erythrocytes and leukocytes compared with 1 cell/HPF obtained with microscopy of the urinary sediment. Fewer epithelial cells and bacteria were seen in this population.

In both groups, however, the values for erythrocytes and leukocytes varied, with ranges of $\sim1$–36 cells/$\mu$L and $\sim3$–57 cells/$\mu$L, respectively, when the results between the 5th and 95th percentile were examined. These values are obviously higher than those obtained with microscopic examination of the urinary sediment. Thus, the results should be interpreted with care because the units obtained with the UF-100 (cells/$\mu$L) are obviously different from those obtained after centrifugation and microscopy of the urinary sediment (cells/HPF). This may be a problem at the beginning when clinicians are not used to the units of the UF-100. Our experience with certain wards, however, shows that clinicians will adjust to changes relatively quickly.

The small round cells (SRCs) most probably originated from the tubular epithelium of the kidney or the transitional epithelium of the urinary tract. Very small quantities of these cells were seen in urine samples from both groups. Thus, the presence of up to 5 SRC/$\mu$L in neonates and up to 2 SRC/$\mu$L in children are within the 95th percentile and are not regarded as pathological.

We hope that these values are helpful to those colleagues already using the UF-100 in routine urinalysis.

This work is dedicated to Professor Eckart Köttgen on his 60th birthday.

References


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High Concentrations of Lithium Heparin Decrease Measured Serum Sodium in Some Analyzers

To the Editor:
While studying a handheld analyzer (i-STAT) in a neonatal intensive care unit (NICU), we found hyponatremia ($<128$ mmol/L sodium) in 25 of 137 newborn infants (postnatal age <6 days for 75% of the infants) with sodium values within the reference interval on a Vitros 750 analyzer (Johnson & Johnson). The difference in sodium values ranged from 5 to 19 mmol/L. Investigation into the clinical presentation and into the various treatments disclosed no common feature.

We tested the hypothesis that the heparinized capillary tubes used in the NICU for sample collection may explain the observed discrepancies in sodium values. We used the i-STAT analyzer and adult venous blood samples to compare capillary tubes supplied either by Chiron (from Ortho Diagnostics, with 130–200 kIU lithium heparin/L) or by Radiometer (50 kIU electrolyte-balanced heparin/L). The sodium results were lower (mean difference, $-2.14$ mmol/L; range, 0 to $-7$ mmol/L) with the Chiron capillary tubes (Fig. 1A). The same discrepancy was obtained when we tested the Chiron heparinized capillary tubes vs nonheparinized tubes (not shown). Moreover, incomplete capillary tube filling (a common situation in premature newborn infants) further increased the mean difference to $-4.8$ mmol/L (range, $-3$ to $-8$ mmol/L). This difference was also present when tests were performed on an ABL500 blood gas-ion analyzer (Radiometer), using full Chiron capillary tubes (mean difference, $-4.4$; range, $-2$ to $-8$ mmol/L). Decreased sodium values were thus observed exclusively when Chiron capillary tubes were used. We postulate that the effect reflects the high concentration of lithium heparin in the tubes.

Fig. 1. Effect of different heparinized tubes (A) and dry lithium heparin concentrations (B) on sodium measurements in adults, and comparison of sodium values for neonates <1 month measured with i-STAT and Vitros instruments (C).

(A), Chiron and Radiometer heparinized capillary tubes were used to collect adult blood for i-STAT analysis. $r = 0.98$; slope = 1.0; y-intercept $= -4.8$ mmol/L. (B), control adult blood samples were analyzed on i-STAT, ABL500, and Vitros instruments. (C), $r = 0.79$; slope = 0.89; y-intercept = 12.8 mmol/L. Insets show Bland-Altman plots comparing differences between paired values with their mean. Horizontal lines indicate mean ± 2 SD of the values for paired differences. Deming regression analysis was used.
Heparin’s ability to chelate calcium has been documented (1). Zoppi et al. (2) suggested similar effects on sodium analyses, but only for sodium heparin. The intended use of the Chiron capillary tubes (model no. 478504) is the measurement of pH and blood gases; the package insert made no mention of the use of these capillary tubes for electrolyte determinations.

Dry lithium heparin decreases measured sodium in adult blood (Fig. 1B), producing a mean decrease of −2.1 to −3.1 mmol/L at 150 kIU/L heparin and as much as −5.8 to −8.6 mmol/L at 500 kIU/L heparin (consistent with incomplete filling of the Chiron capillary tube) on the i-STAT and the ABL500 analyzer, respectively, but only minimally on the Vitros analyzer.

When adult venous blood samples (n = 30) were collected in heparinized tubes (<50 kIU/L), i-STAT, ABL500 (both using whole blood), and Vitros 750 (using plasma) agreed well. Deming regression analyses for the i-STAT vs the Vitros or ABL yielded slopes of 1.09 for the Vitros and 1.04 for the ABL, with y-intercepts of −12.2 mmol/L for Vitros and −4.40 mmol/L for ABL. Bland-Altman plots revealed no significant nonlinear trend.

We analyzed venous blood (500 μL) from discarded samples obtained with butterflies on 32 newborn infants with postnatal age <1 month picked at random from the NICU and collected in heparinized tubes (<50 kIU/L); whole blood samples (95 and 200 μL) were analyzed simultaneously on the i-STAT and ABL, respectively, and supernatant (40 μL) was analyzed on the Vitros. Bland-Altman analysis (Fig. 1C) of the i-STAT and Vitros sodium values exhibited a difference up to −7 mmol/L (mean, −2.3 mmol/L). No difference (mean, 0.32 mmol/L) was observed between the i-STAT analyzer and the ABL500. There was no correlation between hematocrit (r = −0.29; P >0.9) or protein (r = 0.28; P >0.9) and the difference between the i-STAT and Vitros analyzers.

In summary, we report evidence of a negative bias in sodium values between the i-STAT or the ABL systems and the Vitros analyzer similar to the bias described previously between Corning and Vitros (3, 4) in neonates but not observed in older children (5) or adults. Sodium measurements on blood collected in capillary tubes that contain high lithium heparin concentrations may produce an apparent bias up to −8 mmol/L. If lithium heparin must be used for sodium analysis with the i-STAT or ABL500 instruments, we recommend the use of full capillary tubes with low concentrations of lithium heparin.

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References


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Performance of the IMx Tacrolimus II Assay and Practical Limits of Detection

To The Editor:
Recent correspondence to Clinical Chemistry (1, 2) addressed the performance of the second generation Tacrolimus assay for the IMx analyzer (Abbott Diagnostics), with the former letter identifying nonequivalence in results from its predecessor and the latter considering performance approaching the lower limits of detection. Our own published results (3) have considered these points, and we report here our additional experience.

In their comparison of the second- vs the first-generation assays, Garg et al. (1) described comparable coefficients of variation (CVs), but this is not the case when identical control samples are used in each assay at low concentrations (5 μg/L), e.g., 14.2% vs 42.4% at 4.2 μg of tacrolimus per liter of blood (1). In common with previous findings (3–5), Garg et al. (1) reported lower values with the second-generation assay using 36 samples of undefined origin. The slopes and intercepts reported for these various comparisons differed (as did the comparison methods applied), but Garg et al. (1) did not relate these data into the practical measurement of mean differences in assay results. Mean underestimates of 1–2 μg/L were reported for tacrolimus concentrations of 3–35 μg/L both by Wallemacq et al. (4), who used renal and liver recipients, and ourselves (3) (adult and pediatric liver and adult renal transplant recipients and patients with autoim-