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Predictive prognostic value of reverse shock index multiplied by Glasgow scale in trauma patients

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Abstract:

Background: Trauma is one of the leading causes of death and disability around the world, and it is one of the important issues in public health. In the field of emergency medicine, a careful evaluation of trauma severity is essential to steer clinical interventions and enhance patient outcomes. The Reverse Shock Index multiplied by Glasgow Scale (RSIG) holds promise as a potential prognostic tool for trauma patients. However, there is limited research examining its predictive efficacy in real-world clinical settings, particularly within the context of Colonel Lotfi Hospital. This study aims to externally validate the accuracy of the rSIG in the prediction of mortality, need for transfusion and need for surgical procedure

Materials and methods: This is a retrospective, comparative, analytical cohort study, Data were collected from the medical records of hospitalized patients and operative protocols of Colonel Lotfi Mixed Hospital and Hmida Benadjila Hospital in Laghouat for severe trauma between January 2018 and December 2022, where the series focused on patients aged between 18 and 80 years who were hospitalized for severe trauma or polytrauma. The outcomes were circumstances of the trauma, vital signs (SBP, DBP, HR, RR) at ED presentation, GCS and hemoglobin levels at ED presentation, the need of transfusion and the need of surgical intervention, and the in-hospital mortality.

Results:78 patients were admitted to the emergency department for severe trauma, the average age of our study population was close to 40 years old, with a male predominance (80.8%). The inferential analysis comparing two groups (survivals and dead) found that rSIG, HB, need for transfusion, Damage control, some sites of injury like traumatic brain injury and many has significant impact on the mortality rate. the average of rSIG score among survivals was around 17.4, and its average among dead was 7.9 with a ($P < 0.00$*), another inferential analysis comparing group A (rSIG<15) and group B (rSIG>15) with different parameters that tend to have significant results whom are Dead in hospital, need for transfusion, damage control, operated patients and re-operated patients. The frequency of in-hospital mortality was significantly higher in group A when compared to group B [51.2% versus 02.7%; P<0.00

Conclusion: The rSIG is more accurately identifies patients with severe trauma at highest risk of death. These findings may help further refine early risk assessments for patient management.

Key words: reverse shock index, Glasgow scale

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INTRODUCTION:

Trauma, the sixth leading cause of death worldwide and is also the leading cause of death and disability in people under the age of 40 years(1,2). Trauma causes 10% of global mortality and it is responsible for 90% of mortality in Low and Middle-Income Countries (LIMCs)(2). Trauma also decreases the disability adjusted life years (DALY) in different communities(1,2), emphasizing the urgent need for comprehensive strategies to mitigate its toll. The sheer magnitude of trauma-related incidents underscores its status as a critical area requiring focused attention and intervention.

Today, trauma is one of the important issues in public health that should be given more attention in the health care system, because not only thousands of deaths and millions of injuries occur due to various trauma annually, but also it imposes direct and indirect socio-economic costs on the health care system of communities and individuals. These costs include treatment costs, reduced productivity, stopping activities, and loss of family income during hospitalization(2,3).

Many studies have investigated and published prognostic predictive models for patients with trauma. Presently, the Reverse Shock Index multiplied by Glasgow Scale (RSIG) holds promise as a potential prognostic tool for trauma patients. However, there is limited research examining its predictive efficacy in real-world clinical settings, particularly within the context of Colonel Lotfi Hospital. A comprehensive assessment of RSIG as a prognostic indicator for trauma patients upon admission to the emergency department is conspicuously absent. Understanding the predictive capacity of RSIG in this environment could substantially influence clinical decision-making, resource allocation, and patient care, ultimately culminating in enhanced trauma management and superior patient outcomes. Consequently, this study aims to rectify the current dearth of evidence and furnish valuable insights into the predictive prognostic utility of RSIG in trauma patients at Colonel Lotfi Hospital.

MATERIALS AND METHODS:

1. Study population:

Patients included in this study were admitted to the emergency departments of Colonel Lotfi Mixed Hospital and Hmida Benadjila Hospital in Laghouat for severe trauma between January 2018 and December 2022.

2. Study Type:

This research is a retrospective, comparative, analytical cohort study.

