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THE VALUE OF IMPELEMENTATION OF REVISED TRAUMA SCORE IN THE OUTCOME OF TRAUMATIZED PATIENTS ADMITTED TO SUEZ CANAL HOSPITAL AS REGARD MORTALITY

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Suez Canal University

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Master Dgree In Emergency Medicine

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Introduction

Major injury is a leading cause of death and disability around the world. For both sexes, one in every ten deaths is the result of injury. Globally, unintentional injuries are ranked as the sixth leading cause of death and the fifth leading cause of moderate and sever disability(1).

The epidemiological study of trauma leads to an increased understanding of the injury process and identification of its clinical course and outcome(2).

Many scoring systems have been developed to measure or predict severity or outcome of trauma, intensive care unit result, mortality, morbidity and development of complications(2).

A score that may indicate the chance of mortality shortly after admission can be useful to become aware of severity of trauma and might influence further therapeutic decisions. Trauma is most common cause of non-obstetric morbidity and mortality in pregnancy and complicates at least 6% to 7% of all pregnancies (3).

Maternal death rates from trauma may be noted as high as 10% to11%. Death to the fetus is reported to be even higher than death of the mother from traumatic injuries. With trauma, fetal mortality is as high as 65%. Traumatic injuries are the leading cause of most of disabilities among children(4) .

Inadequate evaluation, resulting in inappropriate treatment, may contribute in approximately 30%of early death in children with severe trauma(5).

In contrast, prompt and accurate assessment of the severity of injury and early initiation of critical care is of crucial importance for preventing these deaths(6).

Elderly trauma patients represent an important clinical sub- group and pose significant challenges to both acute and long-term care. Co morbidity, use of multiple medications, frail anatomies and a reduced physiological reserve all predispose elderly trauma patients to an increased risk for poor prognosis - including functional decline, diminished quality of life and mortality subsequent to injury[7].

Aim of the work

To study the role of revised trauma scoring in predicting mortality in trauma patients. For better prognosis. And management.

Objectives

1. To correlate the revised trauma score to the outcome of the traumatized patients attending to the emergency department of Suez Canal hospital.
2. To compare between the available values and the predicted values in order to assess the efficacy of the Emergency department services offered to such patient.

Trauma epidemiology, types and classification

Definitions.

Trauma: can be defined as “a wound, especially one produced by sudden physical injury[8].

An injury: is defined as "“unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen[8].

Epidemiology.

A World Health Organization (WHO) report in 2003 estimated that 5.18 million people worldwide died from trauma in 2002 and approximately 80,000 in Europe. Injuries account for the 9% of the total number of world's deaths and ranks fourth among all causes of mortality after cardiovascular diseases, infections and malignancies[9].

In the developed countries, the three greatest causes of violent death are road traffic accidents (RTAs), falls and suicides. Generally, death rates from RTAs and falls are declining, while that from suicide is increasing[10].

The enlarging elderly population is more likely to have domestic accidents and to be more severely injured in any accident. Another influential factor affecting patterns of injury all over the world is the increasing use of alcohol and other drugs. In one study, about 50% of people dying from injury tested positive for blood alcohol[11].

Scoring system in emergency department

Concept of grouping patients according to severity of their illness is more than 100 years old. However, it was not well accepted until burn units and trauma centers were established in the 1940s and 1950.([29]

Scoring may allow collection of data more accurately and consistently, costs may be reduced, clinical research is facilitated, epidemiologic analysis is possible, the time course of illnesses can be documented (organ dysfunction etc.) earlier determination of a problem.([30]

General principles of scoring systems

Scoring systems were designed initially to categorize patients with single, specific diagnoses into risk and prognosis groups. Well –known examples still in use today include the burns score (1971) and the Glasgow coma score (GCS)(1974).[(31)]

Clinical assessment of severity of illness is an essential component of medical practice. It is intuitive to consider whether patterns and severity of physiological disturbance can predict patient outcome.[(31)]

Scoring systems for use in emergency room patients have been introduced and developed over the last 30 years. They allow an assessment of the severity of disease and provide an estimate of in-hospital mortality. This estimate is achieved by collating routinely measured data specific to a patient. A weighting is applied to each variable, and the sum of the weighted individual scores produces the severity score. Various factors have been shown to increase the risk of in-hospital mortality after admission to hospital, including increasing age and severity of acute illness, certain pre-existing medical conditions (e.g. malignancy, immunosuppressant, and requirement for renal replacement therapy), and emergency admission to ICU.[31]

Two main types of scoring system have been developed for use in the emergency patient: those primarily focused on a single end-point, survival, and those focusing on describing morbidity as it evolves organ dysfunction scores.[32]

Scoring systems essentially consists of two parts: a severity score, which is a number (generally the higher this is the more severe the condition) and a calculated probability of mortality. Most commonly, this is the risk of in-hospital mortality, though other outcome measures (e.g. survival to 28 days post-hospital discharge) can also be modeled[32].

1. Severity scores are instruments that aim at stratifying patients based on their severity, assigning to each patient an increasing number of points (or score) as their severity of illness increases.[33]
2. Prognostic models, apart from their ability to stratify patients according to their severity of illness, aim at predicting a certain outcome - usually the vital status at hospital discharge – based on a given set of prognostic variables and a certain modeling equation. Other outcomes, both in the short-term and in the long-term can eventually be considered, but are of little interest for the patients, their families, and the health care providers[33].

Severity scoring systems allow generation of a score that reflects the severity of the condition resulting in ICU admission. The scores allow the factors that influence outcome and those differ between patients to be taken into account and can be standardized to allow comparison between patients[31].

Scoring value:

The purposes and value of scoring systems for groups have been thought to be:

1. To predict outcome or prognosis.
2. Describe or classify the severity of illness.
3. To set entry criteria for randomized clinical trials.
4. To evaluate the impact of various therapies.
5. To describe metabolic and cardio ventilatory characteristics. Consistent with illness or survival.
6. To compare therapies.
7. To assist, guide or stop therapy.
8. To normalize for the severity of disease.
9. For status indexes, change indexes, prognostic indexes, and clinical guidelines.
10. To evaluate expenses, hospital costs [34].

