LIFE HAZARD RATIO – A NEW SCALE FOR ASSESSING THE SEVERITY OF INJURY IN THE POPULATIONAL STUDY

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The heterogeneous population of patients affected by trauma is extremely difficult to systematize. This is due to the diversity of mechanisms of injury, the nature and severity of the injury and the population, which relate to injuries, diverse in terms of gender, age, presence of comorbidities that make up the final severity of the injury and a certain degree of danger to life.

The aim of the study was to develop a universal method to assess the severity of injury and loss of life resulting from their consequences, using the parameters available in the Polish administrative databases, a similar diagnostic efficacy as other used scales to assess the severity of damage.

Material and methods. The study analyzed a group of 92,463 patients hospitalized due to injuries sustained as a result of injuries in all hospitals of the Lublin region in 2003-2005. Developed catalogs risk factors, reference to the population of the Lublin province.

Results. Developed five models predictive of injury severity scale counterparts, which include different combinations of risk factors associated with the type of injury, age of the patient and the mechanism of injury that have been evaluated for their diagnostic efficacy in differentiating the expected outcomes. Prediction model have the best diagnostic efficacy AUROC 0.9615, SE 0.0025 and 95% CI 0.9565-0.9665, hereinafter referred to as Life Hazard Ratio (LHR), which has a similarly high diagnostic efficacy as the other, examined in the work of the rock assess the severity of damage AUROC 0.9585, SE 0.0368, 95% CI 0.8849-1.

Conclusions. 1. The proposed method of use of the International Classification ICD-10 allows the use of regional administrative databases to conduct detailed analyzes of population and monitor trends in the epidemiology of injuries. 2. Developed Life Hazard Ratio (LHR) is a universal method for the objective evaluation of the severity of injuries and the associated risk of life-threatening, can also conduct population studies. 3. LHR has a comparable rate of diagnostic efficacy as other commonly used scales assessing the severity of the injury.

Key words: severity of injury, risk factors, scale traumatic

Heterogeneous population of patients affected by trauma is extremely difficult to systematize. This is due to the diversity of mechanisms of injury, the nature and severity of the injury and the population, which relate to injuries, diverse in terms of gender, age, presence of comorbidities, differences in immunologic and genetic factors as well, which make up the final severity of the injury and a certain degree of threat to life occurs in each individual case. Then there are no less important factors related to the quality and the time to take treatment of the victims (1, 2, 3). Assess the actual degree of risk associated with trauma, requires systematization of information and their summaries in the form of a mathematical formula, objectively describing the complex processes associated injuries. This is precisely the role of numerical scales to assess the severity of injury.

The common objective of all scales trauma is therefore replace specific parameters that reflect the consequences of an injury occurring in the victim, the numerical values. With the diagnostic and prognostic values of rock trauma are versatile in all aspects of trauma (4-7). Most numeric scales assessing the severity of injury are used to divide patients into specific
groups according to the degree of threat to life. This division set is the result of trauma scale used to assess the current patient by determining the severity of the damage and estimate the risk of life or to predict the long term outcome. In countries where the injury severity scales are commonly used, play a key role in monitoring the treatment process, to monitor the effectiveness of changes in the treatment of injuries, in the conduct of epidemiological studies, as well as in the development and modernization programs, treatment of injuries at the hospital of the region or country (8, 9).

Assessment of severity of injury and various physiological parameters summarized as a result of trauma scoring scale allows you to implement the right treatment and assessment of the effectiveness of treatment undertaken.

Used worldwide and refined over time, different scales to assess the severity of injury became a kind of common language, which they can communicate with everyone involved in the treatment of injuries, regardless of economic conditions and local. Many authors emphasize that the application of the universal prevalence of trauma on the world scale will in future make easier to solve global problems associated with the treatment of injuries (10, 11).

The aim of this study was to develop a universal method to assess the severity of injury and loss of life resulting from their consequences, using the parameters available in the Polish administrative databases, a similar diagnostic efficacy as other used scales to assess the severity of damage.

MATERIAL AND METHODS

The study analysed a group of 92,463 patients hospitalized due to injuries sustained as a result of injuries in all hospitals of the Lublin region of 1 January 2003 to 31 December 2005. The starting material was a database of Lublin Centre for Public Health (LCPH), which collects information on all patients requiring hospitalization in all health care facilities.

Criteria for inclusion in the analysed group of patients:

1. First Patients treated for injuries specific code from the underlying disease T35.7 S00 according to the ICD-10 classification, determining the anatomical effects of trauma.

