The Egyptian Journal of Hospital Medicine (January 2024) Vol. 94, Page 263-268

The FASILA Score versus Shock Index and ABC Score to Predict Need for Massive Blood Transfusion in Patients with Abdominal Trauma

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ABSTRACT

Background: Trauma has been demonstrated to be responsible for a considerable number of emergency visits worldwide. Abdominal trauma participates significantly in the morbimortality of trauma cases. Of note, there were several studies that evaluated the role of Shock Index (SI) in the context of abdominal traumas. However, fewer researches only that emphasized on the role of FASILA score.

Objective: To compare these three scoring systems (FASILA Score versus Shock Index (SI) and Assessment of Blood Consumption (ABC Score)) to detect which is a better predictor for MTP activation in cases with abdominal traumas.

Patients and Methods: This was an observational prospective study conducted on a total of 54 patients admitted to the Emergency Department (ED) with abdominal trauma. The FASILA score was evaluated in terms of cases with abdominal injuries, for the initial prediction of massive blood transfusion (MBT) together with being an acronym for FAST+SI+lactate.

Results: The median SI, ABC and FASILA score were 1.4, 3 and 6 respectively. Cases with MBT were accompanied by a considerable increase in FASILA score compared to MBT free ones, while SI and ABC demonstrated insignificant differences between both groups (P>0.05). ABC could be used as a predictor for MBT with a higher sensitivity (Sn) and lower specificity (Sp). FASILA could be used as a significant predictor for MBT with higher Sn and Sp.

Conclusion: The FASILA score may be used as a promising feasible and simple modality, which predicts the need for BT and MTP activation, in patients with abdominal trauma.

Keywords: Abdominal Trauma, Massive Transfusion Protocols, Shock Index, FASILA Score.

INTRODUCTION

Uncontrolled hemorrhage has been considered as the main preventable etiology of death from trauma all over the world. About 50% of all deaths within the initial twenty four hours following traumas are owing to both exsanguination and coagulopathy [1]. Massive transfusion (MT) could be described as the BT of at least ten units of packed red blood cells (PRBCs) in 24 h, is needed in three percent of traumatized cases. MT is often unintentional and needs huge amounts of BT; on the other hand, it is frequently the distinguishing factor between life and death. Delay in stimulating MT protocols (MTP) could negatively interfere with patients' outcomes; on the other hand, improper stimulation could waste resources and incur charges to the organizations. Sustained and proper MTP activation is still a challenge to whole trauma centers [2].

MTP activation mainly depends on the subjective evaluation of initial vital signs and the results of resuscitative measure. Different scores are suggested to recognize cases in need of MT. Till now; no general score has been broadly utilized and well-established [3].

A lot of scores utilize several laboratory tests besides physiological and anatomic parameters; on the other hand, other scores utilize physiological parameters besides point of care (POC) tests. They involve the Assessment of Blood Consumption (ABC) score, generally for penetrating traumas, the SI (heart rate (HR)/systolic blood pressure (SBP)), and the FASILA score [4].

FASILA score is the sum of several variables that involves clinical, physiologic, and laboratory items, which are independently valid indicators of mortality and the requirement for BT. The incorporations of FAST, SI, and serum lactate into a single score (in other words FASILA score) could offer a precise, easy system, providing better results in comparison with different prediction scoring systems. FAST is a traditional test, which is conducted to determine free fluid in the peritoneum in the context of cases with abdominal traumas. According to its results physician could determine the needs for MT [5]. On the other hand, no study has compared such preceding scoring systems in a direct manner to detect which is a better indicator in the context of MTP stimulation.

Aim of work was to compare those three scoring systems (FASILA Score vs SI and ABC Score) to determine which was a better predictor for MTP activation in cases with abdominal traumas.

PATIENTS AND METHODS

This study was an observational cohort prospective study on patients who attended and were admitted to the ED at Mansoura University with abdominal trauma during the period from July 2022 to July 2023. This study included patients aged between 18 to 60 years old from both genders with abdominal trauma, but it excluded any patient younger than 18 years old or older than 60 years old, or pregnant females, or patients with brain trauma.

