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Tertiary survey in polytrauma patients should be an ongoing process

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ABSTRACT

Introduction: Due to prioritisation in the initial trauma care, non-life threatening injuries can be overlooked or temporally neglected. Polytrauma patients in particular might be at risk for delayed diagnosed injuries (DDI). Studies that solely focus on DDI in polytrauma patients are not available. Therefore the aim of this study was to analyze DDI and determine risk factors associated with DDI in polytrauma patients.

Methods: In this single centre retrospective cohort study, patients were considered polytrauma when the Injury Severity Score was ≥16 as a result of injury in at least 2 body regions. Adult polytrauma patients admitted from 2007 until 2012 were identified. Hospital charts were reviewed to identify DDI.

Results: 1416 polytrauma patients were analyzed of which 12% had DDI. Most DDI were found during initial hospital admission after tertiary survey (63%). Extremities were the most affected regions for all types of DDI (78%) with the highest intervention rate (35%). Most prevalent DDI were fractures of the hand (54%) and foot (38%). In 2% of all patients a DDI was found after discharge, consisting mainly of injuries other than a fracture. High energy trauma mechanism (OR 1.8, 95% CI 1.2–2.7), abdominal injury (OR 1.5, 95% CI 1.1–2.1) and extremity injuries found during initial assessment (OR 2.3, 95% CI 1.6–3.3) were independent risk factors for DDI.

Conclusion: In polytrauma patients, most DDI were found during hospital admission but after tertiary survey. This demonstrates that the tertiary survey should be an ongoing process and thus repeated daily in polytrauma patients. Most frequent DDI were extremity injuries, especially injuries of the hand and foot.

Introduction

Due to prioritisation in the initial trauma care, non-life threatening injuries can be temporally neglected or overlooked. Therefore a tertiary survey was introduced [1]. The necessity for the implementation of a tertiary survey has been well established in literature, showing rates between 1 and 10% of injuries not diagnosed during initial assessment and resuscitation in the primary and secondary survey [2–6].

Polytrauma patients in particular might be at risk for delayed diagnosed injuries (DDI). In two Dutch cohort studies a relationship between the percentage of polytrauma patients and the incidence of DDI was previously observed [5,6]. The majority of DDI are extremity injuries but also injuries to the head, thorax and abdomen are potentially missed [1–8]. However, by broader implementation of the CT-scan in initial trauma care, numbers of the latter have been reduced [1–8].

Over the past two decades several risk factors for DDI in a whole trauma patient population have been identified; higher injury severity score (ISS), intensive care unit (ICU) admission, and lower Glasgow Coma Scale (GCS) being most important [3,5–7]. Despite these known risk factors, rates of DDI still remain high in recent studies [6,8,9]. Interestingly, formalisation of the tertiary survey using checklists or other tools, does not seem to further reduce the rate of DDI [9].

Previously performed studies on polytrauma patients either analyzed ICU admitted polytrauma patients only or a specific subgroup of injuries (e.g. hand or foot injuries) in polytrauma

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patients [10–13]. However, none of the available studies solely focused on DDI in polytrauma patients in general. Therefore the aim of this study was to analyze DDI in polytrauma patients, to determine the time until diagnosis, most affected body regions for DDI and determine risk factors associated with DDI.

Materials and methods

This was a single centre retrospective cohort study. Patients were considered polytrauma when the ISS was ≥16 as a result of injury in at least 2 body regions. The ISS was calculated using Abbreviated Injury Scale (AIS) scores [14]. Polytrauma patients aged ≥16 years, admitted from January 2007 until December 2012 to our hospital, a level 1 trauma centre, were identified. Fig. 1 shows the in- and exclusion criteria.

A multidisciplinary team following the ATLS guidelines provided trauma care. Primary and secondary surveys were performed during initial trauma care in the Emergency Department and tertiary survey was performed within 24 h after admission to the hospital [15]. Tertiary survey included repetition of primary and secondary survey, including a head-to-toe examination in which all body regions and extremities were investigated for missed injuries. Review of any diagnostic assessments e.g. laboratory and radiologic findings were performed and when necessary, additional diagnostics were obtained [15]. In patients with a decreased level of consciousness, those admitted to the ICU, patients with severe distracting injury, and patients with other factors compromising adequate response, a final survey was performed when the patient was able to communicate or discharged to a rehabilitation centre.

