Benefit of Revised Trauma Score in Determining Admission to Trauma ICU Ward at Siriraj Hospital

Lertpong Somcharit MD*, Sirichai Thadapradit MD*, Dhinada Bordeesrisakul MD**

** Division of Trauma Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*
*** Department of Nursing, Faculty of Medicine Siriraj Hospital, Bangkok, Thailand*

Objective: *Trauma is one of the most common causes of death in Thailand. Most seriously injured patients need admission to ICU, but there are no definitive criteria for ICU admission especially for trauma patients. Revised Trauma Score (RTS) is widely used worldwide for trauma triage because it is effective and easy to calculate. The purpose of this study is to evaluate the benefits of RTS in determining category of admission to trauma ICU ward or general trauma ward. Moreover, to analyze APACHE II currently being used in general ICU, then compare the scores to RTS.*
Material and Method: *A retrospective review of trauma registry data from January to June 2015 of 109 trauma patients who were brought to resuscitation room of Division of Trauma, Siriraj Hospital. 69 patients were admitted to trauma ICU, 40 patients were admitted to general trauma ward. RTS of both groups were calculated. Demographic data, ISS, hospital stay and mortality rate were collected. APACHE II was also calculated in trauma ICU group.*
Results: *A total of 109 patients, sixty-nine patients were admitted at Trauma ICU, the median RTS was 7.11, forty patients were admitted at general trauma ward; the median RTS was 7.84. After adjusted data, median RTS of TICU and the ward groups were 6.9 and 7.84. The appropriate cutoff point of RTS in determining category of admission to TICU was RTS <7. The average APACHE II in ICU group was 8. The correlation between RTS and APACHE II was -0.356.*
Conclusion: *The RTS can be used as the guideline in determining which trauma patients require TICU admission or general trauma ward admission. The appropriate cutoff point is RTS <7. RTS and APACHE II are different and cannot replace each other. They both have benefits, RTS is good as an initial screening tool, whereas APACHE II is better in ward monitoring.*

Keywords: *Trauma ICU admission, RTS*

J Med Assoc Thai 2017; 100 (Suppl. 4): S137-S142
Full text. e-Journal: *http://www.jmatonline.com*

Trauma is one of the most common causes of morbidity and mortality in Thailand. Siriraj Hospital serves as one of the level 1 trauma centers of Bangkok, Thailand. Most of the seriously injured patients are admitted to trauma intensive care unit (TICU) with no definitive criteria. Trauma surgeons make their decisions based on severity of patients' injuries and their own observations to determine patient admission to TICU. This determination is unscientific and each trauma surgeon has a different standard. Sometimes surgeons decide to admit trauma patients at TICU in clinically stable condition until they are discharged to the general trauma ward. These patients use hospital facilities more than necessary. On the other hand, trauma patients who are admitted at general trauma ward (WARD), have unstable vital signs and should be transferred to TICU. These patients may have an increase in morbidity and mortality due to delayed monitoring.

Revised Trauma Score (RTS) is one of the trauma scores that is used worldwide by paramedics for scene triage[1,2] because it is effective, easy to calculate by using only patients respiratory rate, systolic blood pressure and Glasgow Coma Scale (GCS) score. RTS also has a high efficacy rate to predict the mortality of trauma patients[3].

Other trauma scores such as Injury Severity Score (ISS) need information after imaging or surgical procedures to calculate the score. Some scores are used to determine patient admission to ICU, such as APACHE II which requires more information and results of many blood tests to calculate.

The purpose of this study is to evaluate the benefits of RTS in determining admission to TICU or general trauma ward and to compare RTS with

Correspondence to:
Somcharit L, Division of Trauma Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
Phone: +66-2-4197727
E-mail: lertsur@hotmail.com

APACHE II currently being used in TICU.

Material and Method

Statistical analysis

Sample size was calculated by using nQuery Advisor 6.0 program, total number of calculated sample size was 100 cases (TICU group 60 cases, WARD group 40 cases) based on pilot study (Fig. 1).

All available data were entered into a database and were analyzed with PASW 18.0 software with *p*-values less than 0.05 considered significant. RTS of both groups were calculated. Demographic data, ISS, hospital stay and mortality rate were collected. APACHE II was also calculated in TICU group. Benefits of RTS to determine admission to TICU were calculated by using the area under receiver operating characteristic curves (AUROC). The correlation between RTS and APACHE II was calculated by Spearman rank correlation.

