Section: Anesthesiology

Original Research Article

PREDICTING POST INTUBATION HYPOTENSION WITH AGE SHOCK INDEX, MODIFIED SHOCK INDEX AND SHOCK INDEX IN THE EMERGENCY DEPARTMENT OF A TERTIARY CARE HOSPITAL

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Abstract

Background: Post intubation hypotension is one of the major complications of endotracheal intubation. Post intubation hypotension can cause increased ICU and hospital stay and is also associated with increased morbidity and mortality. To compare Age Shock Index, Modified Shock Index and Shock Index in predicting the development of post intubation hypotension and to identify other factors that has association with development of post intubation hypotension. **Materials and Methods:** This was a longitudinal observation study in adults patients needing rapid sequence intubation in the Emergency department of Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla, Kerala. Consecutive sampling was done. Sample size calculated was 80. Approval obtained from the institutional research committee and institutional ethics committee. Patients satisfying inclusion and exclusion criteria were selected and after obtaining informed consent from the relatives, their data was entered in the pre-prepared proforma and they were monitored for 1 hour post intubation for development of hypotension. **Result:** Study was done in 85 adults who presented to the Emergency department who required rapid sequence intubation, of which 53 (62.4%) were males and 32 (37.6%) were female. The observed mean SBP of the study population was 152.67mm Hg with a standard deviation of 31.08, mean DBP was 86.72mm Hg with a standard deviation of 15.37 and mean heart rate was 101.27±26.97. Post intubation hypotension was found to be high among the pulmonary cause of intubation (p value: 0.025) and was less among cerebral cause of intubation (p value: 0.031). Age SI predict the development of post intubation hypotension better with a value of ASI ≥49 has 77.8%sensitivity, 67.1% specificity, 22.6% PPV and 96.1% NPV with accuracy 68.3. **Conclusion:** Age shock index has better predictive value for the development of post intubation hypotension than SI and MSI.

INTRODUCTION

Endotracheal intubation is a life-saving procedure being performed in critically ill patients within the hospital and now even in pre-hospital setting with the emergence of EMS facility. Though it is a life-saving procedure, it is associated with multiple complications too like hypoxemia, hypotension, cardiac arrest, aspiration etc. Post intubation hypotension is one such complication and it is defined by many criteria in the literature. For ease, it can be defined as development of hypotension (SBP< 90 mm Hg or MAP <65 mm Hg) within the 1 hour after intubation.[1]

The hypotension can usually be managed or prevented by adequate IV fluids or vasopressor support if needed. So, identifying the risk factors for the development of post intubation hypotension can help us prevent it by taking necessary precautions or at least will make physicians understand the need for close monitoring of such patients for prompt treatment and thus will help improve patient outcome.[2]

Calculating shock index, age shock index and modified shock index before intubation to predict the development of postintubation hypotension doesn't require much of any investigations or tests other than assessment of vitals before intubation. Though there are some studies on post intubation hypotension, most of them are retrospective chart analysis and very

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few prospective studies are available.[3-5] Also, though there are many studies that evaluate association of pre intubation shock index and postintubation hypotension, very few literatures exist on evaluation of modified shock index and age shock index with post intubation hypotension. A study evaluating the development of post intubation hypotension in EDs of our country especially in our state is also lacking, to know what all factors an contribute to it in our population like the comorbidities, reasons for intubation, presentation to ED, the drugs we use and the ventilator parameter we set.[6]

In view of above reasons, the present study is to evaluate the development of post intubation hypotension, its frequency and whether shock index, modified shock index or age shock index better predict the development of post intubation hypotension prior to intubation. This knowledge will help to prevent post intubation hypotension in future and thus will help improve patient outcome and decrease period of ICU stay and mortality.

MATERIALS AND METHODS

It was a Longitudinal observational study conducted at Emergency department of Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla, Kerala from 1st April 2021 to 15th July 2022. Adult patients presenting to the emergency department needing rapid sequence intubation were included as the sample size of the study and consecutive sampling technique was used.

