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Reduction in mortality in severely injured patients following the introduction of the "treatment of patients with severe and multiple injuries" guideline of the German society of trauma surgery – a retrospective analysis of a level 1 trauma center (2010–2012)

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ABSTRACT

Objective: The German society of trauma surgery published the "Treatment of Patients with Severe and Multiple injuries" guideline in 2011. This achieved the highest level of recommendation for guidelines published in Germany. This study investigated if there was an improvement in the survival rates of severed injured patients following the introduction of the guideline in clinical treatment.
Methods: All patients with an injury severity score ≥16 on primary admission to hospital between January 2010 and December 2012 (a total of 373 patients) were included in this study. The data for these patients were collected from the German Trauma Registry and from patients' hospital records. Patients who were treated in 2010 were compared with patients who were treated in 2011 and 2012, following the introduction of the "treatment of patients with severe and multiple injuries" guideline in the authors' clinic at the beginning of 2011.
Results: Significant differences were found in ISS, RTS, New ISS, and TRISS between 2010 and 2011/2012. No differences were found in the severity of injury when classified by different body regions. Major differences were found in the total volume replacement, the length of emergency surgery, the length of surgery performed within the first 24 h and the rate of whole-body computed tomography. The mortality rate dropped from 32.48% in 2010 to 18.75% in 2011/2012 ($p = 0.003$).
Conclusions: The introduction and use of a guideline-based medical care regime for severely injured patients might reduce the rate of mortality.

Introduction

In 2011 the German society of trauma surgery (DGU) published the "treatment of patients with severe and multiple injuries" guideline [1]. This guideline is also available in the English language [2].

In Germany, medical guidelines are developed under the patronage of the association of the scientific medical associations (AWMF). The AWMF has defined three levels of guideline development (Table 1). The "treatment of patients with severe and multiple injuries" guideline is rated at level 3.

In 2006 (revised in 2012) the DGU published the "Whitebook on the medical care of the severely injured" [4]. In this publication, recommendations are given on structure, organization, installations, and equipment for the treatment of severely injured patients.

In the past, several improvements in the medical care of severely injured patients have been made. For example, the rule of damage control surgery was discussed [5,6]. Also, Huber-Wagner et al. have shown that the use of whole-body computed tomography could reduce the mortality rate [7]. A permissive hypotension and a reduced fluid volume replacement might also have a positive impact on the survival outcome of severely injured patients [8].

In addition to general aspects of trauma care, the guideline also includes these aspects from the above-named publications.

The authors' hospital is a level 1 trauma center in Germany. Employees of the clinic also participated in the development of the guideline. The essentials of the guideline were introduced in the

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Table 1
AWMF table of levels for guideline development [3].

Level 1	Expert recommendation
Level 2k	Consensus-based guideline
Level 2e	Evidence-based guideline
Level 3	Evidence and consensus based guideline

routine treatment of severely injured patients at the beginning of 2011. This was established through internal clinical education and training.

The aim of this study was to investigate, if there was an improvement in survival rates after the introduction of the guideline in clinical treatment.

Patients and methods

This study was an analysis of data collected for the Trauma Registry of the DGU, which collected data from collaborating trauma centers, prospectively. The data of the Trauma Registry of the DGU have received the full approval of the Ethics Committee of the University of Witten/Herdecke, Cologne, Germany.

For this analysis the data of a level 1 trauma center, which is one of the largest trauma centers in Germany, was used.

Patients were selected according to the following criteria:

- Primary admission to the hospital,
- Injury severity score (ISS) $\geq$16,
- Admission between January 2010 and December 2012.

The following items were collected for each patient:

- Scales: injury severity score (ISS) [9], abbreviated injury scale (AIS) [10], new ISS [11], glasgow coma scale (GCS) [12], revised trauma score (RTS) [13], revised injury severity classification (RISC) [14], trauma and injury severity score (TRISS).
- General facts: Age, gender, systolic blood pressure at the accident scene, heart rate at the accident scene, length of intensive care unit (ICU) stay, length of hospital stay, count of performed surgery, administered fluid volume, multiple organ failure (MOF), sepsis, type of injury (penetrating vs. blunt).
- Laboratory tests: first hemoglobin value, initial number of platelets, partial thromboplastin time (PTT), prothrombin time.
- Periods: time from admission to cranial computed tomography (CCT), time from admission to whole-body CT, time in trauma room, time from admission to operation room, preclinical rescue time, length of emergency surgery, length of second surgery within the first 24 h, length of surgery within the first 24 h, total length of surgery within the first 24 h.
- Interventions: intubation, resuscitation, thoracic drainage by emergency physician at the accident scene, intubation, resuscitation, thoracic drainage in trauma room.

