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Fitness Between The Value of $Etco_2$ Rate with The Valance of $Paco_2$ in Hemodynamic Repair on Severe Brain Injury Patients

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Abstract: *This research is to determine the correlation and suitability between clinical diagnosis and the value of $EtCO_2$ with the $PaCO_2$ value at 15 minutes and 120 minutes later and to know the hemodynamic improvement and outcome in severe brain trauma patients after the target of $PaCO_2$ was reached 120 minutes later and at day 6.This study was an observational analytic study to assess the correlation and suitability between the values of $EtCO_2$ and $PaCO_2$ of severe brain trauma patients in ER RSSA. We collected patient data for 5 months (October 2016 until February 2017) at ER RSUD Saiful Anwar Malang, Indonesia. The results indicated that there was no correlation between clinical diagnosis and the value of $EtCO_2$ with the $PaCO_2$ value at 15 and 120 minutes, there was a correspondence between the $PaCO_2$ value at the 15th and 120th minutes, there was haemodynamic improvement at 15-120 minutes, although there was a significant improvement in RR At 60-120 minutes, the target value of $PaCO_2$ can improve the patient's haemodynamics at 120 minutes in marginal margin and there was no significant difference in outcome on day 6 based on the value of $EtCO_2$ and $PaCO_2$ at 120 minutes.*

Keywords*: Severe brain injury, $EtCO_2$, $PaCO_2$, hemodynamics, outcome.*

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I. Introduction

Handling of the airway is the basis of the determinants of successful resuscitation. Each emergency physician has a primary obligation to maintain airway patency and must master all airway handling techniques. Intubation is one of the procedures performed to secure the airway in patients with severe brain injury. The indications of intubation in the ER are hypoxia or hypercarbia repair, threatening hypoventilation, maintaining airway patency, where emergency medications are included(Vissers & Danzl, 2011).

$EtCO_2$ is the partial pressure or maximum concentration of carbon dioxide (CO_2) at the expiratory patient, where the unit is mmHg. Normal values are 5% to 6% CO_2 where equal to 35-45 mmHg. CO_2 represents cardiac output (CO) and pulmonary blood flow where the flow is transported by the right venous system of the heart and pumped into the lungs by the right ventricle of the $EtCO_2$ detection device can also be used to estimate the levels of $PaCO_2$ in the blood without having to do blood gas analysis so it is a monitor tool that is more non-invasive, cost-effective and results that can quickly be known every time. But the accuracy of the $EtCO_2$ detection tool in assessing $PaCO_2$ levels is sometimes questionable especially in critical patients (Grmec & Klemen, 2001). $PaCO_2$ is the pressure caused by CO_2 dissolved in the blood. Normal value of $PaCO_2$ 35-45 mmHg. $PaCO_2$ can be used as a parameter of whether or not alveolar ventilator is adequate. Low $PaCO_2$ referred to as hypokapnia, means hyperventilation due to respiratory stimulation, if high $PaCO_2$ (hypercapnia) means alveolar ventilation failure (hypoventilation). At the beginning of the increase in $PaCO_2$ the respiratory system will be aroused to lower the $PaCO_2$. Conversely, if $PaCO_2$ is very high it will suppress the respiratory system (Visser & Danzel, 2011).

The characteristic of brain circulation is that blood flow of the brain dynamically adjusts to protect the blood from the brain from changes in perfusion pressure, the blood circulation of the brain remains constant at the systemic blood pressure (cerebral autoregulation). The increase and decrease in $PaCO_2$ values will increase and decrease cerebral blood flow by vasodilation and brain vasoconstriction, independent cerebral autoregulation. In most patients with brain injury there is damage to autoregulation in the bloodstream of the brain, whereas in severe brain injury CO_2 damage occurs during the initial phase, in patients with severe head injury can occur acidosis due to lactate production due to glycolysis process so high mortality / outcome and

also duration.Thefirst hour maintains the value of $PaCO_2$ and the value of $EtCO_2$ is very crucial (Ni Made Ayu Apsari Dewi, 2013).

In resuscitation situations, pulmonary blood flow determines oxygenation and CO excretion. Examination of blood gas analysis 10 to 15 minutes after administration to avoid inadequate perfusion resulting in lactic acidosis. Examination of blood gases was re-examined several hours after resuscitation and BGA was usually taken 2 to 4 hours post resuscitation (Menzel et al., 2001). At ER RS Saiful Anwar in airway management, intubation often becomes one of the selected measures in the management of the airway, especially in severe brain injury patients. Selection of severe brain injury patients in this study is due to eliminate the bias such as lung abnormalities, heart abnormalities.

In determining the level of $PaCO_2$ in which the mortality rate of severe brain injury patients worldwide is 76% in 6 days (Rondinna & Videtta, 2005), blood gas analysis is the best test but the use of blood gas analysis has drawbacks such as arterial blood sampling Is invasive, but it takes a long time about 3-4 hours in getting the results and the cost is quite expensive.

