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ORIGINAL ARTICLE

Comparison of arterial and venous blood gases in patients with COPD (Chronic Obstructive Pulmonary Disease) and CLD (Chronic Liver Disease).

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ABSTRACT… Objective: To Determine Correlation between mean Venous and Arterial Blood Gases in patients with COPD and CLD. **Study Design:** Cross Sectional Descriptive study. **Setting:** Department of Internal Medicine (MW6) and Accident and Emergency Department of PIMS, Islamabad. **Period:** 3rd September 2021 to 3rd March 2022. **Methods:** The study included 110 patients with COPD and CLD who were hospitalized to MW6 and the Emergency Department. The correlation sample size calculator was used to determine the sample size. Consecutive Non-Probability Sampling was the method used to choose samples. Patients with COPD and CLD who were older than thirty years, regardless of gender, were included in the study; however, patients with other metabolic disorders, such as diabetic ketoacidosis, lactic acidosis, a history of poisoning, etc., were not. **Results:** The average age of patients was 66.3 + 13.6 years and male were 79 (71.8%). Samples were taken from arteries and veins of each patient and pH was calculated. The average pH1 (arterial) level was found to be 7.41 + 0.68 mg/dl whereas the average pH2 (venous) level was 7.35 + 0.76 mg/dl in current study. **Conclusion:** Venous blood gas analysis cannot be used in place of arterial blood gas analysis due to the differences in pH levels. In many clinical circumstances, venous pH, PCO2, and bicarbonate cannot replace their arterial equivalents.

Key words: Arterial Blood Gases, COPD, CLD, Venous Blood Gases.

INTRODUCTION

Arterial sampling is standard procedure in emergency rooms (EDs) for blood gas analysis.[1] When patients present with a range of dangerous illnesses, including poisoning, DKA, acute exacerbation of chronic obstructive pulmonary disease, etc., they are essential to the assessment and monitoring of oxygen and metabolic status.[2] Data on blood oxygen saturation, bicarbonate levels, pH, and partial pressures of carbon dioxide and oxygen are obtained via arterial blood gases analysis. Although ABG analysis is quick and accurate, others contend that because pulse oximetry is now widely used to measure oxygen saturations, arterial punctures are no longer required to diagnose respiratory failure because they are uncomfortable, carry a risk of haemorrhage and other vascular problems. Peripheral venous blood gas (PVBG) analysis is becoming more and more popular as an alternative to the ABG, particularly in the emergency department (ED).[3,4]

Acid-base problems are frequently seen in people with liver disease. It's interesting to see how little research has been done on acid-base problems in liver disease. Furthermore, the underlying acid-base problems in liver illness are often not shown by traditional acid-base factors.[5] Although pulmonary alkalosis is the most frequent acid-base disruption in liver disease patients, individuals with both stable and decompensated cirrhosis can also experience a number of intricate metabolic disturbances of acid-base equilibrium.[6]

ABG analysis is uncomfortable for the patient in addition to the other risks, which include hematoma, reflex sympathetic dystrophy, thrombosis or embolization, artery damage, and aneurysm formation.[7] Venous blood gas (VBG)

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analysis is a less invasive method of assessing acid-base status that can be utilized in place of ABG analysis. It requires fewer punctures and is generally safer for both the patient and the healthcare professional.[8] The treatment's broader utilization is limited by the lack of validation studies on clinical results.[9] The purpose of this study was to compare the arterial and venous blood gases in patients with COPD and CLD.

METHODS

The study was conducted in medical ward 6 and emergency department of Pakistan Institute of Medical Sciences, after the approval from ethical review board on 3-12-2020 having No.F,1-1/2015/ERB/SZABMU/753. This cross-sectional study comprised 110 patients with COPD and CLD who required blood gas analysis during their therapy. The patients were selected using non-probability sequential sampling from the MW6 and Emergency departments of PIMS Islamabad. Each patient who consented to participate in the trial did so voluntarily. Basic demographic information, such as age and gender, was obtained from each and every patient.

The patients in the study were asked about the nature of their illnesses. The brachial or radial arteries were used to extract blood for arterial blood gases using a heparinized syringe. Using a separate heparinized syringe, a sample for venous blood gases was taken from the brachiocephalic vein five minutes following the arterial blood gas sample.These samples underwent a blood gas analysis by the PIMS laboratory. The arterial and venous blood gas pH results were included in the research performa.

Data entry and analysis were done using the statistical software for social sciences, SPSS v11. Descriptive statistics were used to find the mean and standard deviation for quantitative variables like age, pH, PCO2, etc. On the other hand, frequency and percentages for qualitative variables such as illness kind and gender. The results are shown using tables and graphs. The Bland-Altman method[8] was used to assess the correlation between arterial (A) and venous (V) measurements of pH, PCO2, and bicarbonate. The average value (A+V/2) and the A-V difference were plotted. Along with the Pearson correlation between A-V and (A+V)/2, the means, standard deviations, and 95% confidence intervals of the A-V differences are displayed. If there is no trend in the A-V differences, then this correlation should be 0.

Furthermore, equations for estimating arterial values from central venous values were established by linear regression, and Pearson correlations between the arterial and venous values are presented. A random slope and intercept model was used to assess whether there was between-patient heterogeneity in the regression analyses, and components of variance computations were performed to ascertain whether there was between-patient SD heterogeneity due to the multiple A and V measurements for a single patient. Additionally, Pearson correlations between the arterial and venous values are provided, and formulae for calculating arterial values from central venous values were constructed via linear regression.To determine whether there was between-patient SD heterogeneity resulting from the multiple A and V measurements for a single patient, components of variance computations were carried out in conjunction with a random slope and intercept model to evaluate whether there was between-patient heterogeneity in the regression analyses.

