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Outcome prediction of different groups of patients using a modified scoring system

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Abstract

Background: In this study we aimed to examine the discrimination and calibration of a severity characterization of trauma (ASCOT) in our setting to determine whether its usage is appropriate to predict outcome of our trauma patients.

Methods: This study was conducted in three hospitals. All patients admitted in studied hospitals were divided randomly into two equal subgroups. In each group, new coefficients for ASCOT were derived from the first subgroup of patients. Then the newly developed model was validated in the second subgroup and the measures of discrimination and calibration were calculated.

Results: 78% of our patients were male and 27% were children. The study mortality rate was 6%, and 20% of patients had penetrating trauma. The average age of our patients was 28 ± 19 (Mean ± Standard Deviation). The area under ROC for ASCOT was 0.96 and Hosmer-Lemeshow goodness of fit p value was 0.81.

Conclusion: In spite of many differences of the trauma care systems between our country and western countries, current survival probability models can be used in our country after customization and development of new coefficients derived from regional databases.

Keywords: ASCOT, ISS, customization, Iran.

Introduction

Trauma is an important cause of mortality and morbidity in our country and involves the most active group of society. Therefore, improvement of trauma care and prevention of avoidable deaths are among the main goals of the health care system of our country. Many different models have been devised for prediction of outcome of trauma patients to evaluate the quality of care delivered to trauma patients but all of them are not the ideal ones.

The Trauma and Injury Severity Score (TRISS) introduced by Champion et al [1] is the standard model but it has major limitations in severe trauma [2-6]. A Severity Characterization of Trauma (ASCOT) is another model which was developed to improve the accuracy and minimize the number of errors of the TRISS [7-9].

The TRISS and ASCOT models have been evaluated in many western European countries, Eastern Europe, Australia and South Africa [10,11] and one study described customization of TRISS in Iran [13].

Nowadays, in our country the trauma system

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and pre-hospital care is improving. However, some problems remain to be solved. Following are some of these problems:

-Inadequate prehospital care,

-Ineffective Emergency Medical Service (EMS),

-Poor triage at the scene,

-Long stay in the emergency department,

-Low quality of trauma surgery educational programs in some hospitals.

Therefore, it seemed reasonable to apply these patient care evaluation systems to our setting in Iran with new coefficients derived from our database and use these new coefficients to evaluate the trauma system of our country.

In this study we applied a customized ASCOT model developed from our database as a tool to criticize the quality of care.

Methods

This study is based on the trauma registry of Sina Research Center which has been done in three hospitals with the highest load of trauma patients. Trauma registry data elements included the information necessary for calculation of ASCOT. These data were entered in a microcomputer for each of the blunt and penetrating groups; the patients were divided randomly into two equal subgroups. In each group, new coefficients for ASCOT were derived from the first subgroup of patients. Then the newly developed model was validated in the second subgroup and the measures of discrimination and calibration were calculated. These calculations have been described elsewhere [14]. In summary, Ps values for ASCOT were computed with the logistic regression using new regression coefficients derived from development database. Patients with a Ps $\geq$ 0.50 were predicted to live while those with Ps < 0.50 were predicted to die. Discrimination was defined as ability of an index to classify patients correctly as survivors or non-survivors. Calibration was defined as degree of agreement between actual and model-predicted number of survivors and deaths in various risk strata. We used the area under the receiver-operating characteristic (ROC) curve as a measure of discrimination and the Hosmer-Lemeshow (H-L) statistic as a measure of calibration. The H-L statistic measures a logistic function's predictive calibration across the range of Ps's. It is based on comparisons of the actual and expected numbers (i.e. based on model predictions) of survivors and deaths for

	Number	*Percent*	*Mean*	*SD*
Total patients	4096	100		
Mechanism of injury				
Road traffic accident	1884	46		
Falls	778	19		
Strike by blunt object	606	14.9		
Cuts	614	15		
Stab Wound	210	5		
Gunshots	4	0.1		
Patient age group				
All patients	4096	100	28	19
< 15	1100	27	8	4
15-55	2535	62	30	11
> 55	461	11	67	8
RTS on ED admission			7.54	1.16
ISS				
Blunt	3268	80	7.2	7.1
Penetrating	828	20	5.7	5.6

Table 1- Statistical summary of patients.

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Subgroup	*Number*	*Expected mortality*	*Actual mortality*	*Actual survival*	*Expected survival*	*W score**
Craniotomy	51	7.96	8	43	43.04	-0.08
Abdominal surgery	35	5.34	10	25	29.66	-13.31
Orthopedic surgery	293	12.17	7	286	280.83	1.76
Pelvic fracture	25	4.61	6	19	20.39	-5.56

*W score compares the predicted outcome using the models with the true outcome.

Table 2. Calculation of W score in different subgroups of patients.

all Ps deciles. The statistic has an approximate c2 distribution with 8 degrees of freedom. Values of H-L $\leq$ 15.5 do not reject the hypothesis that the model provides an adequate fit of the data ($P<0.05$) [14].

Then we used the customized model to evaluate the care offered to different subgroups of trauma patients treated in our hospital. W score is used to determine the quality of care delivered to patients by comparing the predicted outcome using the models with what is truly observed [15,16].

Results

A total of 4096 patients had complete data required for ASCOT evaluation.

Table 1 shows the statistical summary of patients. The mortality rate was 6% and 20% of all patients had penetrating trauma. The average age of patients was 28 ± 19 (Mean ± Standard Deviation).

In comparison with trauma data of western countries, we had a higher proportion of pediatric patients, lesser proportion of gunshots and stab wounds and most importantly less severe injuries [17].

The coefficients we derived were: $K^0 = -4.32$, GCS= 0.74, Systolic blood pressure= 1.32, Respiratory rate= 0.29, Head and spinal cord= – 0.59, Thorax and anterior neck= –0.54, Other sites= – 0.30 and age= – 0.41.

The area under ROC for ASCOT was about 0.96 for both blunt and penetrating patients. Hosmer-Lemeshow goodness of fit P value was 0.81 for penetrating patients and 0.76 for blunt patients.

Table 2 shows the results of analysis of trauma patients of our hospital. The W score was worst for abdominal surgery and pelvic fracture and best for orthopedic operations.

Discussion

This study has focused on a customized ASCOT model which has been used to evaluate the different subgroups of trauma patients at our hospital. Our patients differ in many aspects from most studies in western countries. We had a higher proportion of pediatric patients, lesser proportion of gunshots and stab wounds and most importantly less severe injuries [17]. These differences suggest the need for customization of standard models in Iran.

Our results with customized ASCOT model are in accordance with some other studies [14]. These results can be useful for authorities of every trauma center to find the problems and improve the quality of care given to trauma patients.

Mechanisms accountable for quality of care can be divided into 3 levels: internal mechanism, market place mechanisms and governmental mechanisms [18].

In our study, the customized model was useful to evaluate the different subgroups of trauma patients in our hospital. After this study, we have found some of the problems with critical management of abdominal surgery and pelvic fractures in our hospital. Likewise we feel that the comparison between different hospitals around the city, which serve trauma patients, would be a good estimate of quality of care given to trauma patients and the results can be used

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by the authorities to improve the trauma management around the city. This would be a good start for improvement of health care programs, which need to establish a timetable evaluation of quality of care within the major hospitals.

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