Journal of Acute Medicine 7(1): 19-23, 2017
DOI: 10.6705/j.jacme.2017.0701.003
Original Article

Clinical Profile, Treatment Details and Survival of Trauma Patients Treated at Intensive Care Unit in a Level II Trauma Center

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Objective: This retrospective study evaluated all trauma patients who were admitted to intensive care unit in Turku University Central Hospital, Finland in 2000-2004.
Methods: We reviewed details of demographic factors, injury mechanism, treatment details, and the overall recovery of patients after the hospital episode.
Results: A total of 427 trauma patients were identified, 66% of these were severely injured (ISS > 15). 79% of patients were men. The median age of 44 years. The most frequent injury type was road traffic accidents, leisure-time accidents and injury mechanism a high-energy blunt trauma. Head injuries were the most frequently diagnosed severe injury and 59% of the patients were multiple traumatized.
Conclusions: Current results suggest that the overall survival of these patients is satisfactory, although, the head and cervical spine injuries are still often related to compromised prognosis. Despite the improvements in morbidity and mortality of these patients during last decades, still almost every tenth of trauma patient treated in the ICU dies to the complications of the injury.

Key words: *clinical, intensive care, severely injured, trauma, treatment protocol*

Introduction

Treatment of severely traumatized patient often represents a multidisciplinary challenge to trauma organisation in each hospital.[1] The current treatment of these patients is based on modern technical resources as well as on refined therapeutic strategies involving a multidisciplinary team. However, due to the variable characteristics and unexpected timing of these injuries, the fast onset of appropriate treatment algorithms demands clear guidelines and well-defined roles and responsibilities.

Trauma patients who need intensive care can be divided into two groups: those who have severe transient physiological instability and need basic or advanced life support and those who at the time of primary survey are stable but need to be intensively monitored because of a risk of complications with latent onset.[2-4] The first group includes patients with severe head trauma, circulatory shock and impaired tissue perfusion, respiratory insufficiency and those who have undergone extensive surgical procedures. The latter group includes trauma patients with a risk of progressive organ dysfunction.

This retrospective study was designed to review all trauma patients treated in intensive care unit (ICU) of Turku University Central Hospital in 2000-2004. Detailed clinical data was collected to clarify characteristics and clinical profile of these patients, define the treatment protocol and requirements and also find

Received: March 30, 2015; Revised: May 23, 2016; Accepted: October 18, 2016.
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out the overall outcome of severely injured patients.

Methods

Turku University Central Hospital is an 830-bed referral center serving a population of over 700 000 residents in Southwest Finland. The hospital is equipped to handle the most critically injured patients and has a 24 hour emergency and critical care facility and 24 hour availability of care in orthopaedic and traumatologic surgery, as well as abdominal-, thoracic and neurosurgery, anaesthesiology, radiology, internal medicine.

This retrospective chart review was conducted of all trauma patients treated in the intensive care unit (ICU) from 2000-2004. The inclusion criteria were that patients had a diagnosed trauma (ICD-10 code S-) in the ICU records and were delivered to our hospital directly from the scene without treatment periods (more than first aid) in other hospitals. The information retrieved from the medical chart included: patient demographics, accident details, pre-hospital and emergency room clinical status, treatment details and final outcome. These data included patient age, gender, occupational level, accident and injury pattern. The injury was considered high energy in a case of fall > 3m, high-speed car or motorcycle crash (> 60km/h), ejection from car, car-pedestrian or car-bicyclist injury or other high energy collision between the patient and the external environment.

Further, based on the emergency room notes, the primary stability of central hemodynamics and oxygenation, need for mechanical ventilation, blood alcohol level, and injured body regions were obtained. In order to estimate the severity of the total injuries, Glasgow Coma Score (GCS) and Injury Severity Score (ISS) were calculated.[5] The data for treatment details included the type of the surgical procedures, number and timing of the operations. Further, types and timings of complications during intensive care, the duration of intensive care and outcome were also recorded.

