Predictive factors for post-intubation hypotension after emergency airway management

ORIGINAL ARTICLE

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ABSTRACT

OBJECTIVE

To identify factors predicting post-intubation hypotension (PIH) after emergency airway management in the emergency department.

METHODS

This was a prospective cohort study enrolling intubated adults with non-traumatic hemodynamic stable patients in the emergency department, Khon Kaen Hospital from September 2016 to September 2017. The factors potentially associated with PIH were collected. The data was analyzed to define predictive factors for PIH and PIH effects, all-cause mortality was analyzed as the secondary outcome.

RESULTS

A total of 483 patients were enrolled. The patients experienced PIH were 33.1% after multiple logistic regression analysis, baseline systolic blood pressure (SBP)>140 mmHg was significant predictive factors for PIH (adjusted odds ratio (AOR) 1.51%; 95% confidence interval (CI), 1.01 to 2.24) and all-cause mortality in PIH group was higher when compared to non-PIH group (AOR, 3.94; 95% CI, 2.61 to 5.95).

CONCLUSION

Baseline SBP>140 mmHg was independently associated with increase PIH after emergency intubation.

INTRODUCTION

Post-intubation hypotension (PIH) is a common and serious complication in emergency endotracheal intubation and its incidence can be varied from 0.5 to 44%.[1-3] It affects about 25% of patients who are hemodynamically stable before intubation.[1] Nearly a half of the patients with this complication need vasoactive agents for support hemodynamic system.[4] Increasing catecholamine production leads to increase blood pressure and heart rate but when the patients are intubated, giving intravenous medications to relax during endotracheal intubation will reduce catecholamine to varying degrees, which may cause abrupt arterial and venous dilatation.[5-8] And initiation of positive pressure ventilation raises mean intra-thoracic pressure is transmitted to the right atrium to increase right atrial pressure. Because mean systemic pressure decreases and right atrial pressure increases, venous return decreases and cause of hypotension. It is explained as a physiologic response to intubation due to multiple mechanisms including induction sympatholytic drug and effects of positive-pressure ventilation, this risk leading physicians to assume that PIH is a benign, transient, or self-limited consequence of airway management.[8] However, PIH is a high-risk sign that is independently associated with increased in-hospital mortality and longer intensive care unit (ICU) and hospital length of stay.[1,9] Many studies that were conducted in various settings; ICU, emergency department and general ward that performed emergency airway management found that there were many factors which associated with a higher rate of this complication such as low body weight patients, high value of shock index, type of sedative drugs and neuromuscular blocking agent use.[2,9-14] But some factors were not included in current studies such as the use of some sedative drugs and methods of intubation. Thus, we designed this study to identify potential predictors for PIH.

METHODS

STUDY DESIGN AND SETTING

We conducted a prospective cohort study of patients who were intubated from September 2016 to September 2017 at Emergency Department, Khon Kaen Hospital, Thailand. The Institutional Review Board of Khon Kaen Hospital approved this study under a waiver of informed consent with the approval number of KE 59039.

STUDY POPULATION AND ELIGIBILITY CRITERIA

Our inclusion criteria were as the followings; (i) patients undergoing intubation with age 18 years or older, (ii) non traumatic patients, (iii) hemodynamic stable i.e., SBP≥90 mmHg or mean arterial pressure (MAP)≥65 mmHg without vasopressor drugs used for 10 consecutive minutes before intubation, (iv) being intubated in the emergency department.

STUDY PROCEDURES

The patients who met the inclusion criteria were enrolled in the study. The methods and medications of intubations were performed according to the physician's decision. Variable of interest data which included: age, body weight, underlying disease, baseline SBP before intubation, shock index, indication for intubation, number attempts of intubation, sedative drug use, neuromuscular blocking agents were records then

