Original Paper

Polytrauma and Multiple Severity Scores

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ABSTRACT: The initial assessment and management of seriously injured patients is a challenging task and requires a rapid and systematic approach. Injuries causing this mortality occur in predictable patterns and recognition of these patterns led to the development of advanced trauma life support (ATLS) by the American College of Surgeons, and standardized protocol for trauma patient evaluation has been developed. Different systems of trauma scoring have been developed. This study was conducted out of the need for unified scale to assess polytrauma patients from the moment patient are admitted in, till when discharged from Intensive Care Unit (ICU), so we compared the accuracy of few scoring systems in predicting mortality rate in polytrauma patients, and then assessed the cost-effectiveness applying these methods, and how much are these applicable. Here we chose 3 scoring systems: Glasgow Coma scale (GCS), Revised Trauma score (RTS) and Acute Physiology and Chronic Health Evaluation II scales (APACHE II). APACHE II system proved to be helpful in giving primary impression about case prognosis, and overall it reflects the quality level provided in the facility which is providing the health care for the polytraumatized patients, and it can be used as unified scale to compare the healthcare results and outcomes in different hospitals. APACHE II can be considered to be a largely accurate and applicable system for the polytraumatized patients but the association between three of scores offers better results about predicting prognosis of these patients.

KEYWORDS: *polytrauma, severity scores, intensive care unit*

Introduction

Trauma continues to be a leading cause of death and disability in all age groups, especially the young.

The initial assessment and management of seriously injured patients is a challenging task and requires a rapid and systematic approach [1].

Injuries causing this mortality occur in predictable patterns and recognition of these patterns led to the development of advanced trauma life support (ATLS) by the American College of Surgeons, and standardized protocol for trauma patient evaluation has been developed. Different systems of trauma scoring have been developed. [2]

Characterization of injury severity is crucial to the scientific study of trauma, yet the actual measurement of injury severity began only 50 years ago. In 1969, researchers developed the Abbreviated Injury Scale (AIS) to grade the severity of individual injuries. Since its introduction, by the Association for the Advancement of Automotive Medicine (AAAM) International Injury Scaling Committee (IISC), the parent organization of the AIS modified the AIS, most recently in 2005 (AIS-2005). The AIS is the basis for the Injury Severity Score (ISS), which is the most widely used measure of injury severity in patients with trauma. Attempting to summarize the severity of injury in a patient with multiple traumas with a single number is difficult at best; therefore, multiple alternative scoring systems have been proposed, each with its own problems and limitations. [3]

Materials and method

This study was conducted out of the need for unified scale to assess polytrauma patients from the moment patient are admitted in, till when discharged from ICU, so we compared the accuracy of few scoring systems in predicting mortality rate in polytrauma patients, and then assessed the cost-effectiveness applying these methods, and how much are these applicable.

Here we chose 3 scoring systems:

- Glasgow Coma scale (GCS)
- Revised Trauma score (RTS)
- Acute Physiology and Chronic Health Evaluation II scales (APACHE II)

Trauma scores are designed to facilitate triage of patients in the ER (emergency rooms unit), and identify patients with polytrauma with low chances of survival, and to allow a fair comparison between different trauma patient, also to organize and improve the quality of trauma care systems, and to assess resource allocation.

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Scores are very important to the scientific study of the epidemiology and treatment of trauma. Trauma systems are vital components of trauma care chain. The efficiency in trauma centers must be well organized, centralized, disciplined in reducing mortality and morbidity in patients with trauma, and should be well documented, and trauma systems play a very important role.

This study included 105 patients. All patients were victims of polytrauma, received in ER, primary support was afforded, live threatening problems were properly addressed immediately, and then laboratory and radiological investigations were conducted, after resuscitation most of the patients were shifted to ICU. Excluded from the study were patients with severe cardiovascular injury cases because the hospital does not have a cardiac surgery care unit. Our study applied for patients in triage ER (resuscitation room), then we follow our patients in Intensive care unit. Patients included in the study have following conditions, such as: airway compromise in traumatized patients, cardiac arrest in traumatized patients, severe shock after trauma, cervical spine injure, polytrauma patients and altered level of consciousness (LOC)-unconsciousness after trauma.