Inclusion criteria

Trauma patients with age of 15 to 60 years who are injured within 24 hours before arrival to Siriraj Hospital without any definitive treatment before being admitted toTICU or general trauma ward.

Exclusion criteria

Any patients who have respiratory tract disease, hypertension, or neurological disease that would interfere with calculated RTS were excluded from the study.

Input measures

The medical records of study subjects were reviewed, mechanism of injury, demographics and injury-specific data, operative interventions, radiological procedures and interventions, laboratory values, blood product utilization, hospital stays, discharge information and mortality were abstracted.

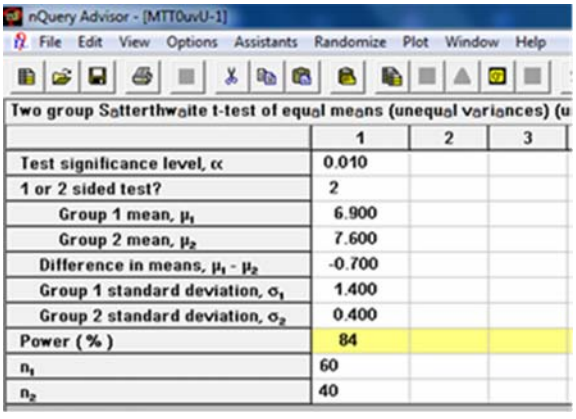

Fig. 1 Sample size calculated by using nQuery Advisor 6.0 program.

Outcome measures

The primary outcome of the study was RTS. The secondary outcome was overall hospital stays, mortality rate, ISS and APACHE II.

Ethics consideration

This study was approved by the Ethics Committee (Si. 503/2015) and performed at the Faculty of Medicine Siriraj Hospital, Mahidol University.

Results

Between January and June 2015, a total of 109 patients who were brought to trauma resuscitation room were included in the study. Sixty-nine patients were admitted at TICU, 40 patients were admitted at general trauma ward. Ninety-five patients (87.15%) were male (60 in TICU group, 35 in WARD group). Median age of TICU group was 35.5 while the WARD group was 32.6. The demographic data is shown in Table 1.

The average ISS in TICU group was 19$\pm$8, while the WARD group was 9$\pm$6 (p<0.001). The median RTS of TICU group was 7.11, and the median RTS of the WARD group was 7.84 (p<0.001) but area under curve (AUROC) was 0.691. Normally, patients who are admitted at TICU should have severe injuries (ISS $\geq$16) and patients who are admitted at general trauma ward should have mild injuries (ISS <16). After the authors analyzed the data, there were 46 patients in the TICU group who had ISS $\geq$16, and there were only 32 patients in WARD group who had ISS <16 (Table 1).

The median RTS of the TICU group after adjusted data was 6.90 while RTS of the WARD group remained 7.84, and the AUROC was 0.805 as shown in Table 2. The sensitivity and specificity for each point of RTS is shown in Table 3. Due to appropriate sensitivity and specificity, the appropriate cutoff point is RTS <7.

There were 7 patients in TICU group who had died after being admitted (mortality rate in TICU was 10.1%), but no patients in the WARD group had died. The median hospital stays in TICU group was 9 days (1 to 181), and 3 days (1 to 40) in the WARD group.

The average APACHE II in TICU group was 8. The mean APACHE II in deceased group was 19 (14 to 28) while the average APACHE II in the survival

Table 1. Demographic data and ISS of TICU and Ward groups

	Number (%)		*p*-value
	TICU (n = 69)	WARD (n = 40)	
Age: mean ± SD	33.5±12.9	32.6±13.3	0.727 (2-sample t-test)
Sex: male	60 (87.0)	35 (87.5)	0.935 (Chi-square)
Mechanism of injury			0.126 (Fisher's exact test)
Blunt	56 (81.2)	26 (65.0)	
Penetrating	11 (15.9)	12 (30.0)	
Blast	2 (2.9)	2 (5.0)	
Cause of injury			0.280 (Fisher's exact test)
Traffic	45 (65.2)	19 (47.5)	
Assault	16 (23.2)	14 (35.0)	
Work	2 (2.9)	1 (2.5)	
Other	6 (8.7)	6 (15.0)	
ISS: mean ± SD	19±8	9±6	
<16	23 (33.3)	32 (80.0)	<0.001 (2-sample t-test)
≥16	46 (66.7)	8 (20)	<0.001 (Chi-square)
Hospital stay			
Median (min-max)	9 (1-181)	3 (1-40)	<0.001 (Mann-Whitney U test)

