Shock Index in predicting fluid resuscitation in patients with hypovolemic shock

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ABSTRACT

Introduction: Hypovolemic shock is diagnosed by the signs of hemodynamic instability and when the source of volume loss is obvious. Among various types, hypovolemic shock is the most common which results either from the loss of blood from hemorrhage or from the loss of plasma alone due to extravascular fluid sequestration or gastrointestinal, urinary, and insensible losses. The objective of this research was to find the use of shock index in predicting fluid resuscitation in patients with hypovolemic shock. **Methods:** An analytical cross-sectional study was conducted among 120 patients with hypovolemic shock visiting to the Emergency department of College of Medical Sciences and Teaching Hospital from July 2022 to September 2022. Data was collected from patients and checked for completeness, accuracy and then entered and analyzed using SPSS-20. Data was analyzed using descriptive and inferential statistical tools. P-value <0.05 was considered as statistically significant. **Results:** Out of 120 patients, majority of the patients were >50 years. Minority of the patients only required blood transfusion. Among total patients 60% of the patients were admitted in ICU, 25% of them were admitted in ward and 4.17% of them were expired. In 60% cases shock index was <1 while in 40% case shock index was ≥1. The number of patients receiving blood transfusion at ER increased with increase in shock index and that the number of patients with hypovolemic shock are admitted in hospital more in shock index category ≥1 as compared to shock index <1 (p-value <0.05). **Conclusions**: This study reveals that shock index is accurate in predicting the amount of fluid. The risk of all clinical complication is increased with increase in shock index.

Keywords: Blood transfusion, emergency, fluid resuscitation, hypovolemic shock, shock index.

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INTRODUCTION

Shock is defined as the clinical syndrome that results from inadequate tissue perfusion, irrespective of cause, due to hypoperfusion, between supply and demand of oxygen and substrates leads to cellular dysfunction; ultimately causing multiple organ failure and, if not interrupted, leads to death.[1] Among various types, hypovolemic shock is the most common which results either from the loss of blood from hemorrhage or from the loss of plasma alone due to extravascular fluid sequestration or gastrointestinal, urinary, and insensible losses.[2]

Hypovolemic shock is diagnosed by the signs of hemodynamic instability and when the source of volume loss is obvious. The following symptoms and signs reflect the underlying pathophysiology: tachycardia, skin pallor, hypotension, confusion, aggression, drowsiness and coma, tachypnoea, general weakness, thirst, oliguria.[3] The aim of resuscitation includes infusion of fluids thus preventing the onset of irreversible haemorrhagic shock and death.[1] Crystalloids are typically used for initial fluid resuscitation but the 2-L crystalloid fluid challenge previously recommended is no longer standard practice. Colloids are more expensive than

crystalloids and are associated with risk of anaphylaxis and have no significant advantages over crystalloids in the early stages of resuscitation.[3]

Although the heart rate (HR) and systolic blood pressure (SBP) alone have been shown unreliable in determining the presence of hypovolemic shock, their ratio as reflected by the Shock index (SI) is a capable measure for hemodynamic instability and can be used to assess the presence of hypovolemic shock if point-of-care testing technology is not available.[4-6] The SI, first introduced by Allgöwer and Buri in 1967 is a bedside assessment defined as HR divided by SBP. Its normal value ranges from 0.5 to 0.7 in healthy adults. Even with apparently stable vital signs, shock index is a specific indicator of acute circulatory failure and can be used for early recognition of hypoperfusion and the severe illness which would later need intensive resuscitation therapy. Also SI maybe a valuable tool for tracking progress of resuscitation.[7-10] There are numerous patients who present daily in our emergency ward who are in great risk of going into hypovolemic shock. The evaluation and treatment of shock is commonly guided in emergency by variables like HR, BP and mean arterial pressure (MAP). But studies have shown that normalization of these parameters did not improve the morbidity or mortality.[11] Previous researches have shown that SI (HR/BP) has been used to gauge the degree of hypovolemia in hemorrhagic states and can be used as a predictor of poor outcomes including mortality in patients with shock. In our setup, SI is easy and reliable parameter to predict severity and to risk-stratify the patient with hypovolemic shock, thereby triggering the attending physician to initiate aggressive treatment early and improving the possible morbidity and mortality.[12] The objective of this research was to find the use of SI in predicting fluid resuscitation in patients with hypovolemic shock.

