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T₃ RESIN UPTAKE IN
PROTEIN-CALORIE MALNUTRITION

By

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ABSTRACT

RT₃U³) is significantly elevated ($P < 0.001$) in the acute stage of kwashiorkor and returns to normal after 2 weeks of appropriate refeeding. RT₃U is characterized by a high negative correlation with TBGcap. This negative correlation is maximal on admission ($r = -0.88$) and gradually declines to normal value ($r = -0.63$) with clinical recovery. This finding is consistent with the main role attributed to TBG in determining RT₃U level.

The collected data emphasize the importance of the protein plasma levels in the evaluation of the thyroid function with RT₃U in protein-calorie malnutrition.

³) Abbreviations used

PCM: protein-calorie malnutrition.
SA: serum albumin.
TBPA: thyroxine-binding prealbumin.
TBG: thyroxine-binding globulin.
TBP: thyroxine-binding protein.
RT₃U: triiodothyronine resin-uptake.
$\text{FT}_4$: free thyroxine.
TBPAcap: thyroxine-binding prealbumin binding capacity.
TBGcap: thyroxine-binding globulin binding capacity.
RT₃U is routinely used in the evaluation of the thyroid function. This test provides an estimation of the availability of the thyroxine-binding sites on the serum T₄-carrier proteins: TBG (thyroxine-binding globulin) and TBPA (thyroxine-binding prealbumin). These carrier proteins are significantly decreased in children suffering from protein-calorie malnutrition (Ingenbleek et al. 1972, 1974). It was therefore of interest to ascertain to what extent the protein status could affect the RT₃U, and eventually, interfere in the assessment of the endocrine function.

**Patients and Methods**

Thirty-nine Senegalese children (age 18 to 30 months) suffering from severe PCM were included in this study. Dietary treatment was begun immediately upon admission. Blood samples were collected on admission (day 1) and at weekly intervals (day 8, 15 and 22) until nutritional recovery.

Serum albumin (SA) was measured after protein electrophoresis with the phoroslide system (Millipore Corp. Bedford, Mass., USA). TBPA was assessed by radial immunodiffusion (Partigen, Behringwerke AG, Marburg a/Lahn, West Germany) (Mancini et al. 1965). TBPCap and TBGcap were estimated by using reverse-flow paper electrophoresis in glycine acetate buffer at pH 8.6 (Ingbar & Freinkel 1960; Oppenheimer et al. 1963). The RT₃U test was performed with ¹²⁵I-T₃ diagnostic kits (Triosorb Abbott, North Chicago, Ill., USA) with time and temperature corrections (Tabern et al. 1967).

The normal group was composed of 28 healthy Senegalese children of the same age. Statistical analysis follows the recommendations of Snedecor & Cochran (1967).

**Table 1.**

<table>
<thead>
<tr>
<th>RT₃U and TBP in normal and PCM children (mean values ± sd)</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>RT₃U (mg/100 ml)</td>
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<tr>
<td>TBGcap (mg/100 ml)</td>
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<tr>
<td>TBPA (µg T₄/100 ml)</td>
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<td>SA (g/100 ml)</td>
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RESULTS

In the normal group (n = 28), the mean average value obtained for RT₃U and expressed in arbitrary units was 22.7 ± 1.95%. The results of albumin and TBPA concentrations and TBGₜₙ, are collected in Table 1.

A high negative correlation exists between RT₃U and TBGₜₙ (r = -0.63 and P < 0.001), a lower negative and non-significant correlation exists between RT₃U and TBPA and between RT₃U and TBPAₜₙ. No correlation was found between RT₃U and serum albumin (r = 0.04).

RT₃U and TBPA data recorded in the PCM patients (n = 39) are also shown in Table 1. On admission, RT₃U reached 35.1 ± 7.25%, a mean significantly higher (P < 0.001) than in the normal group. On day 8, RT₃U mean value was 25.9 ± 4.60% and remained significantly higher (0.05 > P > 0.01) than in the control group. From 15th day on until discharge, RT₃U mean values were no longer statistically different from the normal group.

RT₃U and TBGₜₙ always show a significantly high correlation. The correlation between individual values obtained for RT₃U and for TBGₜₙ on admission is given in Fig. 1.

![Correlation and regression line between the individual values obtained for RT₃U and TBGₜₙ on admission.](Image)

Fig. 1.

Correlation and regression line between the individual values obtained for RT₃U and TBGₜₙ on admission.
DISCUSSION

Protein bound T₄ is in equilibrium with a small fraction of physiologically active thyroxine, the free thyroxine (FT₄) (Robbins & Rall 1967; Oppenheimer 1968). FT₄ levels are directly proportional to the concentration of total T₄ and inversely proportional to the number of unoccupied binding sites on the TBP. Measurement of these unoccupied binding sites gives, therefore, an indirect approach of peripheral thyroid hormonal status. The validity of the RT₃U test depends finally on at least three factors: the total amount of binding sites on circulating TBP, the affinity of each of the three TBP for T₃ and the degree of saturation of these TBP among which TBG plays the major role (Oppenheimer 1968).

Our normal values for RT₃U (22.7 ± 1.95 %) in Senegalese children are significantly lower than those reported by other investigators in normal children aged 2 years (Murray et al. 1971; O’Halloran & Webster 1972; Fisher 1973). Our normal values for TBG cap (37.2 ± 4.51 μg T₄/100 ml) are significantly higher than those recorded in Belgian and North American children of the same age. (De Nayer et al. 1965; Fisher 1973). This finding is reminiscent of the description of an ethnic related TBG cap difference between black and white subjects (Starr & Nicoloff 1967).

In the acute stage of kwashiorkor, the mean average value for RT₃U is significantly higher than normal (P < 0.001) and is very well correlated with decreased TBG cap (r = −0.88). In the course of nutritional rehabilitation, the negative correlation between RT₃U and TBG cap remains high, although declining gradually. This evolution corresponds to a progressive restoration of TBG cap in malnourished children submitted to appropriate refeeding and is consistent with the main role attributed to TBG in determining the RT₃U level. A good correlation exists between TBG cap and TBG actual concentration as measured by radioimmunoassay (Levy et al. 1971).

Serum albumin and TBPA both present a low negative correlation with RT₃U on admission, which is notably accentuated on day 8 of the survey (r = −0.60 and −0.65, respectively). The existence of a higher negative correlation on day 8 could mean that during the first days of nutritional recovery, SA and TBPA play, by reference to TBG, a transitory relatively greater role in peripheral thyroid hormones binding.

High RT₃U values reflect a relative saturation of the TBP binding sites. The situation could be due to either to a decrease in TBP levels or to a relative increase in total T₄. In the latter case, a high RT₃U is associated with elevated FT₄ levels (Ingbar & Freinkel 1960; Robbins & Rall 1960). The former condition is encountered in partial or total TBG deficiency (Nikolai & Roberts 1969; Nusynowitz et al. 1971), and in androgen therapy (Federman et al. 1958): RT₃U is high but FT₄ values remain normal. In severe PCM, high RT₃U

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is also associated with low TBG which emphasizes the importance of serum protein levels in determining RT₃U. In this peculiar situation however, high RT₃U values are observed associated with FT₄ levels in the hypothyroid range, as the result of thyroid involution due to prolonged malnutrition.

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REFERENCES


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