Developing a scoring methodology and its validation

All critical care predictive scoring systems utilize numerical values to describe the severity of a patient's illness. Scores are then assigned predicted mortalities using a mathematical formula. Once a satisfactory equation has been developed it can be used to calculate a probability of death for an individual patient. Similarly an overall probability of death can be calculated for a group of patients.[31]

However, this methodology cannot indicate which of the patients in the cohort is going to die. The usefulness of any system depends upon its predictive accuracy. The two characteristics used to judge the value of a predictive system are

1) discrimination (its ability to predict which patients will survive and which will die) .

2) calibration (how well a model correctly predicts the overall observed mortality). In a perfect model the aim would be that:

- Overall predicted and observed outcomes should be the same.

- Individual patients observed to die or survive have been predicted.[31]

A further potential problem is that scoring systems do not have a linear scale: a score of 20 does not mean a patient is twice as sick as another patient with a score of 10, and likewise does not have twice the risk of dying.[31]

It is apparent that the use of physiological variables in scoring systems may give rise to potential bias and lead to the calculation of an inaccurate severity score. Values of the variables included can alter spontaneously or as a result of resuscitative therapy before admission of the patient to the hospital (occurring before transfer from emergency department , or out-of-hospital care performed by ambulance personnel). This is termed lead time bias and can render the scoring system inaccurate. As a result, scoring performed on hospital admission can suggest a better severity and predicted mortality than is actually the case. In one study, six variables accounted for the most lead time bias: heart rate, blood pressure, respiratory rate, oxygenation, pH, and blood glucose[35].

However, the most important potential limitation of scoring systems is the inappropriate interpretation of the score. Clinicians must be aware that the probability of in-hospital mortality based on a particular score relates to a similar group of patients and not to an individual. This is important to understand before attempting to use scoring systems in clinical practice. So, although it can be useful to know the predicted mortality of a group of patients with a similar score, we cannot be sure which patients will die and which will survive[32].

Classification of the scoring systems

1. **Anatomical scoring**. These depend on the anatomical area involved. Anatomical scoring systems are mainly used for trauma patients [e.g. abbreviated injury score (AIS) and injury severity score (ISS)].(31)

2. **Therapeutic weighted scores**. These are based on the assumption that very ill patients require a greater number of interventions and procedures that are more complex than patients who are less ill. Examples include the therapeutic intervention scoring system (TISS). (31)

3. **Organ-specific scoring**. This is similar to therapeutic scoring; the underlying premise is the sicker a patient the more organ systems will be involved, ranging from organ dysfunction to failure [e.g. sepsis-related organ failure assessment (SOFA)].(31)

4. **Physiological assessment**. It is based on the degree of derangement of routinely measured physiological variables [e.g. acute physiologyand chronic health evaluation (APACHE) and simplified acute physiology score (SAPS)]. (31)

5. **Simple scales.** It is based on clinical judgment (e.g. survive or die).(31)

6. **Disease specific** [e.g. Ranson's criteria for acute pancreatitis, subarachnoid hemorrhage assessment using the World Federation of Neurosurgeons score, and liver failure assessment using Child-Pugh or model for end-stage liver disease (MELD) scoring](31)**.**

Trauma scoring systems in emergency room

Trauma scoring is a useful tool for:

(I) Triage and prehospital treatment.

(II) Documentation using common terminology.

(III) Injury severity description.

(IV) Quality of care and patient outcome evaluation.

(V) Trauma system evaluation and comparison.

(VI) Trauma epidemiology, research, and funding[36].

Classification: Scoring systems for trauma patients are classified on physiological and/ or anatomical basis into the following examples:

(I)Physiological scores

Measure the physical changes induced by trauma. They tend to focus on neurological, hematological and respiratory abnormalities, and are strong predictors of mortality.

1- Trauma scores for adults.
2- Revised trauma score for adults.
3- APACHE scores.
4- The Simplified Acute Physiology Score.
5- Mortality Prediction Model.
6- Organ dysfunction description scores.
    A-Multiple Organ Dysfunction Score (MODS)
    B-Sequential Organ Failure Assessment (SOFA)
    C-Logistic Organ Dysfunction System (LODS)
7- Glasgow Coma Scale for adults.
8- FOUR Score.[31]

Most physiological scoring systems fail to recognize the importance of site-of-injury on subsequent disability. These scoring systems provide the most accurate data on functional status and functional outcome, and are especially valuable in triaging a patient to the appropriate level of care.[31]

(II)Anatomical scores:

Anatomical scoring systems characterize anatomical derangement, weighted by the importance of the site of injury.

1-Abbreviated Injury Score.

2-Injury Severity Score.

3-New Injury Severity Score. (NISS.

4-The Anatomical Profile. (AP).

5- Penetrating Abdominal Trauma Index. (PATI)

6- ICD-based Injury Severity Score. (ICISS).[31]

(III) Combined physiological and anatomical scores:

attempt to overcome the limitations of the pure anatomical or physiological systems by incorporating elements from both. Combined systems are superior to either anatomical or physiological systems as predictors of survival. However, combined systems are more comprehensive.

1. Trauma score injury severity score.
2. Trauma index score.
3. Circulation, Respiration, Abdomen ,Thorax, Motor and speech score.
4. A severity characterizing of trauma. [31].

(I)Examples of physiological scores

1-Trauma score for adults.

The TS for adults includes 1-16 points and is of prognostic value with decreasing the chance of patient survival at 12 points or less. The TS for adults is also of value for comparing the performance of different trauma centers or the same trauma centre over-time (***Champion, et al,.1989)***[37].

