The Relative Associations of the Paediatric Trauma Score and Revised Trauma Score with the Severity of Childhood Trauma

Joseph E. Asuquo, Innocent E. Abang, Chukwuemeka O. Anisi, Omolade A. Lasebikan[1], Pius U. Agweye, Nwakeago E. Okeke[2], Best J. Asuquo[3]

Department of Orthopaedics and Traumatology, University of Calabar, Calabar, [1]Paediatric Unit, National Orthopaedic Hospital, Enugu, [2]Department of Orthopaedic and Traumatology, University of Calabar Teaching Hospital, Calabar, [3]Department of Community Medicine, University of Calabar Teaching Hospital, Calabar, Nigeria

Abstract

Background: Children are prone to unintentional injuries and various scoring systems have been used to triage these injuries. The aim of this study is to determine the associations between paediatric trauma score (PTS), revised trauma score (RTS) and the length of hospital stay as an indicator of injury severity. **Methods:** This is a descriptive cross-sectional study conducted in the University of Calabar Teaching Hospital, Calabar and National Orthopaedic Hospital, Enugu from February 2018 to March 2020. A structured questionnaire was used to collect personal, injury-specific and treatment-specific data. The relationship between PTS, RTS and the length of hospital stay was evaluated using the one-way analysis of variance (ANOVA). **Results:** A total of 212 patients were included in the study. Majorities (129, 60%) of the injured children were male and most of the injuries were due to falls from height (54%). The mean PTS was 5.36 ± 1.9, while the mean RTS was 7.10 ± 0.9. The Pearson's product momentum correlation coefficient shows that there was weak but statistically significant correlation between the PTS and the RTS ($r = 0.22$, $P = 0.02$). The one-way ANOVA showed a statistically significant decrease in the RTS with increasing duration of hospital admission (F-statistic = 6.654, df = 3, $P = 0.000$). The PTS showed a less obvious decrease with no trend. **Conclusion:** In this study, the RTS showed an inverse relationship with the length of hospital stay.

Keywords: Duration of hospital stay, injury severity, paediatric trauma, paediatric trauma score, revised trauma score

Introduction

Paediatric patients constitute a large proportion of trauma patients which sum up to about a third of all patients who are seen in the emergency department.[1] More paediatric patients die from trauma than from other causes combined.[2,3]

A number of trauma scoring systems have been developed and standardised for triaging and predicting the survival of these patients.[3,4] Most of these scoring systems were developed for adult patients but modifications were made to account for the differences in physiology and anatomy of the paediatric patients' subsequently.[3]

The paediatric trauma score (PTS) is a score which combines anatomic and physiologic parameters that emphasise a child's weight and airway functions, among others.[2-4] It has been validated for the three decades for assessing trauma in patients younger than 18 years.[5-7] The PTS allows for rapid assessment of trauma severity in a multiply injured child. This assists in appropriate field triage, transport and early emergency treatment of these patients.[5,6] The PTS is based on six variables: Weight (KG), systolic blood pressure (SBP) (mmHg), airway maintenance, mental status, skeletal fracture and open wounds.[2,4,5] It assigns the highest score of 2, moderate score of 1 (minimal injury) and the lowest score of-1 (severe injury) for each parameter. A cumulative score of 6 is the minimum and +12, the highest. There is a linear relationship between low scores and mortality risk, a score of <8 attracts mortality of 9%. Its main drawback is that it does not assess the abdominal injury.[7-9] It has 68.3% triage accuracy.[9,10]

The revised trauma score (RTS) is a physiologic score that triage patients based on the paediatric Glasgow coma

Address for correspondence: Dr. Joseph E. Asuquo, Department of Orthopaedic and Traumatology, Faculty of Medicine, College of Medical Science, University of Calabar, PMB 1115, Calabar, Nigeria. E-mail: itansuq@gmail.com

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scale (PGCS), SBP and respiratory rate (RR). These parameters are assigned the coded value (0, 1, 2 or 4).[6,8,11] The RTS is estimated by multiplying the value of each parameter with its weighted coefficient as shown below:

RTS = (0.9368 × PGCS code value) + (0.7326 × SBP code value) + (0.2908 × RR code value)

Paediatric coefficients were developed and established by Eichelberger to validate the score for use in paediatric trauma.[6] The RTS is very useful for both pre-hospital and hospital triage. It has a triage accuracy of 78.8%.[10]

In the new trauma score, the actual GCS score is used instead of the GCS code, along with a revision of the SBP interval used for the code value in RTS, peripheral oxygen saturation replaces RR. It is used for in-hospital patient and has a better sensitivity than RTS.[12] For the purpose of this study, we are using the RTS without applying the coded value.