Methods

Every patient was subjected to primary survey (**ABCDE**) that included airway maintenance, breathing and ventilation, circulation assessment, disability detection, neurologic condition, exposure and

Received: 10/08/2023
Accepted: 09/10/2023

environment control. Secondary survey included **AMPLE** history (allergy, utilized medications, past illness, last meal, events related to traumas), frequent reassessment of vitals, head-to-toe clinical examination, and mode of trauma. Also, initial vital signs in the ED as systolic blood pressure (SBP), DBP, HR, and oxygen saturation (SaO_2) were obtained at arrival by a specialized medical monitor to stay informed about a patient's health status.

Laboratory investigation included complete blood count (CBC), blood typing, cross-matching, LFT, KFT, INR and serum lactate. Radiological modalities included abdominal computed tomography and abdominal ultrasonography.

The FASILA score was the sum of the next items which were measured at arrival: FAST tests (negative = zero, positive = I), SI (zero = 0.50–0.69, 1 = 0.70–0.79, 2 = 0.80–0.89, and 3 ≥ 0.90), and first serum lactate (zero ≤ 2.0, I= 2.0–4.0, and II ≥ 4.0 mmol/l). The lowest score is zero and the highest score is six [1]. Shock index (SI) could be described as the HR divided by SBP measured at arrival. The value of SI among healthy subjects is ranging from 0.5 to 0.7 [6]. The ABC score is the sum of several variables, which include FAST (positive=I), SBP (≤ 90 mmHg=I), HR (HR more than 120 beat/minute = I), and mode of trauma (penetrating =I); all parameters are measured at arrival [7].

Ethical approval:

Mansoura Medical Ethics Committee of the Mansoura Faculty of Medicine gave its approval to this study. All participants gave written consent after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical Analysis

SPSS (version 26, IBM, USA) was utilized to analyze the gathered data. Shapiro-Wilk test was utilized to assess the normal distribution of the data. Entire tests were carried out with 95% CI. P<0.05 was considered significant. Independent sample T and Mann Whitney tests were utilized for intergroup comparison of continuous data, which were presented as mean ± standard deviation (SD) or median and range. Fisher exact and Chi square tests were utilized for intergroup comparison of nominal data, which were presented as frequency and percentage.

RESULTS

Table **(1)** shows that the mean age was 42 and male to female ratio was 2/1. Blunt trauma was the commonest mode of trauma, while penetrating ones represented only 5.6% of cases. The mean HR, SBP, DBP, respiratory rate, O_2 saturation and serum lactate and the median SI, ABC and FASILA score are shown in table 1.

Table (1): Demographic characteristics, vital signs and serum lactate of the studied cases:

	N=54	%
Age / years (Mean ±SD)	41.94±15.79	
Sex		
Male	36	66.7
Female	18	33.3
Mode of trauma		
Penetrating	3	5.6
Blunt	51	94.4
Heart rate (Mean ±SD)	117.25±23.42	
Systolic blood pressure Mean ±SD	90.20±14.67	
Diastolic blood pressure Mean ±SD	55.70±12.28	
Respiratory rate (Mean ±SD)	23.24±2.54	
O_2 saturation (Mean ±SD)	96.66±3.26	
Serum lactate (Mean ±SD)	5.56±2.36	
Shock index, median (min-max)	1.35 (0.72-2.43)	
ABC, median (min-max)	3 (0-4)	
FASILA Score median (min-max)	6 (3-6)	

Table **(2)** demonstrates that there were no significant differences between both groups in terms of age, sex, mode of trauma, HR, SBP, DBP, RR O_2 saturation and serum lactate.

Table (2): Comparison of demographic characteristics and vital signs between cases with and without massive blood transfusion

	Blood transfusion		Test of significance
	Not massive N=11(%)	Massive N=43(%)	
Age / years mean ±SD	44.91±16.13	41.19±15.82	t=0.694 p=0.491
Sex			
Male	6(54.5%)	30(69.8%)	X^2=0.913
Female	5(45.5%)	13(30.2%)	p=0.339
Mode of trauma			
Penetrating	1(9.1%)	2(4.7%)	FET=0.329
Blunt	10(90.9%)	41(95.3%)	p=0.502
Heart rate	112±24.38	118.60±23.27	t=0.832 p=0.409
Systolic blood pressure	90.35±15.78	89.64±9.68	t=0.142 p=0.887
Diastolic blood pressure	58.18±12.68	55.07±12.25	t=0.747 p=0.459
Respiratory rate	24.36±2.41	22.95±2.52	t=1.67 p=0.101
O_2 Saturation	97.45±2.21	96.47±3.47	t=0.898 p=0.374
Serum lactate	4.95±2.23	5.72±2.39	t=0.953 p=0.345

Table **(3)** displays that cases with MBT were associated with a significant increase in FASILA score compared to MBT free ones, while SI and ABC demonstrated insignificant differences between both groups.