Table I: Trauma scores for adults [37]:

Variable	Score
Respiratory Effort	
10-24	4
25-35	3
> 35	2
< 10	1
0	0
Respiratory expansion	
Normal	1
Shallow or retractive	0
Capillary refill (s)	
Normal	2
Delayed (>2s)	1
None	0
Glasgow Coma Scale	
14-15	5
11-13	4
8-10	3
5-7	2
3-4	1
Systolic blood pressure (mmHg)	
>90	4
70-90	3
60-89	2
< 60	1
0	0

Total	16

Trauma scores for adults.[(37)]

Table II: Survival rate from trauma score for adults:

Trauma score	**Survival (%)**
16	**99**
13	**93**
10	**60**
7	**15**
4	**2**
1	**0**

Survival rate from trauma score for adults.[(38)]

TS is limited because of the difficulty in assessing capillary refill and respiratory response under prehospital conditions, Intubation, alcohol, and drugs interfere with the scoring of GCS.[(37)]

2- Revised trauma score for adults

Field use of the trauma score has revealed that capillary refill and respiratory expansion were difficult to assess at night, and respiratory expansion has always been difficult to observe, also trauma score underestimates the severity of head injured patients.(37) In response to these concerns ,the trauma score has been revised based on Glasgow Coma Scale ,and patients systolic blood pressure and respiratory rate . This revision is easier to apply to triage, more accurately characterizes head injury, and is more reliable for care evaluation than the original trauma score[(37)].

Revision of the score was based on the following design objectives:

- **The exclusion of capillary refill and respiratory expansion.**
- **The adoptions of commonly used and accepted intervals of the Glasgow coma scale, that indicate mild, moderate and severe head injury.[37]**
- The adoption of intervals of systolic blood pressure and respiratory rate values whose associated survival probabilities are equivalent to those of corresponding Glasgow coma scale intervals.[37]
- Easier implementation in field triage without concurrent diminished usefulness in care evaluation.[37]
- Empirical development and evaluation.[37]

The Revised Trauma Score (RTS) is a physiological scoring system, with high reliability and demonstrated accuracy in predicting death. It is scored from the first set of data obtained on the patient, and consists of Glasgow Coma Scale, Systolic Blood Pressure and Respiratory Rate[37].

Table III: Revised trauma score for adults:

Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (RR)	Coded Value
13-15	89	29-10	4
9-12	76-89	29	3
8-6	75-50	9-6	2
5-4	1-49	5-1	1

3	0	0	0

Revised trauma score for adults(39).

The RTS is a good outcome predictor when the coded values are multiplied by weighted coefficients (derived from the Major Trauma Outcome Study), according to the following equation:

RTS = 0.9368 GCSc +0.7326 SBPc+ 0.2908 RRc.

Values for the RTS are in the range 0 to 7.8408. The RTS is heavily weighted towards the Glasgow Coma Scale to compensate for major head injury without multisystem injury or major physiological changes. A threshold of RTS < 4 has been proposed to identify those patients who should be treated in a trauma center, although this value may be somewhat low.(39)

Table IV : Patient Survival Probability According to the Integer Values of the Revised Trauma Score.

RTS	Ps
7.84	0.988
7	0.969
6	0.919
5	0.807
4	0.605
3	0.361
2	0.172
1	0.071
0	0.027

Ps, probability of survival**. RTS,** revised trauma score.

Patient Survival Probability According to the Integer Values of the Revised Trauma Score.(37)

The RTS has several limitations that affect its usefulness. Most of these limitations are related to the GCS. As originally described, the GCS was intended to measure the functional status of the central nervous system. Because of the importance of head injury in determining trauma outcome, the GCS also is used by many as a component of trauma severity scoring. Problems inherent to the GCS and RTS include the inability to accurately score patients who are intubated and mechanically ventilated where determining the verbal component of the GCS and the respiratory rate are difficult in these patients.(68)

Patients who are pharmacologically paralyzed or under the influence of alcohol or illicit drugs also are difficult to score. Alternative approaches in this setting include using the best motor response and the eye-opening response to calculate or predict the verbal response. Research has shown that substitution of the best motor response for the GCS results in no loss of predictive capability. More recently researchers have shown that the best motor response predicts trauma mortality as well as, or better than, other trauma severity scores. (68)

3-Glasgow coma score

Glasgow Coma Scale Score – means the neurological assessment developed by G. Teasdale and B. Jennitte in (Assessment of Coma and Impaired Consciousness: A Practical Scale)*(59)*.

The Glasgow Coma Score (GCS) is scored between 3 and 15, 3 being the worst, and 15 the best. It is composed of three parameters. Best Eye Response, Best Verbal Response, and Best Motor Response, as given below.

Table V : Glasgow coma scale score:

Behavior	Best response	Score
Eye opening	Spontaneous	*E4*
	To verbal command	*E3*
	To pain	E2
	None	E1
Motor response	Follows commands	M6
	Localizes	M5
	Withdraws	M4
	Abnormal flexion	M3
	Abnormal extension	M2
	None	M1
Verbal response	Oriented	V5
	Confused conversation	V4
	Inappropriate words	V3
	Incomprehensible sounds	V2
	None	V1

Glasgow coma scale score.[59]

Note that the phrase 'GCS of 11' is essentially meaningless, and it is important to break the figure down into its components, such as E3 V3 M5 = GCS 11.[59]

The GCS score is labeled a measure of brain injury but in actuality it measures brain function. It ranges from 3 (completely unresponsive) to 15 (completely responsive) and has been shown to be highly associated with survival and the motor component is the most important value in the GCS. The motor component score correlates highly with the total GCS score[60].

Disadvantage:

- **Is only an indicator for head injury?**
- **Alcohol and drugs interfere with scoring.**
- **Intubation will interfere with scoring.**
- **Does not take into account focal or lateralizing signs.**[60]

(II) Examples of anatomical scores

1-Abbreviated injury score.(AIS)

The Abbreviated Injury Scale (AIS) is an anatomical scoring system first introduced in 1969. Since this time, it has been revised and updated against survival so that it now provides a reasonably accurate was of ranking the severity of injury. The latest incarnation of the AIS score is the 1990 revision. Injuries are ranked on a scale of 1 to 6, with 1 being minor, 5 severe and 6 an unrevivable injury.[65]

TableVI : Abbreviated injury score (AIS):

AIS Score	Injury
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unrevivable

(Abbreviated Injury Score (AIS).[65]

The purposes of AIS are to:

(I) Describe the injuries anatomically.

(II) Standardize injury terminology.

(III) Rank injury by severity.

(IV) Facilitate injury comparisons.

(V) Consider injury, not consequence.[66]

Its limitations are mainly in describing physiologically based injuries and specifying them. It cannot accurately describe all fractures and locations (e.g., anterior, posterior, bilateral), contusions commonly seen together in the same region (e.g., rib fractures and pulmonary contusions), near-drowning, hypo and hyperthermia, or inhalation injuries. Scoring systems based on AIS must also be assessed for these shortcomings[66].

