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TRAUMA SCORING SYSTEMS

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ABSTRACT:

Worldwide, traumas represent an actual theme of discussion. The recognition and interpretation of severe traumas are essential for choosing the right treatment strategy. There are two approaches to mark the patients with a high risk of unfavorable evolution and death. First, to use the terms as "major trauma", "severe trauma" and "polytrauma", without ability to stratify the patients according the severity of lesions inside categories mentioned above. Second, to implement the trauma scoring systems (anatomical, physiological or mixed), when a doctor uses a mathematical algorithm/model to calculate the risks for each trauma patient. At the same time, according to the articles found on PubMed/Medline, Web of Science, and EBSCO databases, there is no international consensus concerning the most accurate traumatic score. This article's goal was to revise the existing trauma scoring systems to highlight the potential scoring systems that in perspective can be validated in the Moldovan medical system.

INTRODUCTION.

Actually, traumas represent an actual subject at international scale, being the main cause of death in the world for the patients in the age category of 1-40 years [1, 2]. In the Republic of Moldova, according to the National Center for Management of the National Agency of Public Health, in the period of 2008-2017, traumas are on the 4th place in the list of causes of lethal outcome, constituting 8.1% (36889 cases) of all registered cases, being placed after the cardiovascular diseases (61%, 226195 cases), tumors (15.8%, 58518 cases) and digestive system diseases (10%, 36889 cases). The analysis of lethality structures according

to the age showed that in the first year of life, traumas are placed on the 2nd place (30.3%) after the respiratory system diseases (57.9%).

The lethality rate related to traumas is progressing along with the age and has its maximum incidence at the age of 18 years (81.3%), after that, it is decreasing, the lethality rate of traumas being 24.1%, and loses it predominance in the age category of 44 years and further, when the cardiovascular diseases are dominant (26.3%), being in decrease until 0% at the senile age category [3]. The recognition and interpretation of severe traumas is essential for choosing the right treatment strategy.

Trauma is your body's response to a horrific, shocking, or dangerous event. Examples of traumatic events may include experiencing or witnessing an accident, crime, natural disaster, abuse, neglect, violence, or war.

It's completely normal to feel fear and sadness after a traumatic event. How everyone experiences a scary or dangerous event differs—some don't experience any symptoms, while others develop post-traumatic stress disorder .

Trauma may occur after you witness or experience a stressful or dangerous event.3 It is estimated that up to 60-75% of people in North America will experience a traumatic event at some point in their lives.2

There are several types of trauma. If you experience a traumatic event, you may develop one of the following.

- Acute trauma: Results from a single stressful or dangerous event
- Chronic trauma: Repeated or prolonged exposure to a stressful event
- Complex trauma: Exposure to multiple traumatic events
- Post-traumatic stress disorder (PTSD): Trauma that lasts longer than one month

Symptoms of Trauma. Trauma symptoms can be serious enough to interfere with your daily life. Everyone's experience with trauma can vary—some experience symptoms for a handful of days, while others have symptoms severe enough to develop PTSD. If you've just encountered or lived through a traumatic event, it's possible to develop the following symptoms:2

- Excessive worry or anxiety
- Being easily startled
- Sadness and frequent episodes of crying
- Having flashbacks
- Trouble sleeping
- Difficulty concentrating

- Withdrawing from social activities
- Avoiding places that remind you of the traumatic event
- Feeling angry or fearful

To describe the patients with a high risk of unfavorable evolution and also of death, there exists a series of terms like “severe trauma”, “major trauma” and “polytrauma”. The analysis of entries/documents in Web of Science database shows 24441, 19471 and 2813 entries for these notions, respectively. The terms “severe trauma” and “major trauma” are very similar, synonymic, but the criteria are not precise and fixed, the critical value of ISS (Injury Severity Score) or NISS (New Injury Severity Score) varies in different studies at the threshold of 16-17 points [4, 5 ,6]. The polytraumas represent the most unexplored and unresearched part of traumas, being a narrow notion compared to severe trauma and major trauma. There are a lot of definitions for polytrauma. In most of the sources, the criteria for polytrauma represents the anatomical scale ISS, the value of more than 15 being the threshold. At the same time, according to other authors, this value varies from 15 up to 26 and more. In a study made in 1996, it was proven that the medical personnel’s incompetence represents one of the causes of the errors in the usage of ISS for polytrauma diagnosis. Another criteria used for polytrauma definition are at least two lesions in any topographical region and at least one of them is a threat for the patient’s life [9]. According to the New Berlin Definition, proposed and validated in studies with high evidence, the polytrauma is defined as severe lesions for at least 2 body regions, appreciated by AIS (Abbreviated Injury Scale) with a score of ≥ 3 being present at least one of the 5 physiological parameters (systolic blood pressure ≤ 90 mmHg, GCS ≤ 8, acidosis, coagulopathy and age ≥ 70 years) [11]. At the same time a series of scores and algorithms are created to assess the severity of traumas, but at the moment, as a study has shown, there is no international consensus in the articles found on PubMed/Medline, Web of Science, and EBSCO databases according the most efficient scale, many of them claiming different things, this situation being related to geographical factors and differences in the medical systems, particularities of demographic structure On the other hand, the Moldovan medical system doesn’t use any trauma scoring system that was validated in order to evaluate the patient’s risk of death and complications in case of trauma. Because of that, at the patient’s evaluation there are disagreements on the prognostic, different scores often estimating the outcomes completely different. The solution for this problem includes a few stages as follows. First of all, we need to revise the existing trauma scoring systems that can be used in the Moldovan medical system. Secondly, to validate these scores for the Moldovan

medical system and to elaborate the new trauma scoring systems. Lastly, the comparative evaluation of the trauma scoring systems is necessary in order to identify the ones that have the optimal ability (determination, calibration and discrimination) to predict the outcomes for the medical system of Moldova. This article's goal is to accomplish the first task listed above, especially to revise the existing trauma scoring systems to highlight the potential scoring systems that in perspective can be validated in the Moldovan medical system.