METHODS

An analytical cross-sectional study was conducted at the Emergency Department of College of Medical Sciences and Teaching Hospital from July 2022 to September 2022. Ethical approval was taken from Institutional Review Committee of College of Medical Sciences (Ref No. COMSTH-IRC/2022-20/3). All the cases with hypovolemic shock and who had given the consent for data collection were included in this study. Sample was selected by using non-probability purposive sampling technique. Research conducted by Bajracharya et.al,[13] in 2016 showed the prevalence of hypovolemic shock as 26.3% by taking this as a prevalence, p= 0.263%, q= 73.7% and margin of error as 8%. Using formula, $n= Z^2*p*q/e^2 = (1.96)^2 *0.263* 0.737/(0.08)^2=116$. By adding 5% non-response error, this research was conducted among 120 patients with hypovolemic shock. Sociodemographic data was recorded from emergency ticket while other information was asked with patients/visitors. A systematic medical examination was done and recorded in the questionnaire and then collected data was checked for completeness, accuracy and then entered and analyzed using statistical package for social sciences (SPSS) version 20.0. Data was analyzed using descriptive and inferential statistical tools. In the descriptive statistics for categorical variables frequency and percentage was calculated. While for continuous variable mean and standard deviation will be calculated. In the inferential Statistics to find the association between levels of shock index with others categorical variable chi-square test was used. To find the association of level of shock with other continuous variable independent t-test were used (after checking normality of the data). P-value <0.05 was considered as statistically significant.

RESULTS

Out of 120 patients, majority of the patients were >50 years 52(43.33%) of age group followed by 40 to 50 years 26(21.67%) and least belonged to 16 to 30 years 18(15%) of age group. Among them majority were males 64(53.33%). Majority of them were road traffic accident (RTA) patients (38%) followed by upper gastrointestinal (GI) bleeding (29%). Most of them were given normal saline (NS) (55%) followed by NS + ringer lactate (RL) 37(30.83%). Minority of the patients only required blood transfusion 10(8.33%) with only one pint of blood 108(90%). Majority of them required didn't require inotropic support 113(94.17%) and intubation 116(96.67%). Only fluid was given to majority 90(75%) of the patients. Among 120 patients, 72(60%) of the patients were admitted in ICU, 30(25%) of them were admitted in ward and 5(4.17%) of them were expired (Table 1).

Table 1: Sociodemographic characteristics of patients with shock (n=120)

Variables	Frequency	Percentage (%)
Age		
16-30	18	15
30-40	24	20
40-50	26	21.67
>50	52	43.33
Gender		
Male	64	53.33
Female	56	46.67
Heart rate (Mean+-SD)	85.32±7.85	
SBP Mean+-SD	81.31±12.42	

Diagnosis		
Acute gastroenteritis	24	20
RTA	46	38.33
Upper GI Bleeding	35	29.17
Burn	4	3.33
Others	12	10
Fluid		
NS	66	55
RL	4	3.33
NS+RL	37	30.83
NS+DNS	12	10
RL+DNS	1	0.83
Amount of fluid required		
Blood transfusion		
Yes	10	8.33
No	110	91.67
Unit of Blood		
1	108	90
2	12	10
Intropic support		
Yes	7	5.83
No	113	94.17
Need for intubation		
Yes	4	3.33
No	116	96.67
Treatment Category		
Fluid only	90	75
Fluid with support	30	25
Outcome		
Admitted in ward	30	25
ICU	72	60
LAMA	6	50
Expire	5	4.17
Discharge	7	5.83

SPACE

Table2: Prevalence of Shock index (n=120)

Shock index category	Frequency	Percentage
<1	72	60
≥1	48	40

Finding showed that in 60% patients had SI <1 had while in 40% patients had SI ≥1 (Table 2). The mean heart rate in SI category (SI <1) was 73.1 ± 3.2 and that in second Group (SI≥1) was 103.64 ± 21.9. The mean SBP in SI category (SI <1) was 85.24 ± 3.6 and that in second group (SI≥1) was 75.4 ± 8.66. The mean amount of fluids received by the patients enrolled in the study was 2700 ± 643.15 in SI category <1 and 3404 ± 1102.47 in SI category ≥1. The number of patients receiving blood transfusion at ER increased with increase in SI and that the number of patients with hypovolemic shock are admitted in hospital more in SI category ≥1 as compared to SI <1 (p value <0.05) (Table 3).

Table 3: Association of Shock index with others variables (n=120)

