Beta glucuronidase and hyperbilirubinaemia in breast fed infants of diabetic mothers

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Abstract
A prospective study was performed comparing bilirubin concentrations in 10 breast fed term infants of diabetic mothers (IDM) to those of 10 breast fed normal term infants. The β-glucuronidase concentrations in serum and breast milk were assayed in the respective mothers. Significantly higher bilirubin concentrations were noted in the IDM group. Serum and breast milk β-glucuronidase concentrations were significantly higher in diabetic mothers as compared with those of non-diabetic mothers. We suggest that the high concentration of β-glucuronidase in breast milk of diabetic mothers is an additional important cause leading to hyperbilirubinaemia in their breast fed infants.

Hyperbilirubinaemia is observed more frequently in infants of diabetic mothers (IDM) than those of non-diabetic mothers. Although a number of hypotheses have been suggested, the pathogenesis remains uncertain. To our knowledge, there are no previous reports describing the relationship between breast feeding and hyperbilirubinaemia in IDM.

Neonatal intestinal β-glucuronidase antagonises the net clearance of bilirubin by increasing enterohepatic circulation causing increased serum bilirubin. In 1986, Gourley and Arend reported that the β-glucuronidase present in maternal milk is an important factor in breast milk jaundice. In a previous report higher values of serum β-glucuronidase were found in pregnant diabetic women in comparison with non-diabetic women.

In the present study we have examined the hypothesis that the increased concentration of breast milk β-glucuronidase in diabetic mothers may be an additional cause of hyperbilirubinaemia in their breast fed infants.

Patients and methods
Ten breast fed IDMs and their mothers were examined. All the diabetic mothers were insulin dependent, classes B and C, according to White’s classification of maternal diabetes.

A group of 10 breast fed term infants, of appropriate weight for gestational age, and their mothers served as a control group. All the infants in the study were born by spontaneous vaginal delivery. Babies with blood incompatibilities, sepsis, birth asphyxia, bruising, cephalhaematoma, and other obvious causes of neonatal jaundice were excluded. IDMs with hypoglycaemia treated with dextrose fluids orally or intravenously were not included in the study.

On the third postpartum day maternal serum and breast milk were collected and analysed for β-glucuronidase. Breast milk was collected with a manual pump and immediately deposited in an iced container. All serum and breast milk samples were kept at −20°C and thawed at room temperature before assaying.

The β-glucuronidase activity was assayed with phenolphthalein mono-β-glucuronide substrate (Sigma kit No 325) and was expressed in Sigma units at 56°C.

On the third day of life bilirubin was measured in the serum of all babies studied. This was done spectrophotometrically by the Advanced Bilirubin Stat-Analyzer Photometer model BR2.

Statistical analysis was performed using Student’s t test.

Results
Mean (SD) serum β-glucuronidase concentration was significantly higher in diabetic mothers (71·5 (23) Sigma/units) as compared with non-diabetic mothers (30 (10) Sigma/units) (p<0·0005, figure).

In both diabetic and non-diabetic mothers, breast milk β-glucuronidase concentration was significantly higher (640 (205) and 216 (70) Sigma/units, respectively) than in the serum (p<0·005, figure).

Birth weight was not significantly different between the IDMs (3760 (800) g) and the control group (3400 (300) g). The packed cell volume at the age of 24 hours was not significantly different between the IDMs (54·3 (9·4)) and the controls (53·3 (6·6)).

The mean (SD) peak of serum bilirubin concentration on the third day of life was significantly higher in IDMs (210·3 (107·7) μmol/l) in comparison with controls (123·0-3 (30·1-5) μmol/l).
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(66.7) μmol/l p<0.005). None of the normal (control) infants was treated with phototherapy in contrast to 50% treated in the IDM group. None of the IDM group had phototherapy before bilirubin estimation on day 3.

Discussion

Hyperbilirubinaemia is frequently observed in IDM.5–8 Although several mechanisms have been proposed to explain this clinical finding, the pathogenesis of hyperbilirubinaemia remains uncertain. The jaundice observed in the IDM was often attributed to biochemical immaturity of the liver of the IDM. Several studies have analysed morbidity carefully, according to gestational age, and have rejected this concept.9–12 The increased incidence of Coombs' positive ABO incompatibilities in IDMs has not been confirmed either.5 Polycythemia frequently observed in IDMs may well be the most important factor associated with hyperbilirubinemia. Venous packed cell volume above 0.65 has been observed in 20% to 40% of IDMs. Presumably the major stimulus for the enhanced red cell production is a state of relative hypoxia in utero.9 To our knowledge this is the first report which describes the association between breast feeding and hyperbilirubinaemia in IDMs.

The association between breast milk feeding and neonatal jaundice was first described in 1963.13 Recent studies have documented an increased incidence of hyperbilirubinemia in breast fed infants during the first week of life.14–16 Earlier studies reported that the onset of breast feeding jaundice occurred only at the end of the first week of life.17–20 Some studies have attributed breast milk jaundice to the inhibition of hepatic uridine diphosphate glucuronoyl transferase by the steroid pregnane 3α,20β-diol21–22 or to the increased concentration of lipoprotein lipase and non-esterified long chain fatty acids in human milk.23 Recently, Gourley and Arend reported the β-glucuronidase in maternal milk is an important factor facilitating intestinal reabsorption of bilirubin in breast fed infants, thus increasing the concentration in the enterohepatic circulation.9

Previous studies reported higher values of serum β-glucuronidase in pregnant diabetic women in comparison to non-diabetic ones.24 We found significantly higher concentrations of serum β-glucuronidase in diabetic mothers in comparison with non-diabetic ones, thus delivery does not have an immediate direct effect on decreasing the serum β-glucuronidase value. Our finding is in accordance with that of Gaffney et al confirming that concentrations of β-glucuronidase in breast milk are much higher than those in the serum.25 As the concentration of β-glucuronidase was significantly higher in the breast milk of diabetic mothers, we assume that the amount in breast milk is in direct relationship with that in the serum. Because no significant differences were noted in the birth weight, packed cell volume, ABO and Rh incompatibility, and abnormal thyroid or liver function in IDMs compared with controls studied, we suggest that the significantly higher serum bilirubin concentration observed in the IDMs may be attributed to the higher concentrations of β-glucuronidase in maternal milk.

In conclusion we suggest that the higher concentrations of breast milk β-glucuronidase in diabetic mothers may be an additional important cause leading to hyperbilirubinemia in the breast fed IDM by enhancing the amount of bilirubin in the enterohepatic circulation.