

Plasma Adrenocorticosteroid Changes during Thyroxine-Induced Accelerated Maturation of the Neonatal Rat Intestine

The vacuolated villous epithelial cells of the terminal small intestine of the young rat take up antibodies and other macromolecules during the 18 days following birth. At this time there is a change in the appearance and function of the cells emerging from the crypts of Lieberkühn: both the characteristic vacuolation and the permeability to macromolecules disappear. As these more mature cells ascend the villi, the uptake of macromolecules such as ^{125}I PVP declines progressively to zero by 21 days after birth: a process termed 'closure'^{1,2}.

There is considerable evidence that the adrenal cortex is implicated in this phenomenon. Thus, exogenous glucocorticoids provoke precocious closure; there is an increase in endogenous corticosterone concentrations coincident with normal closure; and bilateral adrenalectomy will delay the process³⁻⁶.

Recent experiments have shown that closure can also be induced to occur early by daily injections of thyroxine⁷. Daily injections of thyroxine (T_4), unlike cortisone acetate which has an effect on PVP uptake within 24 h, have little action during the first 4-5 days administration, after which time however closure occurs in a manner which resembles the normal process (Figure 1A).

The present experiments were undertaken to determine whether thyroxine-induced closure involved the adrenal cortex, by measuring the plasma corticosterone concentrations in control rats and rats receiving T_4 , 2 $\mu\text{g/g}$ body $\text{wt}^{-1}\text{day}^{-1}$. From Figure 1B it will be seen that the plasma corticosterone concentrations in T_4 -treated rats began to

increase progressively above the relatively stable control values until, on day 13 when closure was complete, the concentration was similar to that seen at the comparable stage during normal closure (20-21 days).

From these results we suggest that the early maturation of the intestine promoted by exogenous thyroxine may be brought about via the adrenal cortex. The dose of thyroxine administered in these experiments was $100\times$ the daily secretion rate calculated by BELTZ and REINEKE⁸. Preliminary experiments with injection of 1/10 of the dose of thyroxine from day 15-day 12 ($0.2 \mu\text{g/g}$ body $\text{wt}^{-1}\text{day}^{-1}$) have demonstrated a significant increase in plasma corticosteroid concentrations and a 40% decrease in PVP uptake compared with control animals fed on day 13. In the newborn rat, plasma thyroxine concentration increases significantly between days 9-11 and days 13-14 (A. L. THOMAS, unpublished observations). This is 5 days before PVP uptake begins to decrease. In species in which closure occurs within the first few hours of birth such as the calf and the lamb, the post-natal pattern of plasma thyroxine concentration is very different from that in the rat: plasma thyroxine is highest at the time of birth and falls in the first few days of life in both the calf and lamb^{9,10}. The physiological role of thyroid activity in natural closure remains to be established¹¹.

Résumé. L'intestin des rats nouveau-nés peu absorber des macromolécules pendant les 18 premiers jours. L'arrêt de cette absorption («la clôture») est accompagnée d'une augmentation significative de la concentration du corticostéroïde du plasma sanguin. Du 5e au 12e jour, l'administration de 2 μg de thyroxine par g de poids corporel ($\text{wt}^{-1} \text{day}^{-1}$), eut pour résultat une augmentation des concentrations de plasma stéroïde et la «clôture» prématurée de l'intestin avant le 13e jour.

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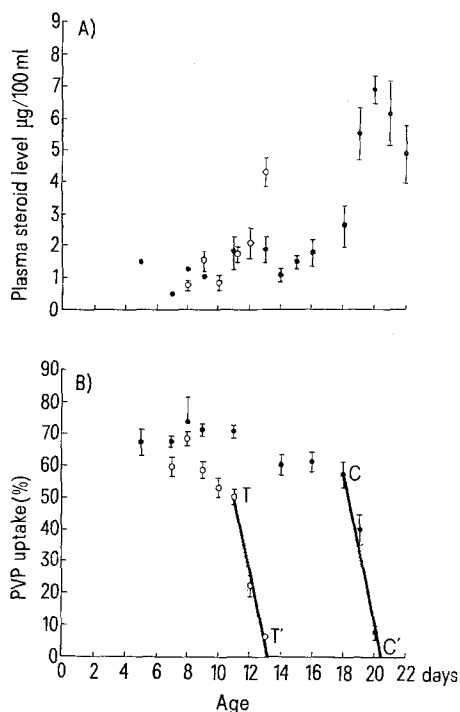


Fig. 1. A) plasma steroid concentration and B) PVP uptake in the newborn rat. Normal control animals (\bullet) are compared with animals receiving thyroxine, 2 $\mu\text{g/g}$ body $\text{wt}^{-1}\text{day}^{-1}$ (\times). Vertical bars indicate standard error of mean where this exceeds the dimensions of the plotted point. Regression lines were derived by the method of least squares (T-T'; thyroxine-treated animals, 11-13 days inclusive; C-C' control animals, 18-20 days inclusive). Abscissae, age in days; ordinates, A) plasma steroid concentration and B) % PVP uptake^{1,2}.

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