Table (3): Comparison of studied indices between cases with and without massive blood transfusion

	Blood transfusion		Test of significance
	Not massive N=11	Massive N=43	
Shock index	1.28±0.43 1.33(0.90-2.36)	1.36±0.41 1.38(0.72-2.43)	Z=0.184 P=0.854
ABC	2.73±1.42 3(0-4)	2.28±1.05 3(0-4)	Z=1.77 P=0.076
FASILA score	4.27±0.90 4(3-6)	5.51±0.79 6(3-6)	Z=3.65 P<0.001*

Z: Mann Whitney U test, *: Statistically significant

Table **(4)** demonstrates that shock index and ABC could be used as predictors for MBT at cut off ≤1.059, and ≤4 respectively. While at cut off ≥5, FASILA could be used as a significant predictor for MBT.

Table (4): Validity of shock index, ABC and FSAILA score in prediction of need for massive blood transfusion

	AUC (95% CI)	P value	Cut-off point	Sensitivity %	specificity %
Shock index	0.585 (0.403 - 0.766)	0.390	≤1.059	62.8	45.5
ABC	0.659 (0.449 - 0.868)	0.107	≤4	97.7	27.3
FASILA	0.825 (0.664 - 0.985)	0.001*	≥5	90.7	81.8

AUC: Area under curve, *: Statistically significant

Table **(5)** displays a highly statistically significant correlation between MTP and FASILA only, while no significant corrections were recorded between MTP and age, shock index and ABC.

Table (5): Correlation between MTP and age, shock index, ABC and FASILA score among studied cases.

	MTP	
	R	p value
Age/ years	-0.200	0.147
Shock index	0.157	0.257
ABC	-0.057	0.684
FASILA	0.454	0.001*

r: Spearman correlation coefficient, *: Statistically significant

Table **(6)** displays that FASILA score was the only significant predictor for massive blood transfusion, while the remaining parameters (age, sex, mode of trauma, SI and ABC) were not.

Table (6): Predictors of need for massive blood transfusion among studied cases

	B	p value	Odds ratio (95%CI)
Age / years	-0.023	0.580	0.978 (0.903-1.06)
Sex Male Female	-0.404	0.766	0.668 (0.046-9.60)
Mode of trauma Penetrating Blunt	2.63	0.437	13.89 (0.018-20.56)
Shock index	0.499	0.567	1.65 (0.299-9.07)
ABC	-1.50	0.09	0.223 (0.039-1.26)
FASILA	3.09	0.001*	22.17 (3.62-135.73)
Overall % predicted	90.7%		

*: Statistically significant

DISCUSSION

Trauma has been reported to be responsible for a considerable number of emergency visits all over the world. Abdominal traumas participates considerably to the morbimortality of traumatized cases [8]. The initial MTP stimulation and its close adherence is displayed to enhance the outcomes in nearly all critical cases and reduce the amount of BT [9]. A delay in MTP activation is demonstrated in fifty percent of cases and as a result it was the only etiology of noncompliance of MTP. MTP activation according to data coming from the field may reduce delays and enhance compliance [10]. As a result, we aimed to compare FASILA score versus SI and ABC score to detect which is a better predictor for MTP activation in cases with abdominal traumas.

This study was an observational cohort prospective study conducted on a total of 54 patients who were attended and admitted to the ED with abdominal trauma during the period from July 2022 to July 2023. Our study suggested and evaluated the FASILA score in terms of cases with abdominal injuries, for the early prediction of MT.

Regarding demographic characteristics the current study demonstrated that the mean age was 42 and male to female ratio was 2/1. Blunt trauma was the commonest mode of trauma, while penetrating ones represented only 5.6% of cases. Concerning the distribution according to studied indices, the present study displayed that; the median FASILA score were 6, the current study demonstrated that; cases with MBT were associated with a significant increase in FASILA score in comparison with MBT free ones (P<0.001).

This came in the same line with **El-Menyar and his colleagues** [1] who have displayed that the differences between the demographic features of patients receiving MBT, and those who didn't were non-significant. Patients receiving MBT had greater FASILA scores, greater ISS, a greater possibility of laparotomy, increased length of hospital stay (LOS), and higher death rate.

