ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 10, pp. 20738-20740, October, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ETCO2: A NON INVASIVE GUIDE TO ARTERIAL PaCO2 IN THE EMERGENCY ROOM

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DOI: http://dx.doi.org/10.24327/ijrsr.2017.0810.0953

ARTICLE INFO

Article History:

Received 05th July, 2017
Received in revised form 08th August, 2017
Accepted 10th September, 2017
Published online 28st October, 2017

Key Words:

ETCo2, PaO2 Non Invasive, ABG

ABSTRACT

Background: Patient arriving in emergency room need rapid reliable evaluation of their respiratory status. Main stream End-tidal carbon dioxide is one of the methods used for this purpose in intubated patients. Side stream end-tidal carbon dioxide might be a non invasive, rapid and reliable predictor of arterial pCO2 in non intubated patients in respiratory distress. AIM: The aim of this study was to verify whether the end-tidal carbon dioxide (ETCO2) can accurately predict the arterial partial pressure of carbon dioxide (pCO2). **Meterials And Methodes:** This study was on patients were 37 females and 61 males who came to emergency room for respiratory distress. End-tidal carbon dioxide level was recorded at the same time of arterial blood gas sampling for all patients. Other parameters recorded were: Age, Pulse, Blood pressure, Respiratory rate, Arterial blood gas abnormalities, Saturation, and Medical diagnosis. In our study we included all patients presented in ER with respiratory distress. Pregnant, pediatric age groups patients were excluded in this study. **Results:** In this study a significant correlation was found between arterial partial pressure of CO2 and End-tidal CO2 (p Value = <0.001) in patients with respiratory distress, in the Emergency room. **Conclusions:** In this study conclude that, there is a significant orrelation between arterial partial pressure of CO2 and End-tidal CO2 in patients with respiratory distress, in mergency room. Further studies are needed to confirm these findings.

INTRODUCTION

Patients presenting to the emergency department require close assessment of the oxygenation, ventilation, and acid-base balance. Methods for immediate and continuous noninvasive monitoring include pulse oxymetry and capnography (End-tidal CO_2 ($ETCO_2$)). Arterial blood gases (ABG) examination provides accurate information, but an arterial blood analyzer is not available in every ED, and blood is usually sent to the laboratory. This is not only time consuming but is also invasive.

The term Capnography refers to the non-invasive measurement of the partial pressure of carbon dioxide ($CO2_)$ in exhaled breath expressed as the carbon dioxide concentration over time and End-tidal CO_2 (EtCO2), the maximum CO_2 Concentration at the end of each tidal breath,. While pulse oxymetry provides instantaneous feedback about oxygenation, Capnography provides instantaneous information about ventilation (how effectively carbon dioxide is being eliminated by the pulmonary system), perfusion (how effectively carbon dioxide is being transported to the vascular system), and metabolism (how effectively carbon dioxide is being produced by cellular metabolism). It is immediate, noninvasive, and does not require cooperation of the patients. Capnography provides numerical value of the $ETCO_2$, $ETCO_2$ graph, and $ETCO_2$ trend.

The last provides important information on circulatory status and ventilation. The numerical value of the $ETCO_2$ can be of great importance for the immediate evaluation of patients in severe respiratory distress, who are potentially CO_2 retainers. To verify whether $ETCO_2$ can accurately predict the arterial pCO_2 and to detect variables that can effect this correlation, we conducted the following prospective randomized study in our ER.

Objectives

The aim of this study was to verify whether end-tidal carbon dioxide ($ETCO_2$) can accurately predict the arterial pCO2 in patients came in emergency room with respiratory distress.

METHOD AND MATERIALS

This was a prospective randomized study conducted on 98 adult patient's arterial blood gas with Respiratory distress who

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presented to Emergency room of Amrita Institute of Medical Sciences Kochi, during the time Period from July 2015 to April 2016.This study consisted of thirty-seven females and sixty-one males.

The blood samples were drawn by the Radial artery puncture. Samples were immediately analyzed for partial pressure of carbon dioxide using a blood gas analyzer. The end-tidal carbon dioxide was measured using an End-Tidal carbon dioxide analyzer at the time of arterial blood gas sampling after six breaths, End-tidal carbon dioxide were determined and the highest reading were recorded , by using a nasal canula in non intubated patients and on the expiratory side of the circuit's endotracheal tube connector in intubated patients . The arterial to end-tidal carbon dioxide gradient were determined.

The mean +_ SD 26.60 of partial pressure of carbon dioxide, +_ SD 14.94 of End-Tidal carbon dioxide values and the partial pressure of carbon dioxide, End-Tidal carbon dioxide gradient in all of the groups were determined.

RESULTS

Arterial Blood Gas Abnormalities

In this study, out of 98 patients, 23 patients have ABG abnormalities, of which 9(75%) patients had respiratory alkalosis, 2 (17%) patients had metabolic alkalosis, 8 (67%) patients had metabolic acidosis, 4 (12%) patients had respiratory acidosis. This shown in figure 1.

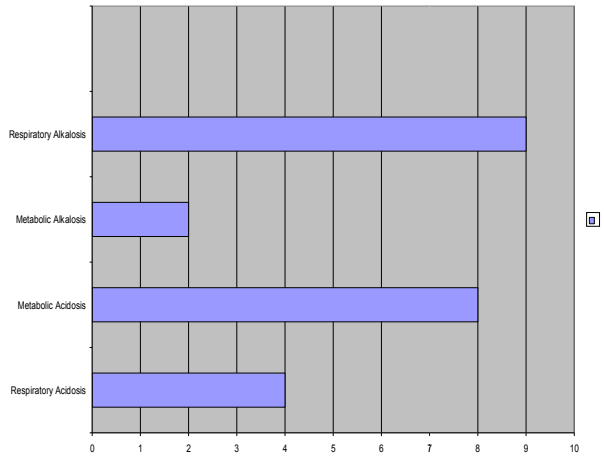

Figure 1 Arterial Blood Gas Abnormalities

Distribution of Arterial partial pressure of Carbon dioxide: Figure 2 shows that, Out of 98 patients, 23 (23%) had Normocapnea, 45 (46%) had Hypocapnea, 30 (31%) had Hypercapnea.

