Technical methods

Estimation of sodium, potassium, and chloride in urine using a Technicon AutoAnalyzer

J. K. DAWBORN¹, C. PATALINGHUG, AND S. E. L. BLACK *From the Medical Unit, University College Hospital Medical School, London*

The estimation of the concentration of sodium and potassium in plasma is performed routinely by automatic analysis in most hospital laboratories and has been shown to be accurate and reproducible (Snodgrass, Fuwa, and Hviid, 1962). The range of concentrations of these electrolytes in urine is so wide that they cannot be estimated satisfactorily by this method. We have, therefore, modified the Technicon² method for the estimation of sodium, potassium, and chloride so that all three electrolytes can be estimated on the same sample in concentrations of 0 to 200 mEq./l. using standard equipment.

¹British Council Commonwealth scholar.

²Technicon Instruments Co. Ltd.

Received for publication 1 March 1965.

REAGENTS

LITHIUM REAGENT Lithium nitrate 3.5 g./litre in 0.4 N sulphuric acid.

CHLORIDE REAGENT Saturated aqueous mercuric thiocyanate, 9 vol., and ferric nitrate 0.5 N in 0.5 N nitric acid, 1 volume.

STANDARD SOLUTIONS These were made from stock solutions of 5 N sodium chloride and 1 N potassium nitrate. Combined standards containing sodium, potassium, and chloride each in concentrations of 5, 10, 20, 40, 60, 80, 100, 130, 160, and 200 mEq./l. were used initially. Later the 5 and 80 mEq./l. standards were omitted.

METHOD

The manifold was constructed as shown in Figure 1. The position of the pumping tubes in the end block was found to be important and is indicated on the flow diagram. The sample is passed through a dilution circuit (A). An aliquot is then removed from the air segmented stream and diluted again with lithium internal reference standard in circuit B. Two separate aliquots are then

FIG. 1. Diagram of the manifold for urine electrolytes. Channel 1 leads to the flame photometer which has been omitted from the diagram for purposes of clarity.

removed through a fine bore Y piece 'debubbler'. One aliquot passes to the flame photometer (channel 1) and the other is mixed with chloride reagent (circuit C) and the colour developed is estimated at 480 m μ . as in the standard Technicon method for chloride. It is essential that a fine-bore debubbler is used and that the tubes pumping the diluted sample are cut as short as possible. If this is not done separation between samples may be inadequate.

With the dilute lithium reagent used it was not necessary to modify the intensity of the sodium, potassium, or lithium emissions by filters. Both sodium and potassium circuits are used in the K position to eliminate the 2.5 amplification used in the plasma sodium method.

The samples were run at 40 determinations per hour. Urine samples were arranged in order of colour to give a rough grouping according to the concentration of solutes. Each group of 12 urine samples was separated by water samples from a group of four standards of 10, 20, 40, and 100 mEq./l. The 10 and 20 mEq./l. standards were included because samples of rabbit urine and faecal extract with a low sodium content were being estimated as well as samples of human urine. The reading of each

sample was corrected in relation to the nearest standard.

RESULTS

The shape of the calibration curve and degree of separation between standards is shown in Figure 2. Adequate separation was obtained between samples which differed in concentration by 60 to 80 mEq./l. except with very dilute urines. Very few samples needed to be repeated because of poor peak definition.

There was some drift in the amplitude of the standards and the reading of each sample was corrected for this. The validity of this correction was shown by estimating 59 urine samples, covering a range of 5 to 185 mEq./l., twice during the same run. The coefficient of variation between paired estimations was 1% for each of the three electrolytes.

In addition five urine samples were estimated repeatedly over a period of four to six months. The results are summarized in Table I. The coefficients of variation were 1.6-2.5% for sodium, 1.4-1.6% for potassium, and 1.7-2.0% for chloride.

FIG. 2. Diagram of a typical recording to show the amplitude and separation between standards containing 5, 10, 20, 40, 60, 80, 100, 130, 160, and 200 mEq./l. of sodium, potassium, and chloride. The calibration on the ordinate corresponds to that on the recorded chart.

TABLE I
RESULT OF REPEATED ESTIMATIONS OF SODIUM, POTASSIUM, AND CHLORIDE
ON FIVE SAMPLES OF HUMAN URINE

Sample	No. of Estimations	Na		K		Cl	
		Mean $\pm$ S.D.	Coefficient of Variation (%)	Mean $\pm$ S.D.	Coefficient of Variation (%)	Mean $\pm$ S.D.	Coefficient of Variation (%)
1	14	90.1 $\pm$ 1.4	1.6	96.1 $\pm$ 1.3	1.4	129 $\pm$ 2.3	1.8
2	14	151 $\pm$ 3.7	2.5	74.2 $\pm$ 1.1	1.5	160 $\pm$ 3.0	1.9
3	14	116 $\pm$ 2.9	2.5	82.8 $\pm$ 1.1	1.4	125 $\pm$ 2.5	2.0
4	10	159 $\pm$ 2.5	1.6	47.8 $\pm$ 0.7	1.5	188 $\pm$ 3.7	2.0
5	9	116 $\pm$ 1.9	1.7	49.6 $\pm$ 0.8	1.6	110.7 $\pm$ 1.9	1.7

We wish to thank Professor M. L. Rosenheim for his support and Dr. E. J. Ross for critical discussion.

We are grateful to the British Council for financial support (J.K.D.) and Mr. Asta for the diagrams.

REFERENCE

Snodgrass, P. J., Fuwa, K., and Hviid, K. (1962). *J. Lab. clin. Med.*, 60, 983.

Estimation of hydroxyproline by the AutoAnalyzer¹

R. A. GRANT *From the A.R.C. Institute of Animal Physiology, Babraham, Cambridge*

ADDENDUM

In the procedure for elastin the second autoclaving with water is preferably replaced by a one-hour extraction with 0.1 N sodium hydroxide solution at 100°C. The alkaline extract is discarded and the residual elastin hydrolysed with 6 N hydrochloric acid in the usual way.

¹*J. clin. Path.* (1964). 17, 685.

Since it has been found that the hydroxyproline content of aortic elastin varies with the site of origin a single factor based on the average hydroxyproline content does not give sufficient accuracy in the calculation. In the following calculation use the factors given in the table below.

% elastin = % hydroxyproline (remaining after autoclaving and alkali extraction) $\times$ factor

TABLE

Species	FACTORS FOR AORTIC ELASTIN			
	Arch	Mid-thoracic	Upper Abdominal	Sub-renal
Sheep	70	63	44	39
Pig	76	76	45	39
Goat	87	89	58	48
Human	88	88	80	69