

Comparison of potassium, sodium and lactate measurements between a blood gas analyser (RAPIDPoint 500) and a core laboratory analyser (Alinity)

Cappelle D, Jacobs S, D'hondt M, Meskal A

Clinical Laboratory, Department of biochemistry, GZA Hospitals, Belgium



Introduction and aims

Blood gas analysers (BGA) are frequently used in acute settings for the rapid evaluation of blood gases, electrolytes and metabolites. BGA and core laboratory chemistry analysers use different techniques for measurement, and therefore results are not interchangeable between both methods. In this study, we evaluated the concordance between the RAPIDPoint 500 BGA (Siemens) and the Alinity (Abbott) core laboratory analyser for potassium, sodium and lactate. In addition, the impact of total protein concentration on the potassium and sodium results was investigated. For the measurement of potassium and sodium, BGA uses direct ion-selective electrodes (potentiometry), while Alinity uses indirect ion-selective electrodes (potentiometry). Amperometry (BGA) and colorimetry (Alinity) are used for the measurement of lactate.



Samples and methods

Samples from patients presenting at the hospital (GZA, Sint-Augustinus, Wilrijk) between May 2018 and February 2019 were retrospectively investigated for potassium, sodium and lactate. Patient selection was based on the concurrent availability of BGA as well as core laboratory analyser results obtained within a time frame of 30 min. For lactate, we also performed a prospective analysis of samples collected from patients at the intensive care unit between October 2018 and February 2019. A total of 4357 potassium, 3384 sodium and 720 lactate samples measured with the BGA were compared with the corresponding results on the Alinity.

	RAPIDPoint 500 BGA	Alinity	N
Potassium	Whole blood (heparinized)	Serum	4357 (retrospective)
	Whole blood (heparinized)	Serum	3384 (retrospective) 2417 (TP available)
Lactate	Whole blood (heparinized)	Plasma (fluoride)	170 (retrospective) 550 (prospective)

Table 1: Overview of the samples included in the study. Abbreviation: TP, total protein.

Results and discussion

Figure 1, 2 and 5 show the correlations for the retrospective patient cohort for potassium, sodium and lactate, respectively ($R^2 = 0.828$, 0.814 and 0.996). In figure 3 the linear regression of the difference between indirect and direct sodium concentrations in function of the total protein concentration is presented. Figure 4 displays the correlation for lactate in the prospective patient cohort ($R^2 = 0.966$).

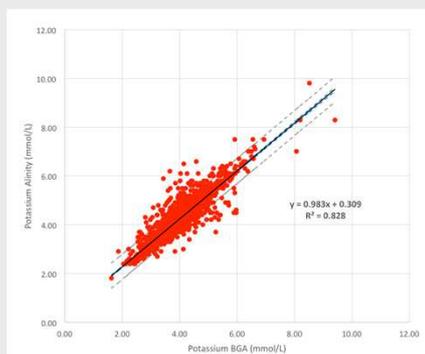


Figure 1: Linear regression potassium.

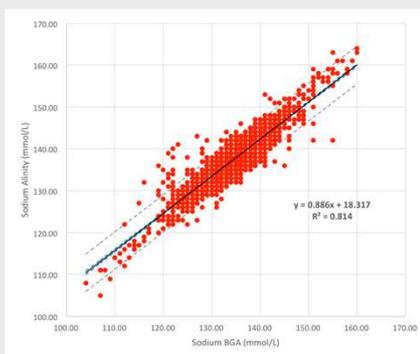


Figure 2: Linear regression sodium.

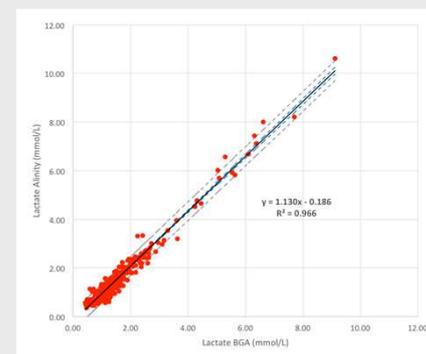


Figure 4: Linear regression lactate, prospective patient cohort (only ICU).

For **potassium**, results of paired samples are a bit lower on the BGA compared to Alinity, which is in accordance with the difference in reference range between both methods. Total protein concentration had no influence on the potassium results obtained by indirect ion-selective electrodes.

There was a significant negative correlation between **sodium** measured by indirect ion-selective electrodes and sodium measured by direct ion-selective electrodes relative to the changes in total protein concentration.

Correlations obtained for **lactate** are similar between the retrospective and prospective patient cohort, which indicates the retrospective approach is a valuable tool to compare analysis methods. Different reference ranges exist for lactate depending on the sample type, however in the current study we used the same sample type to be able to use the same reference ranges for both methods.

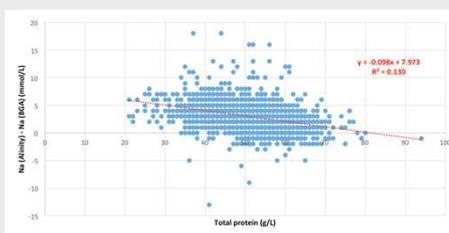


Figure 3: Linear regression of difference between indirect and direct sodium concentrations in function of total protein concentration.

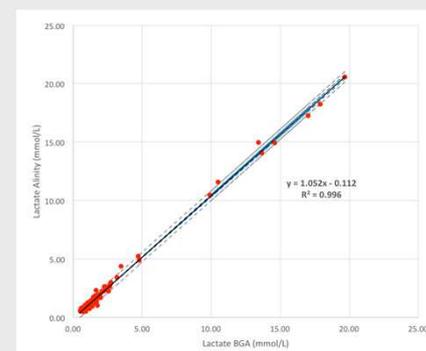


Figure 5: Linear regression lactate, retrospective patient cohort (only ICU).

Conclusion

A strong correlation is observed between potassium, sodium and lactate levels measured with a BGA (RAPIDPoint 500) and results obtained by the core laboratory analyser (Alinity). As reported in previous studies, our study demonstrated the influence of low total protein on the measurement of sodium using indirect ion-selective electrodes. Sodium measurements on a BGA are not influenced by the total protein concentration in the sample, and therefore they should preferentially be used in patients with abnormal protein concentrations. Potassium results should be interpreted based on the reference range corresponding to the sample type used.