Tyrosine and Its Metabolites in Urine and Serum of Premature and Mature Newborns: Increased Values During Formula Versus Breast Feeding

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Abstract. 90% of preterm and 10% of mature neonates are reported to have increased tyrosine levels in blood and urine when fed certain cow's milk formulas which are relatively high in protein compared to human milk. It has been suggested that sustained raised tyrosine levels in early infancy might result in decreased intellectual functions at school age.

We determined tyrosine by ion exchange and its parahydroxylated metabolites by gas chromatography as oxime-TMS derivatives. Mature neonates (n=30) on adapted cow's milk excreted significantly more (P<0.001) tyrosine, pHPLA, and pHPPA than control neonates (n=7) on human milk. Tyrosine levels in serum on adapted milk were high (17.5 vs. 6.6 μMol/100 ml) compared to human milk, as were pHPLA (7.6 vs. 3.7), pHPPA (1.8 vs. 0.3), and pHPPA (0.4 vs. nil). In premature (850 to 2500 g, n=40) fed milk with a higher protein content (2.3 g/100 ml), the excretion of tyrosine and its metabolites was significantly raised (P<0.005) when compared to those on human milk (n=7). Excretion was highest in the lowest weight group (850 to 1500 g, n=10), and decreased with increasing birth weight. The low values reached on human milk were not reached by artificially fed preterms. In 5 small neonates (850 to 1700 g) who were followed continuously over the first 7 weeks of life, there were no significant changes in the excretion of tyrosine and its metabolites with increasing age and weight up to 2500 g.

It is concluded that breast milk feeding in mature and premature newborns avoids an increase of tyrosine and its metabolites in serum with overspill into the urine.

Key words: Transient neonatal hyper tyrosinemia – Protein requirement – Feeding premature and term infants – Breast feeding.

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Introduction

The non-essential amino acid tyrosine is derived from dietary sources or from phenylalanine. Increased serum tyrosine levels were found in almost 90% of all premature infants (Menkes and Avery, 1963) and in 10% of all mature babies (Avery et al., 1967) on the high protein formulas widely used at the time. Thus increased values, which were never observed at a later age, were reached during a vulnerable developmental period. When fed such a high-protein formula the increase—as compared to normal values—was threefold or more in 1.5% of all the children investigated (Wong et al., 1967). In a study of 50 prematures, 28% had hypertyrosinemia when fed 2.3 to 5.32 g protein/kg/day (Bremer et al., 1960).

Tyrosine spills over into the urine and is excreted together with its para-hydroxylated metabolites, para-hydroxyphenyllactic acid (pHPLA), para-hydroxyphenylacetic acid (pHPAA), and para-hydroxyphenylpyruvic acid (pHPPA) (Levine et al., 1941). This condition has been named transient neonatal hypertyrosinemia (La Du and Gjessing, 1972). More than 4 mg/dl serum tyrosine may be called hypertyrosinemia, the degree being closely related to the dietary protein intake (Avery et al., 1967; Kretchmer, 1959, 1965).