3. Data Collection:

Data were collected from the medical records of hospitalized patients and operative protocols. A questionnaire was used to collect this Data, providing patient information, circumstances of the trauma, vital signs (SBP, DBP, HR, RR) at ED presentation, GCS and hemoglobin levels at ED presentation, the need of transfusion and the need of surgical intervention, and the in-hospital mortality. We calculated rSIG using the following formulae: rSIG=(SBP/HR) *GCS

4. Selection Criteria: Our study included all patients aged between 18 and 80 years who were hospitalized for

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severe trauma or polytrauma. Patients whose medical records lacked information on blood pressure, heart rate, Glasgow Coma Scale score, and hemoglobin levels were excluded from our study.

5. Statistical analysis:

All statistical analysis were performed using SPSS software version 27.0.1(IBM Corp., Chicago, IL, USA).

Data analysing will be conducted at:

- Descriptive analysis: All the continuous variables are reported as mean ± standard deviation (SD), while categorical variables are presented as numbers and percentages.

- Univariate analysis: All continuous data were analysed with Student's t-test for differences between groups. Nominal variables were compared using Pearson $\chi 2$ test or Fisher's exact test, depending on the sample size.

All the tests were 2-sided, and p values < 0.05 were considered statistically significant.

The 95% confidence intervals for means and percentages will be provided.

RESULTS:

General characters of the population:

During the study period, 78 patients were admitted to the emergency department for severe trauma, of which 67.9% were from Laghouat. The average age of our study population was around 40 years old, and with a predominance of males (80.8%), The results are mentioned in the table1 & the diagram I below:

Table 1: comparison between the 02 groups: group 01 (the survivals), group 02 (the dead

Parameters (n)	Survivals (56)	Dead (22)	P	±SD	CI at 95%
Age (mean)	39.1	43.5	0.31*	4.42	[-13.27 , 4.34]
Gender n (%)			0.21***		
Male	43(76.8)	20(90.9)			
Female	13(23.2)	02(09.1)			
Diabetes n (%)			0.06**		
Yes	06(10.7)	06(27.3)			
No	50(99.3)	16(72.7)			
Hypertension n (%)			0.71***		
Yes	09(16.1)	02(09.1)			
No	47(83.9)	20(90.9)			
Cardiopathy n (%)			0.19***		
Yes	01(01.8)	02(09.1)			
No	55(98.2)	20(90.9)			
DAA (mean)	47.4	38.4	0.31*	8.84	[-8.61 , 26.61]
rSIG (mean)	17.4	7.9	<0.00*	1.53	[6.44 , 12.56]

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HB (mean)	11.7	10.0	<0.00*	0.48	[0.72 , 2.66]
Need for transfusion n (%)			0.00***		
Yes	23(41.9)	18(81.8)			
No	33(58.9)	04(18.2)			
TBQ (mean)	1145.8	1333.3	0.35*	198.67	[-589 , 214]
Damage control n (%)			0.03**		
Yes	10(17.9)	09(40.9)			
No	46(82.1)	13(59.1)			
Operated patients n (%)			0.72**		
Yes	33(58.9)	12(54.5)			
No	23(41.1)	10(45.5)			
Re-operated patients n (%)			1.00***		
Yes	07(12.5)	02(09.1)			
No	49(87.5)	20(90.9)			
Site of injury n (%)	15(26.8)	19(86.4)	<0.00***		
Traumatic brain injury	20(35.7)	18(81.8)	<0.01***		
Facial trauma	06(10.7)	04(18.2)	<0.45***		
Spinal trauma	04(07.1)	09(40.9)	<0.00***		
Cervical trauma	46(82.1)	15(68.2)	0.17**		
Chest trauma	29(51.8)	11(50.0)	0.88**		
Abdominal trauma	11(19.6)	09(40.9)	0.05**		
Pelvic trauma	24(42.9)	11(50.0)	0.56**		
Upper limb injuries	21(37.5)	09(40.9)	0.78**		
Lower limb injuries	04(07.1)	05(22.7)	0.10***		
Vascular trauma					
Type of injury n (%)					
Blunt trauma	53(94.6)	21(95.5)	1.00***		
Open trauma	15(26.8)	12(54.5)	0.02**		

