Rapid detection of neonatal hypoglycaemia

Evaluation of Dextrostix Reflectance Meter system

The use of Dextrostix Reflectance Meter (DRM)* to measure blood glucose has been reported recently. The method has proved to be simple, rapid, and accurate, and to correlate well with various reference methods (Mazzaferri *et al.*, 1970; Jarret, Keen, and Hardwick, 1970; Scherstén, 1971; Deckert and Futtrup, 1971). The handiness of the DRM seemed to make it an excellent tool in the diagnosis of neonatal hypoglycaemia, and for this reason the DRM system was evaluated in the newborn under conditions of daily nursery use.

Material and methods

Capillary or venous blood was taken repeatedly during the first 48 hours of life from infants referred to the neonatal unit for various clinical conditions, such as low birthweight, respiratory distress syndrome, and maternal diabetes mellitus. In addition to this, capillary blood was obtained from normal newborn infants in the maternity ward on the first or fourth day of life. Blood was collected simultaneously for immediate glucose determination by a glucose oxidase method (Marks, 1959). Readings on the DRM above 70 mg glucose/100 ml blood were excluded from the study, as our primary interest was to evaluate the method in the low blood glucose range. 264 determinations by DRM were made in 106 infants by three observers.

Results and comments

The blood glucose values measured simultaneously in 28 infants with the DRM and the glucose oxidase method are compared in Fig. 1 which shows that the DRM underestimated the blood glucose values as given by the reference method. As a consequence, 9 infants out of 24 with blood glucose concentrations above an arbitrarily chosen level, 30 mg/100 ml by the reference method, had lower values according to the DRM, i.e. were false positives with respect to hypoglycaemia.

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FIG. 1.—Correlation between blood glucose concentrations (mg/100 ml) measured by DRM (ordinate) and glucose oxidase method (abscissa). The solid line represents the regression equation $y = 3.5 + 0.56x$, $SE = 6.3$, $r = 0.84$.

By chance, it was observed that the back of the standardization strip gave a constant reading of 18 mg/100 ml on the low range scale when inserted in the calibration slit of the instrument. As we thought that a separate standardization strip for this scale would improve the correlation between the DRM and the glucose oxidase method, we used the back of the ordinary standardization strip to calibrate the instrument.

The closest agreement between the DRM and the glucose oxidase method was obtained when 34 mg/100 ml was used as the calibration point. The results are shown in Fig. 2 where the blood glucose values by the two methods were compared in 59 individuals. Obviously the DRM no longer underestimated the blood glucose values, which also is reflected by its improved capacity for discovering infants with hypoglycaemia. Among 59 infants only 1 out of 56 with blood glucose levels above 30 mg/100 ml according to the reference method was classified incorrectly by the DRM as having a blood glucose level below this value. 3 infants with blood glucose concentration below

FIG. 2.—Correlation between blood glucose concentrations (mg/100 ml) measured by DRM after modified calibration and glucose oxidase method. The solid line represents the regression equation $y = 8.3 + 0.88x$, $SE = 6.6$, $r = 0.81$.

30 mg/100 ml were classified correctly by the Reflectance Meter.

Before and after changing the calibration point from 110 to 34 mg/100 ml, a pair of special calibration strips (provided by the courtesy of the manufacturers) with reference values of 10.5 and 54 mg/100 ml, respectively, were used as a control of the instrument. When the Reflectance Meter was calibrated at 110 mg/100 ml, these strips gave readings of 10.5 and 50 mg/100 ml, respectively, indicating that the instrument worked correctly. When the calibration point was changed to 34 mg/100 ml, the strips gave readings of 30 and 80 mg/100 ml, respectively.

The demand for exact timing of the colour reaction as stressed by the manufacturers seemed to be less important at blood glucose levels below 40 mg/100 ml. Departures of 5 to 10 seconds from the suggested 60 seconds reaction time gave readings which did not differ significantly from readings obtained from the same samples when the reaction was timed exactly at 60 seconds.

The difference between repeated DRM determinations made on one individual simultaneously averaged 2 mg/100 ml. However, sometimes widely diverging values were encountered. Defective strips, e.g. unusually narrow ones, gave too low readings; in other instances the blood on the strip coagulated and therefore was difficult to

remove; sometimes no reason for a strip giving a different reading could be found.

