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Major influence of interobserver reliability on polytrauma identification with the Injury Severity Score (ISS): Time for a centralised coding in trauma registries?

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ABSTRACT

Objective: The Abbreviated Injury Scale (AIS) and the Injury Severity Score (ISS) find increasingly widespread use to assess trauma burden and to perform interhospital benchmarking through trauma registries. Since 2015, public resource allocation in Switzerland shall even be derived from such data. As every trauma centre is responsible for its own coding and data input, this study aims at evaluating interobserver reliability of AIS and ISS coding.

Methods: Interobserver reliability of the AIS and ISS is analysed from a cohort of 50 consecutive severely injured patients treated in 2012 at our institution, coded retrospectively by 3 independent and specifically trained observers.

Results: Considering a cutoff ISS $\geq$ 16, only 38/50 patients (76%) were uniformly identified as polytraumatised or not. Increasing the cut off to $\geq$20, this increased to 41/50 patients (82%). A difference in the AIS of $\geq$ 1 was present in 261 (16%) of possible codes. Excluding the vast majority of uninjured body regions, uniformly identical AIS severity values were attributed in 67/193 (35%) body regions, or 318/579 (55%) possible observer pairings.

Conclusion: Injury severity all too often is neither identified correctly nor consistently when using the AIS. This leads to wrong identification of severely injured patients using the ISS. Improving consistency of coding through centralisation is recommended before scores based on the AIS are to be used for interhospital benchmarking and resource allocation in the treatment of severely injured patients.

Introduction

Data from trauma registries find an increasingly widespread use for identification of the burden to the health system caused by severely injured patients and also for interhospital benchmarking. A key element is the Injury Severity Score (ISS) [1,2]. An internationally accepted definition of polytraumatised patients is an ISS $\geq$ 16 [3,4]. This threshold is based on the first description as being predictive of a mortality risk above 10% [5]. Data collection and assessment for input into the trauma registries often has to be provided by each participating hospital, performed either by physicians or professional coders with a varying degree of training. In Switzerland, coding is also outsourced to institutions serving several hospitals [6]. As the ISS is calculated by summing squares of the Abbreviated Injury Scale (AIS) [1,7], there is a significant leverage power of the initial injury coding. A difference of a single point in an AIS severity value might make the difference between classification of a case as being a polytrauma or not.

In order to optimise nationwide management of severely injured patients, the Swiss National Health Department recommends to allocate polytraumatised patients to 12 core hospitals [2], roughly equivalent to the definition of level 1 trauma centres [8]. In Switzerland however, the cutoff for the definition of polytraumatised patients has been set at an ISS $\geq$ 20 [2]. This political decision had been made based on expert opinion for a better discrimination of severely injured patients. As these data shall be used in Switzerland to compare the trauma burden and performance between hospitals, with the aim of influencing allotment of resources and funding to the treating hospitals, this study was set up to analyse the impact of interobserver reliability

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on the ISS. Both variability of the ISS and the identification of polytraumatised patients with this score are analysed. Results from this study may also be useful for other countries than Switzerland, where trauma registries are already running, in order to optimise data quality.

Methods

Since 2010, all patients triaged as potentially severely injured and treated by the dedicated trauma resuscitation team have been collected prospectively in an in house registry. The cohort had been established as part of the certification process as a core trauma centre within the Swiss intercantonal agreement for highly specialised medicine (IVHSM) [2]. Patients with medical conditions not related to trauma were excluded. From this consecutive cohort, the first 50 patients treated in 2012 have been selected for this study. Two patients from this cohort were not adults, being 9 and 12 years old, respectively. As it was an observational reanalysis of an already established and authorised anonymous dataset, no submission to an ethical committee was required.

Based on full medical records, as available in the electronic clinical information system, three observers coded independently and blinded to each other all injuries they could identify retrospectively, following the 05/08 update of the AIS manual [7]. AIS coding is valid for both adults and children. The three observers, two registrars and one resident in specialist training, had been specifically trained for this study by a certified AIS coding specialist. Every injury was coded with the full 7-digit AIS code. In this coding system the first six digits refer to a unique numerical identifier for the body region, the type of anatomical structure and the specific injured structure. The seventh digit describes the severity of the injury on an ordinal scale ranging from 1 to 6, grading from minor to untreatable injury. The body regions coded in AIS08 are Head, Face, Neck, Thorax, Abdomen, Spine, Upper Extremity, Lower Extremity, External and other. In order to group lesions appropriately for the ISS, spine injuries have been subdivided in cervical, thoracic and lumbar injuries. Thus a total of 11 body regions have been analysed separately instead of the official 9.

