EFFECT OF TIME ON THE ARTERIAL BLOOD GAS ANALYSIS

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Abstract

The present study was done to find out whether there is any change occurring during delay in ABG analysis. In our study we first took baseline reading and from the remaining blood sample, stored at room temperature, repeat analysis were done from it after 30minute, 60 minute and after 90 minute and the change in result is compared with the baseline result. In our study if the sample is stored for more than 30 minutes at room temperature there is no significant changes occurs in pH, PCO₂, but there is significant change in the PO₂. The value of PO₂ increase 20.23 mmHg if the sample is stored for more than 30 minutes at room temperature. In our study although the changes in pH, PCO₂ are statistically greater in sample kept at room temperature, those changes do not appear to have major clinical significance until the time of analysis after arterial puncture exceeds 90 minutes. The PCO₂ remained very stable with the different sampling methods. In our study there is no significance change found in Hco₃⁻ and O₂sat if sample is stored for more than 30 minutes at room temperature.

Keywords: ABG analysis; PCO₂; pH; Arterial puncture; ABG analyzer

1. INTRODUCTION:

An arterial blood gas (ABG) is a blood test that is performed using blood collected from an artery. The test is used to determine the pH of the blood, the partial pressure of carbon dioxide and oxygen and the bicarbonate level. This test is used to check how well your lungs are able to move oxygen into the blood and remove carbon dioxide from the blood.[1]

1.1 Measuring of PH, PCO₂, PO₂, HCO₃⁻ std and O₂ sat:

1.1.1 pH:

pH expresses the hydrogen ion activity in a solution as the negative logarithm of the hydrogen ion concentration.

$$pH = -\log H^+$$

1.1.2 PCO₂:

Carbon dioxide is produced during normal cell metabolism and is released into the blood stream where it is transported to the kidneys and lungs for excretion. CO₂ is transported through the blood as bicarbonate, dissolved CO₂, and carbonic acid.

1.1.3 PO₂:

Oxygen is essential for cell and tissue metabolism in the body. The cardiopulmonary system is responsible for transporting oxygen to the cells. Oxygen transport involves four major steps: convection and diffusion from the air into the pulmonary circulation, combination of O₂ from the lungs with haemoglobin in red blood cells, and finally the release into the tissues and utilization of O₂ cellular level.

1.1.4 Bicarbonate Ion (HCO₃⁻):

Bicarbonate is the major buffer substance present in the body, and play a major role in maintaining the pH level in blood. It is present in large amount in the blood as a result of the dynamic state of CO₂ in the blood. The majority of CO₂ is transported as HCO₃⁻.

1.1.5 Oxygen Saturation:

Oxygen saturation is a ratio, expressed as a percentage of the volume of oxygen carried to the maximum volume that can be carried. Knowledge of oxygen saturation is useful for predicting the amount of oxygen actually available for the tissues and can be

used to determine the effectiveness of oxygen therapy.

2. MATERIAL AND METHOD

The study was carried out at Cardiac Centre of Shree Krishna Hospital, and Biochemistry department of Pramukh Swami Medical College Karamsad. The procedures followed were in accordance with the Clinical Research Ethics Committee of Pramukh Swami Medical College, Karamsad. The study include total 100 patients who was admitted in the MICU, SICU, CICU, PICU, NICU & TEC at the Shree Krishna Hospital Karamsd.

➤ **Duration of the study:** April 2010 to February 2011

➤ **Sample collection:**

2.1 Arterial Blood:

An arterial blood gas (ABG) is a blood test that is performed using blood from an artery. It involves puncturing an artery with a thin needle and syringe and drawing a small volume of blood. The most common puncture site is the radial artery at the wrist.

2.2 Arterial puncture:

Blood is usually withdrawn from the radial artery as it is easy to palpate and has a good collateral supply. The patient's arm is placed palm-up on a flat surface, with the wrist at 45°. A towel may be placed under the wrist for support.

Figure 1: Performing an arterial puncture

2.3 Processing of the sample:

Syringes should be kept and rolled between the two palms and gently inverted to mix the blood. Open the probe lever up to second position and insert the syringe. If syringe is inserted press: 1 No. key

(Button). Hold the sample in place. When sampling is complete a beep sound is heard. Remove the syringe and close the probe.

The analysis will be repeated at time interval of ½ hour, 1 hour and 1½ hour, and there result will be compared. I am planning to analyze the following parameters pH, PCO₂, PO₂, HCO_{3std}⁻. The sample will be preserved at 25 c temperature.

Figure 2: Rapid 348 Gas Analyser

2.4 Calibration:

The 348 automatically calibrates at a specified interval. The interval is user selectable, and can be 30 or 40 minutes. A one point calibration is carried out at every interval. A full two point calibration is carried out at every fourth interval. Hct slope check is prompted at least every 25 days.

2.5 Calibration Gases:

Two gas standards are used to calibrate the pCO₂ and po₂ sensors. **Gas1(cal)** provides the calibration point for 1 & 2 point PCO₂ and PO₂ calibration. The cal gas cartridge contains 5.00% carbon dioxide & 12.00% oxygen balanced with nitrogen & is NBS traceable.

3. RESULT AND DISCUSSION:

The study comprises of 100 patients and all the cases were studied in department of Biochemistry, at CDL (Clinical biochemistry), Shree Krishna Hospital, Karamsad.