Previous attempts to compare and validate different scoring systems in paediatric patients have yielded varying results. However, there is no consensus on an ideal tool for predicting the outcome of paediatric trauma.[13,14] Our study seeks to compare the RTS and PTS in terms of predicting prognosis with respect to the duration of hospital admission.

Methods

This was a descriptive cross-sectional hospital-based study. Data were collected over 12 months. The study was conducted in two tertiary health facilities located in adjoining geopolitical zones of Nigeria. These were the University of Calabar Teaching Hospital (UCTH) and the National Orthopaedic Hospital Enugu (NOHE). The UCTH is an 800-bed multi-specialist hospital including subspeciality in paediatric orthopaedic surgery. It is located in the South-South Nigeria. The NOHE is a 350-bed speciality hospital with various sub specialisation including trauma and paediatric orthopaedic, it is located in the South-East zone of the country. Data were collected in these hospitals between 1st February 2018 and 31st March 2020.

All patients below18 years of age who had sustained various types of injuries following traumatic incidences and who presented in the accident and emergency units or outpatient clinics of both institutions were recruited into the study. Informed consent was given by either parents or guardians of the participants. Data were collected using an interviewer-administered structured questionnaire. The questionnaire consisted of both close-and open- ended questions. The study instrument elicited data on socio-demographic profile, injury profile, PTS and duration of admission. The study investigators and trained research assistants administered the questionnaire to the patients directly or to a proxy (for example, in situations where the patient is a minor or is speech incapacitated). Two hundred and twelve participants who gave consent were recruited into the study.

The PTS was calculated using assigned scores of − 1 (severe injury), −2 (moderate injury), +2 (mild injury) to the six parameters. It ranges from-6 (worst prognosis) to +12 (best prognosis). The patients with scores below or equal to 8 are considered to suffer major trauma.[11]

The RTS was calculated by assigning the following scores; For PGCS, 13–15 is 4 points (PTS), 10–12 is 3 PTS, 6–9 is 2 PTS, 4–5 is 1pt while score of 3 is 0pt. For RR of 10–29 is 4 PTS, above 29 is 3 PTS, RR of 6–9 is 2 PTS, RR of 1–5 is 1pt while no RR is 0pt. For SBP, 4 PTS for SBP above 89 mmHg, 3pts for 76–89 mmHg, 2pts for 50–75 mmHg, 1 pt for 1–49 mmHg and 0pt for no SBP. RTS varies between 0 and 12, patients with scores below 11 are considered to have severe trauma.[11] We excluded the coded values in calculating the RTS.

Data were analysed using the SPSS statistics (version 22; IBM Corp., Armonk, NY, USA). The mean, standard deviations and median values of both trauma scores were determined. Key variables were summarised as frequencies and proportions. The relationship between PTS, RTS and the length of hospital stay was evaluated using the one-way analysis of variance. The categories of duration of stay were compared using Tukey's honestly significant difference (HSD) *post hoc* test. $P \leq 0.05$ were considered statistically significant.

The Institutional Research and Ethics Committee of both facilities gave approval.

Results

A total of 212 patients were included in the study, of these 129 (60%) were males. Higher percentages (42%) of the children were in primary school, while about 31% were in secondary school. The majority of the injuries were due to falls from heights (54%) followed by domestic injuries or assaults (29%). Most of the injuries were uncomplicated [Table 1]. The majority of the children did not require hospital admission (69%), while those who were admitted more frequently stayed for <2 weeks (25%) [Table 1].

The mean PTS was 5.36 ± 1.9, with a range of 5–11 whiles the mean RTS was 7.10 ± 0.9, with a range of 6–8 [Table 2]. The Pearson's product momentum correlation coefficient shows that there was weak but statistically significant correlation between the PTS and the RTS ($r = 0.22$, $P = 0.02$).

In our study, we had five patients who died, their PTS ranges from 5 to 7 while RTS ranges from 6 to 7, respectively. Only one of them was within a year old, the rest were from 10 to 15 years old. Among those that died, all of them except one received initial resuscitation in a peripheral hospital before being referred to the tertiary facility. Three of them had operative intervention before dying within 48 h of admission while others were dead on arrival. They all had multiple injuries from road traffic accidents.