Sequence steps done in ER for all our patients as follow:

1. Complete history including:
   - Mechanism of injury
   - Patients past medical history
   - The distance and the time till hospital.
2. Complete primary and secondary clinical evaluation according to ATLS and ACLS measures.
3. Radiological evaluation: Including plain skull, cervical spine, chest, and pelvis X-rays, in addition to injury related necessary investigations like limbs X-ray, CT scan for brain, ultrasound scan abdomen.
4. Laboratory investigations: including CBC, blood electrolytes (Na,K,Cl), blood sugar, renal function tests, liver function tests, blood gases, blood bicarbonate.
5. Then two polytrauma scores calculated: The Glasgow Coma Scale (GCS), and the revised trauma score (RTS).

Also there was protocol for traumatized patients in ICU as follow:

1. The primary and secondary survey were conducted again.
2. Recheck vital signs and complete clinical reexamination.
3. Complete the initial and scheduled Laboratory investigations according to particular case situation.
4. Complete the initial and extended radiological studies.
5. Repeat the calculation of Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), Acute Physiology and Chronic Health Evaluation II (APACHE II scale).

Results

The Correlation between APACHE II and Mortality Rate: through analyzing the data we notice that the correlation is at level 0.05 which signifies a direct relationship, where the higher the score the higher comes the mortality rate, as shown in Table 1.

Table 1. Correlations between APACHEII value and Mortality

		Mortality	APACHII
Mortality	Pearson Correlation	1	.271(**)
	Sig. (2-tailed)		0.005
	N	105	105
APACHII	Pearson Correlation	.271(**)	1
	Sig. (2-tailed)	0.005	
	N	105	105

**Correlation is significant at the 0.01 level (2-tailed)

The Correlation between the Scored GCS in ER and Mortality Rate: analyzing the data we notice the presence of opposite relationship between the GCS on arrival and mortality rate, where with every decrease in GCS at presentation the mortality rate becomes higher, as is shown in Table 2.

Table 2. Correlation between ER.GCS and death

		Mortality	ER.GCS.
Mortality	Pearson Correlation	1	-.406(**)
	Sig. (2-tailed)		0
	N	105	105
ER.GCS.	Pearson Correlation	-.406(**)	1
	Sig. (2-tailed)	0.005	
	N	105	105

**Correlation is significant at the 0.01 level (2-tailed)

The Correlation between The RTS Score In ER And The Mortality Rate: analyzing the data we noticed the presence of opposite relationship between the RTS score on ER arrival and mortality rate, where with every decrease in RTS score mortality rate comes higher, as is shown in the Table 3.

Table 3. Correlation between ER RTS and Mortality

		Mortality	ER.RTS
Mortality	Pearson Correlation	1	-.429(**)
	Sig. (2-tailed)		0
	N	105	105
ER.RTS	Pearson Correlation	-.429(**)	1
	Sig. (2-tailed)	0	
	N	105	105

**Correlation is significant at the 0.01 level (2-tailed)

The Correlation between the GCS in ICU and Mortality Rate: analyzing the data we notice the presence of opposite relationship between the GCS in ICU and mortality rate, where .with every decrease in GCS the mortality rate becomes higher, as is shown in Table 4.

Table 4. Correlations between ICU GCS and Mortality

		Mortality
Mortality	Pearson Correlation	1
	Sig. (2-tailed)	
	N	105
ICU GCS	Pearson Correlation	-.223(*)
	Sig. (2-tailed)	0.022
	N	105

*Correlation is significant at the 0.05 level (2-tailed)

The Correlation between the RTS scores in ICU and the Mortality Rate: analyzing the date we notice opposite relationship between RTS score in the ICU and Mortality rate, where with every decrease in RTS score mortality rates comes higher, as is shown in Table 5.

