letters

Hitachi 736 Chloride Bias with Abnormal Bicarbonate

To the Editor:

We have been using "Selective"-style (Boehringer Mannheim Diagnostics, Indianapolis, IN) chloride ion-selective electrode (ISE) cartridges almost exclusively since their introduction into the US in 1989. Except for problems with poor shelf life on early lot numbers, these chloride ISE cartridges have significantly better precision and less drift than do the earlier "Classic"-style electrodes on the Hitachi 736 (H736; Boehringer Mannheim). However, with recent chloride ISE lots (received after October 1991), we have noted a bias between samples run on our Beckman (Fullerton, CA) Synchron CX3 and the H736. Particularly on samples with a low bicarbonate, the H736 chloride result would frequently be significantly lower (6 mmol/L or more) than the CX3 result. To resolve this bias, we performed method comparisons (n = 111) with the CX3 and H736, and compared the results of each with those of a coulometric chloride titrator (Radiometer CMT10; Radiometer America, Westlake, OH). For the correlation studies we selected routine samples with chloride concentrations ranging from 76 to 117 mmol/L. Serum or plasma was obtained predominately from serum- or plasma-gel-separator tubes. After centrifugation, the samples were stored in the capped evacuated tubes up to the time of analysis (<1 h) and were then uncapped and placed directly on the H736 analyzer for sampling. These samples were then reanalyzed within 30 min by the CX3 and by coulometric titration. Comparisons between the CX3 and coulometric titration showed good agreement (r^2 = 0.967); however, the correlation between coulometric titration and the H736 (r^2 = 0.888) was much poorer.

We then obtained additional sample comparisons between the coulometric titration and two H736 instruments in our laboratory. Again, samples were selected on the basis of their H736 results, with reanalysis being performed within 30 min. Combined results from 234 paired sample comparisons between H736 and coulometric titration are summarized in Figure 1 as the difference (H736 chloride − coulometric titration chloride) at various bicarbonate (CO_2) concentrations. The observed linear-regression line of the difference was as follows: Difference = 0.231 [CO_2] − 6.6. As is evident from Figure 1, the H736 chloride method shows a significant bias relative to coulometric titration at both low and high bicarbonate concentrations. For specimens with bicarbonate in the range 17–37 mmol/L, agreement is acceptable with a mean bias of $<\pm 2.5$ mmol/L, a difference that is typically less than two times the precision SD for each chloride method.

We have also observed that as the on-line electrode ages, the slope of the observed bias line increases. We routinely use a control with a low bicarbonate content as a gauge for electrode replacement. With prolonged ISE use, the chloride result for the low bicarbonate control shifts below the lab-established (mean − 2 SD) limit. Once the electrode has been replaced and calibrated, control results usually return to acceptable values.

Recently, Boehringer Mannheim introduced a gentamicin-containing sample diluent and internal reference solution to eliminate mercury-containing reagents. To evaluate what influence, if any, the preservative might have on the bias, we used gentamicin-preserved reagents on one H736 while operating a second H736 with the earlier version, thimerosol-preserved reagents. Linear-regression equations for the difference (H736 − coulometric titration) as a function of bicarbonate for the two preservative solutions were as follows: for gentamicin-preserved reagents (n = 68), Difference = 0.198 [CO_2] − 6.2; for thimerosal-preserved reagents (n = 65), Difference = 0.210 [CO_2] − 6.2. The similar regression coefficients suggest that the preservative solutions do not affect this observed bias and that the bias is due to a nonspecificity of the electrode itself.

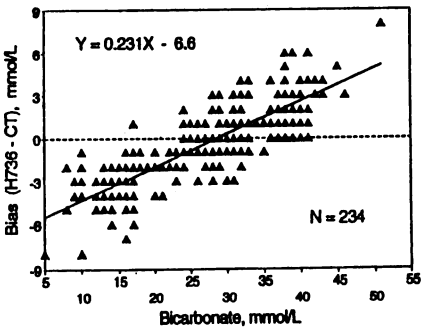

Fig. 1. Bias, difference between Hitachi 736 and coulometric titration (CT) chloride determinations, vs bicarbonate in serum and plasma samples

Dashed line: expected; *solid line:* linear regression line

An earlier report (*1*) of a case study involving a limited number of patients' samples comparisons (n = 12) also noted problems with Selective-style chloride cartridges on the Hitachi 717. We confirm this problem, using a much larger number of comparisons with two H736 instruments and different reagent formulations. On the basis of these findings, we recommend that laboratories repeat and confirm all H736 chloride results by an alternative method when the plasma or serum bicarbonate content is outside the range of 17–37 mmol/L.

Reference

1. Faulkner AM, Peake MJ. Bicarbonate interference with Hitachi chloride electrodes. Ann Clin Biochem 1991;28:107–8.

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Spokesmen for Boehringer Mannheim Corporation comment:

To the Editor:

The average selectivity factor for the "Selective"-style chloride ion selective electrode cartridges used on the BM/Hitachi systems is 0.2, as found in studies reported by Boehringer Mannheim and Hitachi at the 1988 AACC meeting (poster reprints available on request). This value is essentially identical to that inferred by Lipke et al. in their report. In three separate sample sets, they estimate the selectivity factor to be 0.231, 0.198, and 0.210. The selectivity factors for bicarbonate and other significant anions have been communicated to all BM/Hitachi systems users through two customer bulletins. The first included a reprint of the