International Journal of
Gerontology & Geriatric Research

Research Article

Shock Index in the Acute Care Geriatric Patient and its Correlation to the Need of a Life Saving Intervention

Batsheva Tzadok[1], Stav Soffer[2], Shay Shapira[2]*, Sandra Bushnak[1] and Eran Tal Or[1]

[1]Baruch Padeh Medical Center, Poriya Israel

[2]Bar Ilan Faculty of Medicine, 8 Henrietta Szold Street, Tzefat Israel

***Address for Correspondence:** Shay Shapira, Bar Ilan Faculty of Medicine, 8 Henrietta Szold Street, HaKarmel 7, Kfar Yona 4033453, Israel, Tel: +972-528-973-430; E-mail: Shay_Shapira@yahoo.com

Submitted: 20 November 2018; **Approved:** 04 January 2019; **Published:** 08 January 2019

Cite this article: Tzadok B, Soffer S, Shapira S, Or ET. Shock Index in the Acute Care Geriatric Patient and its Correlation to the Need of a Life Saving Intervention. Int J Gerontol Geriatr Res. 2019;2(1): 001-004.

ABSTRACT

Five-level triage is the gold standard in Emergency Departments (ED) worldwide; the Emergency Severity Index (ESI) and Canadian Triage and Acuity Scale (CTA) are the leading systems. The accuracy of these systems is in question with respect to the aging population. We examined Shock Index (SI) and Age-Adjusted Shock Index (AASI) as well as traditional vital signs such as Blood Pressure (BP) and Heart Rate (HR) in patients above age sixty-five. We investigated their association to the need for a Lifesaving Intervention (LSI) or mortality (mort) within 48 hours of presentation to the ED.

This retrospective study examined medical files of patients aged sixty-five and above who presented to the ED during 2015-2017 and were then hospitalized in a medical ward or intensive care unit. We then dichotomized them into two groups, those who required an immediate life-saving intervention and/or mortality within 48 hours (LSI/mort), and those who did not. We searched for a correlation between the need for these interventions/mortality with HR, BP, SI, and AASI.

Using T-test we found a positive correlation between SI and AASI and the need for an LSI/mort. In the non-LSI group, the mean SI was 0.59 compared to 0.66 in LSI/mort group (p = 0.033). AASI mean value was 46 non-LSI compared to 52 with LSI (p = 0.027). In contrast, we found no correlation between HR, systolic blood pressure, and age for prediction of LSI. In the patients who died within 48 hours we found a strong association of elevated SI and AASI. Those who died had a mean SI of 0.83 in contrast to 0.60 in the no mortality cohort (p = 0.004). AASI had a comparable trend: 72 for those with mortality and 47 who survived (p = 0.001).

Our findings support the assertion that there is a need to reconsider which vital signs we use for elder patients within our emergency triage algorithms. We also believe there is a place to consider the incorporation of SI and AASI into ED triage of elder patients.

INTRODUCTION

Patients aged 65 years and above account for approximately 20% of Emergency Department (ED) presentations, a number that is expected to rise substantially in the coming decades. The delivery of timely acute care to this vulnerable population will be an increasingly larger challenge in the future; therefore, it is important to optimize our triage tools [1,2].

Physiological and pathological changes of aging may alter homeostatic capacity. A tachycardia might not develop since sympathetic response to stress is reduced and a hypotensive response may be difficult to detect in the elder population, where hypertension is prevalent [3]. The manifestation of such in the triage vital signs of the aging ED population inspired our study.

"Triage" refers to the methods used to assess patient acuity and assignment to the appropriate place of care and treatment. It is an essential factor in proper function of emergency departments. A five-level triage is the gold standard in EDs worldwide. Triage algorithms such as the Canadian Triage and Acuity Scale take into account vital signs of heart rate, O2 saturation, respiratory rate, systolic blood pressure, fever, and Glasgow coma scale [4]. Emergency Severity Index, another popular triage system, considers the vital signs of heart rate, respiratory rate, and oxygen saturation and resources needed [5-8]. There are five classes of urgency in these triage algorithms: one is resuscitation, two is emergent with a high risk of deterioration and a time critical problem, three is stable with need of multiple resources, four and five are less urgent and non-urgent, respectively.

In the Emergency Department (ED) appropriate triage may have a direct effect on mortality. The geriatric patient population has a higher percentage of severe illness and injury than any other age group [9,10]. The impact of growth of this group will be in ED overcrowding with a potentially sicker patient population [11], making the subject of triage in this vulnerable population of paramount importance.

Not many studies have examined the performance of the triage algorithms on the elderly population. In 2010 Platts-Mills et al. studied the accuracy of the Emergency Severity Index (ESI) triage system for identifying elder ED patients 65 years and above receiving an immediate life-saving intervention and found it to have a sensitivity of only 42% [12].