II. Research Method

The study design was an observational analytic study to examine the correlation and suitability between the value of $EtCO_2$ and $PaCO_2$. In determining the level of $PaCO_2$ in which the mortality rate of severe brain injury patients worldwide is 76% in 6 days (Rondinna & Videtta, 2005), blood gas analysis is the best test but the use of blood gas analysis has drawbacks such as arterial blood sampling Is invasive, but it takes a long time about 3-4 hours in getting the results and the cost is quite expensive. The samples of this study were all patients with severe brain injury who came to RSSA of 50 samples with the largest number of patients were men (72%) with inclusion kriteia: all severe brain injury patients with GCS 3-6 who came toDoctor Saiful Anwar Hospital, Malang, Indonesia, aged> 14 years. Severe brain injury patient data retrieval was conducted for 5 months in the period of October 2016 until February 2017. This study used data from each severe brain injury patient who came to RSSA after intubation and ventilator installed and then analyzed blood gas 15 minutes post intubation and assessed the value of $EtCO_2$, $PaCO_2$ value and clinical patient after standard therapy then at 120 minutes post patient intubation Was examined again the value of $EtCO_2$, $PaCO_2$ value, clinical patient after that seen outcome patient for 6 days treatment and analyzed patient sample data.

III. Results

The following is the result of analysis of research data on severe brain injury patients in accordance with established inclusion and exclusion criteria and aims to determine the correlation between clinical diagnosis and the value of $EtCO_2$ with the value of $PaCO_2$ at minute 15 and 120 minutes later, knowing the suitability between clinical diagnosis and value $EtCO_2$ with a $PaCO_2$ value at 15 minutes and 120 minutes later, confirmed haemodynamic improvement in severe brain injury patients after the target of $PaCO_2$ was reached 120 minutes later, knowing improved outcome in severe brain injury patients after target of $PaCO_2$ on day 6. Data collection of patients with severe brain injury conducted for 5 months in the period of October 2016 - February 2017 conducted at Emergency InstallationDoctor Saiful Anwar Malang Hospital (RSSA).

Table 1. Clinical Characteristic Patients

Variable	Mean ±SD	Median (min-max)
$EtCO_2$ 15 min post intubation	32,4 ± 3	32,8 (25,8-39,3)
$EtCO_2$ 120 min post intubation	33,3 ± 3,9	33,7 (19-38,9)
$PaCO_2$ 15 min post intubation	33,5 ± 4,3	33,2 (22,7-44,2)
$PaCO_2$ 120 min post intubation	34,8 ± 2,9	34,6 (28,4-42,4)
Clinical Diagnose 15 min post intubation	11,5 ± 2,3	12 (5-15)
Clinical Diagnose 120 min post intubation	9,1 ± 3	9 (4-14)
Systolic 15 min post intubation	144,7 ± 30,3	140 (54-215)
Systolic 30 min post intubation	146,1 ± 30,2	140 (65-229)
Systolic 60 min post intubation	140,5 ± 27,8	140 (59-235)
Systolic 120 min post intubation	131,4 ± 27,6	122,5 (61-218)
Diastolic 15 min post intubation	81,7 ± 15,8	80,5 (21-116)
Diastolic 30 min post intubation	82,8 ± 13,9	85 (29-120)
Diastolic 60 menit post intubasi	79,02 ± 14,3	80 (26-100)
Diastolic 120 min post intubation	77,64 ± 15,2	80 (33-132)
Heart rate 15 min post intubation	103,8 ± 24,7	106,5 (55-168)
Heart rate 30 min post intubation	102,2 ± 24,7	100 (49-168)
Heart rate 60 min post intubation	97,6 ± 23,9	91 (51-155)
Heart rate 120 min post intubation	89,6 ± 21,7	88 (52-139)
RR 15 min post intubation	22,02 ± 7,6	22 (1-50)
RR 30 min post intubation	21,92 ± 7,07	22 (1-48)
RR 60 min post intubation	21,86 ± 5,5	22 (10-44)
RR 120 min post intubation	18,78 ± 6,2	18 (5-41)

Table 1 shows that the normal distributed variables (p> 0.05) were $EtCO_2$ minute 15**,** systolic minute 15, heart rate at minute 15, heart rate 30 minute, systolic minute to 60, $PaCO_2$ minute to 120 post intubation.

Table 2.Conformity $EtCO_2$ with $PaCO_2$

15th min Median (min-max)		p	120th Min Median (min-max)		p
$EtCO_2$	$PaCO_2$		$EtCO_2$	$PaCO_2$	
32,8 (25,8-39,3)	33,2 (22,7-44,2)	0,156	33,8 (19-38,5)	34,7 (28,4-42,4)	0,06

Table 2 shows that **t**here was a match between $EtCO_2$ value and $PaCO_2$ value at minute 15 and minute 120 with median value respectively is 32.8 and 33.2 at minute 15, while at minute 120 each median is 33 , 8 and 34.7.

Table 3. Haemodynamic Changes (Systolic, Diastolic, Heart rate, Respiratory rate).