2-Injury severity score(iss)

It was developed as an extension of AIS, as an ordinal summary severity score of a patient with multiple injuries. ISS correlates with mortality, morbidity, hospital stay, and other measures of severity. It is the most widely accepted severity-of-injury index in use today. [67]

Each injury is assigned an AIS code and classified in one of six body regions, as follows:

(1) Head/neck.

(2) Face.

(3) Thorax.

(4) Abdomen.

(5) Extremities (including pelvis).

(6) External "General/skin.[68]

ISS body regions

1. Head and neck
2. Face
3. Chest
4. Abdominal and pelvic contents
5. Extremities and pelvis
6. General/skin

Computational formula:

ISS score = √ of:

(AIS score of most severe injury in ISS any region)^2 + (AIS score of next most severe injury in another ISS region)^2 + (AIS score of most severe injury in any remaining ISS region)^2 =ISS score

Where ISS region is defined as above.

To calculate the injury severity score (ISS), only the highest abbreviated injury scale (AIS) score in each body region is used. The three most severely injured body regions have their score squared and added together to produce the ISS score.[68]

Table VII : An example of the ISS calculation is shown below:

Region	Injury Description	AIS	Square Top Three

Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver Complex Rupture Spleen	2 5	 25
Extremity	Fractured femur	3	
External	No Injury	0	
	Injury Severity Score:		**50**

An example of the ISS calculation. *(68)*

Injury Severity Score range 1-75

If injury is assigned 6 (unrevivable), ISS = 75

Table VIII : ISS Score Reflective of Injury:

ISS Score	**Severity**
1-9	Minor
10-15	Moderate
16- 24	Moderate/Severe
≥ 25	Severe/Critical

ISS Score Reflective of Injury. (69)

TableIX: Injury severity score and relationship with mortality:

ISS	**Prognosis/outcome**
10	Unlikely to cause death
15	Major trauma, but mortality is less than 10%

17	Critical value
›25	Linear increase of mortality
50	50% probability of mortality
75	No survivable injury

Injury severity score and relationship with mortality. *(70)*

Weaknesses**:**

1. Its weaknesses are that any error in AIS scoring increases the ISS error.
2. As multiple injuries within the same body region are only assigned a single score.
3. Many different injury patterns yield same ISS score
4. Injuries to different body regions are not weighted.

3- The anatomical profile (AP)

The AP was developed in response to the limitations of the ISS. The AP classifies injuries by regional anatomical values into only four categories. The AP uses four components, A–D, representing all body regions, as seen in" Table-20". The A–C components summarize all the serious (A head, neck, thorax, and other body regions. Component D injuries are less serious and have not shown significance in mortality outcome predictions, but are useful for disability outcome assessments.

(III) Examples of Combined physiological and anatomical scores

1-Trauma score - injury severity score (TRISS)

The TRISS is used for outcome prediction, quality assessment, and improvement. TRISS determines the probability of survival (Ps) in trauma patients by using combined initial admission ISS and RTS scores, along with the age of the patient.[74]

$Ps = 1/(1 + e^{-b})$

Where 'b' is calculated from:

$b = bo + b1(RTS) + b2(ISS) + b3(Age\ index)$

Age Index is 0 if the patient is below 54 years of age or 1 if 55 years and over.

ISS Injury Severity Score. **RTS** The Revised Trauma Score.

e=2.718282

	Blunt	Penetrating
b0	-0.4499	-2.5355
b1	0.8085	0.9934
b2	-0.0835	-0.0651
b3	-1.7430	-1.1360

(Boyd, et al, .1987)[74].

The TRISS method predicts trauma patient outcomes on the basis of their injuries and enables comparisons of patient outcomes among trauma systems while controlling for differences in injury severity. [75]

The limitations of the TRISS method relate mainly to the anatomical component of the ISS, thus limiting injuries per body region; and, severe neurological trauma is imperfectly weighted, giving inaccurate predictive estimates in adult and pediatric trauma. The age parameter has an incomplete grading range[75].

2-A Severity characterization of trauma

Champion developed a scoring tool, termed "A Severity Characterization of Trauma" (**ASCOT)** in 1990, in an effort to improve TRISS methodology. In the **ASCOT** scoring system, the anatomical component of the ISS was replaced with AP to improve outcome prediction by eliminating ISS shortcomings[76].

Despite these modifications, the predictive performance of ASCOT is only marginally better than the ISS. This coupled with the complex nature of the AP component. ASCOT has been compared to TRISS in numerous studies there have been differences of opinions on the more accurate outcome system. Both methods have their limitations in accurate survival predictions.[77]

All the values are statistically weighted in such a manner as to produce a probability of survival[71].

1-RTS points as in the original score. Each component of RTS is given a coefficient (k1-k3).[71]

2-AP: The body is divided to 3 regions as in AP: each area is given a coefficient (k4-k6)

Region A: head, brain and spinal cord region,

Region B: thorax and front of neck region, and

Region C: all other body areas.

Anatomic Profile Points for each region:

= √ ((number of AIS 3 injuries) * (3^2)) +

((number of AIS 4 injuries) * (4^2)) +

((number of AIS 5 injuries) * (5^2).[71]

3-Age: is divided into 5 categories: coefficient K7.[71]

TableXI :Coefficients (weights) used for ascot calculation.[71]

≤54 years	0 point
55 – 64	1 point
65 – 74	2 points
75 – 84	3 points
> 85	4 points

Mechanism		Blunt	Penetrating
	Intercept k0	-1.1570	-1.1350
RTS	GCS k1	0.7705	1.0626
	SBP k2	0.6583	0.3638
	RR k3	0.2810	0.3320
AP	area A k4	-0.3002	-0.3702
	Area B k5	-0.1961	-0.2053
	Area C k6	-0.2086	-0.3188
Age	k7	-0.6355	-0.8365

Log it = k0 + k1(GCS) + k2(SBP) + k3(RR) + k4(A) + k5(B) + k6(C) + k7(age)

Predicted death rate = $1/(1 + e^{\log it})$

e = 2.718282 (base of Napierian logarithm)

Patient and methods

Study design

Our study was prospective descriptive study

Study location:

The study was conducted in emergency department in Suez Canal university hospital, Ismailia Egypt.