RESULTS

A total of 110 individuals with chronic obstructive pulmonary disease (COPD) and chronic liver disease (CLD) were included in the study to determine the ABGs level in this group. The average age of the patients was 56.3 + 13.6 years. The majority of the patient population, or almost two thirds, were 61 years of age or older. In this study, there were 31 (28.2%) female cases and 79 (71.8%) male cases. This means that there were more male cases than female ones. (Table-I).

The ABGs' outcomes were looked at. In 17 (15.5%) of the study cases, a pH1 level of up to 7.34 mg/dl was found. Thirty-three research participants (27.3%) had a pH1 level of 7.46 mg/dl or higher, while sixty-three patients (57.3%) had a normal pH1 level between 7.35 and 7.45 mg/dl.

The average pH1 level and average pH2 level in the current study were 7.41 + 0.68 mg/dl and 7.35+0.76mg/dl, respectively.

The pH2 levels were looked at in the study. Out of all instances, 44 patients (40.0%) had levels as high as 7.34 mg/dl. Of the participants in the study, 55 (50.0%) had a normal pH2 (7.35 to 7.45 mg/dl), while 11 (10.0%) had a pH2 level of 7.46 or higher. (Table-I).

	Number (n = 110)	Percentage (%age)
Age (years)		
Mean + SD	56.3+13.6	
Range (min-max)	43-70	
Age Categories (years)		
41 to 50	09	8.2 %
51 to 60	28	25.4%
61 to 70	41	37.2 %
71 or above	30	27.2%
Gender		
Men	79	71.8%
Women	31	28.2%
pH 1 level		
up to 7.34	17	15.5%
7.35 to 7.45	63	57.3%
7.46 or above	30	27.3%
Mean +SD	**7.41+ 0.68**	
pH 2 level		
up to 7.34	44	40.0%
7.35 to 7.45	55	50.0%
7.46 or above	11	10.0%
Mean +SD	**7.35+ 0.76**	

Table-I. Distribution according to age, gender, pH 1 and pH 2 LEVELS

DISCUSSION

Our study revealed that the pH1 level was as high as 7.34 mg/dl in 17 (15.5%) of the sample cases. Thirty-three research participants (27.3%) had a pH1 level of 7.46 mg/dl or higher, while sixty-three patients (57.3%) had a normal pH1 level between 7.35 and 7.45 mg/dl. The average pH1 level and average pH2 level in the current study were 7.41 + 0.68 mg/dl and 7.35 + 0.76 mg/dl, respectively. The pH2 levels were looked at in the study. Out of all instances, 44 patients (40.0%) had levels as high as 7.34 mg/dl. Of the participants in the study, 55 (50.0%) had a normal pH2 (7.35 to 7.45 mg/dl), while 11 (10.0%) had a pH2 level of 7.46 or higher.

Richard T. et al. conducted an analysis and discovered that the mean arterial minus venous discrepancies for bicarbonate, pH, and PCO2 were 0.027, -3.8, and -0.80, respectively. The Bland-Altman plots for pH, PCO2, and bicarbonate showed 95% limits of agreement of -0.028 to 0.081, -12.3 to 4.8, and -4.0 to 2.4, in that order. In order to estimate arterial values from venous data, the regression equations that follow were created: arterial pH = −0.307 + 1.05 × venous pH, arterial PCO2 = 0.805 + 0.936 × venous PCO2, and arterial bicarbonate = 0.513 + 0.945 × venous bicarbonate. The mean central minus peripheral differences in pH, PCO2, and bicarbonate were not statistically significant.[10]

Malinoski DJ et al.[11] discovered in previous studies that the pH range for the mean arterial minus venous difference was -0.04 to 0.05. With 95% confidence ranges of −4.0 to 2.4, the mean arterial minus central venous differential for bicarbonate was −0.80 (SD 1.58). The mean arterial minus venous difference for bicarbonate can vary between −1.88 and −0.52, per Middleton P et al.[12] investigation. The mean arterial minus central venous difference for PCO2 was −3.8 (SD 4.3), with a 95% confidence interval of −12.3 to 4.8. The arterial and central venous data show a satisfactory correlation with PCO2. Bayir A, Kayis SA, et al. showed in their published study that the range of the mean arterial minus venous difference for Pco2 was -6.6 to -3.1.[13]

The mean arterial minus venous difference was found to be −5.8 in the study by Kelly et al., with 95% ranges of agreement between −8.8 and 20.5[14] but −3.0 in the study by Malatesha et al., with 95% limits of correlation between −7.6 and 6.8. When compared to other research that also offered 95% limits of correlation, these results were better than ours. All things considered, the PCO_2 results of our study are consistent with earlier investigations.

Because blood gas measurements should be interpreted in light of each patient's particular clinical situation and because repeated blood gases are frequently taken to aid in assessing a patient's course, central venous PCO2 should

essentially be able to substitute arterial PCO2 in the majority of clinical settings.[15] This is, as far as we know, the first study to examine the consistency of central and arterial VBG samples over a broad spectrum of medical and emergency ICU patients using all of the commonly used markers. It is unlikely that any of these pathophysiologic situations would show a clear correlation between arterial and venous values without severe circulatory collapse, as shown by Adrogue et al.[16]

CONCLUSION

Venous blood gas analysis cannot be used in place of arterial blood gas analysis due to the differences in pH levels. In many clinical circumstances, venous pH, PCO2, and bicarbonate cannot replace their arterial equivalents.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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2	**Hina Akhtar:** Data collection, data entry.
3	**Irfan Younus:** Data entry, analysis and preparation of final manuscript.
4	**Shoaib Sarwar:** Draft writing.
5	**Shama Iqbal:** Data entry and analysis.
6	**Faisal Rasheed:** Preparation of final manuscript.