A multidisciplinary quality management system for the early treatment of severely injured patients: implementation and results in two trauma centers

Steffen Ruchholtz
Christian Waydhas
Ulrike Lewan
Karl Piepenbrink
Dieter Nast-Kolb

Abstract Objective: The impact of a multidisciplinary quality management system (MQMS) on the early treatment of severely injured patients was tested. Design and setting: Prospective clinical study in two level 1 trauma centers. Methods and materials: MQMS comprised a protocol for documentation, 20 assessment criteria, and the judgement of data by a quality circle. After implementation in Munich (1st period, n=90; 2nd period, n=77) the validation took place in Essen (1st period, n=175; 2nd period, n=150). Results: Improvements in diagnostics were shown by significant time savings in radiological diagnostics and before computed tomography in severe traumatic brain injury. In patients with hemorrhagic shock there was a reduction in time before transfusion (49 to 14 min in Munich; 31 to 22 min in Essen) and before emergency operation (74 to 43 min in Munich; 69 to 45 min in Essen). The time before craniotomy was reduced from 97 to 67 min in Munich. The incidence of delayed diagnosis of life-threatening lesions was diminished from 6% to 3% in Munich (not found in Essen). The TRISS technique showed a reduction in mortality in both hospitals in the second period (Munich: 15.4% TRISS vs. 9.1% observed mortality; Essen: 17.8% vs. 11.3%). Conclusions: MQMS improved early clinical treatment in severe injury with respect to therapeutic effectiveness and outcome. The effectiveness of the MQMS was shown at two different hospitals.

Keywords Quality management · Early clinical therapy · Multiple injuries · Severe blunt trauma · Penetrating trauma · Emergency operation

Introduction

Mortality has been greatly reduced in major trauma care over recent decades. Improved care of severely injured patients depends mainly on good prehospital organization and equipment, early clinical treatment in the resuscitation room, well devised strategies for operative treatment, and intensive care especially in the treatment of organ failure. Expectations regarding the results of treatment have been growing continuously. Numerous analyses published during the past three decades have identified the possible complications in the treatment of severely injured patients leading to preventable deaths [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. The following measures have been proposed for resolving these problems:

- The creation of regional trauma centers. This is the only measure unanimously regarded as an effective
tool for improving treatment and reducing the rate of preventable deaths (from 42–28% to 14–2%) [2, 5, 6, 10].

- The development and implementation of treatment guidelines. Guidelines contain the state of knowledge about the treatment of severely injured patients; their implementation can improve the process and possibly survival [14, 15, 16].

- The holding of expert conferences (audit committees, peer review groups) for case discussion and analysis. Expert conferences (audit committees) are a basic feature in trauma centers [17]. These conferences have noted the persistence of preventable deaths even in trauma centers [7, 8, 10, 11, 18, 19, 20, 21]. Scientific confirmation is still lacking, however, that expert conferences lead to improved treatment quality with reduced rates of preventable deaths.

Another possibility for reducing the rate of preventable mortality and morbidity is the implementation of a quality management system with a strong multidisciplinary approach. Quality management, first developed in industry [22, 23, 24], entails the following characteristics: (a) the company’s focus lies on the customer’s needs, (b) results are improved by process improvement, (c) staff is motivated by participation in evaluation processes and decision making, and (d) organizational changes are based on fact only.

Especially in the early clinical treatment of severe trauma, a systematic, coordinated approach of the different medical professionals (e.g., surgery, anesthesiology, radiology) requires precise timing and organization to achieve the most rapid and uncomplicated functioning of the diagnostic and therapeutic process. This is particularly important in view of the finding that management deviations may lead to severe, preventable complications especially during this treatment phase [1, 2, 3].

For improved early clinical treatment of severely injured patients a multidisciplinary quality management system (MQMS) was developed. The present study tested the following hypotheses: (a) MQMS leads to an improvement in process and outcome quality in the treatment of severely injured patients, and (b) MQMS is effective and independent of structural characteristics of the respective hospitals.

**Patients and methods**

The MQMS comprises four main components

**Documentation**

A protocol for online documentation was designed [25] based on guidelines [26] for the treatment of severely injured patients. A physician not involved in the therapeutic process filled out the six-page protocol for every case parallel to the patients' treatment.

**Assessment criteria for the treatment process**

To enable objective, reproducible measurement of every treatment quality assessment criteria were defined with respect to documentation, timely appearance of the team, diagnostics, and timely and adequate therapy (Appendix 1). Criteria were developed out based on the audit filters formulated by the American College of Surgeons [17]. However, these audit filters could not be used unmodified in the presented MQMS because of the following characteristics: (a) Only 8 of the 22 audit filters specifically fit the process of the early clinical treatment of severe injury. (b) The assessment of emergency situations allows excessive tolerance levels, such as 2 h until laparotomy, not considering the patient’s circulatory situation (i.e., hemorrhagic shock). (c) Major aspects of the early clinical treatment of severe injury are not accounted for, such as the duration before blood transfusion in shock and before intubation in respiratory failure and the nature and importance of missed lesions or delayed diagnoses. (d) No analysis is possible of the reasons for delays (i.e., delayed diagnostics with consecutive delayed operation).

**Data analysis**

Demographic data, surgical procedures, complications, lethal courses, and results of the assessment criteria were analyzed regularly and then discussed during the quality circle meetings.

**Quality circle**

The quality circle was composed by the heads of all departments involved in trauma care (Table 1). The bimonthly quality circle

| Table 1 Quality circle members at the Department of Surgery, Klinikum Innenstadt, Ludwig Maximilian University of Munich, and the Department of Trauma Surgery, University Hospital of Essen (ED emergency department, OR operating room, ICU intensive care unit) |
|-----------------|-----------------|-----------------|
| Munich          | Essen           |                  |
| Trauma surgery  | Physicians       | Physicians, ED, OR, ICU nursing staff |
| General surgery | Physicians, ED, OR, ICU nursing staff | Physicians |
| Neurosurgery    | Physicians       | Physicians, OR, ICU nursing staff |
| Anesthesiology  | Physicians, nursing staff | Physicians, nursing staff, ICU nursing staff |
| Radiology       | Physicians, radiological-technical staff | Physicians, radiological-technical staff |
| Laboratory      | Laboratory-technical staff | Physicians, laboratory-technical staff |
| Blood bank      | Laboratory-technical staff | Physicians, laboratory-technical staff |
| Thoracic surgery| –               | Physicians       |

a In Munich the department belongs to the surgical department; in Essen it is independent