Table 2. RTS of TICU and ward groups

	Real data (n = 109)		Adjusted data (n = 78)	
	ICU	WARD	ICU	WARD
n	69	40	46	32
RTS:				
Median	7.11	7.84	6.90	7.84
Min, max	4.09, 7.84	4.09, 7.84	4.09, 7.84	5.97, 7.84
p-value	<0.001		<0.001	
AUROC	0.691		0.805	

Table 3. Sensitivity and Specificity of each RTS point

RTS	Real data (n = 109)		Adjusted data (n = 78)	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
<6.5	31.9	92.5	39.1	96.9
<7.0	49.3	80.0	63.0	90.6
<7.5	52.2	75.0	65.2	84.4

group was 7 (0 to 26). The correlation between RTS and APACHE II by using Spearman rank correlation was -0.357, while the correlation between RTS and APACHE II of the adjusted groups was -0.356 (Fig. 2).

Discussion

Management in trauma cases is a time-dependent condition. Early definitive care at trauma centers has been shown to decrease mortality[4].

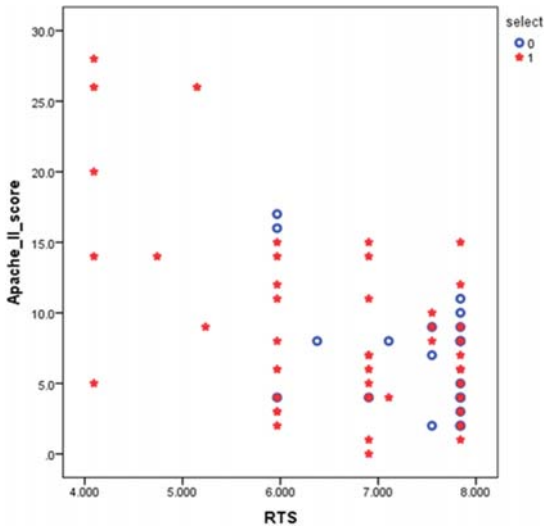

Fig. 2 Spearman rank correlation between RTS and APACHE score II.

However, it is not easy, in a crowded trauma center like Siriraj Hospital, for a trauma surgeon to determine in multiple or mass casualty situations which patients need to be admitted to TICU. Sometimes the severity of patients' injuries or anatomical trauma score such as ISS can help surgeons to make a decision, but they have to wait for the results after surgical procedure and patients' imagings. This situation is time consuming and may delay admission because the TICU nurses need time to clear the occupied bed and set the ventilator before admitting new patients.

Revised Trauma Score (RTS) was developed by Champion et al more than 26 years ago[1]. The score results are based on patient's physiological injury severity; Glasgow Coma Score (GCS), Respiratory Rate (RR), and Systolic Blood Pressure (SBP) which are varied from 0 (severe) to 7.84 (mild). Revised Trauma Score has high efficacy[1,3,5], and also can predict the patient's mortality rate[1,6]. By using the calculator program that presents in many websites, such as www.trauma.org, it is very easy to calculate and uses a few seconds to interpret. So surgeons can calculate the score while resuscitating patients at the emergency department.

From the data in Table 2, RTS between TICU and WARD groups has statistically significant (p<0.001) but AUROC is only 0.691. Typically, AUROC would be excellent when it is >0.8. After analyzing the data, authors found 23 of 69 patients who were admitted at TICU had ISS <16. These patients had mild injuries and were in stable condition until discharged from TICU, but surgeons had used their observations to admit them at TICU. On the other hand, 8 of 40 patients who were admitted at general trauma ward had ISS ≥16. Some had impending unstable vital signs but they could not be admitted to TICU due to unavailable beds.

When the authors analyzed the 46 patients in TICU group which had ISS ≥16, and 32 patients in WARD group who had ISS <16, RTS of the 2 groups was still statistically significant (p<0.001), and the AUROC increased to 0.805.

For the cutoff point of RTS in determining TICU admission, the authors found all RTS points in table 3 had low sensitivities. However, after adjusted data, the RTS <7 had high sensitivity and specificity to use for the cutoff point screening. So the appropriate RTS to determine TICU ward admission should be RTS <7.