Inclusion criteria

Patients of age above 18 years undergoing Rapid sequence intubation in Emergency department

Exclusion criteria

Pre-intubation SBP <90 mm Hg
Pre-intubation MAP <65 mm Hg
Patients in cardiac arrest
Received antihypertensive drugs upon the procedure
Severe traumatic brain injury
Patients whose bystanders didn't give consent

Methodology

Before conduct of the study, approval was obtained from the institutional research committee and institutional ethics committee. Eligible patients who met the inclusion criteria were enrolled into the study after an informed consent. The treating physician used to begin his assessment, stabilization and work-up of the patient and meanwhile the investigator was informed. The investigator used to assess the patients' HR, BP and calculate SI, MSI and age SI. The patients were monitored 1 hour post intubation for the development of hypotension (SBP< 90 mm Hg, MAP < 65 mm Hg). Other factors like age, comorbidities, cause of illness, reason for intubation, laboratory values, medications used for intubation and ventilator parameters were also recorded and evaluated.

Sample Size estimation-

Sample size is obtained using the formula:

$n = (Z_{(1-\alpha)/2})^2 p(1-p)/d^2$

n = sample size
1-α = confidence level (95%)
p = Proportion of study subjects developing post intubation in previous study[7]
d = absolute precision (10%)

Sample size was calculated using proportion of study subjects developing post-intubation hypotension (p) from previous study[7], confidence level (1-α) as 95%, absolute precision (d) as 10%.

The sample size obtained was 80 using the formula.

Statistical Analysis

All the data were collected by the principal investigator and was recorded in the proforma. The hard copies of the consent forms and the proforma are with the principal investigator. All the data collected were then coded and entered in Microsoft Excel sheet which was re-checked and analysed using SPSS statistical software version 22. Quantitative variables were summarised using mean and standard deviation (SD). Categorical variables were represented using frequency and percentage. Independent sample t test and Mann Whitney U test were used to test statistical significance of difference between means of variables among different independent groups. Pearson Chi-square test and Fisher's Exact test were used for comparing categorical variables between groups. Receiver Operating Characteristics (ROC) curve was created to predict the development of post intubation hypotension using age shock index, modified shock index and shock index. A p value of <0.05 was considered statistically significant.

Ethical Considerations

The study was purely an observational study. So, patients needing rapid sequence intubation were managed according to the usual protocol. No additional investigation was done for the study. The routine ABG which used to perform before each intubation was the only investigation that was needed. So, no further financial burden was imposed on the patient. Data was collected using a pre-prepared proforma after getting informed consent from the patient's relatives. Confidentiality of the data saving was also maintained throughout the study.

RESULTS

Among the study population, 53 (62.4%) were males and 32 (37.6%) were female. The mean age of the study population was 64.15 with a standard deviation of 15.74. The minimum age included in the study was 19 years and the maximum age was 98 years. Among the 85 number of patients, cerebral cause for intubation were the most common (47.1%) followed by pulmonary cause (37.7%). There were also cases of intoxication and trauma among the study population.

As per [Table 2] Other than the 3 patients who developed cardiac arrest, 9(11%) patients developed

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post intubation hypotension. The mean SBP at the time of detection of PIH was 77.78±6.66 and the mean DBP was 48.89±9.28. Mean time of development of post intubation hypotension was 17.78±10.92 minutes and out of the 9 patients who developed post intubation hypotension 8 were started on Noradrenaline infusion.

As per [Table 2] the different causes of illness were compared and two statistically significant associations were found. Post intubation hypotension was found to be high among the pulmonary cause of intubation (p value: 0.025) and was less among cerebral cause of intubation (p value: 0.031).

The most common indication for intubation was airway protection in the study. Among the study population 55.2% of patients were intubated for airway protection alone and 25.9% for respiratory failure alone. 18.8% of patients were intubated for both airway protection and respiratory failure.

The observed mean SBP of the study population was 152.67 with a standard deviation of 31.08, mean DBP was 86.72 with a standard deviation of 15.37 and mean heart rate was 101.27±26.97. Based on these vital signs the MAP, SI, MSI and ASI were calculated. Statistically significant association was found between DBP and MAP with PIH with a p value of 0.004 and 0.010 respectively. Thus, low DBP and low MAP can predict development of post intubation hypotension.

Among the different shock indices that we evaluated in our study, only ASI showed a significant association with post intubation hypotension. (P value: 0.023).

ABG was taken for each patient prior to intubation and the recorded mean pH, PCO2, PaO2 and bicarbonate were 7.25±0.16, 56.05±27.51, 82.25±71.71 and 21.92±5.94 respectively.

Among the study population the mean of PEEP used was 4.81cm H2O with a standard deviation of 1.54 and tidal volume 409.94ml with a standard deviation of 29.50. Out of the 85 patients of the study, 3(3.5%) patients had cardiac arrest immediately after the intubation. (Within 10 minutes). The initial ventilator settings were also compared for evaluating association and the initial tidal volume was found to have association with PIH. (p value: 0.036).

