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How is the injury severity scored? a brief review of scoring systems

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ABSTRACT

The management of injured patients is a critical issue in pre-hospital and emergency departments. Trauma victims are usually young and the injuries may lead to mortality or severe morbidities. The severity of injury can be estimated by observing the anatomic and physiologic evidences. Scoring systems are used to present a scale of describing the severity of the injuries in the victims.

We reviewed the evidences of famous scoring systems, the history of their development, applications and their evolutions. We searched electronic database PubMed and Google scholar with keywords: (trauma OR injury) AND (severity OR intensity) AND (score OR scale).

In this paper, we are going to present a definition of scoring systems and discuss the Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS), the most acceptable systems, their applications and their advantages and limitations.

Several injury-scoring methods have been introduced. Each method has specific features, advantages and disadvantages. The AIS is an anatomical-based scoring system, which provides a standard numerical scale of ranking and comparing injuries. The ISS was established as a platform for trauma data registry. ISS is also an anatomically-based ordinal scale, with a range of 1-75. Several databases and studies are formed based on ISS and are available for trauma management research.

Although the ISS is not perfect, it is established as the basic platform of health services and public health researches. The ISS registering system can provide many opportunities for the development of efficient data recording and statistical analyzing models.

Introduction

Management of traumatic patients is a critical issue in emergency medicine (1). The injuries are one of the most important causes of mortality and morbidity among young and active population(2). In 2009, tens of thousands of deaths were reported due to the accidents in USA, with most victims aged 10 to 40 years (3). In Iran, unintentional injuries are mentioned as the second cause of death (4). Trauma management is debatable in three phases, prehospital, hospital and follow-up.

Management of the patients at prehospital and hospital phases is in the domain of emergency medicine. Simplicity, speed, accuracy and the capacity for reform are the important features of efficient emergency management systems (1).

There are two ideas about the treatment of traumatic patients including taking the patients to the nearest hospital or transfer them to a trauma center. The first evidences that mentioned the superiority and better quality of trauma care in

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specialized trauma centers, were related to 1970. The first questions appeared in this model of management, are "which patients should be taken to trauma center?" and "what scoring system should be used?" (5-7).

Here, we are going to have a review of scoring systems, their history and applications.

We reviewed the evidences of more famous scoring systems. We searched electronic databases such as Google scholar and PubMed by these key words: (trauma OR injury) AND (severity OR intensity) AND (score OR scale). Among the search results, forty articles were found relevant about the basis of the injury scoring systems, the history of their development, applications and their evolutions. Different scoring systems were introduced based on different aspects of trauma and the needs for trauma registries. There was no one scoring system that was globally accepted but it seemed that Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS) were more frequently applied to the data registries for trauma researches and planning.

In this paper, we are going to present a definition of scoring systems and their applications and we will discuss the AIS and ISS, the most acceptable systems, their applications and a brief review of their advantages and limitations.

Literature review

Scoring systems: Initial expectation of an efficient injury scoring system is clarity, simplicity and being user-friendly and the ability to accurately classify and include both anatomic and physiologic evidences. Furthermore, it should be able to provide a general conclusion with regard to patient age, co-morbidities, mechanism of injury and clinical judgment (5,8-11).

The injury severity scoring has different applications. Databases include the traumatic patients and injury severity scores, which allow the trauma management researchers to evaluate quality of care and overall trauma management and compare different centers and various therapeutic protocols, estimate the risk of mortality and morbidity, predict the length of hospital stay and provide a valid measure for monitoring trauma centers at different levels. Moreover, the results of the analysis of these databases can be used to provide the accident prevention plans. Besides, the injury severity scoring has been used as a common language for scientific exchange among researchers and trauma centers (7,8,12,13).

Several injury scoring methods have been introduced. Initially, these scoring methods were applied to the prehospital triage. These methods were based on anatomic or physiologic criteria or a combination of them.

ISS and New Injury Severity Score (NISS) are anatomic-based and Glasgow Coma Scale (GCS) and Revised Trauma Score (RTS) are physiologic-based scoring methods. A Severity Characterization of Trauma (ASCOT) and Trauma Related Injury Severity Score (TRISS) apply a combination of anatomic and physiologic criteria for injury scoring (2,5,10,13,14).