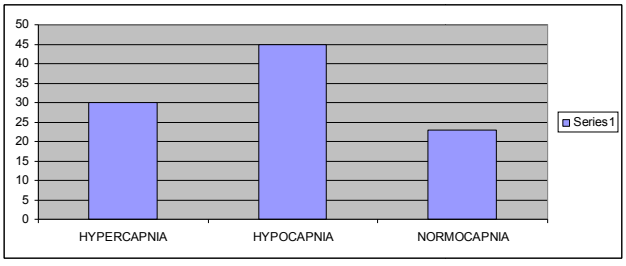

Figure 2 Arterial Partial pressure of carbon dioxide

Distribution of End-tidal carbon dioxide

In figure: 3, Distribution of $ETCO_2$ and was found that norrnocapnea in 23 (23%), hypocapnea in 45 (46%) patients, and hypercapnea in 30(31%) patients.

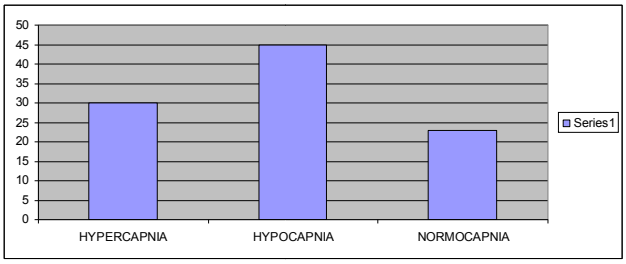

Figure 3 Distribution of $ETCO_2$

Mean Comparison between pCO_2 and $ETCO_2$

Table 1

	Mean	N	Std. Deviation	P VALUE
PCO2	42.50	98	26.64	
ETCO2	36.65	98	14.94	<0.001

The mean of pCO2 was 42.50 and the ETCO2 was 36.65. (Table 1) The Standard Deviation of pCO2 was 26.64 and ETCO2 is 14.94.The p value is < 0.001

Linear comparison between pCO2 and $ETCO_2$

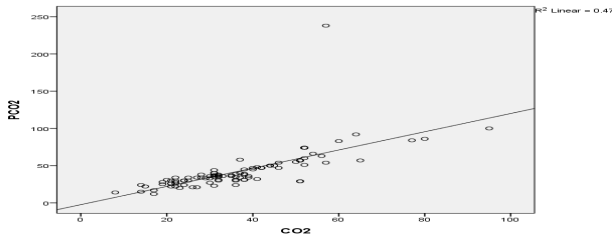

Figure 4 Linear correlation between pCO_2 and $ETCO_2$

The Figure: 4 show that significant correlation between Arterial carbon dioxide and End-tidal carbon dioxide statistically.

DISCUSSION

Our results clearly show a good correlation between the arterial PCO_2 and the End-tidal CO_2.

In contrast to the study of 37 intubated patients conducted by Yamanaka MK, Sue DY this study demonstrated that ETCO2 can be used as a non invasive guide in diagnosis and management of patients with respiratory distress and has a good correlation with arteria PaCO2. An increase in anatomical and physiological dead space and disturbances in pulmonary circulation, decreases the $ETCO_2$ and increases the $PCO_2/ETCO_2$gradient.[22, 23, 24] A gradient of 5-6 mmHg is considered normal in haemodynamically stable patients.[22, 23, 27] Pulmonary embolism and circulatory shock decrease the $ETCO_2$ level and increase the $PCO_2/ETCO_2$ gradient.[22,25,26] Increased aging has been shown to increase the $PCO_2/ETCO_2$ gradient, probably by increasing the anatomical dead space.[28] The probable effect of increased diastolic blood pressure on the $ETCO_2/PCO_2$ correlation curve in our study may be explained by the fact that most of the patients had pulmonary edema, implying an increase in the dead space..In

our study we also had the impression that the correlation between the End-tidal CO_2 and the arterial PCO_2 was weak in respiratory rate over 30/minute, but it did not make statistical significance, probably because of the small number of sample size.We divided the patients into subgroups according to the level of arterial PCO_2 and the different pathogenesis. The subgroup was too small to be compared and analyzed statistically.

There were limitations in our study. Firstly, the small sample size. Secondly, the comparison of the influence of different parameters on the curve of the whole group instead of a comparison with the normogram of healthy controls. Therefore, further studies should be performed to determine a normogram of healthy people and to examine the influence of the various parameters in this normogram. Finally, the positioning of the sampling tube might have had some effect on the $ETCO_2$ estimate along with differences in ETCO2 readings of those checked via nasal prongs (non-intubated) and those who were intubated due to differences in dead space.

Summarizing, we found a good correlation between $ETCO_2$ and arterial PCO_2 in the Emergency room setting. ETCO2 level is useful for checking the ventilatory status instead of arterial blood gas analysis in order to avoid recurrent puncture of arterial blood analysis. This can cause severe pain and hematoma. If pH is required, arterial blood gas should be checked. The difference between both ETCO2 and PCO_2 is only $^{+}$- 5 mm Hg. Young age may increase the arterial $PCO_2/ETCO_2$ gradient while raised temperature may decrease this gradient. Further studies are needed to confirm these findings in the normal healthy population. We recommend the use of this non-invasive method in other Emergency departments.

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