Data on complications were retrieved from individual patient charts based on the need for treatment and the definition of the complication was done by the treating physician. The definition of the complications was followed by the global and national clinical guidelines. Infection was defined by prolonged fever (more than two days) combined with progressive leukocytosis. Ventilation-associated pneumonia (VAP) was diagnosed based on new or progressive pulmonary infiltrates on X-ray or CT combined with fever, leukocytosis, purulent secretions and possible positive pleural fluid culture. The criteria for acute kidney injury (AKI) were oliguria and significant rise in blood urea and creatinine levels. End-organ disorders and multiple organ dysfunction syndrome (MODS) was clinically defined as the development of progressive and potentially reversible physiologic derangement involving two of more organ systems not involved in the disorder that resulted in ICU admission.

For statistical analyses the Spearman rank correlation coefficient was used to determine the connection between ISS, patient age and the total number of days of treatment at hospital. In addition, Pearson correlation was used to evaluate the linear relationship between these variables. Relation of blood alcohol level to different accident types was analysed by Chi-square test. A p-values < 0.05 was considered to be significant.

Results

Among of the 8590 patients treated in the ICU during the study period there were a total of 427 patients with trauma history (Fig. 1). The study group consisted of 339 (79%) males and 88 (21%) females with a median age of 44 years (range 5-90 years). The occupational level was identified with 350 patients. 49% of those were of lower and 9% of higher employment status. 23% were retired, 11% students, 5% unemployed and 3% children (age < 16 years). The most frequent trauma type was high-energy traffic accident with a blunt trauma mechanism (Table 1).

At admission, the blood alcohol level was above the legal limit of 0.5 (1/1000) for 45% (132/291) patients data available. For all types of injuries, the patients with increased blood alcohol level were significantly more likely to be involved in road- (37%) leisure-time- (54%) and violence (71%) accidents (p = 0.0015).

59% of the patients were multitraumatized (two or more injured body parts) and 66% of the patients had an Injury Severity Score (ISS) higher than 15. The clinical status of study patients in the emergency room at admission is shown in Table 2.

In 26% of study patients, the clinical status required primary radiological examinations (X-ray (thorax, pelvis) and/or ultrasound) in the emergency room, prior to transferring the patient to the radiolog-

ical department for additional examinations. 27% of the study patients underwent a CT scan of the head, cervical spine, chest, abdomen and pelvis according to the standardized trauma protocol.

Table 1. Injury characteristics

Accident type	%
Traffic	44
Leisure-time	38
Violence	7
Suicide	7
Occupational	4
Injury Energy	%
Low	40
High	60
Injury mechanism	%
Blunt	91
Penetrating	7
Thermal	3

The anatomical distributions of the injured body regions are shown in Table 3. 41% of patients had a diagnosed trauma only in one of the seven body regions, 29% in two, and 30% in three or more body regions. 8% of the patients had an open fracture. 69% of the patients were treated operatively, of those 55% within first 24 hours of admission. 6% patients needed three or more operations during the hospital episode.

The median length of the ICU stay care was 4 days (range 1-75 days). Complications were reported during ICU period in 40% of the patients, of which 21% (90) were infections, 15% (63) VAP, 2% (7) renal failure and 1% (3) MODS. 9% of the patients died during the ICU stay, 81% of them from head injury and 12% from cervical spine injury.

After ICU period, the mean length of the hospital stay was 9.4 days (range 1 to 85 days). The level of