Current triage systems may not only err in the use of traditional vital signs, they are often difficult to perform in their entirety. The measurement of respiratory rate is an example of such. Respiratory rate, a known predictor for bad outcomes is a relatively burdensome and time-consuming measurement for triage purposes. It is frequently estimated and not measured directly, or completely omitted from vital signs measurement [13].

Shock index has shown superiority to traditional vital signs in predicting severity of illness [14]. Shock Index (SI), defined as Heart Rate (HR) divided by systolic blood pressure, has been shown to be predictive of mortality in trauma and pneumonia [15,16], predicting uterine rupture during pregnancy [17], risk stratification of myocardial infarction, and severity of hypovolemic shock [18,19]. An SI measurement of above 0.7 in the elderly is pathological [20]. Age Adjusted Shock Index (AASI), when SI is multiplied by age, has been shown in some studies superior to SI in predicting mortality and the need for a Life-Saving Intervention (LSI) [15,21].

This combination of factors, known physiological alterations of vital signs in the elder population, the challenges of performing effective triage in the elder population, and the known value of SI for predicting disease severity, drove us to examine SI and AASI as well as traditional vital signs HR and BP at triage in the ED and its association with LSI and mortality within 48 hours in elderly medical patients.

MATERIALS AND METHODS

We conducted a single site retrospective study of medical patients aged 65 and above during 2016 and 2017 admitted to the Baruch Padeh Medical Center via the ED to the Internal, Cardiac, and/or intensive care wards. The Baruch Padeh Medical Center-Poriya is a 300-bed hospital in Tiberius, Israel with 76,000 ED visits a year and a twenty-six percent admission rate. Fourteen percent of the ED patients are over sixty-five and fifty percent of these elder patients are admitted.

The patients were separated into two groups, those with an LSI intervention or mortality within 48 hours, and those without. The patients' triage score and vital signs were recorded, including Heart Rate (HR), Blood Pressure (BP), SI, and AASI.

Life-saving interventions included

1. Airway and breathing support, including intubation or emergent noninvasive positive pressure ventilation.
2. **Procedures:** electrical therapy, including defibrillation, emergent cardioversion, or external pacing, pericardiocentesis.
3. Hemodynamic support, including significant intravenous fluid resuscitation in the setting of hypotension.
4. Emergency medications, including naloxone, dextrose, Atropine, Adenosine, or vasopressors.

RESULTS

The files of three-hundred and twenty-one patients above the age of sixty-five were examined. Eleven patients were excluded from the study because they arrived to the ED mechanically or non-invasively ventilated. Fifty-four patients of the group studied had an LSI/mort while two-hundred and fifty-six patients did not.

Using T-test we found a positive correlation between SI and AASI and the need for an LSI/mort. In the non-LSI group, mean SI was 0.59 compared to 0.66 in LSI group, $p = 0.033$. AASI mean value was 46 in the non-LSI group compared to 52 with LSI, $p = 0.027$.

In contrast we found no significant difference in HR, BP, and age between those with an LSI/mort and those without. In the intervention group the mean age was 78.4, in the intervention group it was 76.5. In addition, using Pearson correlation we found no correlation of age and SI measurements and no added benefit of AASI to SI (Table 1).

We examined BP, HR, age, SI, and AASI with respect to different subgroups of intervention. The airway intervention subgroup showed no significant relation with SI and AASI, yet it did show a difference with respect to HR (81 bpm vs. 97 bpm, respectively; $p = 0.015$). In contrast, the group with PTCA showed no significance with respect to HR, SI, or AASI (Table 2).

Seven patients in the cohort population died within forty-eight hours. In this group there was a statistical difference between SI and AASI between those with and without mortality. Those who died had a mean SI of 0.83 in contrast to the no mortality cohort 0.60, $p = 0.004$. AASI had a similar trend of those with and without mortality: 72 and 47, respectively; $p = 0.01$. There was a statistical difference between diastolic blood pressure in the no mortality to mortality group 75 vs. 61, $p = 0.029$. HR showed a limited statistical difference with 81 and 98, respectively, $p = 0.06$ (Table 2).

DISCUSSION

Triage in the ED is an entity that requires re-evaluation; traditional vital signs that we depend on for detecting severity of disease often fail us in the elderly population [9].

Table 1: Relationship of different parameters and need for life saving intervention/mortality.

	Without intervention (n = 256)		With intervention (n = 54)		
	Mean	Std dev	Std dev	Std dev	P value
BP SYS	140	27	27	35	0.286
BP DIA	75	15.3	15.3	35.32334	0.373
HR	81	21.5	21.5	28.66567	0.238
SI	0.59	0.187	0.187	0.30192	0.033
AASI	46.5726	14.9	14.9	28.47762	0.027
Age	78	9.3	9.3	8.57743	0.169

SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure, HR-Heart Rate, SI-Shock Index, AASI- Age Adjusted Shock index.

