

hydrocephalus. The cause of his symptoms was a pulsion diverticulum of the lateral ventricle, a rarity which does not usually figure in the differential diagnosis of this syndrome, though the history is characteristic of the few recorded cases.

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Thyroxine levels in normal newborn infants

It is well known that thyroxine (T_4) levels in the blood are higher in infancy than at any other time of life. This was shown in the papers of Danowski *et al.* (1951), Durham *et al.* (1954), and Pickering *et al.* (1958). These papers were based on the measurement of protein-bound iodine and butanol-extracted iodine in infants. O'Halloran and Webster (1972) measured thyroid function in Australian Caucasian babies during the first year of life. They used a technique involving a resin column, ^{125}I -labelled thyroxine, and a γ counter. This method of T_4 measurement is marketed in the form of Tetrasorb Kits (Abbott Laboratories), Tetralute Kits (Ames Company), and Thyropac 4 (Amersham Radio Chemical Centre). It is finding increasing favour in biochemistry laboratories as a method of estimating T_4 levels in the blood, for it is quick, easy, accurate, and uses only 0.1 ml serum. The method is attractive to paediatricians because it can be performed on heel prick samples of blood.

In view of the probable increased use of this test, a

study was done to define the normal range of T_4 levels in Caucasian neonates in Britain.

Methods

T_4 measurement was carried out on a series of venous and some capillary samples of blood. The estimations were carried out in the Fazakerley Hospital Biochemistry Department by one of us (D.W.) using a Tetralute Kit and a Thyrimeter Gamma Counter (Ames Company) according to the printed instructions. 30 samples of cord blood, 30 blood samples from 6-hour- to 44-hour-old babies, and 30 samples from 4- to 7-day-old babies were taken for T_4 estimations.

The infants in the trial were normal Caucasian term babies. Any complicating factor such as prematurity, small-for-dates status, jaundice, asphyxia, sepsis, etc., excluded the infant from the study. The only maternal complication allowed was an elective caesarean section for disproportion or because of a previous caesarean section. The samples were not taken serially from individual infants.

Results

The values of serum thyroxine in $\mu\text{g}/100$ ml blood were as follows. In 30 samples of cord blood the range was from 7.2 to 13.5 $\mu\text{g}/100$ ml. The mean value of the cord samples was 9.9 $\mu\text{g}/100$ ml and the normal range (mean ± 2 SD) was 6.1 to 13.7 $\mu\text{g}/100$ ml.

In 30 samples of blood from infants 6 to 44 hours old, T_4 values ranged from 13.2 to 19.6 $\mu\text{g}/100$ ml. The mean value was 16.6 $\mu\text{g}/100$ ml and normal range 13.4 to 19.8 $\mu\text{g}/100$ ml.

In 30 samples of blood from infants 4 to 7 days old, T_4 values ranged from 8.6 to 18.5 $\mu\text{g}/100$ ml. The mean value was 14.4 $\mu\text{g}/100$ ml and normal range 10.4 to 18.4 $\mu\text{g}/100$ ml.

Discussion

The cord blood values are similar to those found by O'Halloran and Webster (1972). The mean cord blood T_4 in our series was 9.9 $\mu\text{g}/100$ ml, which was lower than their mean value of 11.3 $\mu\text{g}/100$ ml.

The mean T_4 value of O'Halloran and Webster's 20 babies aged 0 to 13 days was 13.2 $\mu\text{g}/100$ ml. This is exceeded by the mean value of 14.4 μg of our 30 4- to 7-day-old babies. The mean T_4 levels of our 30 6- to 44-hour-old infants was even higher at 16.6 $\mu\text{g}/100$ ml.

Our findings are in keeping with the findings of Danowski *et al.* (1951) and Fisher and Odell (1969) who found that peak thyroxine levels occurred between days 1 to 4 of life. Fisher and Odell showed a marked increase in thyroxine stimulating hormone at this time. It can be seen that our

results show maximum T_4 levels at 6 to 44 hours, dropping by 4 to 7 days.

Perhaps the lower T_4 levels shown in O'Halloran and Webster's 0- to 13-day-old infants can be explained by most of their infants being nearer in age to day 13 than to day 1. They would then be less affected by the highest levels of thyroid-stimulating hormone on days 1 to 4.

Knowing the normal range of T_4 at 4 to 7 days (10.4 to 18.4 $\mu\text{g}/100$ ml) may be of value in suspected hypothyroidism, in hyperthyroidism, or where there is maternal thyroid disease, where there is maternal antithyroid drug taking, or where the family history suggests an increased chance of hypothyroidism. It is well known that many babies who are discovered to be hypothyroid later in the first year of life do not appear cretinous at birth.

More frequent T_4 measurement in neonates who are jaundiced, with further tests on those whose T_4 levels are below the normal limits described, should be carried out. This policy might detect more of these occult cretins before brain damage has occurred through lack of early thyroxine treatment.

Summary

A study of T_4 values in normal term British Caucasian neonates was made. Mean T_4 values and normal ranges were: (1) cord blood, mean 9.9 $\mu\text{g}/100$ ml, normal range 6.1 to 13.7 μg ; (2) infants

6 to 44 hours old, mean 16.6 $\mu\text{g}/100$ ml, normal range 13.4 to 19.8 μg ; (3) infants 4 to 7 days old, mean 14.4 $\mu\text{g}/100$ ml, normal range 10.4 to 18.4 μg .

This study was performed on normal infants in Fazakerley Maternity Hospital with the informed consent of their mothers, whom we thank. We also acknowledge the help and encouragement of Dr. Hudson, Consultant Paediatrician to Fazakerley Maternity Hospital, on whose patients the study was performed.

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