

Hypophysectomy abolishes sexual dimorphism of liver carbonic anhydrase III

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Hypophysectomy was found to have no effect on the concentration of carbonic anhydrase III (CAIII) in male rat liver, whereas in the female, CAIII was elevated 10-fold, to male levels.

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1. INTRODUCTION

Carbonic anhydrase III (CAIII) is a well characterized isozyme occurring in the skeletal muscle of many different species [1,3,4,8,11], and has recently been shown to occur at high levels in male rat liver, in contrast to markedly lower levels in the female [2,12,13]. Castration of male rats reduces the CAIII concentration in the liver and addition of testosterone to these animals causes the CAIII levels to approach but not reach those in normal males [13]. The effect of testosterone on female rats is to increase the CAIII concentration in the liver, but not up to the male level [13]. To determine whether CAIII regulation by androgens involved the pituitary, male and female rats were hypophysectomized and the concentration of CAIII in liver was measured.

2. MATERIALS AND METHODS

2.1. *Animals*

Age- and weight-matched albino Wistar rats from Charles River (Manston, Kent) were fed ad libitum and housed at 22°C in artificial lighting (12 h light; 12 h dark). Hypophysectomy was carried out by Charles River. Serum testosterone levels were measured by radioimmunoassay as described previously [15].

2.2. *Radioimmunoassay of CAIII*

Rabbit antiserum to purified rat liver CAIII was prepared as described previously [2]. Cytosols were prepared from perfused livers [5] and CAIII was detected by a sensitive and specific radioimmunoassay [14]. Protein concentration in liver cytosols was determined by the method of [6] using bovine serum albumin as standard.

3. RESULTS AND DISCUSSION

The effect of hypophysectomy on the concentration of CAIII in male and female rat liver is shown in table I. Male rats exhibit no difference in the concentration of CAIII in the liver after

Table 1

Effect of hypophysectomy on CAIII concentration in rat liver

Treatment of animal	CAIII (mg/g soluble protein) \pm SE
Normal male control (4)	40.7 \pm 5.4
Hypophysectomized male (7)	50.8 \pm 5
Normal female control (4)	4.4 \pm 2.6
Hypophysectomized female (4)	52.8 \pm 5.5

Rats were left 90 days after hypophysectomy before they were killed and the livers perfused and excised

hypophysectomy compared to age-matched controls, even though the serum testosterone levels are undetectable after removal of the pituitary. The difference in the two groups of females is dramatic. Hypophysectomy increased the concentration of CAIII in the liver of female rats to 10 times those in the control group and up to the level found in intact males. Thus, it appears that in female rats it is the pituitary which is responsible for controlling CAIII synthesis, and current research suggests that it may well be the pattern of growth hormone (GH) released by the pituitary which is responsible for the 'feminization' in rat liver [7,9,10]. Although the most widely accepted model for the action of sex steroids is that the steroid hormone binds to a specific soluble cytoplasmic receptor in the target tissue, it is now apparent that in the liver this may not be the case [7,9,10]. Rather, it appears that an episodic release of GH in male rats, with long periods between peaks when serum GH is zero, leads to one pattern of enzyme synthesis, while a continuous release of GH produces a female pattern [10]. If this is so, it would explain why hypophysectomy of male rats has no effect on CAIII concentration in the liver, as GH will be permanently at zero levels. In contrast to the absence of any effect on male rat liver, CAIII concentrations after hypophysectomy, reduction of serum testosterone by castration reduces liver CAIII to about 25% of the controls [13]. This difference can be explained by the fact that in male rats with an intact pituitary, castration alters the GH pattern to that seen in female rats [7].

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