Encyclopedia of Intensive Care Medicine

Jean-Louis Vincent and Jesse B. Hall (Eds)

Encyclopedia of Intensive Care Medicine

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A

A1M

► Serum and Urinary Low Molecular Weight Proteins

AAA

► Abdominal Aortic Aneurysm: Diagnosis and Management

AAST Spleen Injury Scale

The American Association for the Surgery of Trauma sponsored an expert panel that described five categorizes of progressively more severe spleen injury which correspond to prognosis, and have been used to guide decisions regarding nonoperative management.

Abbreviated Injury Scale

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Synonyms

The Abbreviated Injury Scale has no synonyms. It is commonly known by its acronym (AIS), however, with versions noted by year, for example, AIS 2005

Definition

Injury Severity Scoring

► Injury severity scoring systems are used to measure the impact of injury both in terms of physical damage and of response of the body to that damage. Anatomic scores describe the force applied to the body and indicate site of injury and extent of damage. Physiologic scores (discussed elsewhere) attempt to summarize the body's response to injury (e.g., changes in blood pressure, respiratory rate, and responsiveness).

Injury severity scores are used to characterize injury severity and predict patient outcome; to aid health-care personnel in making triage and patient management decisions; in objective assessment of prehospital, trauma center, and trauma system care; and in clinical research, quality assurance/improvement, and resource allocation. Anatomic scores are used to compare injuries for the purposes of quantifying outcomes for quality assurance and epidemiologic studies. The AIS is one of the most commonly used anatomic scoring systems.

Abbreviated Injury Scale (AIS)

The AIS is a method of ranking anatomic injury in nine body regions along a six-point scale of severity. Promulgated in 1971 by the Association for the Advancement of Automotive Medicine (AAAM) in response to the growing number of worldwide vehicular injuries and deaths, it provided for the first time a simple, standardized vocabulary for describing injuries and a numerical method for ranking and comparing injuries by severity [1]. At present, the AIS is still used as a primary measure of injury severity in clinical research, trauma registries, government, academia, and industry [2].

AIS severity	
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximal (currently untreatable)

AIS Components

AIS 2005, Update 2008, the most recent version, comprises six values, a dot, a one-digit severity code, and eight optional values (see Table 1). The injury descriptor

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comprises the six digits to the left of the dot; this pre-dot code contains values indicating AIS body region injured, type of structure injured, specific anatomic structure injured, and level of injury. The post-dot code contains the severity score, and may also contain optional descriptors indicating location of injury, whether it was intentional or unintentional, cause of injury, etc. Example injuries coded in AIS 2005 Update 2008 (using all but the optional components) are parsed out in Table 2.

Abbreviated Injury Scale. Table 1 AIS components

Code	Description
Pre-dot code	
1	AIS body region/chapter: (1) head, (2) face, (3) neck, (4) thorax, (5) abdomen/ pelvis, (6) spine, (7) upper extremities, (8) lower extremities, (9) external/burns, (0) other trauma
2	Structure type: (1) whole area, (2) vessels, (3) nerves, (4) internal organs, (5) skeleton, (6) skin
3, 4	Specific anatomic structure: (00–99), for example, 30 = femur
5, 6	Level of injury: (00–99), e.g., 01 = proximal portion of bone
Post-dot code	
7	Injury severity: (1) minor, (2) moderate, (3) serious, (4) severe, (5) critical, (6) maximal (currently untreatable), (9) unknown
Optional post-dot codes	
8, 9	Injury location: Side and aspect of injury location (01–99)
10, 11	Injury location: Used with 8, 9 for more specific location information (00–99)
12	Volition: 0 = non-intentional, 1 = intentional (0–1)
13, 14	Cause of injury (01–99)
15	0 or specific situations (e.g., infant seat) (0–?)

Of the components of the AIS, the severity score (first post-dot code) is the most widely used and reflects injury severity by body region along a six-point ordinal scale ranging from minor to untreatable. Severity scores are determined via expert consensus using the criteria of threat to life, permanent impairment, treatment period, and energy dissipation [2]. The severity score component is the feature for which the AIS is most well known and was the starting point for the expanded versions that followed as the AIS evolved.