Each method has specific features, advantages and disadvantages. The ISS was established as a platform for trauma data registry (8,15). Several databases and studies are formed based on ISS and are available for trauma management research.

Abbreviated Injury Scale: The AIS is an anatomical-based scoring system, which was developed in 1971 to provide a standard numerical scale for ranking and comparing injuries (16). AIS was supported and update by Association for the Advancement of Automotive Medicine (AAAM)(17). AIS 05 is the most recent edition that was updated in 2005 (18).

Several thousands of injuries to nine anatomical regions of the body (head, neck, face, chest, abdominal and pelvic viscera, vertebral column, upper extremities, lower extremities and external genitalia) are described. Each injury is assigned an AIS score on an ordinal scale ranging from 1 (minor injury) to 6 (maximum injury, possibly lethal). In multiple injured patients, the highest AIS is known as the maximum AIS (MAIS). The AIS initially was used as an independent system of the injury scoring. But due to its obvious shortcomings, such as non-linear correlation with the risk of mortality in multiple traumas, a new expression of AIS named Injury severity score (ISS) was developed and introduced by Baker et al (5).

Injury Severity Score: ISS is an anatomically-based ordinal scale, with a range of 1-75 (11). For calculating the ISS, first the nine AIS body regions are grouped into six: head and neck, face, chest and thoracic spine, abdominal and pelvic organs and abdominal spine, limbs and pelvic girdle, extra. Then, the sum of the squares of the AIS for the three most severely body regions calculated.

For example, if a person sustained multiple injuries to the head, chest and extremities and it is described by AIS as nondepressed skull fracture (AIS=2), one rib fracture (AIS=1) and open Tibia fracture (AIS=3), then the ISS is equal to $2^2 + 1^2 + 3^2$ that is 14 (Table 1).

If the scale of injury for any anatomic region is six, then ISS score is considered maximum score (ISS=75). If the scale of an injury cannot be determined, the AIS scale is assigned as 9 and ISS score could not be calculate and the number 99 is given (11).

Advantages: ISS is the most common method accepted for trauma severity scoring and frequently

Table 1. An example of Injury Severity Score (ISS) calculation

Anatomical area	Injury description	AIS* score form AIS data base	Square root of three maximum score
Head and neck	Non depressed skull fracture	2	4
Face	No Injury	0	0
Chest and thoracic Spine	One rib fracture	1	1
Abdomen, pelvic viscera and abdominal spine	No Injury	0	0
Upper, lower extremity and pelvic girdle	Open fracture of Tibia	3	9
Extra	No Injury	0	0
ISS			14

*AIS: Abbreviated Injury Scale

used in trauma researches and data registries (15). The ISS is a reliable tool for the mortality prediction and it has been tested in various trauma databases (3,5,8-10,19). Furthermore, it have acceptable results in prediction of the final outcomes in combination with other scoring systems. These results are independent of race and sex and it can be applied to all ages (11). Besides, it has an appropriate support for the reform and development (17).

Limitations: As mentioned previously, several new methods of the injury severity scoring are available. Most of these alternative methods have been devised and developed to correct the limitations and shortcomings of the ISS. These shortcomings include inadequate ISS results in severe multiple injuries in the same anatomical region in addition to the injury score less than expected in penetrating injuries and dependence on angiography or MRI in some cases. Another significant limitation is a decrease in discrimination power of the ISS in scores greater than 15 (ISS>15) and older ages. In addition, the ISS distribution is not normal (7,13,14).

Conclusion

Although the ISS is not perfect, it is established as the basic platform of health services and public health researches. The ISS registering system is a natural twin of trauma data recording systems and designing trauma databases for variety of practical purposes. Moreover, it can provide many opportunities for the development of efficient data recording and statistical analyzing models.

With the development and advancement of the ISS and accurately data recording systems, ISS application in prediction of mortality, hospitalization time, comparison of medical centers, comparison of treatment protocols, treatment monitoring, evaluation and decision-making processes could be extended. The combination of anatomical and physiological scoring systems, age and other preexisting assumptions is important and effective for the overall predictive of outcome in comparison to prediction of mortality.

Acknowledgement

Conflict of Interest

The authors declare no conflict of interest.

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