Table 5. Correlation between ICU RTS and Mortality

		Mortality	ICU RTS
Mortality	Pearson Correlation	1	-.230(*)
	Sig. (2-tailed)		0.018
	N	105	105
ICU RTS	Pearson Correlation	-.230(*)	1
	Sig. (2-tailed)	0.018	
	N	105	105

*Correlation is significant at the 0.05 level (2-tailed)

The Correlation between the Different Scores Applied In ICU: the relationship is direct between GCS and RTS, whereas it is in opposite relationship between APACHE and RTS, as is shown in the Table 6.

Table 6. Correlation between RTS, GCS and APACHEII

		ICU.RTS	ICU.GCS	APACHII
ICU.RTS	Pearson Correlation	1	.992(**)	-.889(**)
	Sig. (2-tailed)		0	0
	N	105	105	105
ICU.GCS	Pearson Correlation	.992(**)	1	-.902(**)
	Sig. (2-tailed)	0		0
	N	105	105	105
APACHII	Pearson Correlation	-.889(**)	-.902(**)	1
	Sig. (2-tailed)	0	0	
	N	105	105	105

**Correlation is significant at the 0.01 level (2-tailed)

The Correlation between Scores Applied In ER And APACHE II In ICU: We noticed a specific and opposite relationship between the RTS and APACHE and between GCS in ER and APACHE, where with every decrease in RTS and GCS scores in ER, the APACHE score rises in ICU in spite of taking correct resuscitation measures, as is noticed in the following Table 7.

Table 7. Correlation between Applied Scores in ER and APACHE II in ICU

		ER.GCS	ER.RTS	APACHII
ER.GCS	Pearson Correlation	1	.935(**)	-.620(**)
	Sig. (2-tailed)		0	0
	N	105	105	105
ER.RTS	Pearson Correlation	.935(**)	1	-.615(**)
	Sig. (2-tailed)	0		0
	N	105	105	105
APACHII	Pearson Correlation	-.620(**)	-.615(**)	1
	Sig. (2-tailed)	0	0	
	N	105	105	105

**Correlation is significant at the 0.01 level (2-tailed)

Discutions

The results shows that in the scale of Glasgow Coma Scale the sensitivity was 75%, were specificity equal to 84% and the accuracy of the scale was 83%. While in the revised trauma score the sensitivity was 81%, specificity was 88% and accuracy of 85%. While in the scale of APACHE II the sensitivity was 88%, specificity was 90% and accuracy of the scale 90%.

The mortality was matched to a large extent to the standard values of APACHE II score.

The statistical analysis of the collected data shows:

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-GCS sensitivity is 0.75, specificity 0.84, and accuracy 0.83.

-RTS score sensitivity 0.81, specificity 0.88, and accuracy 0.85.

-APACHE score sensitivity 0.88, specificity 0.90, and accuracy 0.90.

This indicates the higher sensitivity, specificity and accuracy of the APACHE II which makes it the best used scoring system to accurately predict the mortality and morbidity.

In our study the rate of death predicted by APACHE II is very close to the standard rates of scale and this indicates two things: the first is a measure of accuracy in predicting mortality in polytraumatized patients and the second is that medical procedures which applied for our patients have a good level of accuracy.

As regards **RTS**, the present study showed that the mean RTS score was 4.67400±1.4425 in the poor prognosis group, while in good prognosis group the mean RTS was 6.0548±1.799, there was a significant increase in RTS in good prognosis group than poor prognosis group ($p<0.01$). Our findings are similar to Hafiz [4] study in 2004. He studied 30 adult patients of road traffic accidents sustaining multisystem injuries due to high energy blunt trauma and were managed according to the protocols of advanced trauma life support (ATLS) and from their first set of data RTS was calculated. Score of each patient was compared with his final outcome at the time of discharge from the hospital. He found that RTS is a reliable predictor of prognosis of polytraumatized patients. Therefore, it can be used for field and emergency room triage.

