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# A Comparative Study of Arterial versus Venous Blood Electrolytes

**Cheenu Garg, Gitanjali Goyal*, Kirti**
Department of Biochemistry, Guru Gobind Singh Medical College, Sadiq Rd, Kotakpura, GGS Medical Hospital, Faridkot, Punjab, India

**Original Research Article**

***Corresponding author**
*Gitanjali Goyal*

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**Abstract:** Electrolyte abnormalities are common cause of morbidity and mortality in ICU patients. Quick and accurate results are required for immediate treatment. Conventionally these are measured in serum by electrolyte analyser but now point of care analysers are available to determine them in arterial blood by ABG. To measure electrolyte levels in venous and arterial samples and to evaluate the difference in them. The study was conducted in the department of biochemistry, GGS Medical College and Hospital, Faridkot. It was conducted on the total of 115 patients of either sex admitted in the intensive care unit (ICU). Arterial blood sample was collected for ABG and venous blood was processed in the electrolyte analyser. Results show that there is quite a difference between the mean values of these parameters in venous and arterial blood, with sodium having mean of 124.22 ± 9.18 in arterial blood and that of 137.09 ± 8.71 in venous blood. The mean value for potassium is 3.49 ± 1.28 in arterial blood and 4.21 ± 1.08 in venous blood. For chloride it is 108.54±9.9 in arterial blood and 101.77±7.2 in venous blood. The p values for all the parameters was <0.001. As we observed significant difference between electrolyte levels of venous blood done on electrolyte analyser and that of arterial blood done on ABG analyser so these cannot be used for in exchange for each other and so physicians should be cautious while reporting the results.
**Keywords:** Electrolyte, abnormalities, arterial blood, venous blood.

## INTRODUCTION

Disturbances in the electrolyte levels are one of the common causes of morbidity in ICU patients which requires the minimal turn-around time [1]. Improper and delayed results affect the course of treatment for the patient like sodium and chloride levels are important for the proper fluid administration and to combat the conditions of hyper and hyponatremia [2]. Similarly potassium levels are required for cardiac resuscitation, failure of which may lead to cardiac arrest [3]. So quick and accurate results are required.

Conventionally these electrolytes are measured in serum obtained from venous blood by the electrolyte analyser which takes significant amount of time [4]. As some time is needed to separate serum from the blood by centrifugation. But now point of care analysers are available where these are measured in arterial blood in comparatively lesser time by arterial blood gas analyser. The significance of this is that electrolytes can be measured by the bed side of the patient [5].

Differences in the blood gas analyser and electrolyte auto-analyser [6].

| Blood gas analyser | Auto-analyser |
|---|---|
| Uses arterial blood | Uses venous blood |
| Uses heparinised blood | Uses serum sample without anticoagulant |
| Takes short time to process | Takes long time for processing |

The previous studies have concluded that a significant difference lies in the electrolyte values for these analysers which might be due to dilution of ABG sample with heparin [7]. Arterial blood gas analyzer is used in emergency units for the speedy analysis of electrolytes and their disturbances. Although there is an advantage of quick processing time with ABG analyzer, but issues regarding precision of instrument were of concern [8].

These differences also vary with respect to the type of analyser used based on their accuracy, precision and performance.

So our purpose of the study was to estimate the difference in the electrolyte levels in the electrolyte auto-analyser and ABG analysers in our lab.

## MATERIALS AND METHODS

The study was conducted in the department of biochemistry, GGS Medical College and Hospital, Faridkot. It was conducted on the total of 115 patients of either sex admitted in the intensive care unit (ICU).

Arterial blood sample was collected for ABG and venous blood was processed in the electrolyte analyser. Both samples are collected simultaneously.

The electrolytes in the venous blood were measured in pc lite analyser. It works on the principle of Nernst equation and can measure both positive as well as negative ions in a solution without being affected by any interference of other dissolved components. Indirect ISE, majorly used in the chemistry analyzers, measures on a total plasma sample (or serum) that has been diluted with a large volume of diluent wherein the plasma and erythrocytes are separated by centrifugation. Due to dilution, this method measures the mean concentration in plasma, i.e., the weighted average between the concentration in the electrolyte - containing water part and in the electrolyte - free protein/lipid part. The concentration is calculated by multiplying the result with the dilution factor. The reported result depends on the content of solids in the sample [9].