Table 2: Breakdown by subgroups.

Intervention Type	SBP (mmHg)	DBP (mmHg)	HR	SI	AA-SI
Airway Intervention	152.8 LSI	76 LSI	97.7LSI	0.67 LSI	52.2179 LSI
(n = 12)	139 no LSI	74 no LSI	81 no LSI	0.60 no LSI	47 no LSI
	P = 0.105	*P* = 0.742	*P* = 0.015	*P* = 0.319	*P* =0.371
Medications	120 LSI	60 LSI	86 LSI	0.74 LSI	62
(n = 15)	140 no LSI	75.5 no LSI	81 no LSI	0.60 no LSI	46
	P = 0.008	*P* = 0.001	*P* = 0.414	*P* = 0.008	*P* = 0.001
	111 mmHg	61 LSI	90 LSI	0.88 LSI	71
Hemo (n = 9)	*P* = 0.003	75 no LSI	81 no LSI	0.6	46
		P = 0.011	*P* = 0.259	*P* = 0.001	*P* = 0.001
	147 mmhg	81 LSI	80 LSI	0.55 LSI	40 LSI
PTCA (n = 23)	*P*=0.167	74 no LSI	82 no LSI	0.61 no LSI	48 no LSI
		P = 0.044	*P*=0.639	*P* = 0.193	*P* = 0.05
	132 death	61 death	98 death	0.83 death	72death
Mortality (n = 7)	139 no death	75 no death	81 no death	0.60 no death	47no death
	P = 0.55	*P* = 0.029	*P* = 0.061	*P* = 0.004	*P* = 0.001

SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure, HR-Heart Rate, SI-Shock Index, AASI- Age Adjusted Shock index, LSI- Life Saving Intervention.

In addition, current triage systems use respiratory rate, a problematic vital sign. Due to the time consumption of counting respiratory rate it is often omitted or roughly estimated, affecting the application of triage scores [10].

Our study examined patients admitted to the hospital with and without LSI within 48 hours. We examined HR, BP, SI, and AASI and their correlation with need for LSI and/or mortality.

Overall, we found correlation with SI and AASI but not with HR and BP. The mean value for those with an LSI was 0.66, which is similar to current literature for an abnormal finding in geriatric populations [17].

In our study different subgroups of interventions and mortality showed different trends with respect to variables measured. The twenty-three patients who underwent PTCA had few differences between the intervention *vs.* non-intervention group. Only diastolic BP showed a significant difference, with a higher diastolic blood pressure in the PTCA intervention group (81.4 mmHg versus the non-PTCA group 81.3 mmHg; $p = 0.044$). It is of note that for acute coronary syndrome the most important tool is the electrocardiogram for detecting acute ischemia rather than the triage score by ESI or CTA.

Patients with airway intervention showed no significant association between airway intervention with respect to SI or AASI. There was a significant association with heart rate between those who had airway intervention and those who did not (81 bpm vs. 97 bpm, respectively; $p = 0.015$). Our postulation for this finding is that there was a large proportion of airway patients with pulmonary edema in whom elevated blood pressure is a common finding, thus lowering the SI and AASI despite the relative rise in HR.

In the group of patients who died within 48 hours we found both SI and AASI to be significantly higher. It is of note that AASI showed a stronger trend of association to mortality than SI alone (72 and 47, respectively; $p = 0.01$). Systolic blood pressure had no significant correlation. This is a small group of patients yet it shows a trend that merits further assessment.

We as healthcare workers place a great emphasis on blood pressure and heart rate. They are part of the ESI and Canadian Acuity Score as well as secondary triage criteria such as SIRS criteria and QSOFA criteria for sepsis and ABC score for massive transfusion. With the aging of our patient population we may see changes in trends of vital signs, a rising prevalence of hypertension, as well as an overall alteration in adaptability to stressors of the aging body. We believe there is a need to reexamine our approach to vital signs with respect to ED triage and perhaps to secondary triage tools as well.

There are a few drawbacks to our study, including its small cohort, a single center study, the bias of patient selection. We chose a population that was admitted and thus selection bias towards a sicker population, and not a general ED population.

Shock index for decades has proven useful in detection of sepsis need for massive transfusion, yet it has not found its way yet into primary triage assessment algorithms. We believe our work exemplifies the need to reexamine the traditional vital signs within ED triage. There is a need for larger prospective studies that will examine SI and AASI as triage tools in the elder medical patient population.