Also, Ohaegbulam et al [5,6], conducted a prospective study on relationship between the weighted revised trauma score and patient outcome (mortality), The records of 38 critically injured trauma patients admitted to the general ICU of National Hospital, Abuja, Nigeria over a nine-month period were analyzed. The results confirmed that RTS is a good predictor of both severity of head injury (and thus the need for ICU admission) and mortality.

As regards **APACHEII score** the present study showed that the mean value of APACHEII score in poor prognosis group was 14.94±6.618, while in good prognosis group was 8.72±6.767, there was a significant increase in APACHEII score in poor prognosis group than the good prognosis group.

Similar to our results Markgraf et al [7,8], validated The APACHE II for predicting mortality of trauma patients as well as their length of stay in 2002. Also Similar to our results Liang et al [9] found in 1998 that APACHE II is a better predictor for ICU trauma patients than ISS.

As regards **GCS score** the present study showed that GCS in poor prognosis group was 4.88±4.097, while in good prognosis group was 9.01±5.552, there was a significant increase in GCS in good prognosis patients than the poor prognosis patients ($p<0.01$).

These results are similar to that found by Balestreri et al [10], which was carried out on 2003 in Addenbrooke's Hospital, Cambridge on Data from 358 subjects with head injury. Glasgow Outcome Scores (GOS) were determined at six months; they found a significant correlation between the GCS and GOS for the first five years.

Also Stefan Grote et al [11] in the Department of Trauma Surgery, Ludwig-Maximilians-University Munich, Germany, in 2011, they studied Diagnostic Value of the Glasgow Coma Scale for Traumatic Brain Injury in 18,002 Patients with Severe Multiple Injuries. Although patients with severe multiple injuries may have other reasons for unconsciousness, traumatic brain injury (TBI) in these patients is frequently defined by the Glasgow Coma Scale (GCS). The diagnostic value of GCS≤8 for severe TBI in patients with multiple injuries has low sensitivity (56.1%) but higher specificity (82.2%) versus sensitivity of (74.5%) and specificity of (80%) in the present study.

Actually there is no study with same comparison that in our study. Okasha A., et al. made a similar study and they have studied which carried out on 175 polytraumatized patients who were admitted to Critical Care and Emergency Medicine Departments at Alexandria University Main Hospital. [12] It was found that the most significant sensitive and specific score was the combined score (anatomical and physiological) TRISS (sensitivity 95.0%, specificity 96.0% and accuracy 95.0%), while the grading of the other scores was in the following sequence: APACHE II, RTS, GCS, TISS (All are physiological) and finally ISS score (Anatomical score). Also they found APACHEII score had higher sensitivity (92%) than RTS but the latter had better specificity (94%) &accuracy (92%) than the former (88% and 90%) respectively. In general, the physiological scores in them study tend to have

a better performance than the anatomical one and the combined scores had the best performance. And the higher APACHEII, the higher the mortality while the higher RTS and GCS the lower the mortality rate.

Conclusion

The APACHE II score is the best standard score applied in the study, in terms of sensitivity, specificity and accuracy in predicting prognosis in polytraumatized patients, through assessment on the first day when they entered to intensive care unit, also, the standard applicability is easy, even on patients who have polytrauma.

APACHE II system proved to be helpful in giving primary impression about case prognosis, and overall it reflects the quality level provided in the facility which is providing the health care for the polytraumatized patients, and it can be used as unified scale to compare the healthcare results and outcomes in different hospitals.

APACHE II can be considered to be a largely accurate and applicable system for the polytraumatized patients but the association between three of scores (APACHE II, RTS and GCS) offers better results about predicting prognosis of these patients.

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