Evolution of the AIS: 1971–Present

The initial iteration of the AIS contained five body region classifications (head/neck, chest, abdomen, pelvis/extremities, and general) and a dictionary of 73 blunt injuries, with each assigned a severity score ranging from 1 (minor) to 6 (maximal, untreatable). The scores were determined by a group of experts who ranked each injury based on threat to life, permanent impairment, treatment period, and energy dissipation. Since its introduction, the AIS has been revised and updated several times (Table 3). The dictionary listing grew from its original 73 descriptions of primarily blunt injury to approximately 500 by the time the 1976 version was published to more than 2,000 descriptors by AIS 2005 Update 2008.

AIS 1985 marked an important shift in the AIS progression. Not only were penetrating injury descriptions included, but numeric codes designating specific injuries were added (the pre-dot code) and initial attempts to indicate injury location were made [3]. In AIS 1990, more than 100 injury descriptors (particularly head injuries) were added, the pre-dot code was expanded from five to six digits, and computerized injury location analysis by body chapter was made available.

Use of AIS in Risk Analysis

The AIS has been shown to be a good predictor of mortality. An analysis of National Trauma Data Base

Abbreviated Injury Scale. Table 2 Explanations of AIS 2005 codes for sample injuries

Pre-dot code							Post-dot code
AIS 751251.2: Simple humerus shaft fracture							
7	**5**	**1**	**2**	**5**	**1**	•	**2**
Upper extremity	Skeletal injury	Humerus		Fracture type (simple, oblique, or transverse)			Moderate severity
AIS 140692.5: Penetrating injury to cerebrum > 2 cm deep							
1	**4**	**0**	**6**	**9**	**2**	•	**5**
Head	Organ	Cerebrum		Penetrating injury (depth of penetration)			Critical injury

Abbreviated Injury Scale. Table 3 Evolution of the AIS (Adapted from [4])

Revision year	Description
1971	• Original AIS • Standardized system for classifying type and severity of vehicle crash injuries • 73 injuries classified
1975–1976	• First injury coding dictionary (~500 injuries and severity levels 1–6) published • AIS adopted as standard for US crash investigation teams
1980	• Injury dictionary tripled in scope • Injury descriptions improved • Brain injury section updated
1985	• Nonimpact injury descriptions included • Increased specificity of injury descriptions, especially thoracic and abdominal • Unique code assigned to each injury for computerization • Descriptors for coding penetrating injuries added
1990	• Expanded descriptions • Coding guidelines developed for standardization • Descriptors useful for nonfatal outcome determinations added • Further expansion of penetrating injury descriptors • Inclusion of pediatric injuries • Numerical identifier system improved
1998	• Clarification of 1990 version • Linked with the Organ Injury Scale (OIS)
2005	• Dictionary expanded to ~2,000 injury descriptors • Enables precise location of injury using numerical identifier system • Addresses injury bilaterality • Includes blast and other nonmechanical injuries • Linked with the Orthopedic Trauma Association Fracture Classification System (FCS) • Maps to AIS-98 • Includes optional injury locators (e.g., aspect, side)
2005-Military	• Enables coding of external injuries from multiple fragment wounds • Includes codes for soft-tissue fragment wounds • Includes descriptors for blast overpressure lung injury • Includes descriptors for injuries due to explosions
2005 update 2008	• Includes additional codes (multiple fractures of orbit, palate, appendix) • Includes clarifications for certain codes

(NTDB, which contains data on patients presenting to US trauma centers) data from 181,707 patients with single injuries revealed mortality risk ratios that clearly increased with AIS severity (Fig. 1) [4].

The AIS is an ordinal scale with values assigned in rank order of increasing severity. Therefore, the mortality risks at each severity level are not consistent, i.e., mortality risk is not evenly distributed across each severity level. For example, the increase in mortality between AIS 4 and 5 (23.5%) is much greater than the increase between AIS 1 and 2 (0%) [5]. This reveals that lower AIS scores are influenced by factors other than mortality [4]. Further, the same score may represent a different mortality risk depending on body region. For example, an AIS 3 injury to the head/neck has a different risk of mortality than an AIS 3 injury to the extremities. These limitations, which are echoed in morbidity risk assessment as well, make the AIS insufficiently sensitive to discern changes at the same severity level within and among body regions, particularly when evaluating effects of interventions. Because a myriad of anatomic scoring systems (a prime example being the Injury Severity Score [ISS]) are based on the AIS, its limitations are magnified when these derivative scores are calculated.

AIS-Based Scoring Systems

As discussed above, the AIS is best suited for characterizing single injuries but does not reliably characterize