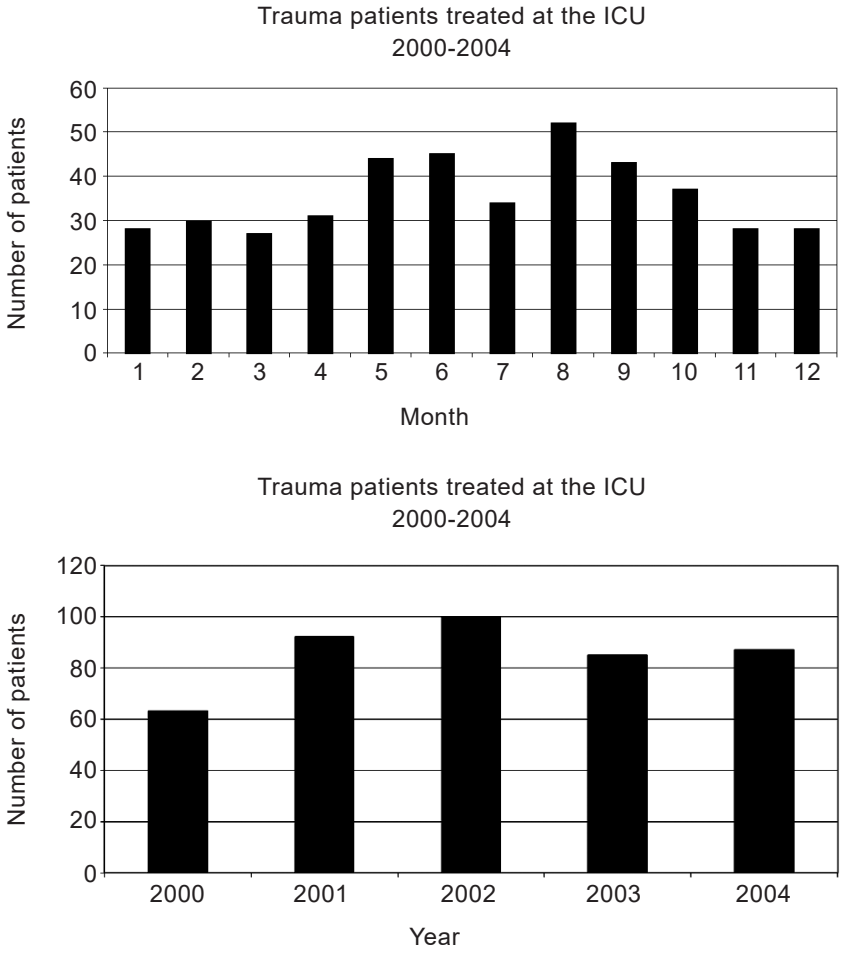

Fig. 1. Average number of trauma patient admissions to ICU from 2000 to 2004.

ISS at admission had positive correlation (p = 0.0003 r = 0.177) and the patient age had negative correlation (p = 0.0275, r = -0.107) with the total length of the hospital stay (Fig. 2).

In the study, the mean follow-up after hospital episode was 11.6 months (range 0.5 to 60 months). 64.5% (n = 258) of the survived patients had information at final follow-up concerning the need of any aids. 18% (n = 46) of those patients needed support for their daily activities and/or for walking. Further, of 224 patients information available, 102 (46%) did not return to their pre-injury level of employment.

Table 2. Study patient's clinical status in the emergency room at admission

Glasgow Coma Scale	%
3-5	26
6-8	13
9-11	8
12-15	52
Injury Severity Score	**%**
1-15	32
16-30	52
31-45	12
45-75	2
Hemodynamics	**%**
Stable	85
Unstable*	15
Mechanical ventilation	**%**
yes	51
no	49
Blood alcohol level (1/1000)	**%**
0	54
0.5-2	21
> 2	24

*Unstable hemodynamics: systolic blood pressure < 90 mm/Hg and pulse > 110/min.

Discussion

It has been estimated that approximately 1,000-1,300 severe injuries (ISS > 15) takes place in Finland every year (19-25/100,000).[6] During the last decade the morbidity and mortality of severely traumatized patient has significantly improved because of more accurate diagnostics, advances of treatment modalities, and modern intensive care.[1,7] However, in many hospitals, the small frequency of these patients, leads to a great need of continually educate specialists to maintain actual diagnostic principles and treatment guidelines.[8]

The epidemiologic profile of these patients gives a guideline for injury prevention.[9] Based on the current results and in accordance with previous publications, the road traffic has been the leading cause

