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Original article

Performance of physiology scoring systems in prediction of in-hospital mortality of traumatic children: A prospective observational study

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ABSTRACT

Background: This study is designed to compare the value of four physiologic scoring systems of rapid acute physiology score (RAPS), rapid emergency medicine score (REMS), Worthing physiology scoring system (WPSS) and revised trauma score (RTS) in predicting the in-hospital mortality of traumatic children brought to the emergency department.

Method: We used the data gathered from six healthcare centers across Iran between the April-October 2016. Included patients were all children with trauma. Patients were assessed and followed until discharge. Moreover, patients were divided to two groups of died and alive, and discriminatory power and general calibration of models in prediction of in-hospital mortality were compared.

Results: Data was gathered from 814 children (average age of 11.65 ± 5.36 years, 74.32% boys). Highest measured area under the curve was for RAPS and REMS with 0.986 and 0.986, respectively. Areas under the curve of WPSS and RTS were 0.920 and 0.949, respectively ($p = 0.02$). Sensitivity and specificity of RAPS were 100.0 and 95.05, respectively. These amounts for REMS were 100.0 and 94.04, respectively. Two models of RTS and WPSS had the same sensitivity of 84.62. Specificity of these two was 98.22 and 96.95, respectively. Three models of RAPS, REMS and RTS had proper calibrations in predicting mortality; however, it seems that WPSS overestimates the mortality in high risk patients.

Conclusion: As calculations of RAPS is easier than REMS and their proper calibrations, it seems that RAPS is the best physiologic model in predicting in-hospital mortality and classifying in traumatic children based on severity of injury. However, further validation of the recommended score is essential before implementing them into routine clinical practice.

1. Introduction

Predicting the outcome of traumatic patients in the emergency ward is a topic which has gained a lot of attention in recent years and many models are proposed to achieve this goal. Using scoring systems is the most emphasized method in many articles.[1–6] For this purpose; researchers have designed different scoring systems and have done modifications on them to improve their efficacy and accuracy.[7–9] Using scoring systems helps in treatment and management of traumatic patients more accurately and according to their priority

The importance of scoring systems is more pronounced in emergency ward as rapid management of patients can have profound beneficial effects on their outcome. On the other hand, overcrowded emergency wards cause physicians and nurses to

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have less time for patient care. For this reason, using scoring systems which lessen the time required for patient evaluation and improve medical care quality [10] can increase the efficacy of the care given. In the face of their many benefits there are many barriers to their usage. These barriers are complicated calculations, having many variables and sometimes lack of validity assessment of scoring systems in different clinical settings. Therefore, research in this topic is ongoing and new models are introduced every year. In addition, most of these models are meant for adults and their validity for children and adolescents has not been evaluated yet.

Physiologic scoring systems can be used as a tool for classification of patients and identifying high risk individuals because of their easy calculations and more feasible factors such as pulse rate, blood pressure, body temperature, respiratory rate and level of consciousness. There are many physiologic scoring systems which "acute physiology and chronic health evaluation (APACHE)" is the most renowned one.[11] However, too many included factors and subsequent difficult calculations have led to emergence of other models. Rapid Acute Physiology Score (RAPS) is another physiologic model which is considered the abbreviated version of the APACHE II score with pulse rate, blood pressure, respiratory rate and Glasgow Coma Scale (GCS) considered prognostic factors in traumatic patients. Although its predictive value is good, researchers are looking forward to improve its accuracy.[12] Studies in 2003 and 2004 by Olsson et al. showed that addition of age and arterial oxygen saturation to the factors increases the RAPS value, so "rapid emergency medicine score (REMS)" was suggested. This model was suggested for predicting mortality of non-surgical patients of the emergency department.[12,13]. However, its validity in traumatic patients has been tested in limited studies. Worthing physiology score (WPSS) is another physiologic model which was introduced in 2007 [14] but, data regarding its overall validity is very scarce. At last, Revised Trauma Score (RTS) is one of the easiest physiologic models for predicting the outcome of traumatic patients using three factors of GCS, systolic blood pressure and respiratory rate.[15]

In the face of many studies investigating the validity of different physiologic scoring systems in adult traumatic patients, there is no study in this aspect targeting children. This study is designed to compare the value of four physiologic models of RAPS, REMS, WPSS and RTS in predicting in-hospital mortality of traumatic children brought to emergency department.

2. Materials and methods

2.1. Study design and setting

This is an observational study comparing value of four scoring models of RAPS, REMS, WPSS, and RTS in predicting in-hospital mortality of traumatic children between the April-October 2016 in six healthcare centers across Iran. Data gathering was done prospectively by an emergency medicine specialist in each center. The six centers were in Tehran (Iran's capital, two hospitals), Urmia and Tabriz (west of Iran), Ilam and Jahrom (south of Iran). The study protocol was approved by the ethics committee of Tehran University of Medical Sciences. During the study period, all researchers adhered to the principles of the Helsinki declaration. In addition, a consent form was obtained from patients or their accompaniments before entering the study.

2.2. Study population

Traumatic patients between 1 to18 years of age brought to emergency wards were entered in this study. Exclusion criteria were patient death before admitting to the emergency ward. Convenience sampling method was used. According to in-hospital mortality prevalence of 5.2% in traumatic patients [16], a confidence interval of 95% ($\alpha = 0.05$), power of 90% ($\beta = 0.1$) and a maximum error of 1.5% ($d = 0.01$) in estimating mortality prevalence, a minimum of 189 individuals were needed for study population. At the end, data from 814 individuals were entered.

Table 1
Cut offs used for calculating of scoring systems in paediatric trauma patients.

	Body temperature (degree of Celsius)	MAP/SBP[a] (mmHg)	Heart rate (pulse per min)	Respiratory rate (per min)	Oxygen Saturation (%)	Level of conciseness[b]
RAPS						
+4	–	>159 or <49	>199 or <39	>49 or <5	–	<5
+3	–	130–159	160–199 or 40–54	40–49	–	5–7
+2	–	110–129 or 50–69	130–159 or 55–69	6–9	–	8–10
+1	–	–	–	30–39 or 10–11	–	11–13
0	–	70–109	70–130	12–30	–	>13
REMS						
+4	>40.9 or <30	>159 or <49	>199 or <39	>49 or <5	<75	<5
+3	39–40.9 30–31.9	130–159	160–199 or 40–54	40–49	75–85	5–7
+2	32.0–33.9	110–129 or 50–69	130–159 or 55–69	6–9	----	8–10
+1	38.5–38.9 or 34.0–35.9	–	–	30–39 or 10–11	86–89	11–13
0	36.0–38.4	70–109	70–130	12–30	>89	>13
RTS						
+4	–	>89	–	10–29	–	13–15
+3	–	76–89	–	>29	–	9–12
+2	–	50–75	–	6–9	–	6–8
+1	–	1–49	–	1–5	–	4–5
0		0		0		3
WPSS						
+3	<35.3	–	–	–	<92	Other
+2	–	<100	–	≥40	92–94.9	–
+1	–	–	≥131	30–39	94–95.9	–
0	≥35.3	≥100	≤130	<30	96–100	Alert

LOC: Level of conciseness; MAP: Mean arterial pressure; RAPS: Rapid acute physiology score; REMS: Rapid emergency medicine score; RTS: Revised trauma score; WPSS: SBP: Systolic blood pressure; Worthing physiology scoring system.

[a] We used systolic blood pressure in calculation of WPSS and RTS and mean arterial pressure for RAPS and REMS.

[b] Based of paediatric Glasgow coma scale.