Table 1. Baseline characteristics of the patients

Characteristic	Total (n = 483)	PIH group (n = 160)	Non-PIH group (n = 323)
Male sex-no. (%)	289 (59.8)	87 (54.4)	202 (62.5)
Age-year	59.9±17.0	61.0±16.9	59.4±17.1
Body weight-kg	55.9±13.6	54.5±14.0	56.7±13.3
Baseline SBP-mmHg	145.4±36.5	151.0±43.1	142.5±32.4
Shock index (SD)	0.79±0.30	0.80±0.34	0.78±0.26
Underlying disease-no. (%)			
Chronic obstructive pulmonary disease	62 (12.8)	16 (10.0)	46 (14.2)
Hypertension	130 (26.9)	42 (26.2)	88 (27.2)
End stage renal disease	61 (12.6)	19 (11.9)	42 (13.0)
Indications for intubation-no. (%)			
Respiratory failure	349 (72.3)	121 (75.6)	228 (70.6)
Impending airway obstruction	131 (27.1)	37 (23.1)	94 (29.1)

* Plus–minus values are means ±SD

patients were divided into two groups; PIH group and non-PIH group. For the PIH group, the patients must have one of the following criteria; (i) decreased SBP (SBP<90 mmHg), (ii) decrease≥20 percent from baseline SBP or MAP<65 mmHg), and (iii) Initiation use of the vasopressor drug at any time in 30 minutes following intubation. All data were analyzed for the predictive factors of this adverse event.

STATISTICAL ANALYSIS

Continuous data are presented as means±SD. Categorical data are reported as proportions. For the primary outcome, factors that are important in the univariate analysis (P<0.2) were included in the multivariable analysis by using binary logistic regression to determine risk factors independently associated with PIH. The interactions between possible predictive factors also were tested. Results were expressed as adjusted odds ratio (AOR) and 95% confidence intervals (CI). Statistical significance determined as P<0.05. Overall mortality was reviewed for both PIH and non-PIH. The effect of PIH for overall mortality was analyzed and other factors that effect for overall mortality were assessed using multiple logistic regression.

RESULTS

A total of 483 patients were enrolled in this study, the mean age of all patients was 59.9 years and 58.9% were men. There were 160 patients in PIH group and 323 patients in non-PIH (non-PIH) group, respectively. There were no significant differences in baseline characteristics between the two groups (Table 1).

Table 2. Comparison of ventilation variables and drugs use during intubation between PIH and non-PIH group

Ventilation and drug variables	Total (n = 483)	PIH group (n = 160)	Non-PIH group (n = 323)
Method of intubation-no. (%)			
Awake intubation	220 (45.6)	71 (44.4)	149 (46.1)
Sedation without neuromuscular blocking agent	233 (48.2)	76 (47.5)	157 (48.6)
Rapid sequence intubation	30 (6.2)	13 (8.1)	17 (5.3)
Number attempt of intubation -no. (%)			
1	364 (75.4)	122 (76.2)	242 (74.9)
2	89 (18.4)	27 (16.9)	62 (19.2)
≥3	30 (6.2)	11 (6.9)	19 (5.9)
Sedative drug use-no.(%)			
None	224 (46.4)	71 (44.4)	153 (47.4)
Etomidate	36 (7.5)	15 (9.4)	21 (6.5)
Diazepam	223 (46.1)	74 (46.2)	149 (46.1)
Neuromuscular blocking agent-no.(%)			
None	453 (93.8)	147 (92.0)	306 (94.7)
Succinylcholine	25 (5.2)	11 (7.0)	15 (4.6)
Rocuronium	5 (1.0)	2 (1.3)	2 (0.6)

Nearly fifty percent of the patients were intubated using sedative drugs without neuromuscular blocking agent method and most of them were given diazepam. Of total 483 patients, 364 were successful in the first attempt of intubation. From the data of ventilation variables and drugs use, we did not find the statistical difference among PIH and non-PIH groups (Table 2).

From the univariate analysis; sex, body weight, Chronic obstructive pulmonary disease (COPD), baseline SBP, respiratory failure, impending airway obstruction, etomidate use, diazepam use and, etomidate and diazepam use variables may be significant predictors for PIH but after adjusted other variables and analyzed by multiple logistic regression baseline SBP>140 mmHg was only single factor which could predict this adverse outcome (AOR, 1.51; 95% CI, 1.01 to 2.24) (Table 3). After multivariable analysis, we found that PIH was a significant predictor for death in intubated patients adjusted (AOR, 3.94; 95% CI2.61 to 5.95) (Table 4).

