A RAPID AND SIMPLE BLOOD SUGAR DETERMINATION USING THE AMES REFLECTANCE METER AND DEXTROSTIX SYSTEM: A PRELIMINARY REPORT

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SYNOPSIS

The Ames reflectance meter/Dextrostix (ARMD) method of determining blood sugar is evaluated. Eighty four capillary blood sugar estimations using the ARMD system and a conventional method (Asatoor and King's method) were done. The mean blood sugar using the ARMD method was 185·6 mg./100 ml. and this was 38·0 mg./100 ml. or 17·0 % below the mean (223·7 mg./100 ml.) obtained by the Asatoor and King's method. The correlation between the two methods is close (correlation coefficient, r, is 0·9859). The linear regression relationship between the two methods can be expressed as: Asatoor and King's method in mg./100 ml. = 1·32 × ARMD method in mg./100 ml. + 22·87. It is concluded that the ARMD system provides a rapid, simple, reliable and economical method of blood sugar determination. Its value in the evaluation of glycosuria and management of diabetes, both inside and outside the hospital, is discussed.

A rapid, simple and economical method of determining the blood sugar is of obvious advantage especially in the management of diabetes mellitus both inside and outside the hospital. To this end, an enzyme test strip (Dextrostix, Ames), was introduced in 1964. Dextrostix is simple and rapid but it relies on colour matching by the observer; the colour matching is difficult at extremes of the range. Thus the use of Dextrostix is limited by observation error and the limited range of blood sugar that it can discriminate. To overcome these limitations of Dextrostix, Ames Company, recently introduced a reflectance meter to measure the colour changes of Dextrostix reflectometrically over a wider range. This reflectance meter/Dextrostix method (abbreviated to ARMD in the rest of the text) for measuring blood sugar has been found to be useful and reasonably accurate in initial studies (Mazzaferri *et al*, 1970; Jarrett, Keen and Hardwick, 1970; Spratt and Rosenquist, 1971). In this paper, we describe our preliminary experience in using the ARMD method to measure blood sugar.

METHOD AND MATERIAL

The reflectance meter is portable and measures $7'' \times 4\frac{1}{2}'' \times 6\frac{1}{2}''$ and weighs 3 lbs. It has a battery charger and can be charged from the mains. The meter scale in the reflectance meter has 3 scales: 0 to 70 mg./100 ml.; 70 to 180 mg./100 ml. and 180 to 1000 mg./100 ml. blood glucose.

Before use the battery condition of the reflectance meter was checked by turning the instrument on and observing that the needle in the meter window was in the "safe operating range". The standardisation of the instrument was checked by placing a reference strip in the instrument and adjusting the meter to the value of the reference strip (110 mg./100 ml. blood glucose). A large drop of capillary blood was applied to the entire Dextrostix reagent area. After 60 seconds excess blood was washed off by a stream of water. After washing the reagent area of strip was firmly blotted with filter paper; immediately the strip was inserted into the strip guide of the reflectance meter. The reading on the scale meter was then read.

In our diabetic clinic, the blood sugar was determined by the semimicro method of Asatoor and King (1954) using capillary blood obtained by pricking a finger tip. When this was done, the blood sugar was also determined using the ARMD method. On alternate cases, the Asatoor and King's method was done first and then followed by the ARMD method immediately and vice versa. This paper compares the results as obtained by the ARMD method and the Asatoor and King's method.

RESULTS

Eighty-four blood sugar estimations were done; 4 were in the range 10 to 70 mg./100 ml; 49 were in the range 71 to 180 mg./100 ml. and 31 were in the range 181 to 1000 mg./100 ml.

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The mean blood sugar by the ARMD method was 185·6 mg./100 ml. and by the Asatoor and King's method was 223·7 mg./100 ml; the difference between the two means is significant ($p < 0·0005$). Thus on the average the ARMD method underestimated the blood sugar by 38·0 mg./100 ml. or 17·0%.

The relationship between the results as obtained by the ARMD method and the Asatoor and King's method is shown in the figure. The correlation coefficient (r) between the 2 methods is 0·9859; the linear regression relationship between the 2 methods is found to be:

Asatoor & King's method in mg/100 ml. = 1·32×(ARMD method in mg./100 ml.)+22·87

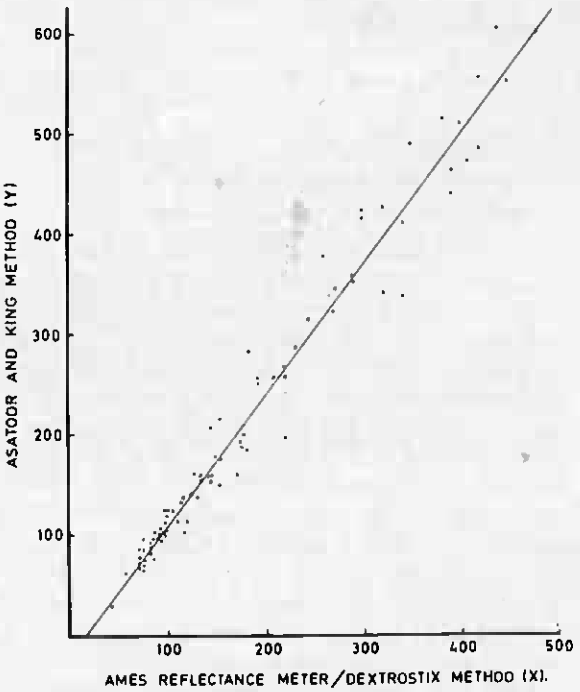

Fig. 1. Showing relationship of the blood sugar estimations in mg./100 ml. as determined by the Ames reflectance meter/Dextrostix method (X) and by the Asatoor and King's method (Y). The correlation coefficient (r) between X and Y is 0·9859 and the relation between Y and X is: $Y = 1·3281\ X + 22·8746$.

The blood sugar readings by the ARMD method in the euglycaemic range (71 to 180 mg./100 ml.) correlated best to those by our conventional laboratory method. The correlation in the lower and higher scales is not so close. When more data is available this would be reported in detail in a later communication.

DISCUSSION

Our initial experience with the Ames Reflectance Meter/Dextrostix (ARMD) method of measuring blood sugar agrees with the results of other workers (Jarrett, Keen and Hardwick, 1970; Spratt and Rosenquist, Schersten, 1971). The overall correlation coefficient with the Asatoor and King's method in this series was 0·98 as compared with 0·95 (Spratt and Rosenquist, 1971) and 0·96 (Schersten, 1971) in previous reports.

Like in other published reports, we find that the ARMD gives lower reading than the conventional laboratory method; in our series the ARMD gave a mean result of 17% below that of the Asatoor and King's method. This is comparable to a discrepancy of 15% reported by Schersten. Jarrett, Keen and Handwick (1970) found that the ARMD method is not as reproducible as the autoanalyser technique: by the ARMD method 11 of 48 replicates differed by more than 10 mg./100 ml. compared with one of 13 replicates using the autoanalyser. Like the other reported series, we found no discrepant values using the ARMD method which might have led to serious clinical error.

There are many clinical situations where the ARMD system would be of value. Its role in the diabetic clinic, both inside and outside the hospital, is obvious; providing almost instant blood sugar measurements to monitor diabetic control and determine changes in the patient's treatment. It can provide immediate differentiation between hyperglycaemic and hypoglycaemic coma. In the routine diagnosis of glycosuria, both inside and outside hospital, the ARMD system can provide much economy of time and cost. Its usefulness in field work has yet to be exploited.

If wider usages of the ARMD method confirm its reliability, it can be concluded that it is an important contribution to progress in diagnosis and management of diabetes.

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