Acute Physiology and Chronic Health Evaluation II (APACHE II) is one of ICU scoring systems which was developed in1985[7]. It adjusted some variables in weights and reduced numbers of individual variables from 34 in the original APACHE score to 12 in APACHE II. APACHE II has rank from 0 to 71 points. This score is the most widely used ICU mortality prediction score[8] especially in most ICUs of Thailand. APACHE II shows better performance than Simplified Acute Physiology Score II (SAPS II) in predicting hospital mortality and could be used to predict mortality and quality assessment in the ICUs[9]. The newer ICU scores such as APACHE III and APACHE IV are not commonly used because they have more variables and their statistical method is under copyright control. Siriraj's TICU also uses APACHE II for predicting the mortality rate and quality assessment the same as many ICUs in Thailand.

Previous study proved APACHE II to be helpful about case prognosis, and overall it reflects the quality level provided in health care facilities for the poly-traumatized patients[10]. The association between GCS, RTS and APACHE II offers better results about predicting prognosis[10]. From the study, authors used Spearman rank correlation to find the correlation between RTS and APACHE II in predicting mortality rate at TICU. The result showed negative values in both real data (-0.357) and adjusted data (-0.356), so there was an opposite relationship between RTS and APACHE II. RTS cannot replace APACHE II in terms of monitoring. However, RTS is more appropriate as a screening tool in initial determination because of time-saving and scientific objective evaluation.

Conclusion

For trauma patients with age of 15 to 60 years who do not have respiratory tract disease, hypertension, or neurological disease, RTS can be used as the guideline in determining which trauma patients require TICU or general ward admission. The appropriate cutoff point is RTS <7. RTS and APACHE II both have benefits; RTS is good as an initial screening tool, whereas APACHE II is better in ward monitoring.

What is already known on this topic?

How to use the Revised Trauma Score (RTS) for trauma patients when they arrive at the Division of Trauma Surgery, Siriraj Hospital.

What this study adds?

RTS can used as criteria in determining which trauma patients require Trauma ICU admission.

Acknowledgements

This research was supported by Faculty of Medicine Siriraj Hospital, Mahidol University. The authors would like to thank Assist. Prof. Dr. Chulaluk Komoltri for assistance in the statistical analysis and Ms. Susan Adler-Shaw for editing assistance.

Potential conflicts of interest

None.

References

1. Champion HR, Sacco WJ, Copes WS, Gann DS, Gennarelli TA, Flanagan ME. A revision of the Trauma Score. J Trauma 1989; 29: 623-9.
2. Lichtveld RA, Spijkers AT, Hoogendoorn JM, Panhuizen IF, van der WC. Triage Revised Trauma Score change between first assessment and arrival at the hospital to predict mortality. Int J Emerg Med 2008; 1: 21-6.
3. Jennings P. A critical appraisal of the revised trauma score. J Emerg Prim Health Care 2004; 2: 1-9.
4. Nirula R, Maier R, Moore E, Sperry J, Gentilello L. Scoop and run to the trauma center or stay and play at the local hospital: hospital transfer's effect on mortality. J Trauma 2010; 69: 595-9.
5. Tinkoff GH, O'Connor RE. Validation of new trauma triage rules for trauma attending response to the emergency department. J Trauma 2002; 52: 1153-8.
6. Moore L, Lavoie A, Abdous B, Le Sage N, Liberman M, Bergeron E, et al. Unification of the revised trauma score. J Trauma 2006; 61: 718-22.
7. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985; 13: 818-29.
8. Vincent JL, Moreno R. Clinical review: scoring systems in the critically ill. Crit Care 2010; 14: 207.
9. Khwannimit B, Geater A. A comparison of APACHE II and SAPS II scoring systems in predicting hospital mortality in Thai adult intensive care units. J Med Assoc Thai 2007; 90: 643-52.
10. Cernea D, Novac M, Dragoescu PO, Stanculescu A, Duca L, Al Enezy AA, et al. Polytrauma and Multiple Severity Scores. Curr Health Sci J 2014; 40: 244-8.