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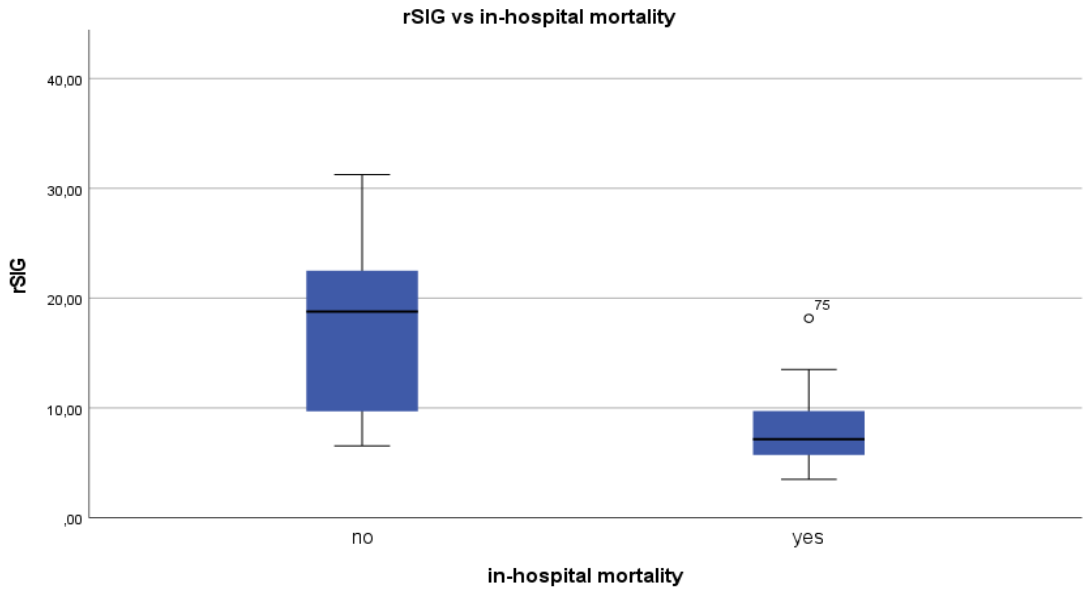

Diagram I: diagram of rSIG vs in-hospital mortality

Comparison between Group A (rSIG < 15) & Group B (rSIG > 15):

Inferential analysis below in the table 2 compares two groups A & B with different parameters that tend to have significant results whom are : Dead in hospital, need for transfusion, damage control, operated patients and re-operated patients.

Table 2: Comparison between Group A (rSIG < 15) & Group B (rSIG > 15)

Parameters	n	rSIG < 15 (37)	rSIG > 15 (41)	P
Dead in hospital	n (%)	21(51.2)	01(02.7)	<0.00***
Need for transfusion	n (%)	33(80.5)	08(21.6)	<0.00**
Damage control	n (%)	18(43.9)	01(02.7)	<0.00***
Operated patients	n (%)	29(70.7)	16(43.2)	0.01**
Re operated patients	n (%)	08(19.5)	01(02.7)	0.03***

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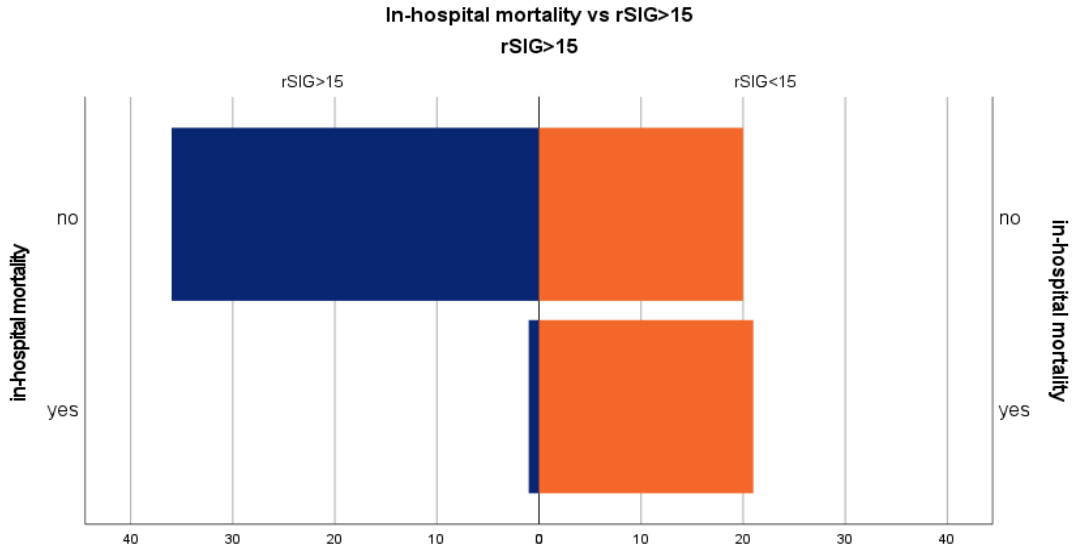

