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Emergency Medicine

THE PREDICTIVE VALUE OF MODIFIED SHOCK INDEX FOR HOSPITAL MORTALITY

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ABSTRACT **INTRODUCTION:** Shock Index uses only systolic blood pressure; however, diastolic blood pressure is also of undeniable importance when determining patient's clinical severity. **METHODOLOGY:** All patients who fit into the inclusion criteria were requested for consent to join the study. The patients were further divided into sub-groups as per their working diagnosis as medical or surgical cases and definitive diagnosis were noted. **RESULTS:** In the present study, the mean age group for patients on whom lactate levels were done was found to be 53.2±15.9 years and the maximum study samples were in the age group 60-69. The mean of systolic blood pressure, diastolic blood pressure, heart rate, MAP, Shock Index, Modified Shock Index and lactate levels in our study was 104.1±26.8 mm/hg, 72.4±18.4 mm/hg, 116.9±18.7, 83.1±20.4 mm/hg, 1.2±0.5, 1.5±0.6 and 4.9±2.6 respectively. **CONCLUSION:** The predictive value of MSI for hospital mortality was calculated by ROC curve where the sensitivity was 0.750 and specificity was 0.454.

KEYWORDS : Modified Shock Index, Hospital Mortality, Shock Index

INTRODUCTION:

Shock Index uses only systolic blood pressure; however, diastolic blood pressure is also of undeniable importance when determining patient's clinical severity. Hence, Liu et al incorporated diastolic blood pressure and developed the modified shock index (MSI), which is a ratio of heart rate to mean blood pressure (MAP). A retrospective database review was performed on 22,161 patients who presented to Peking Union Medical College Hospital Emergency Department and received intravenous fluids from January 1 to December 31, 2009. As per their findings, Multivariate regression analysis was performed to determine the correlation between risk factors and outcome. There was a significant correlation between emergency patient mortality rate and patient's vital signs obtained at the triage desk (HR>120 beats/min, systolic BP<90 mmHg, diastolic BP<60 mmHg). MSI was a stronger predictor of emergency patient mortality compared to heart rate and blood pressure alone, whereas SI did not have a significant correlation with emergency patient mortality rate.[1,2]

In another large-scale study, Singh et al performed a prospective longitudinal study on 9,860 adult trauma patients. Multivariate regression analysis demonstrated that heart rate more than 120 beats per minute, systolic blood pressure less than 90 mmHg, and diastolic blood pressure (DBP) less than 60 mmHg correlate with hospital stay and mortality rate. MSI <0.7 and >1.3 had higher odds of mortality as compared to heart rate, systolic blood pressure, diastolic blood pressure and Shock index.[3]

In another large series study of patients performed by Rau et al, detailed data of 2490 patients hospitalized for trauma between 1 January 2009 and 31 December 2014, who had received blood transfusion within 24 h of arrival at the emergency department, were retrieved from the Trauma Registry System of a level I regional trauma center. In addition to a significantly higher Injury Severity Score and worse outcome, the patients requiring massive transfusion presented with a significantly higher HR and lower SBP, Hb, and base deficit, as well as significantly increased SI, MSI, and Age SI. Among these, only four parameters (SBP, BD, SI, and MSI) had a discriminating power of moderate accuracy (AUC > 0.7) as would be expected. A SI of 0.95 and a MSI of 1.15 were identified as the cut-off points for predicting the requirement of MT, with an AUC of 0.760 (sensitivity: 0.563 and specificity: 0.876) and 0.756 (sensitivity: 0.615 and specificity: 0.823), respectively.[4] However, in the groups of patients with comorbidities such as hypertension, diabetes mellitus, or coronary artery disease, the discriminating power of these three indices in predicting the requirement of massive transfusion was compromised. However, this study revealed no statistical difference between the predictive values of shock index and modified shock index .[5,6]

METHODOLOGY:

Patients who are fulfilling the inclusion criteria were asked to participate in the study and informed consent was taken.

Demographic data like age and sex was obtained. The patients were evaluated clinically, history and hemodynamic were noted. ABG was done on the patients and lactate levels were recorded. Requirement of Inotropic support, mechanical ventilation and dialysis were noted. All the findings were recorded on a predesigned and prepared proforma.