Data were analyzed with the statistical package for the social sciences (SPSS®; version 21, Chicago, IL, USA). Incidences are represented as percentages, and measured values are represented as means and standard deviations (SD). The differences between the two periods were evaluated using the Chi-squared test in cases of categorical variables; and the *t*-test in cases of continuous variables. When performing the *t*-test, a Levene-test was also performed. In cases of variance heterogeneity the Welch-test was used instead of the *t*-test. When an obvious deviation from normality was found, continuous variables were tested with a non-parametric rank test (Mann–Whitney). Significance was accepted for $p < 0.05$.

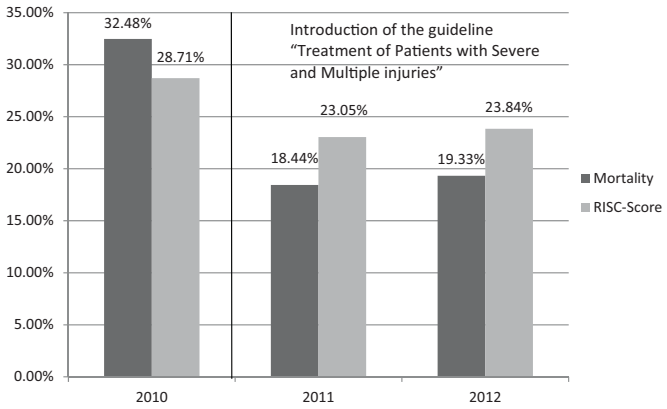

Fig. 1. Comparison of the annual mortality rate and RISC-score.

Results

Between January 2010 and December 2012, 373 patients met the inclusion criteria for this study. The overall mortality rate was 23.06%. The mean ISS was 27.79, the mean GCS 10.22, and the mean age was 48.96 years. Fig. 1 presents the annual mortality rate compared with the annual RISC-score.

In 2010 the mortality rate and the RISC-score was the highest. After 2010 the mortality rate dropped dramatically. The higher RISC-score in 2010 implied an increased proportion of more severely injured patients. In 2010 the mortality rate exceeded the RISC-score, while in 2011 and 2012 the real mortality was below the prognostic mortality rate.

The guideline was introduced at the beginning of 2011 in the authors' hospital, so 2010 was compared with 2011/2012. Fig. 2 shows the differences between the two time periods, with the level of significance also shown.

Significant differences between 2010 and 2011/2012 were found in ISS, RTS, new ISS, and TRISS. In 2010 the patients were, on average, more severely injured (ISS 29.96 vs. 26.79), although the RISC-score was not significantly different (28.71 vs. 23.41). In 2010 the mortality was above the RISC-score, while after 2010 the mortality was below the RISC-score (Fig. 1).

There were no significant differences in the severity of injuries when these were classified by different body regions, as shown by the AIS score (Table 2).

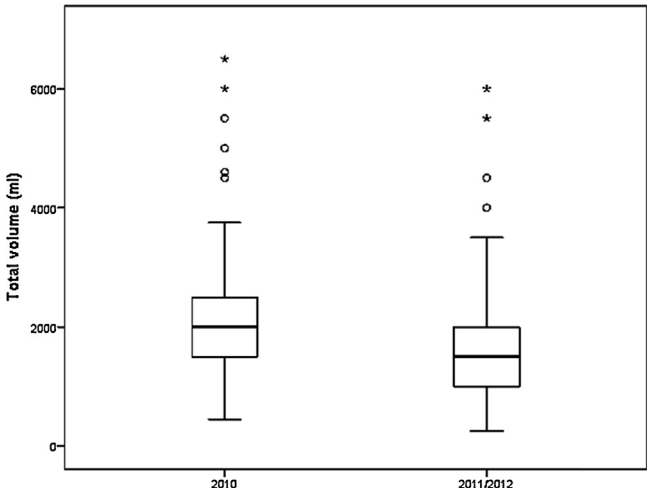

Fig. 2. Differences of the replacement volume $p < 0.0001$.