2. Second Patients hospitalized for the first time because of the injury in hospitals Lublin province, admitted to the hospital ward for at least 24 hours, or patients who died during the first 24 hours.

Regardless of the „Epidemiology” database created four control database:

1. First Database „Exemplary” (90 436 patients). In order to base the calculation of the risk factors associated with the type of injury, age, and mechanism of injury, and to select the best of the developed predictive models, which have the best predictive value, epidemiological removed from the database records of patients hospitalized in the Department of Trauma Surgery and Emergency Medicine, Medical University Lublin (2 051 patients).

2. Second Database „Clinic” (2 051 patients).

Regardless of the records database „Epidemic” was created database of patients treated in the years 2003-2005, at the Department of Traumatology and Emergency Medicine, Medical University in Lublin, located in the Public Hospital No. 1 in Lublin. For this purpose, based on a retrospective analysis of medical records 3375 patients treated in the Department in the years 2003 to 2005 were identified 2051 patients who met the same inclusion and exclusion criteria of the analysed group of patients, such as those used in the preparation of „Epidemiology” database.

3. Database „Comparative” (248 patients). In order to compare the prognostic value of the indicator developed life-threatening (FTU) with selected scales trauma ISS, NISS, RTS, Triss, ICISS, the database „clinic” is patients medical records have all necessary data for the calculation of the numerical values of these scales.

4. Database „Population 2006” (16 620 patients)

In order to objectively assess the prognostic value of predictive models developed, created an additional database of trauma patients treated in the first half of 2006 in all hospitals in the province of Lublin. Current catalogues of risk factors is available on the website www.chirurgiaurazowalublin.pl.

Catalogues risk factors related to the type of injury (WRO), the age of victims (CSF) and the mechanism of injury (WRM), model for the population of the Lublin province, developed
Life hazard ratio – a new scale for assessing the severity of injury in the population on the basis of the results of treatment 90 patients in 436 hospitals in Lublin province in the years 2003-2005.

IRF – the risk factor associated with the dominant type of injury – a specific code ST ICD-10, Chapter XIX.

MRF – risk factor associated with the mechanism of injury – a specific code VY ICD-10, Chapter XX.

ARF – the risk factor associated with the age of victims was calculated for eight age groups (0-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, > 74).

Also developed predictive models, the hazard of life of the patient, whose injuries, age, and mechanism of injury, were converted into numerical values based on relevant risk factor values contained in the catalogues of standard risk factors, calculated on the basis of analysis of the results of treatment of trauma patients in the population of the Lublin province. Risk of death estimated by the predictive model, expressed as a numerical value between 0 and 1 and determines the probability of survival or risk of death of the patient. With the increase in survival probability (PS) decreases the risk of death (DR) and vice versa, it can be expressed in a mathematical PS = 1 – DR.

In this paper all the predictive models developed and used numerical scales severity of injury, have been evaluated for efficacy in differentiating diagnostic anticipated outcome (survival or death), which shows the quality of the prediction model used, or the trauma scale, in contrast to the random distribution of these results (9). This assessment was used to verify the effectiveness of diagnostic predictive models in three independently created databases and select the best prediction model showing the diagnostic efficacy. Prediction models have the best diagnostic efficacy, hereinafter referred to as Life Hazard Ratio (LHR), was then compared to the selected scales assessors injury severity (RTS, ISS, NISS, TRISS, ICISSS). Diagnostic effectiveness of the prediction model or scale trauma was analyzed on the basis of their predictive value, such as: sensitivity, specificity, accuracy, and positive and negative predictive value for the individual limits and under the ROC curve analysis (called Receiver Operating Characteristic Curve – ROC), which is a graphical representation of the full range of sensitivity and specificity for all possible limits.

RESULTS

Table 1 shows a summary ROC curves fields below (Area under the ROC curve – AUROC) and the accuracy of the models indicate that all models have a high diagnostic efficacy (AUROC of 0.9135 to 0.9615 from 0.9827, and the accuracy to 0, 9856). The best ability to differentiate a model M-5 has the highest value and lowest AUROC standard error and the narrowest confidence interval, while the accuracy of the models is almost identical.

Analysis of statistical significance when comparing fields occurring under the ROC curve showed that the numerical values of the area under the ROC curve for all models vary significantly, except for some differences between the M-4 and M-3 and M-models 1 and M-2 that is not statistically significant. This analysis also showed that the model M-5 has the best diagnostic performance, as characterized by the highest AUROC value (0.9615) and the difference was statistically significant when compared to all other models.