All patients who fit into the inclusion criteria were requested for consent to join the study. The patients were further divided into sub-groups as per their working diagnosis as medical or surgical cases and definitive diagnosis were noted. The Modified shock index is calculated on arrival as"Heart rate / Mean arterial pressure" (MAP) = [(DBPx2) +SBP]/3)

The initial lactate values, vital signs and shock index were also noted. The patient was followed up till discharge.

Statistical analysis was performed by using SPSS 22.0 version. The study subjects had been described according to their demographic profiles such as age and gender. Continuous variables like HR, SBP, DBP and MAP was presented as mean±SD and the categorical variables was presented as frequency or percentages and interpreted by student independent "t" test. The cut of values of modified shock index (MSI) was estimated by ROC curve. The correlations between physiological variables and MSI with lactate were performed by Karl pearsons coefficient of correlation. The association between MSI with Inotrope, intubation, dialysis and deaths were analyzed by χ^2 (Chi-square) test.

RESULTS:

Table 1: Association Between Msi With Inotrope Requirement

MSI	Yes	No	Total	X^2	df	Sig
<1.3	23	91	114	87.756	1	p=0.000
1.3+	120	37	157			
Total	143	128	271			

MSI >1.3 was strongly associated with Inotrope requirement (P<0.01).

Table-2: Association between MSI with Intubation

MSI	Yes	No	Total	X^2	df	Sig
<1.3	22	92	114	25.204	1	P<0.001
1.3+	77	80	157			
Total	92	172	271			

MSI 1.3+ was very strongly associated with Intubation (P<0.001).

Table-3: Association between MSI with need for Dialysis:

MSI	Yes	No	Total	X^2	df	Sig
<1.3	14	100	114	1.896	1	P=0.169
1.3+	29	128	157			
Total	43	228	271			

MSI >1.3 was not associated with need of dialysis (P>0.05).

Table-4: Association between MSI with Death:

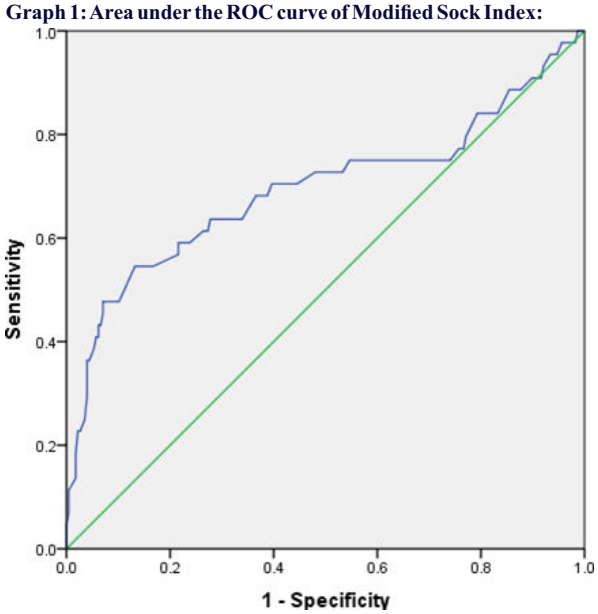
MSI	Yes	No	Total	X^2	df	Sig
<1.3	11	103	114	6.278	1	P=0.012
1.3+	33	124	157			
Total	44	227	271			

MSI >1.3 was associated with death (P<0.05).

Table 5: Area under the ROC curve of Modified Sock Index to predict death

Area	Std. Error	Sig.	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.694	.053	.000	.590	.799

Graph 1: Area under the ROC curve of Modified Sock Index:



The computation of cut of value to predict death was undertaken by Running Operators Characteristics (ROC) curve. The above curve determined the cut of value of MSI. The maximum of sensitivity and specificity was the cut of value for predicting death. In this curve, the sensitivity was 0.750 and specificity was 0.454. These values were corresponding coordinates which was 1.295. The cut off value predictiong the death by MSI was 1.295 and above.

