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CORRELATION OF SODIUM AND POTASSIUM RESULTS ON ARTERIAL BLOOD GAS ANALYZER WITH STANDARD ELECTROLYTE ANALYZER AMONG CRITICALLY ILL PATIENTS ADMITTED IN RURAL TERTIARY CARE HOSPITAL

Anaesthesiology

Dr. Rutuja. Bangal Resident, Department of Anaesthesiology and critical care, Rural Medical college,PIMS, Loni, Maharashtra, India.

Dr. Akshaya N Shetti* Professor Department of Anaesthesiology and critical care, Rural Medical college,PIMS, Loni, Maharashtra, India. *Corresponding Author

Dr. Singla Bhavika AssistantProfessor Department of Anaesthesiology and critical care, Rural Medical college,PIMS, Loni, Maharashtra, India.

ABSTRACT

Electrolyte assessment is very important in critically ill patients. Every attempt is made to get quick and accurate readings of serum electrolytes especially sodium and potassium. Due to lack of facility or no affordability of the patient, multiple times electrolyte assessment in a developing country is really challenging. The venous serum electrolyte is time consuming as it has to be processed in the laboratory unlike arterial blood analysis.

Aims and objectives: To compare and correlate values of arterial sample electrolytes analyzed by the blood gas analyzer with venous serum electrolytes in critically ill patients.

Settings and Design: This is a descriptive cross sectional study done at rural tertiary care hospital.

Methods and Material: After approval of institutional ethical committee and written informed consent from 70 patients' immediate relative this study was conducted. A heparinized blood sample was obtained by an experienced doctor. The same doctor did venous blood sampling for serum electrolytes within 5 minutes. Both samples were sent to central clinical laboratory for assessment. The reports were collected and recorded.

Statistical analysis used: The sample size calculation was done based on previous study and was 10. Considering the patient load we took 70 patients. Pearson's correlation test was used to correlate sodium and potassium of both arterial and venous blood samples.

Results: The correlation coefficient r= 0.2 for potassium and for sodium, r= 0.57 indicating positive correlation. Considering the r value, sodium has higher positive correlation than potassium.

Conclusion: The electrolyte results i.e. sodium and potassium in arterial blood gas analyzer report are having positive correlation with the reports of venous blood.

KEYWORDS

Arterial Blood Gas, Correlation, Serum Electrolyte, Sodium, Potassium

INTRODUCTION:

In critical care, electrolytes disturbances are seen most commonly among patients. This can lead to life threatening problems. Quick and accurate assessment methods are required to treat or to avoid complications related to electrolyte imbalances. In developing countries, due to lack of quick transportation system, assessment of such investigations are delayed thus compromising the safety of the patient. Most of the critical care units do have point of care systems. Arterial blood gas (ABG) analyzer is commonly used in emergency units and in critical care units to allow the quick assessment of electrolytes and ABG disturbances. Along with the advantage of fast processing time with ABG analyzer, concerns have been increased about the precision. There appears to be enormous controversy in the results of different laboratories, possibly because of the use of dissimilar devices. Certain previous studies varied meaningfully for plasma sodium and chloride concentrations; others as well proved major variances in potassium results.Various techniques are used to assess the serum electrolytes in central clinical laboratory.[1-4]

Thus, this study is designed to correlate both the measurements in patients who are admitted in critical care area of our rural tertiary care unit.

Subjects and Methods:

After approval of institutional ethical committee, a written informed consent was obtained from patient's immediate relative. Whenever indicated, under aseptic precautions, a heparinized blood sample was obtained from the radial or femoral artery by an experienced doctor (who had performed minimum of 50 arterial blood sampling). After the arterial blood sampling the same doctor did venous blood sampling for the serum electrolytes. Both samples were sent to central clinical laboratory for assessment of blood through pneumatic chute system. The serum electrolytes were analyzed using Diamond Prolyte analyzer and blood gases were measured using GEM Premier 3500 system analyzer. The reports were collected and recorded accordingly. The reference ranges for sodium and potassium were 135–145 mmol/L and 3.5–5.2 mmol/L respectively. **Inclusion criteria**: Patients' relatives who were willing to give consent for the study. Patients requiring ABG analysis and measurement of venous blood serum electrolytes on admission or during course of treatment were included in this study.

Exclusion criteria: Patient with bleeding disorders, any pathology in the arteries where contraindication of arterial sampling was present.