Study population:

All multiple trauma patients attended emergency department at Suez Canal university hospital from May 2011 to

November 2011

Exclusion criteria

Child below 18 years old

Sample size:

To achieve the study objectives, the sample size was determined by using the following equation

r^2:	Of the regression model done for assess the relation between values of revised trauma scoring (RTS) and mortality percentage in trauma patients. =0.36(Lavoie A., et al.,2006)
$Z_{\alpha/2}$:	A percentile of standard normal distribution determined by 95% confidence level = 1.96

Δ :	The width of the confidence interval = 0. 1

Sample size (n) = 2 + 1.96 [(1- 0.36) / 0. 12]= 127 trauma patients

The calculated sample size was 127 trauma patients. Due to the expected drop-out rates (10%), the studying sample size will be140 trauma patients.

For each multiple trauma patient attended to emergency department, the following data was collected

1) Demographic data:

- Age.
- Sex.

2) Clinical assessment:

- Systolic blood pressure.
- Respiratory rate.
- Glasgow coma scale.

The revised trauma score= [0.9368] GCS coded value + [0.7326] systolic BP coded value + [0.2908] respiratory rate coded value

The revised trauma score ranges from 0-8 each represent a specific survival percentage table **IV**

3) Mechanism of injury

A-Blunt injury: -

- Road traffic accident
- Fall from a height
- Others

B- Penetrating injury: -

- Gunshot wound
- Stab wound
- Others

4) Patients Outcome: -

Survival or death on discharge

Table III

Revised trauma score variable break points[39].

Glasgow Coma Scale	Systolic Blood	Respiratory Rate	Coded Values
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

Table XVI

The Weight for each variable of R.T.S[39].

Variable	GCS	SBP	RR
Weighted values	0.9368	0.7326	0.2908

GCS:Glasgow Coma Scale

SBP:Systolic blood pressure

RR :Respiratory Rate

Table IV

The relation between values of RTS and survival percentage[37].

RTS	Percent Survival
0	2.7
1	7.1
2	.17.2
3	36.1
4	60.5
5	80.7
6	91.9
7	96.9
7.84	98.8

Statistics

Statistical presentation and analysis of the present study was conducted, using the mean, standard deviation and chi-square test by SPSS V.16.

1- Mean value $\left(\bar{X}\right)$ **:** the sum of all observations divided by the number of observations:

$$\left(\bar{X}\right) = \frac{\Sigma x}{n}$$

Where Σ = sum & n = number of observations.

2-Standard deviation [SD]:

It measures the degree of scatter of individual varieties around their mean:

$$SD = \sqrt{\frac{\Sigma \left| x - x \right|^{-2}}{n-1}}$$

3-Chi-square the hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship. Pearson chi-square and likelihood-ratio chi-square. Fisher's exact test and Yates' corrected chi-square are computed for 2x2 tables.

Chi-square test:

For comparison between two groups as regards qualitative data.

$$\mathbf{X^2} = \sum \frac{(O-E)^2}{E}$$

Where:

Σ = Summation.

O = Observed value.

E = Expected value= $\frac{\text{vertical total X Horizontal total}}{\text{grand total}}$

4. Linear Correlation Coefficient [r]:

$$r = \frac{\Sigma\left(X - \overline{X}\right)\left(y - \overline{y}\right)}{\sqrt{\{\Sigma\left(X - \overline{x}\right)2\ \}\{\Sigma\left(y - \overline{y}\right)2\}}}$$

Where :

X= Independent variable.

Y= Dependent variable

Results

The study was carried out on 140 of multiple trauma patients. They were admitted to Suez Canal University Hospital. Data for revised Trauma Score was collected from all patient.

- **Age distribution of traumatized patients :**

The age in the present study ranged between 18 to 77 years with a mean of 34.62years.57patients (40.71 %) ranged in age from 18 – <30 years ,representing the highest affected age group.(Table1)

Table1: Age distribution of traumatized patients :

Age in years	No.	%
18-<30	57	40.71
30-<40	44	31.43
40-<50	24	17.14
50-<60	8	5.71
60-<70	5	3.57
>70	2	1.43

Total	**140**	**100**
Range	18-77	
Mean	34.62	
+S.D	**12.606**	

The relation between age, revised trauma score and outcome:

The lowest range of RTSwas 0.8-4.62 , present in patient with age group from 50 - 60 years . All patients in this age group died. Two patients above 70 years survived . both had higher RTS range and mean values (Table 2).

Table(2): The relation between age, revised trauma score and outcome

Age in years	Outcome				RTS	
	Survival		Death			
	No.	%	No.	%	Range	Mean +SD
18-<3O	44	77.19	13	22.8	0-7.88	4.15+1.63
30-<40	34	77.27	10	22.73	0-7.8	5.20+0.96
40-<50	13	54.2	11	45.83	0.8-7.8	4.20+0.58
50-<60	0	0	8	100	0.8-4.62	2.41+0.41
60-<70	3	60	2	40	0.8-7.8	5.36+1.24

>70	2	100	0	0	7.87-7.88	7.87±0.01
Total	**96**	**68.57**	**44**	**31.43**	**0 -7.88**	**5.74±0.74**
X^2	**5.691**					
p. value	**0.017**					

The highest mortality occurred in age group from 50-<60 years as their mean RTS was

Gender distribution:

Male patients were 119(85%), while female patients were 21(15%). These was a highly significant sex difference(Table3)

Table (3):Gender distribution of trauma patients.

Male		**Female**	
No.	**%**	**No.**	**%**
119	85	21	15
x^2	**3.528**		
P	**0.005**		

There was ahighly significant difference between the male and female in trauma incidence.

Age distribution by sex:

The highest incidence of trauma for male was in age group from 18-<30 years. Also in females the hight incidence of trauma .occured in the same group (Table4).

Table (4):Age distribution by sex.