The assumptions of this study hypothesized that the inclusion of age (model M-3) and mechanism of injury (model M-4) should improve the diagnostic efficacy of models that take into account the severity of the injury only anatomical (models M-1 and M-2). The results in tab. 1

<table>
<thead>
<tr>
<th>Model</th>
<th>Accuracy</th>
<th>AUROC</th>
<th>SE**</th>
<th>95% CI***</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-1</td>
<td>0,9856</td>
<td>0,9135</td>
<td>0,0058</td>
<td>0,9019-0,9251</td>
</tr>
<tr>
<td>M-2</td>
<td>0,9840</td>
<td>0,9247</td>
<td>0,0054</td>
<td>0,9139-0,9355</td>
</tr>
<tr>
<td>M-3</td>
<td>0,9837</td>
<td>0,9498</td>
<td>0,0038</td>
<td>0,9422-0,9574</td>
</tr>
<tr>
<td>M-4</td>
<td>0,9820</td>
<td>0,9432</td>
<td>0,0039</td>
<td>0,9354-0,9510</td>
</tr>
<tr>
<td>M-5</td>
<td>0,9827</td>
<td>0,9615</td>
<td>0,0025</td>
<td>0,9565-0,9665</td>
</tr>
</tbody>
</table>

** SE – Standard Error, *** 95% CI – 95% Confidence Interval
confirm these assumptions, for both the model M-3 and M-4 model are significantly higher than AUROC models M-1 and M-2 (p < 0.05).

Analysis of the predictive value and ROC analysis calculated for the Life Hazard Ratio (LHR) and selected scales to assess the severity of injury presented in tab. 2 shows that the best and just have a high diagnostic efficacy scale ICISS and Life Hazard Ratio. Calculated for these scales AUROC amounts to 0.9613, and 0.9585, and the difference between them is not statistically significant (p = 0.96), their predictive values are high sensitivity, specificity, and accuracy of 0.88, 0 and 97 and 0.96 and are identical in both models. Analyzing the predictive value of other scales trauma should be noted that the scale of TRISS has a very high specificity (0.99) and the highest accuracy, but the sensitivity of this scale is 0.76 lower than the sensitivity of the scale ICISS and Life Hazard Ratio, which is reflected in a lower efficiency This diagnostic scale, AUROC in this case is 0.9452.

In summary assessment of the effectiveness of diagnostic indicator FTU and other scales to assess the severity of injury in this group of patients, as presented in tab. 2 should be noted that the indicator developed by the author of the FTU has high diagnostic efficacy similar to the others, analysed the work injury severity rating scales.

DISCUSSION

Following an injury occurs anatomical lesions of various parts of the body, and each of them can be damaged many systems and organs. Virtually unlimited number of combinations and severity of the damage means that attempts to classify them is always a simplification necessary in analyses of clinical material. Such a wide range of possible ways of classification makes it difficult to compare results from different canters, and the lack of standardized nomenclatures and arbitrary interpretation of the applicable divisions mean that both in Poland and in the world is still a current problem that requires urgent solutions.

According to many authors use universal scale to assess the severity of injury may play a significant role in improving the quality of treatment for patients affected by injuries, as well as in selecting the most effective way in preventing injuries (4, 11). For many years, Injury Severity Score (ISS) and the Trauma and Injury Severity Score (TRISS) based on the Abbreviated Injury Scale classification

<table>
<thead>
<tr>
<th>Injury Score</th>
<th>Analysis</th>
<th>Predictive value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AUROC</td>
<td>sensitivity</td>
</tr>
<tr>
<td></td>
<td>SE (95%CI)</td>
<td></td>
</tr>
<tr>
<td>WZZ*** (LHR)</td>
<td>0.9585</td>
<td>0.8824</td>
</tr>
<tr>
<td>(0,75)</td>
<td>0.0368</td>
<td></td>
</tr>
<tr>
<td>TRISS (0,75)</td>
<td>0.9453</td>
<td>0.7647</td>
</tr>
<tr>
<td>ICISS (0,75)</td>
<td>0.9613</td>
<td>0.8824</td>
</tr>
<tr>
<td>ISS (25 pkt.)</td>
<td>0.9302</td>
<td>0.2941</td>
</tr>
<tr>
<td>(0.8722-0.9882)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NISS (27 pkt.)</td>
<td>0.9489</td>
<td>0.5294</td>
</tr>
<tr>
<td>(0.9147-0.9819)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTS (6,0)</td>
<td>0.9477</td>
<td>0.7059</td>
</tr>
<tr>
<td>(0.8767-1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*PWP – positive predictive value, ** NWP – negative predictive value, *** WZZ – Life Hazard Ratio
Life hazard ratio – a new scale for assessing the severity of injury in the populetional study (AIS), are considered the „gold standard” for classifying injury severity and, despite the proven failures are still the most commonly used scales in the world the medical literature. Despite widespread use in scientific and medical circles recognition, scales TRISS, AIS and ISS were not considered to be universal and suitable for universal application in the world. This is due to a number of elements that are the subject of criticism for years in the literature (12, 13, 14). The problem here is the scale of AIS, as appropriate and accurate coding of injury requires more time and effort people specially trained (15).