REFERENCES

1. McCabe JJ, Kennelly SP. Acute care of older patients in the emergency department: strategies to improve patient outcomes. Open Access Emergency Medicine. OAEM. 2015; 7: 45-54. https://goo.gl/PpPyZM
2. Christ M, Grossmann F, Winter D, Bingisser R, Platz E. Modern triage in the emergency department. Dtsch Arztebl Int. 2010; 107: 892-898. https://goo.gl/A6dwKk
3. Chester JG, Rudolph JL. Vital in older patients: age-related changes. J Am Med Dir Assoc. 2011; 12: 337-343. https://goo.gl/i5BEsd
4. Beveridge R. CAEP issues. The canadian triage and acuity scale: a new and critical element in health care reform. Canadian Association of Emergency Physicians. J Emerg Med. 1998: 507-511. https://goo.gl/puXqGw
5. Murray M. Bullard M. Grafstein E. Cedis national working groups, revisions to the canadian emergency department triage and acuity scale implementation guidelines. Canadian Journal of Emergency Medicine. 2004; 6.
6. FitzGerald G, Jelinek GA, Scott D, Gerdtz MF. Emergency department triage revisited. Emerg Med J. 2010; 27: 86-92. https://goo.gl/kismQd
7. Farrohknia N, Castren M, Ehrenberg A, Lind L, Oredsson S, Jonsson H, et al. Emergency department triage scales and their components: a systematic review of the evidence. Scand J Trauma Resusc Emerg. 2011; 19: 42. https://goo.gl/v5AWLn
8. Gilboy N, Tanabe P, Travers D, Rosenau A. Emergency Seversity Index (ESI): a triage tool for emergency department care, version 4. Implementation handbook2012 ed. AHRQ, Publication. 2011; 12-14.
9. Strange GR, Chen EH. Use of emergency departments by elder patients: a five-year follow-up study. Acad Emerg Med. 1998; 5: 1157-1162. https://goo.gl/ErKa5A
10. Wofford JL, Schwartz E, Timerding BL, Folmar S, Ellis SD, Messick CH. Emergency department utilization by the elderly: analysis of the National Hospital Ambulatory Medical Care Survey. Acad Emerg Med. 1996; 3: 694-699. https://goo.gl/BsEhwQ
11. Pallin DJ, Allen MB, Espinola JA, Camargo CA Jr, Bohan JS. Population aging and emergency departments visits will not increase, lengths-of-stay and hospitilizations will. Health Aff (Millwood). 2013; 32: 1306-1312. https://goo.gl/6qMWxN
12. Platts Mills TF, Travers D, Biese K, McCall B, Kizer S, LaMantia M. Accuracy of the emergency severity index triage instrument for identifying elder emergency department patients receiving an immediate life-saving intervention. Acad Emerg Med. 2010; 17: 238-243. https://goo.gl/QNs42R
13. Kelley C. Respiratory Rate 1: why accurate measurement and recording are crucial. Nursing Times. 2018; 114: 23-24. https://goo.gl/cCwmLm
14. Rady MY, Smithline HA, Blake H, Nowak R, Rivers E. A comparison of the shock index and conventional vital signs to identify acute, critical illness in the emergency department. Ann Emerg Med. 1994; 24: 685-690. https://goo.gl/NVYrkB
15. Kim SY, Hong KJ, Shin SD, Ro YS, Ahn KO, Kim YJ3, et al. Validation of the shock index, modified shock index, and age shock index for predicting mortality of geriatric trauma patients in emergency departments. J Korean Med Sci. 2016; 31: 2026-2032. https://goo.gl/qYKdqV
16. Myint PK, Musonda P, Sankaran P, Subramanian DN, Ruffell H, Smith AC, et al. Confusion, urea, respiratory rate and shock index or adjusted shock index (CURSI orCURASI) criteria predict mortality in community-acquired pneumonia. Eur J Intern Med. 2010; 21: 429-433. https://goo.gl/fE97Fp
17. Jaramillo S, Barnhart K, Takacs P. Use of the shock index to predict ruptured ectopic. Int J Gynaecol Obstet. 2011; 112: 68. https://goo.gl/otdXYm
18. Huang B, Yang Y, Zhu J, Liang Y, Tan H, Yu L, et al. Usefulness of the admission shock index (SI) for predicting short-termoutcomes in patients with ST-segment elevation myocardial infarction. Am J Cardiol. 2014; 114: 1315-1321. https://goo.gl/uuWK8C
19. Birkhahn RH, Gaeta TJ, Terry D, Bove JJ, Tloczkowski J. Shock index in diagnosing early acute hypovolemia. Am J Emerg Med 2005; 23: 323-326. https://goo.gl/sDxHok
20. Berger T, Green J, Horeczko T, Hagar Y, Garg N, Suarez A, et al. Shock index and early recognition of sepsis in the emergency department: pilot study. West J Emerg Med. 2013; 14: 168-174. https://goo.gl/3Mqj7F
21. Zarzaur BL, Croce MA, Fischer PE, Magnotti LJ, Fabian TC. New vitals after injury: shock index for the young and age _ shock index for the old. J Surg Res. 2008; 147: 229-236. https://goo.gl/p68opD