Age in years	Male		Female	
	No.	%	No.	%
18-<30	43	57	14	25
30-<40	39	89	5	11
40-<50	24	100	0	0
50-<60	6	75	2	25
60-<70	5	100	0	0
>70	2	100	0	0
Total	**119**	**100**	**21**	**100**

X^2	4.528
p. value	0.039

Distribution of traumatized patients according to mechanism of trauma:

126 patients(90%) were involved in blunt trauma , while 14 patients (10%) were involved in penetrating trauma . The difference was significant (Table5) .

Table(5): Distribution of traumatized patients according to mechanism of trauma.

Mehanism of injuries	Total	
	No.	%
1.Blunt	126	90
2 .Penetrating	14	10
x^2	10.225	
p	0.001	

There was a significant difference between blunt and peneterating trauma.

Relation between mechanism of trauma and outcome:

126 patients were involved in blunt trauma , their mean RTS values was patients (34.13%)died , while 83 patients (65.87%) survived . 14 patients were involved in penetrating trauma, one patient(7.14%) died , while 13 patients(92.86) survived . The difference was significant as mortality was more common in blunt than penetrating trauma(Table6).

Table (6):Relation between mechanism of trauma,RTS and outcome.

Mechanism	Outcome

of injuries	RTS		Death		Survival	
	Range	Mean+SD	No.	%	No.	%
Blunt	0.0-7.8	4.20+0.24	43	34.13	83	65.87
Penetrating	4.2-7.8	5.66+0.47	1	7.14	13	92.86
x^2			**4.260**			
p			**0.039**			

There significant difference between the mortality in both blunt and peneterating . i.e. the survival is higher in peneterating trauma.

Distribution of blunt trauma,according to different mechanism and outcome:

In blunt trauma, road and traffic accident was the most common mechanism , found in 106 patients(84%).35patients(33 %) died while 71patients(67%) survived.20 patients (16%) suffered falling from hight, 7 patients(35%)died , while 13 patients(65%)survived.

The difference as regard incidence between different mechanism was significant, also the difference between mortality (outcome) was significant(table 7).

Table (7) : Distributing of blunt trauma according to different mechanisms and outcome .

Blunt injury	Total		Outcome			
			Death		Survival	
	No.	%	No.	%	No.	%
RTA	106	84	35	33	71	67

FFH	20	16	7	35	13	65
Total	126	100	42	34.13	84	65.87
x^2			**1.852**			
p			**0.069**			

RTA = Road traffic accident

FFH =Falling from height

Distribution of penetrating trauma according to different mechanism and outcome:

In penetrating trauma, gunshot wound was the most common mechanism, 9 patient(64.3%) were involved and1 patient died (11%)8 patient survive(89%). 5 patients (35.7%)were involved in stab wound, all patients survived , the difference as regard incidence and outcome was significant (table 8).

Table(8):Distributing of penetrating trauma according to different mechanisms and outcome .

Penetrating injury	**Outcome**					
	Total		**Death**		**Survival**	
	No	**%**	**No**	**%**	**No**	**%**
Gun shot	9	64.3	1	11	8	89

Stab wound	5	35.7	0	0	5	100
Total	14	14	1	7.14	13	92.86
x^2	**0.600**					
p	**0.439**					

Gun shot was the most common mechanism in peneterating trauma , while mortality (11%) was most common in gunshot wound

Distribution of traumatized patients according to site of injury:

The head was the most common affected site as it was involved in 87patients (62%) followed by long bone fracture found in 85 patients (61%) ,.(Table 9).

Table(9):Distribution of traumatized patients according to site of injury:

Anatomy of trauma	Number	Percentage%
Head	87	62%
Long bone	85	61%
abdomen	39	28%
chest	49	35%
vascular	26	19%

Head injury was the most common affected site (62%)

Relation between site of trauma and outcome :

Mortality occurred in multiple trauma with head involvement .87 patients were involved in head trauma , 37 patients (46%) died , while 50 patients (54%)survived (Table 10).

Table (10):Relation between site of trauma and the outcome.

Site of injuries	Total	Outcome				RTS
		Death		Survival		
		No.	%	No.	%	
Multiple trauma with head involvement	87	37	46	50	54	0.0 -7.8 4.20±0.24
Multiple trauma without head involvement	53	7	13	46	87	0.8-7.8 5.66±0.47
X^2		**4.523**		**3.224**		
P. value		**0.009**		**0.042**		

Distribution of trauma patients according to duration of stay and outcome.

The duration range from hours to 4 week 78 patients stay for 1 week 17 patients (22%)died 61 patient(78%)survive 12 patients stay for hours all them died.

The mean length of stay in our study was 9.09 day the average stay for survivors was 9.25 days which significantly exceed that of non survivors (8.77)days TABLE(11).

Table(11): Distribution of trauma patients according to duration of stay and outcome and RTS.

Duration of stay	Total	RTS	Outcome				X^2	p
			Death		Survival			
			NO	%	NO	%		
hours	**5**	**0-<1**	**5**	**100**	**0**	**0**		
	1	**1-<2**	**1**	**100**	**0**	**0**		
	2	**2-<3**	**2**	**100**	**0**	**0**		
	2	**3-<4**	**2**	**100**	**0**	**0**		

	2	4-<5	2	100	0	0		
Total	**12**	**0-4.62**	**12**	**100**	**0**	**0**	**8.632**	**0.001**
1Week	3	0-<1	3	100	0	0		
	4	1-<2	4	100	0	0		
	3	2-<3	3	100	0	0		
	8	3-<4	3	37.5	5	62.5		
	8	4-<5	1	12.5	7	87.5		
	6	5-<6	2	33.33	4	66.67		
	21	6-<7	1	4.8	20	95.2		
	25	7-<8	0	0	25	100		
Total	**78**	**0.8-7.8**	**17**	**22**	**61**	**78**	**15.32**	**0.001**
2Weeks	1	3-<4	1	100	0	0		
	15	4-<5	6	40	9	60		
	8	5-<6	2	25	6	75		
	12	6-<7	1	8.3	11	91.7		
	6	7-<8	0	0	6	100	12.101	0.001

Total	**42**	**3.04-7.8**	**10**	**24**	**32**	**76**		
3Weeks	**1**	**1-<2**	**1**	**100**	**0**	**0**		
	2	**2-<3**	**1**	**50**	**1**	**50**		
	2	**4-<5**	**2**	**100**	**0**	**0**		
	1	**5-<6**	**0**	**0**	**1**	**100**		
	1	**6.7**	**0**	**0**	**1**	**100**		
Total	**7**	**1.8-6.2**	**4**	**57**	**3**	**43**	**2.635**	**0.050**
4week	**1**	**3.36**	**1**	**100**	**0**	**0**	**6.356**	**0.002**
Total	**140**		**44**	**31.4**	**96**	**68,75**		
r			**-0.84**		**0.84**			
p			**0.0001**		**0.0001**			

Relation between RTS and outcome

There were 8 patients who had RTS value from 0-<1, the whole 8 patients died , while the whole31 patients who had RTS value from 7-<7.8 survived .There was a high positive correlation between the value of RTS and survival percentage , as the value of RTS increased , the survival percentage increased (Table 12).