DISCUSSION:

In the present study, the mean age group for patients on whom lactate levels were done was found to be 53.2±15.9 years and the maximum study samples were in the age group 60-69. In a similar study done by Cevik et al, the mean age on whom lactate levels were done was 62.35±1.63 years [7].

In our study, we found a male preponderance. The male:female ratio was found to be 2.2:1. Cevik et al had an almost similar male:female ratio of 1.7:1 in their study sample[7].

The mean of systolic blood pressure, diastolic blood pressure, heart rate, MAP, Shock Index, Modified Shock Index and lactate levels in our study was 104.1±26.8 mm/hg, 72.4±18.4 mm/hg, 116.9±18.7, 83.1±20.4 mm/hg, 1.2±0.5, 1.5±0.6 and 4.9±2.6 respectively. Compared to a previous study done by Soon Yong et al where the sample size was 45,880, the recorded mean SBP, DBP, HR, SI and MSI was 140, 80, 80, 0.57 and 0.79 respectively[8]. The study done by Soon Yong et al included only geriatric trauma patients and shows a higher mean in hemodynamic parameters indicating the samples in our current study were probably more sick. In the study done by Civek et al, the sample size was 131 and the mean Shock Index was 1.48±0.09 among females and 1.31±0.06 in males with mean lactate of 2.66±0.35 in females and 3.44±0.42 in males[7]. Though we did not separately analyze male and female values, the above finding may be due to increased muscle mass in male samples.

The SBP, DBP and MAP were negatively correlated with lactate as -0.480, -0.490 and -0.500 respectively. That means SBP, DBP and MAP determined lactate as 23%, 24% and 25% respectively. The HR, SI and MSI were positively correlated with lactate as 0.412, 0.614 and 0.632 respectively. That means, the HR determined the lactate as 17%. The SI determined the lactate as 37.7% and MSI determined the lactate 39.9%. The Shock Index was split into three categories: <0.5, 0.5-0.9 and >0.9. The mean lactate in the <0.5 group, 0.5-0.9 group and the >0.9 group were 4.6667, 3.4807 and 5.2374 respectively. There was a statistically significant difference between the groups. Patients with Shock Index >0.9 had statistically significant higher Lactate levels (5.237±2.649, p =0.000) than patients with Shock Index 0.5-0.9 (3.480±1.643). There was no statistically significant difference between the Shock index > 0.9 and < 0.5 groups (p = 0.916). Our study found a linear relation between Shock Index and Lactate levels. The Modified Shock Index was split into three categories: <0.7, 0.7-1.3 and >1.3. The mean lactate in the <0.7 group, 0.7-1.3 group and the >1.3 group were 5.5000, 3.7060 and 4.8616 respectively. There was a statistically significant difference between the groups. Patients with modified Shock Index >1.3 had statistically significantly higher Lactate levels (5.729±2.846, p = 0.000) than patients with modified Shock Index 0.7 – 1.3 (3.706±1.520). There was no statistically significant difference between the Shock index > 1.3 and < 0.7 groups (p= 0.990). The Modified Shock Index had a linear relation with Lactate levels in our study. We could not find studies with similar correlation between lactate levels, vitals and MSI. However, a study was done by Berger T et al on 2524 samples where he found SI of 0.7 or more was positively correlated with lactate levels compared to SI of <0.7[9].

Ajay Singh et al had conducted a prospective study on 9,860 samples in which they found that MSI may be better than using Heart rate, Systolic blood pressure and Diastolic blood pressure as a predictor of mortality in Emergency patients as a MSI value of >1.3 had higher odds of mortality[10]. Our study found association between MSI and Inotrope requirement, intubation and death. There was no association between MSI and need of dialysis. The predictive value of MSI for hospital mortality was calculated by ROC curve where the sensitivity was 0.750 and specificity was 0.454. The cut-off value for MSI predicting death was found to be 1.295.

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CONCLUSION:

- The cut-off value of MSI for predicting death is 1.298 and above
- MSI > 1.3 was strongly associated with Inotrope requirement and need for intubation
- MSI > 1.3 was associated with death
- MSI > 1.3 was not associated with need for dialysis

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