Variable	15-30th min p	30-60th min p	60-120 min p	15-120th min p
Systolic0,59[a]	0,001*[a]	0,001*[a]	0,000*[a]	
Diastolic	0,196[a]	0,019*[a]	0,339[a]	0,044*[a]
Heart rate	0,316[b]	0,000*[a]	0,000*[a]	0.000*[a]
RR	0,621[a]	0,358[a]	0,000*[a]	0,000*[a]

Explanation: a= *wilcoxon test*
b= *pair T test*
*= meaningful if p<0,05

Table 3 shows that there was no significant change of hemodynamic at minute 15-30, whereas at minute 30-60 there was haemodynamic change in systolic, diastolic and heart rate except RR. In minute 60-120 RR value started to happen significant change simultaneously with systolic as well as the pulse whereas diastolic does not change significantly. Overall at 15-120 minutes both systolic, diastolic, heart rate and RR were significant changes.

Table 4. Clinical Characteristic Patient Haemodynamic**.**

Variable	Rerata ± SD	Median (min-max)
Systolic min 15	144,7 ± 30,3	140 (54-215)
Systolic min 30	146,1 ± 30,2	140 (65-229)
Systolic min 60	140,5 ± 27,8	140 (59-235)
Systolic min 120	131,4 ± 27,6	122,5 (61-218)
Diastolic min 15	81,7 ± 15,8	80,50 (21-116)
Diastolic min 30	82,88 ± 13,9	85 (29-120)
Diastolic min 60	79,02 ± 14,3	80 (26-100)
Diastolic min 120	77,6 ± 15,2	80 (33-132)
Heart rate min 15	103,8 ± 24,7	106,5 (55-168)
Heart rate min 30	102,2 ± 24,7	100 (49-168)
Heart rate min 60	97,6 ± 23,9	91 (51-155)
Heart rate min 120	89,6 ± 21,7	88 (52-139)
RR min15	22,02 ± 7,7	22 (1-50)
RR min 30	21,9 ± 7,07	22 (1-48)
RR min 60	21,8 ± 5,6	22 (10-44)
RR min 120	18,8 ± 6,2	18 (5-41)

Table 4 shows that, in minutes 15-120 there are significant differences in both systolic, diastolic, heart rate, and RR, although still within normal limits mean haemodynamic minutes 15-120 is still in a relatively stable state.

Table 5. The relationship between outcome and value $PaCO_2$.

$PaCO_2$			
Outcome	**n**	**Mean ± SD**	**p**
Passed Away	46	34,69 ± 3	

Survive	4	36,07 ± 2,64	0,379

Table 5 shows that, in the outcome, whether dead or alive, there is no significant difference with p> 0.05, although it has already reached the normal limit of PaCO2 value.

Table 6. The Relationship between outcome and value $EtCO_2$.

$EtCO_2$			
Outcome	**n**	**Mean ± SD**	**p**
Passed Away	46	33,02 ± 3,9	
Survive	4	36,8 ± 1,8	0,03

Table 6 shows that at the outcome both dead or alive there was a significant difference with p <0.05 even though the difference was close to the marginal normal margin of $EtCO_2$ value.

IV. Discussion

Based on the results of research conducted at Emergency Installation RSSA, a total of 50 patients as a sample of the study. Of the 50 head injured patients taken as the study sample, most were male (72%), according to some previous studies at RSHS Bandung in 2013 (79.8%).

The data showed a correlation between clinical diagnosis with the value of $PaCO_2$ with (p = 0.71) minute 15, (p = 0.76) minute 120 and between $EtCO_2$ with $PaCO_2$ with at minute 15 with (p = 0.072) and minute (P = 0.076), the results were all insignificant, for hemodynamic changes at 15-30 minutes there was no significant difference in both systolic, diastolic, heart rate and RR, while at 60-120 minutes there was a significant difference in both systolic and pulmonary When seen in minutes 15-120 there are significant differences in the 4 variables. In the 6th day outcome improvement based on the value of $EtCO_2$ and $PaCO_2$ at 120minutes either death or life there was a significant difference with p <0.05, although the difference was close to the marginal normal margin of $EtCO_2$ value.

V. Conclusions And Recommendations

Based on the results of the research that has been done, it can be concluded: there is no correlation between clinical diagnosis and the value of $EtCO_2$ with the value of $PaCO_2$ at minute 15 and 120, there is a match between the value of $EtCO_2$ with the value of $PaCO_2$ at minute 15 and 120, there is hemodynamic improvement in patient Severe brain injury at 15-120 minutes (systolic, diastolic, heart rate, RR), although RR variables begin to experience significant differences in the 60-120 minutes, the target value of $PaCO_2$ in severe brain injury patients can improve the patient's haemodynamics at 120 minutes in Margin limit, no significant difference in outcome on day 6 of severe brain injury patients based on $EtCO_2$ value and $PaCO_2$ value at 120 minutes.

Thus, based on the discussion, it can be recommended as follows:

1. Patients who come to Emergency Installation RSUD Dr. Saiful Anwar (RSSA) with severe brain injury should check the value of $EtCO_2$ without having to wait for the results of $PaCO_2$ value from a blood gas analysis that takes a much longer time.
2. If the clinical state of a severe brain injury patient during which clinical observation worsens even though the value of $EtCO_2$ reaches the target, immediate intervention is necessary.
3. Need further research outcome on severe brain injury patients who have done surgical intervention compared with non-surgery.

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