Variable	Shock index category		Chi-Square/t-value	p-value
	<1	≥1		
Gender				
Male	38(53.3)	20(42.2)	1.42**	0.233
Female	34(46.7)	28(57.8)		
Age	45.72±11.87	41.71±13.90	1.68*	0.09
Heart rate (beats/minute) (mean ± SD)	73.11 ± 3.24	103.64 ± 21.94	11.64*	<0.001†
SBP (mm of Hg) (mean ±SD)	85.24 ± 3.63	75.42 ± 8.66	8.57*	<0.001†
Urine output(ml) (mean± SD)	1815.56 ± 452.24	1850 ±653.84	0.34*	0.73
Diagnosis				
Acute gastroenterities	11(15.2)	13(27.1)		
RTA	34(47.2)	11(22.9)		
Upper GI Bleeding	20(27.8)	15(31.2)	10.59**	0.032
Burn	3(4.1)	1(2.08)		
Others	4(5.6)	8(16.7)		
Fluid				
NS	46(63.8)	20(41.6)		
RL	4(5.6)	-		
NS+RL	20(27.8)	17(35.41)	16.69**	0.002†
NS+DNS	2(2.8)	10(20.8)		
RL+DNS	-	1(2.08)		
Amount of fluids received (ml) (mean ±SD)	2700 ± 643.15	3404 ± 1102.47	15.016*	<0.001†
Blood transfusion				
Yes	4(5.6)	6(12.5)	1.82**	<0.001†
No	68(94.4)	42(87.5)		
Units of blood transfused	0.07+0.024	0.64+1.09	1.82*	0.178
Intropic support				
Yes	-	7(14.6)	11.52**	0.001†
No	72(100)	41(85.4)		
Need for intubation				
Yes	-	4(8.3)	6.21**	0.013†
No	72(100)	44(91.7)		
Treatment Category				
Fluid only	64(88.9)	26(54.1)	18.52**	<0.001†
Fluid with support	8(11.1)	22(45.9)		
Outcome				
Admitted	32(44.4)	40(83.3)	18.15**	<0.001†
Others	40(55.6)	8(16.7)		

*Independent t-test, **Chi-square test, †Statistically significant

DISCUSSION

This study has emphasized the role of SI by demonstrating that it may discriminate the presence of hypovolemic shock with respect to the need for fluid resuscitation and transfusion requirements, as compared to similar studies. The study revealed that majority of the patients were >50 years (43.33%) of age group and least belonged to 16 to 30 years (15%) of age group. Among them 53.33% of them were males. Similar results were revealed in the previous study.[11] Majority of them were RTA patients (38.33%) followed by upper GI bleeding (29.17%). Most of them were given NS (55%) followed by NS+RL (30.83%). Minority of the patients only required blood transfusion (8.33%) with only one pint of blood (90%). Majority of them didn't require inotropic support (94.17%) and intubation (96.67%). Only fluid (75%) was given to majority of them. 72 (60%) of the patients were admitted in ICU. Similar results were seen in a study conducted by Mutschler et al.[14] In this study, the mean heart rate in SI category (SI <1) was 73.1 ± 3.2 and that in second Group (SI≥1) was 103.64 ± 21.9 which is lower than in study done by Mutschler et al. in which it was 91.3 ± 15.1 and 109.1 ± 17.9 respectively. This study shows that the mean SBP in SI category (SI <1) was 85.24 ± 3.6 and that in second group (SI≥1) was 75.4 ± 8.66 which is lower than in study done by Mutschler et al., in which it was 124.1 ± 20.2 and 96.9 ± 16.8 respectively. This variation is most probably because the study done by them included trauma patients irrespective of their hypovolemic shock status. The mean amount of fluids received by the patients enrolled in the study was 2700 ± 643.15 inSI category <1 and 3404 ± 1102.47 in SI category ≥1 which is different from the study done by Mutschler et al. i.e, 2148 ±2490 and 3071 ± 2690 respectively.[14] This may be because the study done by them has divided the amount of intravenous fluids received at scene and at emergency department into different categories. However point to be noted is that higher the SI more is the amount of fluids administered. This study shows that the number of patients receiving blood transfusion at ER increased with increase in shock index (3 vs 14, p-value=0.003); similar to study done by Mackenzie et al. states that SI was significantly associated with emergency blood use.[15] This result is also similar to that of another study done by Berger at al. which states that patients with abnormal shock index,[8] were more likely to be transfused; and to that of study done by Kelsall et al. showing that SI ≥1 has very high specificity (93.5%) for predicting any blood transfusion in the first four hour of in-hospital resuscitation.[16]

This study shows that increase in shock index is associated with more number of blood transfused (p value <0.05), similar to study done by Andrea et al.[3] The study shows that the number of patients with hypovolemic shock are admitted in hospital more in SI category ≥1 as compared to SI <1 (p value <0.05), similar to a study by Rady et al. done in 1994 which showed that the group with SI >0.9 had a significantly higher proportion of patients who required admission to the hospital.[11] Another study also shows similar result of higher hospitalization rate with increase in shock index, done by Cevik et al.[17]

CONCLUSIONS

Shock index is a most commonly used bedside tool which is reliable and consistent marker to predict the requirement for any amount of blood transfusion, particularly for those patients with hypovolemic shock. The risk of clinical complication is high among patients whose shock index is more than one.

CONFLICTS OF INTEREST: None declared.

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