Stratifying the trauma scores by the duration of hospital stay showed a steady decrease in the RTS with increasing duration of hospital admission (F-statistic = 6.654, df = 3, $P = 0.000$). The PTS showed a less obvious decrease with no trend [Table 3]. A pair-wise comparison of the mean RTS between categories of the duration of hospital admission was done using Tukey's HSD *post hoc* test. This showed a statistically significant lower RTS at > 4 weeks compared to the RTSs at "no admission," "<2 weeks" of admission and "2–4 weeks" of admission [Table 4].

Table 1: Descriptive data

	Frequency (%)
Sex	
Male	129 (60.8)
Female	83 (39.2)
Total	212 (100)
Age (years)	
1-5	66 (32.4)
6-10	63 (30.9)
11-15	59 (28.9)
16-18	16 (7.8)
Total	204 (100)
Educational level	
Nursery	53 (26.2)
Primary	86 (42.6)
Secondary	63 (31.2)
Total	202 (100)
Cause of injury	
Motor vehicle accident	13 (7.9)
Tricycle accident	11 (6.7)
Bicycle accident	4 (2.4)
Falls either from height or ground level	89 (53.9)
Domestic injuries or assaults	48 (29.1)
Total	165 (100)
Complication of fracture	
No complication	201 (94.8)
Complication	6 (2.8)
Dead	5 (2.4)
Total	212 (100)
Duration of admission in weeks	
No admission	147 (69.3)
<2 weeks	52 (24.5)
2-4 weeks	7 (3.3)
>4 weeks	6 (2.8)
Total	212 (100)

Table 2: Summary values of trauma score

	Mean±SD	Median	Minimum	Maximum
PTS	5.36±1.9	5	0	11
RTS	7.10±0.9	7	0	8

SD: Standard deviation, PTS: Paediatric trauma score, RTS: Revised trauma score

Discussion

The paediatric trauma scoring systems were developed to facilitate the pre-hospital and hospital-based triaging of children who sustain trauma to categorize the severity of injury for proper referral to improve outcome and shorten hospital stay thereby reducing the cost of health care.[8] We used the duration of admission to connote severity to determine which of the scoring system can better predict the severity of trauma. No study has proven that duration of stay is synonymous with the severity of the injury. We did not evaluate the effects of confounding factors on the length of hospital stay.

In our study, we discovered a weak correlation between the PTS and RTS implying that both scores can be used independently in cases of paediatric trauma. Similarities between these scores will help reduce the use of multiple scoring systems to improve outcomes.[8,15] However, the two scores are not measuring the same construct.

There is a significant relationship between RTS and lengths of stay in the hospital. This implies that RTS is more likely to predict the severity of trauma more than PTS even though the relationship may be affected by confounders. This finding is similar to that reported by a Turkish study.[1,15] In that study, the relationship was only demonstrated in those who survived. The study further enumerated the confounding factors that could modify the outcome of trauma in children despite the scores.[15]

In our study, PTS had no relationship with the length of hospital stay. Another study reported that PTS has a significant correlation with the length of hospital stay.[1]

The mortality recorded in our study had a low PTS below the cut-off of 8 as reported by the USA and Turkish study, respectively.[1,5] There are confounders such as part of body injured, multiple injuries/fractures and time of arrival to the hospital cum quality of care received, especially in our environment.

The finding that falls from heights was the major cause of injury was different from that reported by another study where the auto crash was the leading cause of injury.[1] The age distributions in their study and ours were closely similar. This is a reflection of a well-developed health referral system.

Conclusion

The RTS is more likely to predict severity due to its inverse relationship with the length of hospital stay, but there are confounding factors that can modify the outcome. Both RTS and PTS can be used independently as a reliable triaging tool with the former being easier to apply.

Table 3: Mean trauma score by duration of admission and one-way ANOVA comparison of means

	No admission	<2 weeks	2-4 weeks	>4 weeks	ANOVA *F*-statistic	df	*P*
PTS	5.43	5.33	4.57	4.67	0.743	3	0.528
RTS	7.17	7.10	6.86	5.67	6.654	3	0.000

PTS: Paediatric trauma score, RTS: Revised trauma score

Table 4: Pair-wise comparison of revised trauma score between categories of duration of stay using Tukey honestly significant difference *post hoc* test

	<2 weeks	2-4 weeks	>4 weeks
No admission	(No admission) ≈ (<2 weeks), *P*=0.956	(No admission) ≈ (2-4 weeks), *P*=0.763	(No admission) > (4 weeks), *P*=0.000
<2 weeks		(<2 weeks) ≈ (2-4 weeks), *P*=0.885	(<2 weeks) > (>4 weeks), *P*=0.000
2-4 weeks			(2-4 weeks) > (>4 weeks), *P*=0.047

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Conflicts of interest

There are no conflicts of interest.

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