3.1 Statistical analysis:

Statistical analysis was performed using statistical software the mean value, the mean difference between groups, and the 95% confidence intervals were determined. A Bland and Altman plot was used

to plot the mean difference between base line and after half hours, one hours, and after one and half hours of pH, PCO₂, PO₂, HCO₃⁻ O₂sat..

3.2 Bland - Altman Analysis:

Bland- Altman Analysis was performed for pH, PCO₂, PO₂, HCO₃⁻std, and O₂sat for base line verses half hour, base line verses one hour and baseline verses one and half hour. The bias and corresponding limits of agreement for different value of arterial blood gas are listed in Table 1.

Table 1: Bland- Altman: Bias and Limits of agreement

Particular	Sample No	Mean difference	Standard deviation	Limits of Agreement
pH Baseline vs after half hour	100	-0.005	0.019	0.033and-0.044
pH Baseline vs after one hour	100	-0.001	0.023	0.035and -0.056
pH Baseline vs after one and half hour	100	-0.013	0.029	0.045 and-0.071
pCo2 Baseline vs after half hour	100	0.7	4.13	7.4 and -6.1
pCo2 Baseline vs after one hour	100	0.5	6.02	11.3 and -10.4
pCo2 Baseline vs after one and half hour	100	0.6	9.89	18.8 and -17.6
pO2 Baseline vs after half hour	100	5.4	32.14	57.6 and - 46.8
pO2 Baseline vs after one hour	100	20.2	61.53	100.4 and -59.9
pO2 Baseline vs after one and half hour	100	38.3	91.53	141.1 and-64.4
Hco3std Baseline vs after half hour	100	0.0	1.53	3.0 and -2.9
Hco3std Baseline vs after one hour	100	-0.4	2.04	3.6 and -4.5
Hco3std Baseline vs after one and half hour	100	-0.7	2.19	3.6 and -5.0
O2sat Baseline vs after half hour	100	1.3	3.06	4.7 and -2.2
O2sat Baseline vs after one hour	100	2.6	5.91	9.0 and -3.9
O2sat Baseline vs after one and half hour	100	3.6	8.01	12.1 and -5.0

Table 2: Descriptive Statistics for PH values

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
PH Baseline	100	6.89	7.60	7.3781	.13867
PH half hour	100	6.89	7.59	7.3728	.13606
PH One hour	100	6.89	7.58	7.3675	.13502
PH One and half H	100	6.91	7.59	7.3653	.13278
	100				

Total number of sample N=100

Figure 3: BOX and WHISKER plot

BOX and WHISKER plot represent the distribution of pH value at different storage time from the base line pH value. it show the pH value is distributed from 6.9 to 7.6.

Figure 4: pH half hour and pH baseline plot

Figure-4 show the average of pH half hour and pH baseline and the pH half hour and baseline difference. the mean difference and SD are represented as the line between two dotted line and dotted line respectively. Mean value is -0.005 and standard deviation is 0.019. if the sample is stored for half hour pH is decrease 0.005 which is clinically not significant.

Table 4: Descriptive Statistics for PO₂

	Minimum	Maximum	Mean	Std. Deviation
PO ₂ Baseline	27.80	421.10	104.7040	68.15605
PO ₂ Half hour	27.00	277.70	110.0910	50.77859
PO ₂ One hour	28.60	240.90	124.9400	46.71987
PO ₂ One and half hour	27.00	222.00	143.0280	43.22474

Total number of sample N=100

Figure 5: Distribution of pO₂ value at base line

Figure-5 show distribution of pO₂ value at base line, after half hour, one hour and after one and half hour. The distribution of pO₂ is 30mmHg to 430mmHg. Analysis delay led to a gradual rise in measured PO₂ that became statistically and clinically significant.

Table 5: Descriptive Statistics for HCO₃⁻ Std

	Minimum	Maximum	Mean	Std. Deviation
HCO ₃ Baseline	8.80	38.00	22.9560	5.61622
HCO ₃ Half hour	9.60	38.80	22.9810	5.54635
HCO ₃ One hour	9.70	36.00	22.5060	5.11549
HCO ₃ One and half hour	9.70	36.70	22.2155	5.01093

Total number of sample N=10

Figure 6: Distribution of HCO_3^- value at base line

Figure-6 show distribution of HCO_3^- value at base line, after half hour, one hour and after one and half hour. The distribution of HCO_3^- is 8mmol/L to 40mmol/L.

Table 6: Descriptive Statistics for O_2 sat

	Minimum	Maximum	Mean	Std. Deviation
O2 Baseline	41.70	99.80	93.8320	8.47894
O2 Half hour	52.70	99.60	95.1200	7.15057
O2 One hour	55.80	99.50	96.4050	6.16544
O2 One and half hour	63.90	99.80	97.3900	5.26201

Total number of sample N=100

Figure 7: Distribution of O_2sat value at base line

Figure-7 show distribution of O_2sat value at base line, after half hour, one hour and after one and half hour. The distribution of O_2sat is 40% to 90%. Dot represent the outlier which is the lowest value than the minimum value.

4. CONCLUSION

There is no significant change found in pH, PCO_2 , HCO_3^- and in O_2sat even if the estimation is get delay for 90 minutes. A significant change was found in PO_2 , If the sample was stored for more than 30 minutes

at room temperature. Although the changes were not that significant which could change the management of the patient.

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