Original Research

Evaluation of the association between postintubation hypotension and lidocaine administered as a premedication for rapid sequence intubation: A comparison between traditional regression methods and propensity score matching-based method

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Abstract

Background: Lidocaine is commonly used for rapid sequence intubation (RSI) in emergency departments. Its benefits remain controversial. Traditional regression methods are commonly used to draw causal inferences. Propensity score matching based method, could be the solution for studies with limited sample size.

Aim: To re-examine the association between postintubation hypotension (PIH) and lidocaine injection using different analysis methods.

Materials and methods: Secondary analysis was conducted of a retrospective cohort study with patients in emergency departments undergoing RSI. Clinical information was recorded. PIH was defined as postintubation systolic blood pressure of <90 mmHg. Based on the propensity score of having lidocaine injection generated by several variables, matching methods were applied and a comparable control group generated. Outcome models based on logistic regression were compared using the original and matched datasets.

Results: Among 149 patients who received RSI agents, 28 developed PIH. Among 120 who received lidocaine injection, 27 developed PIH, as did one the 29 patients who did not receive lidocaine. Lidocaine was not significantly associated with PIH in the traditional regression model adjusting preintubation systolic blood pressure $\leq$ 140 mmHg, underlying history of chronic obstructive pulmonary disease, ongoing septic status, and body weight. After 1:5 nearest matching with replacement based on the propensity score, most measurable potential confounders were comparable in lidocaine-treated and control groups, except ongoing heart disease (e.g., atrial fibrillation and coronary artery disease). In the subsequent logistic regression model adjusted for ongoing heart disease in the matched dataset, lidocaine was significantly associated with PIH.

Conclusion: Lidocaine injection could be associated with PIH; however, further investigation is needed. Alternative statistical methods should be considered when making a causal inference.

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Keywords: Lidocaine; Propensity score; Rapid sequence intubation

1. Introduction

Many patients with airway compromise admitted to emergency departments are difficult to manage because they are either uncooperative or in an unrestrained position. Therefore, development of a safe and rapid method to achieve airway control is critical for improving the prognosis of these patients.[1] Rapid sequence intubation (RSI) has high success rate[2–9] and airway control is achieved faster in patients when RSI is used. Furthermore, RSI reduces the complications of intubation, such as aspiration, hypoxemia, laryngospasm, and bronchospasm, and prevents further cervical injury. Some immediate complications after RSI include hypoxemia, transient decrease in

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systolic blood pressure, arrhythmia, and even death[3−5,7,8] but few studies[10,11] have reported adverse outcomes after RSI.

Lidocaine is a prerequisite premedication agent during RSI for attenuating airway reaction and resistance,[12,13] reducing cough reflex and preventing increase in intracranial pressure (ICP) in the case of head injury.[14,15] Although some studies have reported[16] that lidocaine reduced secondary brain injury by decreasing cerebral flow, cerebral vascular resistance, and cerebral metabolism, and by stabilizing neuronal membranes by acting as a sodium channel blocker, other studies indicate[17,18] that lidocaine increases heart rate and blood pressure, decreases the mean arterial pressure, and decreases perfusion pressure leading to poor neurological outcome in cases of acute stroke. The advantages and disadvantages of lidocaine are still controversial.[19] In a previous study,[11] we identified four independent risk factors of hypotension after RSI using the traditional regression method, but administration of lidocaine failed to achieve statistical significance.

In this study, we re-examined the causal relationship between lidocaine administration and postintubation hypotension (PIH) using a case-control study. We also compared the traditional regression methods with a propensity score matching based method for causal inference. The latter method might have an advantage in evaluating the effects of

treatments on health outcomes and other clinical research using observational data with limited sample size.

2. Materials and methods

2.1. Study design and setting

This is a secondary data analysis of a case−control study. The data obtained between March 2002 and September 2002 from all adult nontrauma patients who received RSI in the emergency department of a tertiary 3700-bed medical center were retrospectively analyzed. This study was approved by the Ethics Committee on Human Research of the hospital and was exempt from the requirement of obtaining informed consent under agreement.

2.2. Patient selection and data collection

Inclusion criteria for selection of patients were patients older than 18 years who were seen in the emergency department requiring emergency airway management and who underwent RSI during the study period. The exclusion criteria included initial systolic blood pressure < 90 mmHg, apparent shock, ventricular arrhythmia, trauma as cause of injury,

Table 1
Characteristics of postintubation hypotension (PIH) and non-PIH patients.

Variable Mean/median (SD/IQR)	PIH (n = 28)	Non−PIH (n = 121)	Total (n = 149)	p
Demographics				
Male (n, %)	18 (64)	79 (65)	97 (65)	0.92
Age (year)	73 (55−79)	71 (58−79)	72 (58−79)	0.80
Weight (kg)	54 (46−58)	57 (49−64)	55 (49−63)	0.055
Pre-RSI vital signs				
SBP (mmHg)	124 (110−146)	148 (122−163)	142 (119−161)	0.004
DBP (mmHg)	70 (61−78)	74 (62−87)	73 (62−86)	0.10
HR (beat/min)*	114 (97−135)	107 (97−125)	108 (97−126)	0.82
RR (breaths/min)**	24 (20−32)	28 (22−32)	27 (21−32)	0.35
SaO$_2$ (%)***	93 (85−96)	89 (82−96)	89 (82−98)	0.66
Post-RSI vital signs				
SBP (mmHg)	70 (22)	141 (36)	127 (44)	<0.001
DBP (mmHg)	42 (37−47)	68 (53−82)	61 (48−79)	<0.001
HR (beats/min)	102 (35)	111 (26)	110 (28)	0.14
Laboratory tests				
WBC (10^9/L)	12.7 (8.9−14.7)	10.9 (7.3−15.3)	11.2 (7.6−15)	0.48
Hemoglobin (g/L)	115 (27)	117 (29)	116 (29)	0.83
Creatinine (mg/L)	15 (8−39)	13 (10−21)	13 (9−23)	0.73
Albumin (g/L)	25 (8)	29 (8)	28 (8)	0.03
Potassium (mEq/L)	3.9 (3.5−4.4)	4.2 (3.6−4.9)	4.1 (3.6−4.7)	0.13
Sodium (mEq/L)	136 (134−139)	138 (133−140)	138 (133−140)	0.29
Glucose (g/L)	1.31 (1.06−1.82)	1.43 (1.15−2.31)	1.38 (1.13−2.21)	0.19
Arterial pH	7.33 (7.23−7.41)	7.33 (7.25−7.42)	7.33 (7.24−7.42)	0.78
Arterial pCO$_2$ (mM)	42.8 (28.5−61.5)	38.3 (29.7−57)	38.5 (29.7−57.5)	0.95
Arterial HCO$_3$ (mM)	22.7 (10)	22.6 (8.5)	22.6 (8.7)	0.94
Drug dosage (mg)				
Lidocaine	70 (80−100)	100 (70−100)	95 (70−100)	0.27
Rocuronium	50 (40−50)	50 (50−50)	50 (40−50)	0.10
Ketamine	50 (45−50)	50 (50−70)	50 (50−50)	0.84
Midazolam	5 (5−5)	5 (5−5)	5 (5−5)	0.29

* = 2 missing data; ** = 27 missing data; *** = 5 missing data.
DBP = diastolic blood pressure; HR = heart rate; IQR = interquartile range; RR = respiratory rate; RSI = rapid sequence intubation; SaO$_2$ = oxygen saturation; SBP = systolic blood pressure; SD = standard deviation; WBC = white blood cells.