RESULTS:

In this study, the arterial and venous blood sampling was done in 70 patients. Out of 70 patients, 61 samplings were from radial artery and 9 from femoral artery. The venous sampling was done from ante-cubital vein in 65 patients and from femoral vein in 5 patients. The reports of sodium and potassium were compared and Pearson's correlation test was applied. The correlation coefficient showed r= 0.57 for sodium (figure 1) and r= 0.2 for potassium (figure 2), indicating positive correlation. Considering the r value, sodium showed higher positive correlation than potassium.

DISCUSSION:

Among critically ill patients, sodium and potassium abnormalities are most frequently seen. Electrolyte and arterial blood gas analysis are most frequently ordered investigations in the critical care area. Electrolyte imbalance is most of the time reversible, provided timely intervention is done. Among the standard laboratory serum electrolyte assessment and electrolytes in arterial blood gas assessment, ABG analysis is done with no delay. Hence, it is important to understand whether or not the serum electrolyte reports correlate with ABG electrolyte reports. In the present study we investigated whether or not sodium and potassium levels measured using different equipments, namely an ABG and standard auto analyzer were equivalent. Sodium and potassium levels measured in whole blood and plasma have been shown to be same. If so, the data could be employed interchangeably in routine practice.[5]

Sampling error and centrifugation mixing with clot activator are some factors which may affect the results of electrolyte. We could not overcome these problems except that an experienced person who had done minimum of 50 samplings of both arterial and venous sampling. One of the interesting factors which was tested in this study was we had sent both samples using pneumatic chute system. Statistically, both the results for sodium and potassium are showing positive correlation,

indicating that pneumatic chute system can safely be used for ABG analysis without any hesitation. Further comparative study is required to compare both manual submissions of ABG sample and by pneumatic chute system.

Various factors may affect the results of electrolytes on ABG analyzer and electrolyte analyzer.

In ABG analyzer, some of the factors are the amount of heparin used, type of heparin used viz, sodium containing heparin or lithium heparin, hemolysis and binding to positively charged ions etc. [2,3,6,7]

Though results show statistically positive correlation, the biological variations in electrolyte levels are so small that a minor error will cause patients to be misdiagnosed. According to the US CLIA 1988 rules accept a difference of 0.5 mmol/L in potassium level, and 4 mmol/L in sodium level, compared to target values.[8,9]

In a study conducted by Budak et al, the correlation coefficient r squared for sodium and potassium were 0.9 and 0.88 respectively, whereas in our study it is 0.33 and 0.5 for sodium and potassium respectively.[3] This difference can be explained by limited number of samples and no standard protocol was maintained for sampling in our study. We did believe that experience of the doctor itself is sufficient.

One important message the authors would like to give is, that every hospital should do such study and calibrate the ABG machine or serum electrolyte measuring equipment carefully. There should be a matching reading between central laboratory device and point of care instruments. Only after this, the electrolyte reports of ABG can be considered during emergency management of critically ill patient.

Limitation of the study:

In this study we did not standardize the amount of heparin to be taken while performing the arterial blood gas analysis. Also, we did not opt for the sodium free heparin or standard pre-heparin treated ABG syringe due to the lack of facility and no affordability by the patients. Centrifugation of samples is a step in assessment of serum electrolyte. During this step this can lead to hemolysis in serum resulting in electrolyte report errors.

CONCLUSION:

The electrolyte results i.e. sodium and potassium in arterial blood gas analyzer report are having positive correlation with the reports of venous blood. Thus, the emergency correction of sodium and potassium based on arterial blood gas analyzer report can be done whenever it is applicable.

Figure 1: Correlation of arterial blood gas analyzer sodium with venous blood sodium

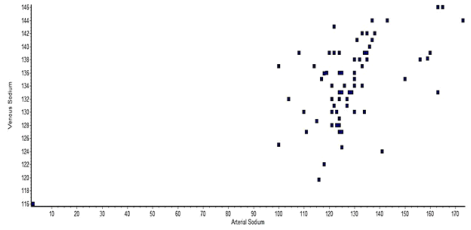
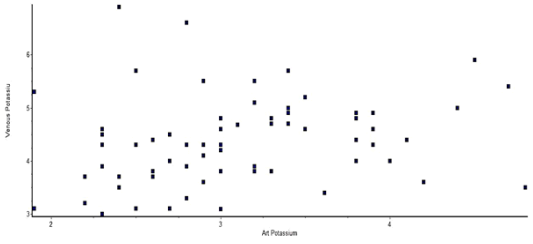


Figure 2: Correlation of arterial blood gas analyzer potassium with venous blood potassium



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