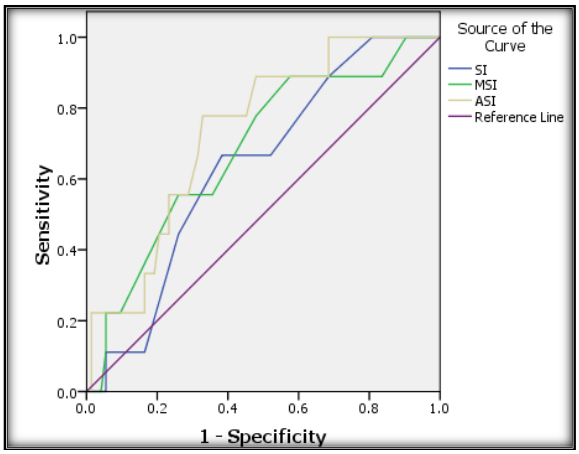

Figure 1: Roc Curve of Si, Msi And Asi For Predicting Post Intubation Hypotension

Receiver Operating Characteristics (ROC) curve was created to predict the development of post intubation hypotension using age shock index, modified shock index and shock index. A p value of <0.05 was considered statistically significant. The ROC-AUC of pre-intubation age SI, MSI and SI for prediction of PIH were 0.734 (95%CI 0.585-0.882), 0.681 (95%CI 0.502- 0.860) and 0.635 (95%CI 0.471-0.799). Only ASI was found to be a significant predictor of post intubation hypotension.

The diagnostic cut-off values for age SI, MSI and SI were found to be ≥49, ≥0.85 and ≥0.75 respectively. Age SI predict the development of post intubation hypotension better with a value of ASI ≥49 has 77.8%sensitivity, 67.1% specificity, 22.6% PPV and 96.1% NPV with accuracy 68.3.

Table 1: Frequency of Post Intubation Hypotension

	Mean±SD	Median(IQR)
SBP of hypotensive patients- mm Hg	77.78±6.66	80(80-80)
DBP of hypotensive patients- mm Hg	48.89±9.28	50(45-55)
Time of detection of Hypotension- minutes	17.78±10.92	10(10-25)

Table 2: Association of Cause of Illness And Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
Cerebral cause			
Yes	1(2.6)	38(97.4)	0.031*
No	8(18.6)	35(81.4)	
Pulmonary cause			
Yes	7(21.9)	25(78.1)	0.025*
No	2(4)	48(96)	
Cardiac cause			
Yes	0	4(100)	1.000
No	9(11.9)	69(88.5)	
Trauma			
Yes	0	3(100)	1.000
No	9(11.4)	70(88.6)	
Intoxication			
Yes	1(25)	3(75)	0.378

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No	8(10.3)	70(89.7)	
Renal cause			
Yes	0	2(100)	1.000
No	9(11.3)	71(88.8)	

Table 3: Association of Reason For Intubation And Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
Reason for intubation			
Airway protection alone	3(6.5)	43(93.5)	0.298
Respiratory failure alone	3(14.3)	18(85.7)	
Both airway protection and respiratory failure	3(20)	12(80)	

Table 4: Association of Hemodynamic Variables and Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
SBP			
Mean ± SD	136.22±20.45	155.08±31.05	0.080
DBP			
Mean ± SD	72.89±12.85	88.70±14.81	0.004*
Heart rate			
Mean ± SD	105.22±27.11	100.82±27.21	0.648
MAP			
Mean ± SD	93.89±13.71	110.85±18.63	0.010*

Table 5: Association of Shock Indices and Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
SI (Shock Index)			
Mean ± SD	0.78±0.19	0.68±0.26	0.186
MSI (Modified Shock Index)			
Mean ± SD	1.14±0.30	0.94±0.33	0.097
ASI (Age Shock Index)			
Mean ± SD	64.76±29.15	44.15±24.15	0.023*

Table 6: Association of ABG Values and Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
pH			
Mean ± SD	7.22±0.15	7.25±0.16	0.528
PCO2			
Mean ± SD	62.92±30.52	55.66±27.68	0.538
PaO2			
Mean ± SD	59.74±28.17	85.81±76.24	0.346
Bicarbonate			
Mean ± SD	22.45±6.87	22.15±5.72	0.884