With regard to validity of FSAILA score in prediction of need for massive BT (MBT), the current study demonstrated that at cut off ≥5, FASILA could be used as a significant predictor for MBT (P<0.001) with Sn, Sp of 97.7 and 81.8% respectively (AUC=0.825). Regarding the correlation between MBT, the present study demonstrated that; there was a highly statistically significant correlation between MBT and FASILA only (P<0.001). In addition, the present study revealed that FASILA score was the only significant predictor for MBT (P<0.001), while the remaining parameters (age, sex, mode of trauma, SI and ABC) were not (P>0.05).

El-Menyar and his colleagues [1] have demonstrated that; FASILA score has a significant positive correlation with the ABC score (r=0.65), SI (r=0.7), RTS (r=-0.3), and GCS (r =-0.3) and outperformed different scoring systems in prediction of MT, MTP, ExLap, and mortality. As a result, they concluded that; the new FASILA score plays an essential role in the context of cases with abdominal trauma and provides benefits over different scores.

Concerning FASILA score, it has been demonstrated that; the FASILA score has a significant correlation with the frequently utilized current scores which include both ABC, and SI, with regard to the prediction of BT and results in traumas [1]. On the other hand, FASILA outperforms such scores among cases with blunt and penetrating abdominal traumas; with ease of measurement, greater AUC values and better discriminatory power. Such score reflects the current physiologic and tissue perfusion condition and has a negative correlation with the PP, an essential substitute for the SV. It could as a result be utilized consequently as a modality to track the blood loss among traumatized cases [11].

In addition, the SI indicates the incorporation between cardiovascular system, sympathetic nervous system and has a potent correlation with the SaO_2 and shock [12,13]. Moreover, a FASILA score of 4.5 doubled the duration of stay in the ICU and hospital. In comparison with dead cases following seven days, 1/3 of cases who died in the initial 24 h had significantly greater FASILA scores [6].

In addition, it has been demonstrated that the initial serum lactate values could be considered as a determining factor in terms of MT [14].

The models of both, Vandromme score and TBSS incorporated lactate [15,16]. Vandromme utilized lactate values of ≥ 5 mmol/l as a criterion for MT besides values of SBP < 110 mmHg, HR > 105 bpm, INR > 1.5, and Hb ≤ 11 g/dl [16]. The TBSS comprise five parameters; age, SBP following abrupt crystalloid infusion, outcomes of the FAST, degree of pelvic fracture, and lactate value at admission; the maximal value is fifty seven points [15]. In comparison with the FASILA score, it requires a prolonged time to measure as infusions, measurements of lactate value, and evaluation of the degree of pelvic fracture needs prolonged time. Novel research revealed that prehospital lactate value could be considered as a good predictive of the requirement for resuscitation among normotensive traumatized cases. On the other hand, it wasn't better compared to the SI as a predictive modality [17].

FAST is utilized to determine the existence of hemoperitoneum and pericardial effusion in cases of trauma. On the other hand, its precision is subjective and mainly reliant on operator's experience. In addition, it cannot quantify the degree of blood loss; as a result, unless used besides different variables, which include the vital signs and mode of injury, FAST has particular limitations as regards MT prediction. Our study demonstrated that, MT was administrated more in cases with positive FAST (35%) compared to twenty five percent in cases with negative FAST; on the other hand, in shock cases the proportion of MT was 46 to 51.5%, correspondingly. **Rowell and his colleagues** [18] recorded that FAST had a Sn of 62% and Sp of 83%, and therefore, in hypotensive cases with a negative FAST result, physicians must take into consideration the higher possibility for considerable abdominal bleeding. **Do and his colleagues** [19] have displayed that FAST has the ability to detect abdominal/pelvic bleeding in approximately 1/2 of noncompressible torso hemorrhage cases.

Concerning the distribution according to studied indices, the present study displayed that; the median SI and ABC were 1.35 and 3 respectively. In terms of the comparison of studied indices, cases with MBT were associated insignificant differences between both groups (P>0.05) in SI and ABC. With regard to validity of SI, ABC score in prediction of requirement for MBT, the current study demonstrated that; at cut off ≤1.059, shock index could be used as a predictor for MBT (P>0.05) with Sn and Sp of 62.8 and 45.5% respectively (AUC=0.585). At cut off ≤4, ABC could be used as a predictor for MBT (P>0.05) with Sn and Sp of 97.7 and 27.3% respectively (AUC=0.659). Regarding the correlation between MBT, the present study demonstrated that no significant corrections were recorded between MTP and age, shock index and ABC (P>0.05). Additionally, our study revealed that the remaining parameters (age, sex, mode of trauma, SI and ABC) were not statistically significant (P>0.05).