The heparinised arterial blood was used to prevent its clotting and for venous blood it was centrifuged first and then the supernatant serum was used [10]. In both the samples estimation of sodium, potassium and chloride levels were done and their comparison was made.

## RESULTS

The statistics in the study included mean, standard deviation, minimum, maximum and p value. Arterial sodium, potassium and chloride was correlated with venous sodium, potassium, and chloride by spearman's correlation. Scatter plot was employed to represent arterial and venous sodium, potassium and chloride.

**Table-1: Mean value, maximum and minimum values of the parameters**

| Parameters | Mean ± SD | maximum | minimum |
|---|---|---|---|
| Arterial sodium | 124.22 ± 9.18 | 150 | 101.7 |
| Venous sodium | 137.09 ± 8.71 | 161 | 107 |
| Arterial potassium | 3.49 ± 1.28 | 10 | 1.5 |
| Venous potassium | 4.21 ± 1.08 | 10 | 2.5 |
| Arterial chloride | 108.54 ± 9.9 | 131 | 77 |
| Venous chloride | 101.77 ± 7.2 | 118 | 77 |

So it shows that mean value of sodium and potassium is more in the venous blood as compared to arterial blood but for chloride it is higher in the arterial blood.

**Table-2: Coefficient correlation values for sodium, potassium and chloride levels**

| Parameters | r value | p value |
|---|---|---|
| Sodium | 0.36 | <0.001 |
| Potassium | 0.68 | <0.001 |
| Chloride | 0.50 | <0.001 |

So the significant difference was found in all the three electrolytes between their arterial and venous levels but there is a positive correlation of these values to each other as is evident from r values.