Better than AIS prognostic and diagnostic value is calculated on the basis of the scale of the ISS, but all of the above issues also apply to this scale. In addition, the calculation of the scale of the ISS, in principle, rule out the possibility of serious injury include several located in the same area of the body. These difficulties resulted in the NISS scale was developed, in which it is possible to incorporate three heaviest damage regardless of the body in which they find themselves (16). Another complaint was not taken into account the age and quality of treatment of patients in the assessment of their risks of life (17, 18). For example, 20-year-old patient with damage to the spleen, which was within an hour of injury operated on, will receive an equal number of points on the ISS and NISS, and 70-year-old patient with the same injury, which was taken to the hospital after 8 hours of injury can hemorrhagic shock. These weaknesses are partially offset TRISS on a scale that takes into account the factor of age and physiological parameters, however, take into account the quality of treatment of the problem remains open. Despite many allegations TRISS scale is the most common scale, not only in the U.S. but also in Canada, Australia and some European countries (19, 20).

In order to develop more effective methods for predicting survival probability of trauma, a number of scales, taking into account various factors variables. The most common parameters are included anatomical and physiological age and mechanism of injury. Inclusion of additional variables generally associated with improved predictive value of the scale (13, 21). The importance of the mechanism of injury as a prognostic factor has long been included in the criteria for prehospital segregation and qualifications relevant to the treatment centers. Therefore, this factor was also included in a number of scales assessing the probability of survival. It was found, however, that the differentiation mechanism of injury only blunt and penetrating injuries, as TRISS scale, ASCOT, HARM, ICISS „full model” and the like is too vague (22). In the present study the mechanism of injury factor adding MRF improved diagnostic efficacy of the prediction model (increase in AUROC of 0.02).

In recent years, a new world-scale International Classification based Injury Severity Score (ICISS) based on experimental method of determining the probability of survival (6, 23). The main advantage is the use of ICISS scale to classify ICD injury and not on the scale of AIS, which gives it a universal value and applicability in all countries of the world. Scale ICISS and the like are becoming more popular around the world, although the number of works documenting their performance so far is less than the work of documenting the effectiveness of the ISS and TRISS scales (21, 24). Many publications and research also indicates the scale of the diagnostic efficacy comparable to that of scales ICISS more precise, albeit for different reasons, rarely used as ASCOT and APACHE II and III (25).

In the world literature there are already results of the first studies to confirm these assumptions (26). In some reports have discussed the problem is to replace the „gold standard” for assessing injury severity and predicting outcome scales for ISS TRISS ICISS scale. Recent research using a large population-based database of the U.S., Australia and New Zealand seem to leave no doubt as to the scale of superiority over its competitors ICISS (22, 26). Discussions on the advantages of a global system of systems ICISS TRISS or similar type is still an open problem, since their change involves the costly process of change in the classification of severity of injury. However, in Polish conditions, this argument is irrelevant because it does not have any large data sets in the form of national or regional trauma registries, and the huge need in this area indicates the need to use existing administrative databases.

CONCLUSIONS

1. The proposed work how to apply the International Classification of ICD-10 allows the
use of regional administrative databases to conduct detailed analyses of population and monitor trends in the epidemiology of injuries.

2. Developed Life Hazard Ratio (LHR) is a universal method for the objective evaluation of the severity of injuries and the associated risk of life-threatening for both individual patients and groups of patients freely chosen, can also conduct population studies based on the information available in administrative databases.

3. Life Hazard Ratio (LHR) has a comparable rate of diagnostic efficacy as other commonly used scales assessing the severity of the injury.

REFERENCES


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