Table(12):Relation between RTS and outcome

RTS	TOTAL	Death		Survival	
		NO	%	NO	%
0-<1	8	8	100	0	0
1-<2	6	6	100	0	0
2-<3	7	6	86	1	14
3-<4	12	7	58	5	41
4-<5	27	11	41	16	59
5-<6	15	4	27	11	73
6-<7	34	2	6	32	94
7-<7.8	31	0	0	31	100
Total	140	44	31	96	69
r		**0.536**		**0.417**	
p		**0.006**		**0.010**	

There is a high negative significant correlation between the RTS and percent of death and a high positive significant correlation between survival and the RTS .

Discussion

Trauma is a time-sensitive condition. Especially during the first hour of trauma management, assessment, resuscitation and definitive care are very important. Providing definitive care earlier at trauma centers has been shown to decrease mortality [[94,95]]. Easy-to-use trauma scoring systems inform physicians of the severity of trauma in patients and help them decide the course of trauma management. The use of trauma scoring systems is appropriate in two situations that occur in trauma patient care. They can be used in the field, before the patient reaches the hospital, to decide whether to send the patient to a trauma center. They can also be used for clinical decision making when the trauma patient has just arrived at the emergency department (ED). When the patient is in the ED, trauma scoring systems can be used to prepare the patient for surgery, to call on medical staff for trauma support and to inform the family of the severity of the patient's condition in the early stage.

Many trauma scoring systems have been developed and used. For instance, the Revised Trauma Score (RTS) [96] is most widely cited and used. It also comprises the content of the Trauma and Injury Severity Score (TRISS) [97]. However, calculation of the RTS is too complicated for easy use in the ED. Also, it might not have high reliability when used by paramedics. Moreover, respiratory rate (RR), a component of the RTS, is less reliable than other factors because it is influenced by patient age, mechanism of injury and mechanical ventilation. The Triage RTS (T-RTS) is based on the same risk intervals and variables of the RTS and is simpler to use (96)However, the T-RTS has the same problems as the RTS. TRISS is also widely used at trauma centers. It strongly predicts probability of survival because it involves the mechanism of the injury as well as anatomical and physiological factors [74], but it is very complex to use.

In this study , the Revised Trauma Score (RTS)has been conducted on 140 traumatized patients attended to suez canal university hospital . The mean age of traumatized patient in our study was this 34.62values agrees with others,[71,107] . and point to corner stone of the problem i.e. Victims are in the productive age of life. The majority of traumatized patients(72.14%)were between 18 and 40years old. The mortality rate of traumatized patients in the age group from 18 to 30years was22.8% In the present study age influenced mortality at a more or less equal RTS. This is observed in the age group 18 to <50 years patients , the mortality increased steady from 22.8%to 45.83% from age group 18 to<30 to age group 40 to <50years.

In the age groups, from 60 to<70 years and from 70 to 77 years mortality was 40%and 0% respectively , compared to 100 % mortality in those between 50 to <60 years . while Battistella FD, et al[105] (1988) found that traumatized patients with older group had higher mortality rate (72%) as compared to younger age group (36%).

In the present study the injury severity of the younger age groups was higher than that of older ones i.e.RTS values in younger groups was 0 -7.88compared to 0.8-7.8 and 7.87-7.88in the groups between 60 to <70and 70 to 77 years respectively . Kilaru S, et al[106](1996) found that mortality rate declined from 100% to 20% in both group of 70 years and 75 years respectively , they attributed these results is due to the higher injury severity score in the younger groups .

Male predominate females as regard trauma occurrence , as male patients constitute 85%of all traumatized patients . A similar finding was reported by

Mock CN et al[107]1998,Kane G,et al[108] (1992) and **Louis J. Magnotti,** [109](2007)in which male constituted 85,82.5 and 68% respectively.

The traumatic insult being more frequent in males than in females as explained by the fact that males live most of the time outdoors , being more exposed to trauma and violence.

As regards mechanisms of trauma, blunt trauma was found in the present study to be more common than penetrating trauma . Blunt trauma constituted 90% of the traumatized patient while penetrating trauma was only 10%. This agrees with the study done by De Knegt C, Meylaerts SA,Leenen LP.2008,[110] champion HR et al[111]1990 and Battestella FD ET AL [105] 1998 who reported blunt trauma in 93.3 ,80 and 95% of traumatized patients respectively.

In blunt trauma road traffic accidents were the most common mechanism.84% of our patients suffered blunt trauma followed by falling from height in16% . This agreed with the studies done by Champion HR et al[111] 1990 Wong DI et al[112]1996and Mock CN ET AL[107] 1998 in which road traffic accident was involved in 60 ,59.8and 57.9% respectively followed by falling from height in 20 % ,25 %and 20.4% respectively.

Gun shot was the most common penetrating trauma in 64.3% of our study patients followed by stab wound found in 35.7%.This agree with Demetriades D., Kimbrell B., Salim[113]2005; in which gunshot found in91.7% and stab wound found in7%on the other hand this is not agree with the finding of Wong DT et al [112]1996 And Mock CN et al,(109)1998 as stabbing constituted 33 and 44% respectively . in the study done by Kane G , et al [108]1992 gunshot wounds constituted 58.5 % followed by stabbing (41%) this difference may be due to the fact that , gunshot are more common in certain society.

