>, accessed 30 October 2007) with at least two injuries which in combination are life-threatening¹ or an Injury Severity Score (ISS) of 16 or more² and primary admission to Hannover Medical School or referral from another institution within 24 h after trauma.

Exclusion criteria were pre-hospital death, i.e. the patients died at the scene of the accident or during transportation to the hospital, or severe isolated injuries such as isolated severe head ($n = 961$) or abdominal trauma ($n = 389$) or amputation injuries ($n = 317$) of the upper or lower extremities. The exclusion was mainly due to the different therapeutic regimens and expected outcomes of isolated

severe injuries when compared to the severe multiply injured patient.

Treatment protocol

The trauma care system in Germany is described in detail by Westhoff et al.⁴⁵ Both transport systems (helicopter/ambulance) based at our institution carry a physician trained in the treatment of multiple trauma patients. The trauma management and the ICU treatment were performed according to the principles and priorities of our institution and were adapted to continuous medical improvement. The senior attending trauma surgeon was responsible for the initial assessment and decision making process with regard to the choice of diagnostics and rapid access to the operating room or admission to the ICU.

Parameters

Patient specific data including age and gender were recorded. In addition, injury mechanism, injury severity according to the ISS² and injury pattern were documented. Pre-hospital treatment, initial clinical treatment, intensive care treatment, clinical course as well as posttraumatic complications and mortality were analysed.

Definitions

In accordance to the 1995 publication, rescue and treatment intervals were defined as follows:

<i>Interval of no therapy.</i>	Time between incident and arrival of ambulance or emergency physician equipped car/helicopter.
<i>Intubation time.</i>	Time between incident and arrival at the hospital for initial treatment.
<i>Rescue time.</i>	Time between incident and intubation of patient.
<i>Resuscitation time.</i>	Time between arrival in the first hospital and initial operative treatment or admission to the ICU if there was no surgery.
<i>Operation time.</i>	Duration of initial operative treatment.

During initial and intensive care treatment, fluid balance, haemodynamic and respiratory parameters, temperature, laboratory parameters, medication, and surgical treatment were documented. Organ failure was defined according to Goris et al criteria.¹⁶

1995 recommendations for improvements

- Fast and effective treatment of pre-hospital shock by decreasing rescue time.
- Avoidance of prolonged in-hospital shock by decreasing resuscitation time.
- Limitation of continuing trauma by early restoration of physiological functions.

Statistics

For comparison of the different time periods an ANOVA was used followed by a post hoc Tukey's test where applicable or Kruskal–Wallis test, respectively. Nominal data were compared using the Chi-squared test. Significance at the $p < 0.05$ level, was marked by asterisks (*). Data in the tables and figures are presented

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