Table 3. Anatomical distribution of the injured body regions

Injured body region	%
Head	59
Musculo-skeletal	36
Abdominal	13
Facial	11
Spinal cord	10
Urogenital	4

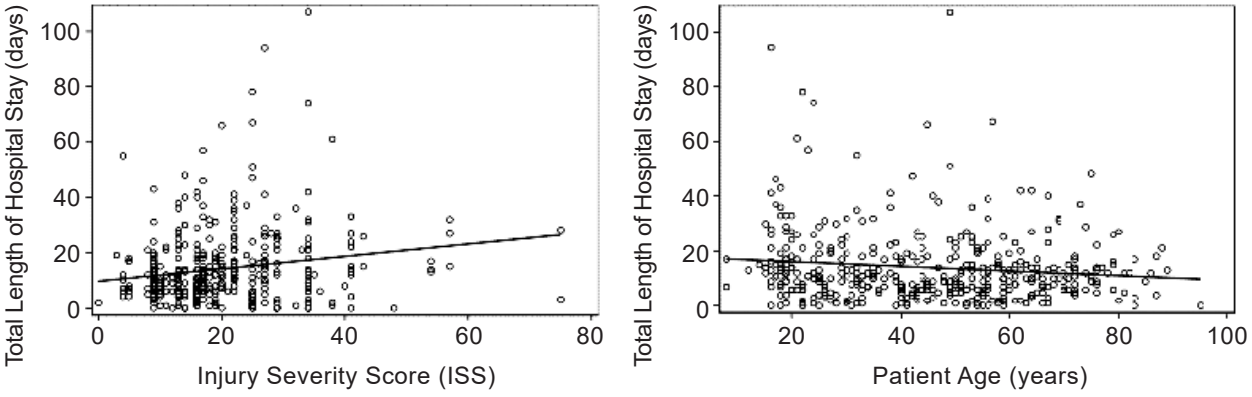

Fig. 2. Scatter plot and regression line illustrating the correlation between the ISS score, patient age and total length of hospital stay.

of severe injuries,[10,11] although in our series, also the leisure-time accident rate (38%) was high. Further, a common risk factor related to these injuries has been high blood alcohol level.[12] Based on our data, a common risk factor related to these injuries was to be with high blood alcohol level. Instead, the frequency of severe occupational accidents was only 4%, although more than two thirds of the study patients had an occupational or student status. Based on a relatively high suicide rate in Finland, the suicide attempts accounted for 7% of the study injuries and were mostly high-energy falls from heights.

Admission criteria for intensive care of trauma patient are based on co-decision of the traumatologist and ICU specialist. The decision relies on patient`s clinical condition and the accident details and must be individually considered. In our series, 30 % of the patients were not severely injured (ISS < 15) during the ICU treatment period. These patients were mostly from the high-energy accidents and were estimated to high-risk patients for late potentially severe complications. Primarily normal vital functions of a multitraumatized patient in emergency room may be compromised within few hours and missed injuries are fairly common.[13,14] Hence, the intake criteria for admission to intensive care unit for patients with signs of severe injuries or potentially life threatening accident details should be reasonably low.

This study has certain limitations. Due to the greatly varied characteristics of study population and retrospective nature of the study, the results were expressed only in descriptive manner without detailed statistical analyses. However, although there are comprehensive literature available for treatment details of severely injured patients, the statistical assessment of the prognostic factors for these patients still remains partly unclear and need further evaluation.

To conclude, the clinical characteristics of trauma patients treated in ICU were reviewed. Current results suggest for satisfactory overall survival of these patients. Head and cervical spine injuries are still often related to compromised prognosis. Despite the improvements in morbidity and mortality of these patients during last two decades, still almost every tenth of trauma patients treated in the ICU dies to the complications of the injury. Due to the great variety in characteristics of severely traumatized patients, the treatment has to be adapted to each situation and provide the optimal possible solution in each particular case. Continuous learning from the trauma data will provide improved assessment of treatment algorithm for these patients.

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