diagram II: in-hospital mortality vs rSIG>15

DISCUSSION:

We found in our series the average of rSIG score among survivals (group 01) was around 17.4 (rSIG > 15) and its average among dead (group 02) was 7.9 (rSIG < 15) with a (P < 0.00*) , our findings indicate that the scoring system of rSIG has a significant Impact on the mortality rate and to the best of our knowledge, The first report done in Japan has shown the utility of rSIG and rSIG/A to identify high-risk trauma patients suggesting it as an easy go to tool to begin with in the emergency room , A higher rSIG means lower in-hospital mortality(4).

Our statistics shows that around 21 patients among 37 (with rSIG less than 15) have died in the hospital with a percentage of 51.2% in contrast of that only one patient from 41 (with rSIG more than 15) has died with less than 3% ,with a significant impact on mortality (P < 0.00***) ,which we suggest based on this ; rSIG scoring tool as a predictor of mortality among patients with severe traumas with a cutoff point was 15 in our population. Therefore, an easy and a quick tool for real-time risk stratification due to the dynamic change during management of these patients is needed. The rSIG uses easily obtainable physiological variables (SBP, HR, and GCS) and is simple to calculate(5).

More recent studies have examined the association of rSIG score and the mortality ;A retrospective review was performed for pediatric patients with war zone injuries has found rSIG score to be superior to SIPA (pediatric age-adjusted shock index) as an independent predictor of early mortality that validate its accuracy in predicting early mortality(6);they suggest more studies to be done to validate its applicability to the civilian population.

Our series count on younger population, the average age of our study population is around 40 years old, our findings could support more other studies in the applicability of Reverse shock index

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multiplied by GCS as a predictor of morality.

In our study, rSIG cutoff point was 15 for severe trauma patients not focusing only on head injuries but our study population has different sites of injuries that can affect GCS differently study conducted in Taiwan was the first to report about the utility of rSIG score for mortality prediction among severe adult trauma patients with head injury but with a different cutoff point than ours (was 14) due to the significantly lower GCS score (6.28 ± 4.25) in their mortality group than in their survivor group (12.70 ± 5.19)(46). Another study by SC Wu et al. showed the best rSIG cutoff point was 14.8 for trauma patients with head injury, with 86.8% sensitivity and 70.7% specificity(7).

Other investigators propose a cutoff rSIG of 16.5 or below. However, in patients with TBI and high rSIG values, these higher rSIG values were also associated with in-hospital mortality(8).

CONCLUSION:

our results indicate that the rSIG ((SBP/HR) × GCS score) is easy to calculate without the need for additional information to remember charts, or equipment , we propose rSIG score as a predictor for high-risk trauma patients and a prognostic indicator to scale patient quickly and easily and to take optimal decisions especially in overcrowded emergency rooms (ER), and might have more value in resource-constrained settings such as LMICs , more studies is needed for that concept .

As our study has proved its utility among patients with severe trauma to predict mortality, the need for transfusion, damage control and surgical procedures. Reverse shock index multiplied by GCS score is more accurately identifies patients with severe trauma at highest risk of death. These findings may help further refine early risk assessments for patient management , we recommend using it in our hospital and others healthcare structures , we also suggest to provide advance diagnostic tools in the hospital structures of Laghouat to prevent errors in the vital parameters ,as well as the documentation of all the vital signs to the admitted patients thus to help the future retrospective studies to prevent excluding patients with messing parameters , more research is needed to support our findings .

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