In the present study , the mortality in blunt trauma was much more higher(34.13%) compared to 7.14% in penetrating trauma similar finding was found by MC Aluanah MJ , et al,[114] 1988 as mortality in blunt trauma was 41% while in penetrating trauma was5.9%.This can be explained by the fact that , blunt trauma is a distributed dissipation of kinetic energy which lead to direct and indirect wide lesion, while penetrating trauma is a more focal dissipation of a projectile 's kinetic energy that lead to localized lesion.

In blunt trauma , road traffic accidents had high mortality rate , which was 33% This agrees with the study by Champion HR et al[15] , as road traffic accidents constituted the highest mortality in blunt trauma , which was 30%. This most attributed to the fact that severe head injury is very common after road traffic accident and head injury was the most common cause of death. Other study road traffic accident account for 19.9 % of death (Demetriades D., Kimbrell B., Salim A., et a[113]; On the other hand gunshot wounds had the highest mortality 11% in penetrating trauma this compared with Champion HRet al[71]in which gunshot wounds had mortality rate of 20.9% in Demetriades D., Kimbrell B[113]., gunshot wounds had mortality rate of 45.9% this can be explained by the fact that the damage in low velocity injuries (stab wound)is confined to the directly disrupted tissues .while in high velocity injuries (gunshot wounds) cavitation occur along the track of the missile depending on it ´s size and velocity , leading to a widespread and sever disruption of surrounding tissues.

The head was the most common affected site . it was involved in 62% followed by long bone which constituted 61%(Demetriades D., Murray J.2004[115] This result was *he most common body area with critical injuries (AIS ≥ 4) was the head (43%), followed by the chest (28%) and the abdomen (19%).* .in the study done by Mattox KL et AL[116]1989 The most common affected site was chest

40.8%followed by abdomen 31.8%while head trauma was 7%.This difference may be due to high incidence of head injuries secondary to blunt trauma, which represent 90% in our study while thoracic and abdominal injuries were common after penetrating trauma which constituted 85% in the study done by Mattox KL et al[116]1989.

In this study , the mortality in head trauma patients with multiple injuries46%. This agrees with the results found by Miller JDet al,[117]1993 as mortality in head trauma was 40% . This can be explained by the fact that hypoxemia, hypotension , anemia and hypercapnia which commonly complicate multiple injuries lead to secondary injuries and increased mortality in head trauma patients .

The mortality percentage in multiple trauma without head involvement was 13 percent in our study . While in the study done by Mock CN et al,[107] 1998 the mortality was 4%.

The mean length of stay in our study was 9.09 day the average stay for survivors was 9.25 days which significantly exceed that of non survivors (8.77)days . this agrees with the study done by Champion HR et al,(113)1990 as the average stay was 9.2 days , and the average stay for survivors was 9.7 days which was significantly exceeded that of non survivors (4.6days).

The mean Revised Trauma Score of non survivors was 3.08. patients who died within the first 24 hours of hospital stay had a lower RTS value (2.1)compared to those who died after the first 24 hours(3.47).

The same finding was found by Malangoni et al,[118](1996)as the average RTS for non survivors was 2.3 which was lower in patients who died within the first 24 hours of hospital stay compared to those who died after the first 24 hours.

The total mortality rate in our study was 31.4% this result agrees with study done by Mock CN et al,[107](1998) in which mortality was 35 %while the study of Wong DT et al,[112] (1996)and Mattox KL et al[116]1989 the mortality was 13% and 19% respectively , this higher mortality in our study may be due to high incidence of head trauma (52)compared to only 7% in the study done by Mattox KI [116]. We found a highly positive correlation between the Revised Trauma Score and survival , as the Revised Trauma Score increased , the survival percentage increased . The same finding was found by Champion HR et al. [71] (1989,1990). The survival percentage in patients with Revised Trauma Score of 0 to <1 and 1 to <2 was 0% for each while the predicted survival would have been2.7 and 7.1 respectively.

This disappointing fact may be due to , small sample size (140 patients) also it may be due to economic factors as the original study was done in highly specialized well equipped trauma centers and the mortality decreased with the increased economic status and financial support.

To summarize , the Revised Trauma Score is an easy applicable measurement , that is valid in assessment of clinical course and outcome prediction of traumatized patients . The Revised Trauma Score can also help in critical decision making as regard intensive care unit admission , discharge , invasive monitoring or therapy , withholding or withdrawing and assessment of the medical service provided to traumatized patients.

Summary and conclusion

Trauma is the most serious and major health problem in developing countries . Trauma is the leading cause of death in the first four decades of life .

In recent years several trauma scoring systems have been developed and validated for use in prediction of outcome. These scoring systems include the trauma score , Revised Trauma Score and Injury Severity Score.

Injury severity score is a good system for assessment of injury severity , but less sensitive as regard outcome prediction.

Trauma score has been used for some years for both patient s triage and outcome prediction , but it was less sensitive in assessment of patients with serious head injuries.

Trauma score has been revised on 1989, based on Glascow Scale Scale , systolic blood pressure and the respiratory rate for developing revised trauma score.

The RTS demonstrates substantial improvement in outcome prediction , also it has yielded more accurate outcome prediction for patients with serious head injuries than trauma score.

In our study the RTS has been correlated with outcome in 140 multiple trauma patients attending emergency department at Suez canal university hospital from May 2011 to November 2011.

There was high positive significant correlation between RTS value and survival as patients with RTS value of 0 to <1 and 1 to<2 died while patients with RTS values from 7 to 7.8 survived.

In summary ,the application of RTS as outcome prediction tool in suez canal hospital is recommended and the RTS helped us in:

- clinical decision-making about icu admission and invasive monitoring or therapy.
- Evaluating of the effect of new technology and outcome.
- Evaluating of medical service provided to traumatized patients
- comparing medical services and performance of different centers.
- Probing cost difference among patients with similar diagnosis

Recommendation

Application of revised trauma scoring may help to improve survival of trauma patients and provide physicians with future decision-making schemes.

Another study with larger sample size may be needed to give more accurate result.

Further study needed to evaluate other scoring system and compare it with each other to reach other to reach most accurate one.

Efforts must be done to reach new scoring system which must be more accurate.

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