El-Menyar and his colleagues [1] showed that the ABC score was evaluated in cases with penetrating traumas, and it as a result has limited applicability in nearly all cases with blunt trauma and in cases with old age. Additionally, it doesn't reflect the condition of tissue perfusion on arrival. The ABC score doesn't depend on the SI, but on its individual components. Also, **Carsetti and his colleagues** [20] have

demonstrated that shock index might have a restricted role as the only modality for the prediction of MBT requirement among adult trauma cases. SI isn't precise for mortality prediction but could have a role to recognize cases with a minimal risk of mortality. They have displayed that; for MT the general sensibility was 0.68, the overall Sp was 0.84 and the AUC was 0.85.

Of note, SI's predictive power could be diminished in subjects with certain comorbidities such as HTN, DM, or CHD, situations where the dynamic responses of BP and HR are affected and hence of SI may vary from that of healthy subjects, limiting its usage in the context of MT prediction [21].

HTN could alter baseline SBP and drugs, which include BBs or CCBs, limit tachycardia in response to hypovolemia [22]. In addition, HF could limit the physiologic responses to shock. Certain investigators recommend that vital signs and SI are of great difficulty to interpret in the elderly as they are associated with a minimal sympathetic activity in the regulation of HR and BP. This has been demonstrated to be accompanied by an increase in the false negative rate [23]. As a result, the efficacy of the SI might be restricted in such populations as they don't have considerable alterations in HR owing to hemodynamic stress [24]. In the same line, SI has a lot of limitations which interfere with its components. For examples, it is affected by the preceding or associated utilization of remedies and by the pain degree [25].

In addition, increased SI means a greater likelihood of bad consequences and the requirement for additional resources for management [26], which include surgery, MV, longer hospital admission in ICU, and a longer hospital stay [27]. On the other hand, **DeMuro and his colleagues** [13] have demonstrated that; the SI is a good indicator of MT in different contexts of traumas.

Regarding SI, it is probably one of the most helpful indices which measure the degree of hypovolemia, in particular when cases still present with SBP in the normal range in spite of having complained considerable bleeding [28]. **Schroll and her colleagues** [7] carried out major research on a total of 645 injured cases who were trauma activations. SI ≥1 had Sn of 67.7% and Sp of 81.3% for prediction of MTP, and ABC score ≥2 had Sn of 47.0% and Sp of 89.8%. In addition, they have displayed that; SI has been considered the strongest indicator then ABC score.

SI was demonstrated to be accompanied by a significant increase in Sn (P=0.035), and a significant decrease in Sp (P<0.001) in comparison with ABC score. **Rau and his colleagues** [21] have demonstrated that SI has a moderate accuracy as regards the prediction of MT requirement, with a cutoff value of 0.95. On the other hand, it had minimal predictive value among cases with associated comorbidities such as HTN, DM, and CAD. **Olaussen and his colleagues** [29] support the efficacy of SI measurement prior to hospital arrival as it may warn the physicians, evading the preparation of needless blood. **Demuro and his colleagues** [13] have reported that SI >0.8 is the better cutoff for prediction of MT requirements.

Shock index (SI) values could differ in a range from zero to infinity and increasing its value greater is the possibility for BT. The values are as a result associated with the grade of shock and impairment of tissue perfusion. Thus, SI could be considered as a better predictor for hemodynamic instability compared to both HR or BP [28]. It has displayed that; the SI has better predictive power in comparison with its isolated parameters [30]. On the other hand, there is no general agreement on the optimum cutoff value for SI. Of note, the most broadly utilized scores that involve the ABC and SI involve limited numbers of variables for measurement, and the such variables are simple to get in emergency contexts; such variables represent their popularity [4].

CONCLUSION

The current study concluded that; the FASILA score may be used as a promising feasible and simple tool, which predicts BT requirement and MTP activation, in the context of cases with abdominal traumas.

- **Funding:** Nil
- **Conflict of interests:** None.

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