Injury Severity Score (ISS) and New Injury Severity Score (NISS):

In the past decades, ISS and NISS were used widely for the evaluation of the severity of trauma. To estimate ISS, we have to use the following formula: $ISS = A^2 + B^2 + C^2$, where A, B, C are the highest AIS values present in each topographic region. It can vary from 0 up to 75. In condition if there is a topographical region with AIS = 6, ISS is automatically equal to 75 [15]. NISS in comparison with ISS, estimates trauma severity taking into account three maximal values of AIS, indifferent of the lesions localization [14]. For example, in case of trauma in 4 topographical regions AISabdomen = 2, AIShead and neck= 3, AIShead and neck = 3 and AISThorax = 5, the NISS value will be higher ($NISS=5^2 + 3^2 + 3^2 = 43$) versus ISS ($ISS=5^2 + 3^2 + 2^2 = 38$). At the same time, according to the results obtained by clinicians from China, NISS is similar to ISS in predicting the outcome of the traumatic patients [2]. We suppose that such result can be explained by insufficient determination coefficient (40%-60%) in equations that use NISS or ISS [16, 17].

Logarithm Injury Severity Score (LISS) and Exponential Injury Severity Score (EISS): LISS uses the natural logarithm of AIS as follows: $LISS = \ln(A_1)5.53\times 1.7987 + \ln(A2\ )5.53 \times 1.7987 + \ln(A3\ )5.53\times 1.7987$, where A1 -A3 are the AIS values for the three most severe traumas. For example, a patient with AISabdomen = 3, AISthorax = 2, AIShead and neck = 4, AISlimbs = 5, will have $LISS = \ln(3)5.53\times 1.7987 + \ln(4)5.53 \times 1.7987 + \ln(5)5.53\times 1.7987 = 38.9716620395$. According to the results obtained by certain researches it has tendency to have better calibration and discrimination characteristics than NISS [18]. EISS is based as LISS on the most severe AIS scores that are used in the following formula: EISS = 3A-2+3B-2 +3C-2, where A, B and C are the highest values of AIS [19]. For example, a patient has AIShead and neck = 3, AISt horax = 4, AISabdomen = 2 and AISlimbs = 5, in this case EISS = 35-2+34-2+33-2= 27+9+3=39.

APC is a scale that was proposed by Copes et al. According to APC algorithm a doctor has to take into consideration only the 3 most severe lesions according to AIS. The AIS scores are grouped in relation to region – A (AIS = 3-5 head, neck, brain and the spinal cord), B (AIS = 3-5 thorax), C (the anterior region of the neck with AIS = 3-5, the abdomen and pelvis with AIS = 3-5, the spine with or without the spinal column with AIS = 3, pelvic fractures with AIS = 4-5), D (the femoral artery with AIS = 4-5, collapse above the knee with AIS = 4-5, amputation above the knee with AIS = 4-5, the popliteal artery with AIS = 4, the face with AIS = 1-4, other traumas with AIS = 1-2). All of the conditions described above being classified based on ICD-9-CM, APC will be further on calculated using the following formula: $APC = M0 + M1 \times A + M2 \times B + M3 \times B^2 + M4 \times C^2$, the used coefficients are: M0 = 4.0801; M1 = -0.4914; M2 = -0.2066; M3 = 0.0161; M4 = -0.0351. D was excluded because in this case it wasn't influencing the survival predictability, but in some geographical regions it may be useful. The obtained value (APC) is considered in logistic regression formula as b and P(survival) = eb /(1+eb) [20]. For example, we have a patient with AISabdomen = 2, AISHead and neck= 3, AISUpper limb = 4 and AISThorax = 5, in this case $APC = 4.0801 - 0.4914 \times 3 - 0.2066 \times 5 + 0.0161 \times 5^2 - 0.0351 \times 0 = 1.9754$, further on, P(survival) = e1.9754/(1+e1.9754)= 0.8781, respectively, the chance for survival in this case is equal to approximately 87.81%.

Conclusion. Trauma Assessment Systems are essential frameworks used in emergency medicine to evaluate and manage patients suffering from traumatic injuries. These systems aim to quickly determine the severity of injuries, prioritize treatment, and allocate resources effectively. Key components include standardized protocols such as triage systems, trauma scoring methods (e.g., Injury Severity Score and Glasgow Coma Scale), and diagnostic tools like imaging technologies. By integrating data from patient monitoring, trauma registries, and real-time assessments, these systems ensure timely interventions and improve patient outcomes. Additionally, they support decision-making in pre-hospital and hospital settings, helping to reduce mortality and morbidity rates. Advances in technology and data analytics continue to enhance the efficiency and accuracy of trauma assessment systems, making them vital for modern critical care and emergency response.

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