DISCUSSION

This study was addressed about predictive factors for developing hypotension after emergency

Table 3. Univariate and multivariable analysis for post-intubation hypotension

Variables	Crude odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Age-year*	1.00 (0.99 - 1.01)	
Male sex	0.71 (0.50 -1.05)	0.77 (0.52 to 1.15)
Body weight-kg*	0.99 (0.97 -1.00)	0.99 (0.97 to 1.00)
Underlying disease		
Chronic obstructive pulmonary disease	0.67 (0.37-1.22)	0.59 (0.32 to 1.11)
Hypertension	0.95 (0.62 -1.46)	
End stage renal disease	0.90 (0.51 -1.61)	
Baseline SBP>140 mmHg	1.36 (0.93-1.99)	1.51 (1.01 to 2.24)
Shock index*	1.30 (0.70 -2.50)	
Indications for intubation		
Respiratory failure	1.30 (0.84-2.00)	0.78 (0.25-2.47)
Impending airway obstruction	0.73 (0.47-1.14)	0.57 (0.18-1.83)
Method of intubation		
Awake intubation	1.00	
Sedation without neuromuscular blocking agent	1.01 (0.69 -1.50)	
Rapid sequence intubation	1.60 (0.74-3.49)	
Number attempt of intubation		
1	1.00	
2	0.86 (0.52 -1.43)	
≥3	1.15 (0.53-2.49)	
Sedative drug use		
None	1.00	1.00
Etomidate	1.65 (0.76-3.58)	1.78 (0.80 -3.95)
Diazepam	1.05 (0.70-1.56)	1.02 (0.67-1.55)
Neuromuscular blocking agent		
None	1.00	
Succinylcholine	1.60 (0.69-3.74)	
Rocuronium	2.08 (0.13-33.51)	

*Increase per 1 unit of variable

Table 4. Univariate analysis and multivariable analysis for overall mortality

Variables	Crude odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Post-intubation hypotension	3.99 (2.67-5.95)	3.94 (2.61-5.95)
Age-year*	1.01 (1.00-1.02)	1.01 (1.00 -1.03)
Male sex	0.86 (0.59-1.25)	
Underlying disease		
Chronic obstructive pulmonary disease	0.41 (0.21-0.77)	0.38 (0.19-0.75)
Hypertension	0.71 (0.47-1.10)	0.65 (0.40-1.06)
End stage renal disease	0.62 (0.34-1.12)	0.67 (0.35-1.29)
Sedative drug use		
None	1.00	
Etomidate	1.32 (0.61-2.86)	
Diazepam	1.01 (0.69 -1.49)	
Neuromuscular blocking agent		
None	1.00	1.00
Succinylcholine	1.89 (0.81-4.37)	1.92 (0.78-4.76)

* Increase per 1 unit of variable

intubation and SBP>140 mmHg was associated with a 1.51- fold risk of this adverse outcome. From previous studies, many factors that can predict hypotension after emergency airway management such as body weight of patients, underlying disease, vital signs before intubation, type of sedative drugs and neuromuscular blocking agent use.[2,9-14] However, we found no relationship between these factors and post intubation hypotension in our study. Result of study differ from result of Lin C-C et al[11] which pre-intubation blood pressure<140 mmHg was associated with post intubation hypotension according to the definition of post intubation hypotension was different and they studied only in RSI method intubated patients. From our result, the patients with high blood pressure (SBP>140 mmHg) had a higher risk to develop hypotension may cause from their high sympathetic stimulation before intubation, when they were created positive pressure ventilation and catecholamine decreased abruptly, post intubation hypotension occurs.

The patients with post intubation hypotension had a 3.94-fold risk of death which confirmed previous reports of the relation between this adverse outcome and mortality.[4,15] Although this outcome was not the primary outcome, we should develop guideline and checklists to avoidance and management of post intubation hypotension to prevent the mortality.

There are several limitations to our study, firstly, our study was performed in one single tertiary care hospital so the results may not be generalized to other patients. Secondly, some factors such as diagnosis or diseases of the patients were not included in the analysis. Thirdly, the method to measure the blood pressure was non-invasive monitoring which may give us the inaccurate values.

In summary, we found that SBP>140 mmHg was an independent factor that associated with higher rate of PIH, a common complication after emergency airway management. For better understanding of this association, a larger cohort study should be conducted as well as trials seeking for an appropriate intervention to prevent PIH especially during emergency airway management should also be conducted.

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