ERYTHROCYTE TRANSKETOLASE ACTIVITY IN BLOOD OF MOTHERS, UMBILICAL CORD AND NEWBORN BABIES IN THAILAND

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Simultaneous determinations of erythrocyte transketolase activity in maternal umbilical cord and newborn baby's blood of 60 full term healthy women from a low socioeconomic group of Bangkok were conducted. Forty-two percent of the women were found to be deficient as judged from thiamine pyrophosphate (TPP) effect. The erythrocyte transketolase activities in umbilical cord and newborn baby's blood were significantly higher than those in maternal blood. During the neonatal period, the thiamine status was normal even though the mother was considered to have a deficiency. The importance of thiamine supplementation to lactating women is discussed.

In Thailand, thiamine deficiency is becoming a serious public health problem as the mortality rate of infantile beriberi is relatively high (1). Studies on the concentration gradient of thiamine across the placenta have been conducted, both in guinea pigs (2) and human subjects (3), by measurement of free thiamine concentration in maternal and cord blood. BRIN (4) has developed an enzymatic method for the assay of transketolase activity in the haemolysate of red blood cells. This enzyme is associated with the glucose oxidative pathway and requires the coenzyme, thiamine pyrophosphate (cocarboxylase), for its function. The test has been employed in nutrition surveys and experimental studies, in patients with beriberi and heart disease. It appears to be a convenient, specific and sensitive index of the level of body thiamine (4-7), although a lack of correlation between erythrocyte transketolase activity and blood thiamine concentration has been noted by LEEVY and his associates (8).

The present paper reports an investigation of the status of the erythrocyte transketolase activity in maternal, umbilical cord and newborn baby's blood of subjects belonging to a relatively low socioeconomic group in Bangkok, in order

to understand the role of pathophysiology in infantile beriberi.

MATERIAL AND METHOD

Sixty normal pregnant Thai women who came for confinement at the Women's Hospital in Bangkok served as subjects. They belonged to a relatively low socioeconomic group. Maternal and newborn baby's blood were drawn simultaneously in heparinized unbore calibrated capillaries from the fingertip within 24 hr after labour. Umbilical cord blood was taken immediately after delivery. Twenty microliter of packed red blood cell from each capillary tube were haemolysed by saponin for haemolysate. Forty microliter of haemolysate were determined for transketolase activity by the method devised by the HOFFMAN-LA ROCHE Laboratory (9). The increase of enzyme activity of samples incubated with thiamine pyrophosphate (TPP), as compared with those without TPP, is expressed as per cent stimulation (TPP effect).

RESULTS

The erythrocyte transketolase activity of the maternal, umbilical and newborn baby's blood of 60 subjects were determined. The mean values of the TPP effect of these erythrocyte transketolase activity are shown in Table 1.

Table 1. The mean values of the TPP effect of maternal, cord and newborn baby's blood in 60 subjects.

Test	Maternal blood	Umbilical cord blood	Newborn baby's blood
Mean Value	26.9%	10.9%	5.7%
S. D.	± 19.0	± 10.4	± 12.1
't' test mother vs cord; $p < 0.001$			
't' test mother vs baby; $p < 0.001$			
't' test cord vs baby; $p < 0.025$			

It was observed that there was a significantly higher thiamine level in both the umbilical blood and the newborn baby's blood than in the respective maternal blood, whereas a difference between umbilical blood and the newborn baby's blood was not so large.

The status of mothers could be classified into three groups, according to the value of TPP effect: adequate (TPP effect $< 15\%$), marginal (TPP effect $= 15-25\%$) and deficient (TPP effect $> 25\%$). The results are shown in Table 2.

It was found that only 33% of the group have adequate thiamine level.

It was found that in the group of mothers who have marginal and deficient statuses, the cord blood and the newborn's blood showed 60-75% and 87% of the

Table 2. Thiamine status of mothers according to the values of erythrocyte transketolase (TPP effect).

Thiamine status	No. of cases	%
Normal	20	33
Marginal	15	25
Deficient	25	42
Total	60	100

Table 3. Maternal thiamine status in comparison with the thiamine statuses of the umbilical cord and newborn baby.

Maternal status	Umbilical cord blood			Newborn baby's blood		
	Normal No.	Marginal No.	Deficient No.	Normal No.	Marginal No.	Deficient No.
Normal	16 (80%)	3 (13%)	1 (5%)	16 (80%)	2 (10%)	2 (10%)
Marginal	9 (60%)	4 (27%)	2 (13%)	13 (87%)	2 (13%)	0 (0%)
Deficient	19 (76%)	5 (20%)	1 (4%)	22 (88%)	2 (8%)	1 (2%)

normal, respectively. This may suggest that even though mothers have marginal or deficient thiamine statuses during the neonatal and prenatal periods, the first day newborn have normal thiamine statuses (see Table 3).

DISCUSSION

From the fact that erythrocyte transketolase activity and TPP effect of this enzyme are closely correlated, it is probable that the level of erythrocyte transketolase activity is higher in umbilical cord blood and also in newborn baby's blood, regardless of the thiamine status of the mother. Similar information can be obtained from the studies of TRIPATHY in Colombia (10). The findings are also in accordance with those of SLOBODY (8), who demonstrated higher levels of free thiamine in cord blood as compared with maternal blood.

In an acute perfusion study in guinea pigs (2), free thiamine was shown to have an active movement across the placental barrier against a concentration gradient, although it did so at a slower rate. From such studies, it seems reasonable to assume that the erythrocyte transketolase activity level in maternal and cord blood reflect the extent to which thiamine is available in respective sides of the placental circulation. However, at present no data are available on the mechanism of erythrocyte transketolase synthesis in the foetus, although the level of erythrocyte transketolase activity has been found to be in agreement with tissue thiamine concentration (11). Therefore, the level of erythrocyte transketolase

activity in a newborn baby may be due mainly to the net transfer of thiamine from the mother across the placenta, or by its synthesis in the foetus itself, or because of minimal utilization by the newborn baby.

From the results of these studies, it was also demonstrated that almost half (42%) of pregnant Thai women in Bangkok who come from a low socioeconomic group have evidence of severe thiamine deficiency, whereas only a third of the group are considered to be in the normal status, as estimated by their erythrocyte transketolase activity. This may explain the high prevalence of infantile beriberi in the Cardiac Unit, especially in those who are breast fed. As a preventive measure, a routine supplementation of thiamine or a B-complex preparation for lactating women, particularly those from a low income group, should be considered.

It was noticed that during the neonatal period, the thiamine status was found to be normal; however, most of the cases of infantile beriberi admitted to the Cardiac Unit are of ages 3 to 12 months. A follow-up clinical observation of how long such a biochemical abnormality will produce infantile beriberi after lack of or marginal intake of thiamine could not be conducted for reasons of medical ethics. In this respect, thiamine supplementation is advocated not only to the mother, but also to infants over 3 months of age, to prevent serious complications from thiamine deficiency in infancy.

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