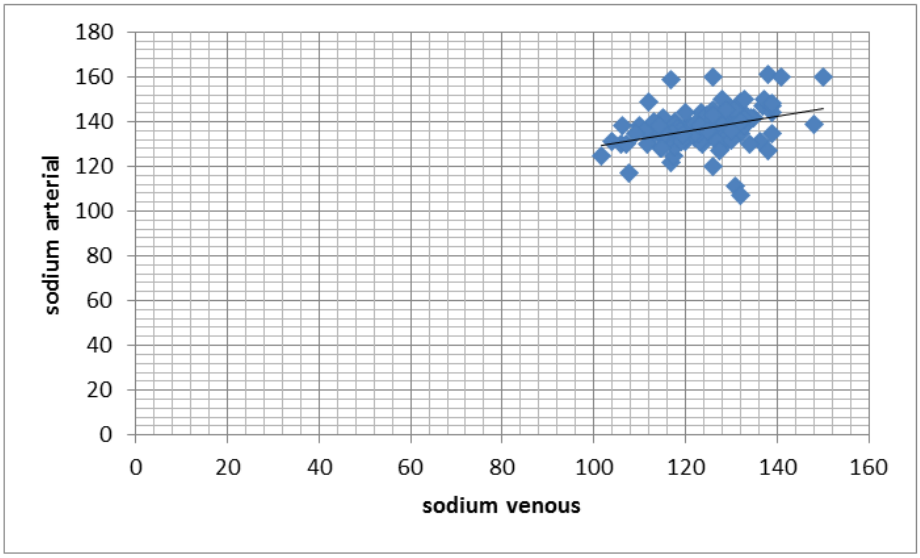


**Fig-1: Scatter plot for arterial vs venous sodium**

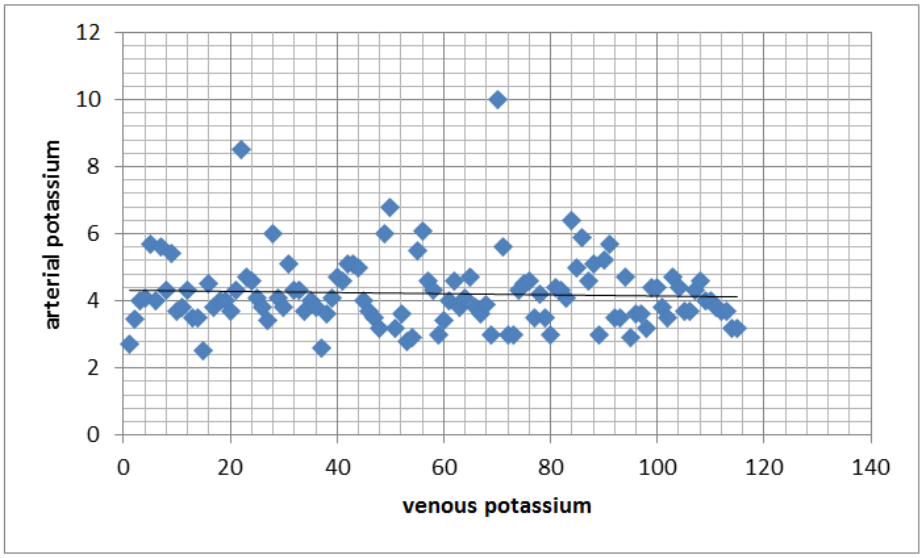


**Fig-2: Scatter plot for arterial vs venous potassium**

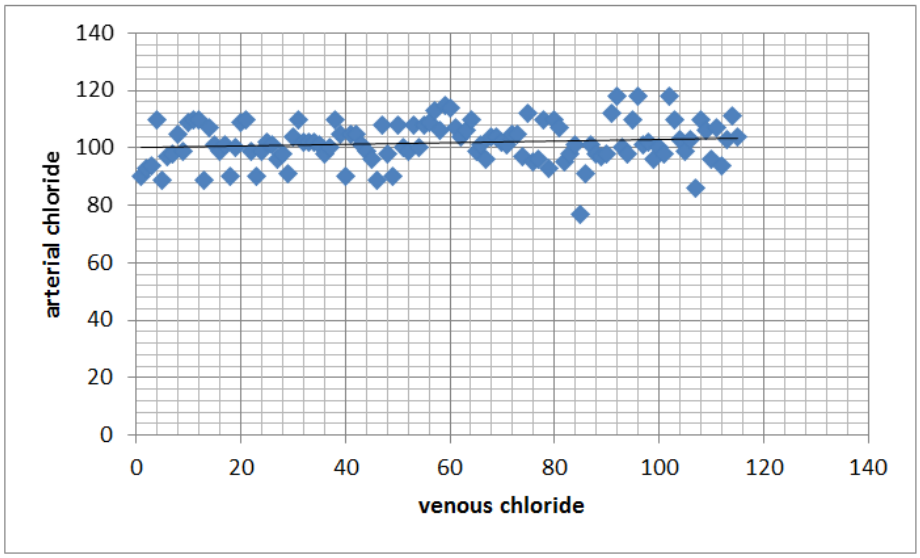


**Fig-3: Scatter plot for arterial vs venous chloride**

## DISCUSSION

So the results show that there is quite a difference between the mean values of these parameters in venous and arterial blood, with sodium having mean of 124.22 ± 9.18 in arterial blood and that of 137.09 ± 8.71 in venous blood. The mean value for potassium is 3.49 ± 1.28 in arterial blood and 4.21 ± 1.08 in venous blood. It shows that mean values for sodium and potassium is higher in venous blood than in the arterial blood but for the chloride it is opposite where mean value for arterial (108.54 ± 9.9) is higher than that of venous blood (101.77 ± 7.2).

Observing the p value it is shown that all the three parameters have p value of <0.001 which concludes that there is significant difference in the values of arterial and venous blood. This is in accordance to the study by Chako. B *et al*., which shows similar results of higher sodium and potassium levels in venous blood as compared to arterial blood and the study further explains that this difference is due to type of analyser used, difference in their magnitude of electrode [11].

Also a study by Chhapola V *et al*., observed that arterial blood gas analysers underestimate sodium and potassium levels which might due to use of heparinised syringes used for arterial blood estimation which dilute the sample and lower the values [12].

Also in our study r values shows positive correlation between the various parameters to each other. A study by Shilpi Awasthi *et al.*, observed similar findings with a strong correlation between the arterial sodium and potassium and venous sodium and potassium [13].

## CONCLUSION

As we observed significant difference between electrolyte levels of venous blood done on electrolyte analyser and that of arterial blood done on ABG analyser so these cannot be used for in exchange for each other and so physicians should be cautious while reporting the results.

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