Estimating the colour of the Dextrostix reagent strip by eye has been proposed as a screening test for neonatal hypoglycaemia (Chantler, Baum, and Norman, 1967). However, there still remains the difficulty of differentiating between glucose concentrations below 40 mg/100 ml, though other investigators have tried to overcome this by a modification of the reagent strip method by using a drop of plasma and a colour chart prepared from plasma of known glucose concentrations (Swiatek, Luebben, and Cornblath, 1969). According to our experience the unmodified DRM does not seem significantly better than the Dextrostix reagent strip for detecting neonatal hypoglycaemia. A method that underestimates blood glucose levels, may, admittedly, be valuable for screening purposes, but for the rapid, cot-side diagnosis of hypoglycaemia in the newborn with suggestive signs, a more accurate method is preferable. Such a method is offered by the DRM when the low-range scale is calibrated adequately against a pertinent clinical material using an established laboratory method. The back of an ordinary standardization strip provided by the manufacturers is useful for calibrating the instrument accordingly.

We encountered several infants with cyanosis or convulsions where the DRM, after modified calibration, correctly showed normal blood glucose levels and hypoglycaemia could be excluded as a cause of the symptoms.

The method is easy, rapid, and reproducible even in the hands of different observers, provided that one keeps to a standardized procedure. Strips giving divergent results were found often enough to warrant duplicate determinations. It is advisable to control the performance of the instrument with blood from newborns against an established laboratory method before the DRM is used routinely in the newborn nursery.

Summary

The performance of the Dextrostix Reflectance Meter in measuring blood glucose in the newborn was evaluated in 106 infants. The DRM proved to underestimate the blood glucose levels considerably and consequently to overdiagnose hypoglycaemia. Using the back instead of the front of the standardization strip in the calibration of the instrument, the agreement between the DRM and the reference method improved, as did the capacity of the DRM for differentiating hypoglycaemia from normoglycaemia. It is concluded that the

DRM provides an easy and rapid method for detecting hypoglycaemia in the newborn. However, before the DRM is used routinely in the newborn nursery the instrument should be calibrated adequately using blood of known glucose concentrations.

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Massive diastematomyelia without cutaneous dysraphism

None of the 41 cases of diverse forms of diastematomyelia discussed by James and Lassman (1972) revealed a massive buttress of bone like that encountered in the case we wish to describe. Usually there was either a bony or cartilaginous spur, or simply a fibrous septum. In only one of the 41 patients did the spinal cord remain split instead of uniting below the spur. Only one other such occurrence was reported by Williams and Nixon (1957). Our patient was a boy 22 months old, who had no external cutaneous dysraphism.

Case report

A boy was born on 30 December 1969 by caesarean section, weighing 3.7 kg. His feet were deformed. There was no skin defect but there was a kyphotic

prominence of the lumbosacral region. There was a central softness on palpation, suggesting a very extensive spina bifida occulta. There was no external dysraphism. It was noticed later that the left leg was shorter and generally thinner. The feet were manipulated. Later, plaster of Paris was applied to the whole of the left leg and foot.

On account of the progressive weakness of the left leg and the onset of minimal weakness of the right leg, the infant was referred to our department on 27 October 1971 at the age of 22 months.

Neurological examination disclosed a hypotonic left leg with generalized atrophy of all groups of muscles, including the left buttock. Tendon reflexes on the left were absent as well as the plantar and scrotal reflexes. The right leg had slightly increased tonus, possibly not significant because the tendon reflexes, though very brisk, were similar to the reflexes of the upper limbs, and the plantar response was flexor. Abdominal reflexes were present and symmetrical. Sensation to pin-prick was not possible to ascertain accurately, but there appeared not to be any overt defect.

X-ray examinations.

Skull and chest. No lesion seen.

Intravenous pyelogram. Evidence of a bifid renal pelvis on the right side was coupled with a slight fullness of the calyces of the left kidney.

Dorsal and lumbar spine. There was a spina bifida occulta involving the lower two dorsal vertebrae as well as all segments of the lumbar vertebrae and of the sacrum. The bodies of L4 and L5 were fused. On the left side of the spinal canal a large bony ridge was made up of the fusion of the remnants of the arches of L2, 3, and 4, while a massive bony buttress arose from the posterior aspect of the fused bodies of L4 and L5, extending as far as the first segment of the sacrum.

Cisternal myelography (under G.A.). An injection of 5 ml iophendylate by the cisternal route showed an extension of the theca and the subarachnoid sac into the lower segments of the sacrum and suggested a marked thickening of the filum terminale (see description of operation). A large central filling defect was present in the column of contrast, corresponding to the bony buttress seen on the spinal x-rays and dividing the spinal canal into two lateral channels (Fig. 1). The bony defect could not have been separated from the spinal cord, which appeared to be split in two and tethered within the lower sacral theca.

Operation (2 November 1971). A midline incision from the upper lumbar to the midsacral region was employed. On the right side of the bony buttress there was no remnant of any lamina and the theca was only separated from the skin by a layer of fat. On the left side there was a bony bridge, the mis-shapen L4 lamina between the lateral wall of the spinal canal on the central buttress. When this was removed the left half