ประโยชน์ของการใช้ Revised Trauma Score ในการคัดเลือกผู้ป่วยเข้ารักษาในหอผู้ป่วยวิกฤติอุบัติเหตุที่โรงพยาบาลศิริราช

เลิศพงศ์ สมจริต, สิริชัย ธาดาประดิษฐ์, ฐิณฎา บดีศรีสกุล

ภูมิหลัง: *อุบัติเหตุเป็นสาเหตุการตายที่พบได้เป็นอันดับต้น ๆ ในประเทศไทย ผู้ป่วยที่มีการบาดเจ็บรุนแรงมักต้องพักรักษาตัวในหอผู้ป่วยวิกฤติอุบัติเหตุ ปัจจุบันยังไม่มีข้อกำหนดชัดเจนในการคัดเลือกผู้ป่วยเข้ารักษาตัวในหอผู้ป่วยวิกฤติอุบัติเหตุ ในโรงพยาบาลศิริราชส่วน RTS ถูกใช้แพร่หลายในการคัดแยกผู้ป่วยอุบัติเหตุ เพราะใช้ง่ายและมีประสิทธิภาพสูงในการคัดแยกผู้ป่วย วัตถุประสงค์ของการศึกษานี้คือ เพื่อประเมินการใช้ RTS ในการคัดเลือกผู้ป่วยอุบัติเหตุเข้ารักษาในหอผู้ป่วยวิกฤติอุบัติเหตุ และเปรียบเทียบประสิทธิภาพกับ APACHE II ซึ่งใช้ในการประเมินผู้ป่วยในหอผู้ป่วยวิกฤติอุบัติเหตุอยู่แล้ว*

วัสดุและวิธีการ: *ทำโดยเก็บข้อมูลจากเวชระเบียนผู้ป่วยอุบัติเหตุที่แพทย์ตัดสินใจให้พักรักษาตัวในโรงพยาบาล หลังเข้ารับการรักษาที่ห้อง resuscitation ตึกอุบัติเหตุ โรงพยาบาลศิริราช ตั้งแต่วันที่ 1 มกราคม ถึง วันที่ 30 มิถุนายน พ.ศ. 2558 จำนวน 109 คน ผู้ป่วย 69 คน ได้รับการรักษาที่หอผู้ป่วยวิกฤติอุบัติเหตุอีก 40 คนได้รับการรักษาที่หอผู้ป่วย สามัญอุบัติเหตุ ผู้ป่วยทั้งสองกลุ่ม จะได้รับการคำนวณหาค่า RTS และเก็บข้อมูลการบาดเจ็บทั่วไปอื่น ๆ ระยะเวลารักษาตัวในโรงพยาบาลรวมทั้งผลการรักษานอกจากนี้ยังเก็บข้อมูล APACHE II ในผู้ป่วยกลุ่มที่เข้ารักษาในหอผู้ป่วยวิกฤติอุบัติเหตุด้วย*

ผลการศึกษา: *อายุเฉลี่ยของผู้ป่วยที่ทำการศึกษา 109 คน คือ 33 ปี มีค่ามัธยฐาน RTS ของผู้ป่วยกลุ่มที่อยู่หอผู้ป่วยวิกฤติเท่ากับ 7.11 ในขณะที่ค่ามัธยฐาน RTS ของผู้ป่วยกลุ่มหอผู้ป่วยสามัญเท่ากับ 7.84 ภายหลังการปรับข้อมูลพบว่าค่ามัธยฐาน RTS ของผู้ป่วยกลุ่มที่อยู่หอผู้ป่วยวิกฤติและกลุ่มหอผู้ป่วยสามัญเป็น 6.9 และ 7.84 ตามลำดับ ค่า RTS ที่ใช้เป็นจุดคัดแยกผู้ป่วยเข้ารักษาในหอผู้ป่วยวิกฤติอุบัติเหตุ คือ RTS <7 ส่วนค่าเฉลี่ยของ APACHE II ของผู้ป่วยกลุ่มที่อยู่หอผู้ป่วยวิกฤติเท่ากับ 8 correlation ระหว่าง RTS และ APACHE II คือ -0.356*

สรุป: *RTS สามารถใช้เป็นแนวทางในการคัดแยกผู้ป่วยอุบัติเหตุ เข้ารับการรักษาในหอผู้ป่วยวิกฤติอุบัติเหตุได้ โดยค่าที่เหมาะสมคือ RTS <7, RTS มีความแตกต่างจาก APACHE II และไม่สามารถใช้ทดแทนกันได้ RTS เหมาะสำหรับใช้เป็นตัวคัดแยกผู้ป่วยส่วน APACHE II เหมาะสำหรับใช้ติดตามผลการรักษา*