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Point of Care Estimation of Blood Glucose in Neonates

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Prolonged hypoglycemia in newborn infants is associated with adverse neurodevelopmental consequences. Therefore, in 1996, the American Academy of Pediatrics recommended routine screening in newborn units which take care of infants at risk for hypoglycemia [1]. The optimum method for measuring blood glucose is laboratory estimation of plasma glucose. Laboratory analyzers use a number of different enzymes to measure glucose eg, glucose oxidase, hexokinase or glucose dehydrogenase. These measure plasma glucose and are less affected by interference by metabolites, are not affected by hematocrit and are considered the gold standard for clinical measurement of glucose levels. The major issues with laboratory based testing are need of a larger volume of blood, non availability of results quickly enough for timely appropriate treatment and errors associated with delayed estimation [2].

Therefore 'point of care' (POC) testing is often used for measurement of whole blood glucose concentration in neonatal intensive care units. Point of care testing is defined as any analytic testing done outside a designated laboratory space. It has several advantages like rapid turnaround time, reduced blood volume requirements, and clinical utility over traditional laboratory-based testing and is especially well suited for acute care settings such as the neonatal intensive care unit. Accuracy studies have shown that their results correlate well with laboratory measured plasma glucose in the normoglycemic and hyperglycemic range, but are not satisfactory in the lower range. This is understandable as the currently used glucometers were initially developed for glucose monitoring in adult patients with diabetes. However, our main concern in newborn babies is the low blood glucose range [3].

As there are accuracy issues with the simple convenient bedside POCT devices, many workers have tried to compare these with the gold standard laboratory estimation. When analyzing the performance of glucometers in the hypoglycemic range, glucometers are required to perform to the standards of the US National Committee for Clinical Laboratory Standards (NCCLS) or the American Diabetic Association (ADA). In 1994, the ADA recommended that a glucometer should achieve a total error (system + user) of less than 10% for the plasma glucose concentration range 1.6–22.2 mmol/L (30–400 mg/dL). NCCLS in 1994 ascertained that for glucose concentrations less than 5.5 mmol/L (100 mg/dL), discrepancies should be no more than 0.83 mmol/L (15 mg/dL) [4].

In recent years, numerous studies have been published analyzing the accuracy of glucometers specifically in the setting of neonatal hypoglycemia. Ho, *et al*. [5] reported on the sensitivity and negative predictive value of 5 glucometers in detecting neonatal hypoglycemia. They found that not even 1 of the 5 was able to meet the ADA standards, whereas 2 of the devices were able to meet the NCCLS standards. Khan, *et al*. [6] compared 7 glucometers and reported agreement between glucometer readings in the hypoglycemic range but found wide discrepancy in the correlation between reference and POCT devices both in the hypo and hyperglycemic range to the tune of 60%. The study by

Ngerncham, *et al.* [7] appearing in this volume of the journal too has used an elegant split sample design and meticulously compared OneTouch SureStep Hospital Test Strips (photometric glucose oxidase system) with a Nova StatStrip (modified glucose oxidase based amperometric system) using Roche Modular P 800 for the reference laboratory measurement. Another recent study reported good correlation as well as recommended their use in neonatal clinical practice [8]. All these studies highlight that POC devices may be used as screening devices for neonatal hypoglycemia, but confirmation of hypoglycemia with laboratory measurement of plasma glucose is still crucial.

It needs to be realized that laboratory estimation too is fraught with preanalytical (sample collection, transport and physiological factors) errors. POCT devices are prone for both pre-analytical and analytical errors (precision of the device being used). The comparison of POCT devices with laboratory sample which has been poorly processed can lead to erroneous estimation of discrepancy where little or none may exist. Any further studies on comparison of POCT devices with reference standard should focus on comparing improved second generation POCT devices with a reference laboratory device taking utmost care to ensure precise laboratory estimation without any processing delays and fall in glucose secondary to glycolysis.

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