Table 7: Association of Ventilator Settings and Post Intubation Hypotension

Variable	Post intubation hypotension		P value
	Yes (N=9)	No (N=73)	
PEEP			
Mean ± SD	4.56±0.72	4.82±1.64	0.294
TV			
Mean ± SD	392.22±22.23	411.85±30.15	0.036*
TV/kg			
Mean ± SD	6.71±1.32	6.09±1.57	0.302

Table 8: Area under The Roc Curve of Si, Msi And Asi For Predicting Post Intubation Hypotension

	Cut off	Sensitivity	Specificity	PPV	NPV	Accuracy
SI	≥0.75	66.7	61.6	17.6	93.8	62.2
MSI	≥0.85	88.9	42.5	16.0	96.9	47.6
ASI	≥49	77.8	67.1	22.6	96.1	68.3

Study	Year	Definition of post intubation hypotension	Frequency
Green et al,[11]	2012	Post Intubation Hemodynamic Instability (PIHI) Decrease in SBP ≤ 90 mm Hg, a decrease in SBP of ≥ 20% from baseline, a decrease in mean arterial pressure to ≤ 65 mm Hg, or the initiation of any vasopressor medication at any time in the 30 minutes following intubation	96/218 (44%)
Ergun et al,[12]	2012	PIH	76/336 (23%)

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		SBP <90 mm Hg within 60 minutes of intubation	
Smischney et al,[1]	2016	PIH Administration of any vasopressor within 60 minutes following intubation	29/147 (20%)
Heffener et al,[13]	2018	Hemodynamic derangement Cardiac arrest and/or the development of systolic pressure <90 mm Hg and/or mean arterial pressure < 65 mm Hg 30 min following intubation	170/420 (40%)

DISCUSSION

Among the study population, 53 (62.4%) were males and 32 (37.6%) were female. The mean age of the study population was 64.15 with a standard deviation of 15.74. The minimum age included in the study was 19 years and the maximum age was 98 years. Out of the 85 patients of the study, 3(3.5%) patients had cardiac arrest immediately after the intubation. (Within 10 minutes). Though this was not an objective of the study, this was an additional observation we had from the study. It has a lesser incidence as compared to study by Heffner et al which showed a 4.2% (17/410) incidence of post intubation cardiac arrest.[2,8,9]

Incidence of post intubation hypotension was 0.47% by Lee10, 28.6%.The study done by Green et al in the year 2012 showed incidence of Post Intubation Hemodynamic Instability as 44%.[11]

Trivedi et al in 2015 has demonstrated that pre-intubation SI ≥ 0.90 have significant association with postintubation hypotension. This study also showed no association between pre-intubation MSI and postintubation hypotension.14Junsung et al in 2016 showed that shock index and modified shock index were closely associated with PIH.5 Lee et al in 2020 demonstrated that SI, MSI and ASI were independently associated with post intubation hypotension and the prognostic performance of Age SI for prediction of PIH was better than MSI and SI.[7]

Junsung et al in 2018 showed age, serum albumin level, shock index and modified shock index were closely associated with PIH.5 In 2019 kim et al showed that age >70 years, shock index > 0.8, arterial acidosis (pH < 7.2), intubation indication and use of non-depolarizing neuromuscular blocking agents were significantly related to PIH.[15]

No statistically significant association was found (p value: 0.298) in the present study. Kim et al,[15] has demonstrated that intubation indication has association with PIH. Statistically significant association was found between DBP and MAP with PIH with a p value of 0.004 and 0.010 respectively. Thus, low DBP and low MAP can predict development of post intubation hypotension. No statistically significant association was found in the present study. But Kim et al15 in 2019 has showed arterial acidosis (pH < 7.2) is associated with development of PIH.

Our study has few limitations. This is a single centre study done in a tertiary care centre with a short duration of time compared to previous studies of the same. Only 9 patients out of the 82 patients had post intubation hypotension. So, the varies association we found was in a small subset of patients. Though previous studies demonstrated association Shock Index and modified Shock Index with Post intubation hypotension, this study did not show any association. The less frequency of post intubation hypotension decreases the validity of association with different variables with post intubation hypotension.

CONCLUSION

Age shock index has better predictive value for the development of post intubation hypotension than SI and MSI. The frequency of post intubation hypotension in the patients attending Emergency department who are undergoing RSI is found to be 11% in the present study. Factors like age, pulmonary cause for intubation, low DBP, low MAP, low TV were associated with development of post intubation hypotension.

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