The ISS was then calculated for each patient by summing the squares of the highest AIS in the three most severely injured body regions, as defined for this score, requiring appropriate grouping of the AIS body regions (head/neck/cervical spine, face, chest/thoracic spine, abdomen/pelvic content/lumbar spine, extremities/pelvic girdle, external/integument) [1]. The ISS scale ranges from 0 to 75. Patients with an untreatable injury (AIS 6) automatically are assigned to an ISS of 75. Both the international cut off value of ISS $\geq$ 16 and the Swiss definition for severely injured patients with ISS $\geq$ 20 were considered in this study to define a polytraumatised patient.

The statistical analysis was performed using the SPSS statistical package, Version 22 (IBM Corp., Armond, NY, USA). Continuous data are described as median and ranges, categorial data as counts and percentages. Interobserver correlation of AIS and ISS is described with proportions of identical scores and distribution of differences, and analysed with correlation coefficients. Intraclass correlation coefficients were calculated to evaluate interobserver consistency, using average measures of a two-way mixed model. The kappa correlation coefficient was calculated to evaluate interobserver agreement, as a mean value of all individual pairs of observers. Correlation in identification of more relevant injuries, compared to less relevant injuries, once with a cut off at AIS > 1 and once at AIS > 2, was analysed, as was classification of patients as severely injured (polytraumatized) for both cut off values of ISS $\geq$ 16 and $\geq$ 20, respectively. Considering the non-normal distribution of values, data are described with median and range, and correlation coefficients were calculated using Spearman's rho rank test. When data were transformed appropriately, Pearson's correlation test could be used.

Results

AIS values were available from all 3 observers for all 11 body regions defined in this study for all 50 patients. ISS scores were calculated accordingly for all patients.

Injury Severity Score

Median ISS were 12, 12.5 and 14 points, ranging from 0 to 75 points, for all 3 observers. Median difference in ISS between every possible observer pairing was 3 points, with a range of 0–17 points, with an overall median of 12.5 points. While the mean intraclass correlation coefficient for the ISS values was extremely high at 0.975 (95% CI 0.961–0.985), indicating an excellent interobserver consistency, the mean ranked Spearman rho correlation coefficient dropped to 0.889. The same ISS score was however attributed in only 57 of the 150 (38%) possible observer pairings (50 patients coded by 3 observers).

An ISS $\geq$ 16 had been attributed to 19, 20 and 22 patients, respectively, by each observer. Considering this limit of ISS 16, only 38 of the 50 patients (76%) had been identified uniformly by all 3 observers as polytraumatised or not. Considering all 150 possible pairings (50 patients coded by 3 observers), observers agreed upon this threshold in 126 (84%) of these 150 cases. Interobserver agreement was rather low, with a mean Pearson's correlation coefficient for this ISS cut off of 0.671 (range 0.622–0.757).

An ISS $\geq$ 20 had been attributed in 11, 13 and 17 patients respectively by each observer. Considering an ISS of 20 as cut off value, 41 of the 50 patients (82%) had been identified uniformly by all 3 observers as polytraumatised or not. This corresponds to an agreement in 132 (88%) of 150 possible observer pairings (50 patients coded by 3 observers). With the higher ISS cut off value, the mean Pearson's correlation coefficient increased to 0.711, but with more variability between observer pairs (range 0.566–0.826).

Abbreviated Injury Scale

No injury (AIS 0) had been identified by the 3 observers in 383 (70%), 407 (74%) and 414 (75%), respectively, of all 550 possible AIS codes (11 body regions in 50 patients). All 3 observers agreed on the absence of any injury in 357 (65%) of all 550 possible AIS codes. Mild injuries (AIS 1) had been identified in 41 (8%), 42 (8%), and 61 (11%), and more severe injuries (AIS $\geq$ 2) had been identified in 94 (17%), 102 (19%) and 106 (19%), respectively, of 550 possible body region codes. The maximum of AIS 6 for untreatable injuries had been attributed once by two observers, but twice by the third. Interobserver consistency for all possible AIS reached a mean intraclass correlation coefficient of 0.951. The mean ranked Spearman rho correlation coefficient was only 0.788.

An inconsistency in the AIS severity value of $\geq$1 point was present in 261 (16%), and a difference of $\geq$2 points was found in 65 (4%), of all 550 possible AIS codes. When excluding all 357 body regions in which the observers had unanimously identified no injury, all three observers had uniformly attributed identical AIS severity values in 67 of 193 (35%) injured body regions. Agreement was then observed in 318 of 579 (55%) possible observer pairings (3 possible pairings of 193 observations each). As the observers had agreed on the AIS severity value in just more than half of possible pairings, the median error however appears as being 0 (range 0–3) points. Differences in AIS severity value coding of $\geq$2 points were observed in 65 (11%), and of 3 points in 12 (2%) possible observer pairings, again considering only body regions in which at least one

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