Patient data were derived from the local prospective database contributing to the Dutch National Trauma Database (DNTD). The DNTD contains information on demographics, trauma mechanism, findings from radiologic imaging or procedures, injuries found during admission, department of admission, GCS, and mortality. The DNTD is a prospectively collected database and two database managers and a trauma surgeon constantly evaluate its accuracy.

Definitions such as high energy trauma (HET) were used according to the ATLS guidelines [15]. Level of consciousness was assessed with the GCS [16]. Patients were divided into three categories: low (GCS ≤ 8), intermediate (GCS 9–13) or high (GCS ≥ 14).

Time of diagnosis for DDI was defined according to Keijzers et al.: type I for DDI found during the tertiary survey, type II for DDI found during admission but after tertiary survey and type III for DDI found after discharge [8]. To determine time of diagnosis and injuries found after hospital discharge, electronic patient documentation of all patients was reviewed. Outpatient department visits of all other disciplines were reviewed to determine follow-up rate.

All injuries were allocated to one of six body regions; head and neck (including cervical spine), face, thorax (including thoracic spine), abdomen (including lumbar spine and pelvis), extremities and external (wounds, lacerations, minor crush injuries with or without involvement of subcutaneous tissue, and burns). The allocations were coded using AIS location codes.

Patients with and without a DDI were compared to identify risk factors. Age, gender, HET, ISS, level of consciousness, body region involvement, transport to the OR and admission department were analyzed as potential factors associated with DDI.

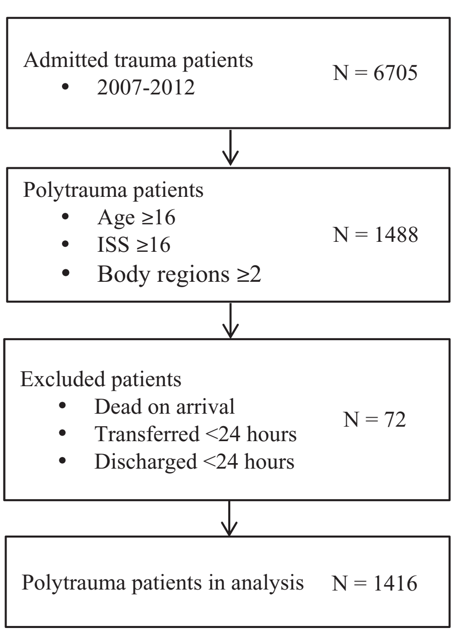

Fig. 1. Flowchart of included and excluded patients (*N*; number, ISS; injury severity score).

Data analysis

Statistical analysis was performed with SPSS version 21 (IBM Corp., Armonk, NY) for Windows. Data were reported as medians noted with interquartile range. The χ^2 test was used for categorical variables, and Fisher's exact test was used for categorical variables in case of a cell volume less than 5. Continuous variables were analyzed using the Mann–Whitney-*U* test, as all variables were non normally distributed. For uni- and multivariate analysis, injuries and level of consciousness documented during initial assessment were included. Missing values for level of consciousness were imputed using multiple imputations with the following variables: age, maximum AIS score for Head injury; maximum AIS score for injuries to other body regions than Head; injury mechanism HET or low energy trauma; if patients died, and duration of ICU stay. Binary logistic regression analysis was used for post-hoc analysis. All variables with a *p*-value of 0.10 or less and possible confounders were included in a multivariate binary regression analysis, using a backward Wald method. A *p*-value of ≤0.05 was considered significant.

Results

A total of 1416 patients were included in this study. The in hospital mortality rate was 15% (*n* = 218) and 6% (*n* = 78) of the patients were transferred to another hospital during admission. Outpatient department follow-up data from 78% patients were available (*n* = 938 of 1198 patients who survived).

Table 1 shows the demographics of the study population per group, with DDI and without DDI. In 172 patients (12%) DDI were found. Two patients had DDI found both at tertiary survey and during admission and four patients had DDI found both during admission and after discharge. In 22% of the DDI it was found during tertiary survey (type I), 63% was type II and 15% was found after discharge (type III), the distribution of time until diagnosis of the DDI is provided in Fig. 2.

Extremity fractures were found in 735 patients and clavicle fractures were the most frequently found fracture of the extremities (14%). In 19% of these patients an extremity DDI was found, making extremity fractures the most prevalent type of DDI. Table 2 provides an overview of the frequency of DDI for other body regions. The highest prevalence of DDI was found in hand and foot, as 54% (*n* = 39) of the hand and 38% (*n* = 23) of the foot fractures were DDI. An overview of all extremity fractures and the