Neuroendocrine Function in Long-Term Pinealectomized Male Rats, Following Visual and Audiogenic Stress

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Summary

Intact, sham-pinealectomized and pinealectomized adult male rats were maintained for 10 weeks on a light : dark (L : D) cycle of 12 : 12, with lights on at 6 a.m. Subsequently they were acutely exposed to (1) visual or (2) audiogenic stress for periods of 2 or 30 min, immediately following which they were decapitated and serum ACTH, corticosterone, FSH, LH, PRL and TSH concentrations were determined. Serum ACTH and corticosterone levels were similar in control and operated groups following both types of stresses. Serum FSH and LH concentrations were elevated in pinealectomized animals as compared to controls, following 30 min of exposure to visual stimulation; no difference in these parameters was observed between the groups following audiogenic stress. Serum PRL levels tended to be lower in pinealectomized animals following both stresses. Serum TSH concentrations following visual stimulation were similar in all groups, but audiogenic stimulation resulted in elevated TSH levels as compared to controls. These data demonstrate that the pineal gland plays an integral role in the responses of the parvicellular neuroendocrine axes to acute neurogenic stress. Possible molecular bases for this involvement are discussed.

Introduction

Basal synthetic and secretory activities of the hypothalamo-adenohypophyseal neuroendocrine axes are drastically altered upon acute stress exposure (Krulich et al., 1974; Libertun and McCann, 1976;
Usategui et al., 1976; Siegel et al., 1979 a). Specific neural pathways are involved in the transmission of diverse sensory information to the medial basal hypothalamus, and the total neuroendocrine response to a given stress situation is selective (Meites et al., 1973; Libertun and McCann, 1974; Conforti and Feldman, 1976; Siegel et al., 1979 b).

The mammalian pineal gland functions as a neuroendocrine transducer. It is influenced by environmental lighting (Herbert, 1971; Fiske, 1975), and by olfactory (Milne et al., 1963; Reiter and Ellison, 1970) and auditory (Dafny et al., 1975) cues. Furthermore, the biochemistry of the epiphysis is subject to the overall sympathetic tone of the organism (Lynch et al., 1973), and elevated adrenomedullary secretion is an integral part of the mammalian stress response (Callingham, 1975).

The details of pineal modulation of the parvicellular neuroendocrine axes are incompletely understood. Although this gland is a modifier of the function of at least some of these axes in certain sensory conditions, we have observed that 70 days following pinelectomy the adult male rat is capable of maintaining normal adenohypophyseal secretory activity under resting conditions (Siegel, unpublished data). This has prompted us to investigate whether the presence of a functional pineal gland is necessary in order that the adenohypophyseal response to two stress situations, to which the pineal itself is responsive, be normal. We therefore estimated serum ACTH, corticosterone, FSH, LH, PRL and TSH concentrations, in intact and in 70-day sham-operated and pinealectomized male rats, following acute exposure to visual and audiogenic stimulation.

Materials and Methods

The experiments were performed on male rats of the Hebrew University strain, aged 3 months at the start of the investigation. They were divided into 3 groups: (1) intact controls; (2) sham-operated controls; (3) pinealectomized animals—the operation was performed according to the method of Hoffman and Reiter (1965). The rats were maintained, 6 per cage, at 22—23 °C, under a lighting schedule of L : D 12 : 12 (light on at 6 a.m.).

Ten weeks following the start of the experiment the animals were exposed to one of two types of stress:

a) Acute visual stress: The animals were exposed, in a dark room, to a bright light, flashing at a frequency of 4 flashes/sec. Duration of the stress exposure was 2 min or 30 min.

b) Acute audiogenic stress: The animals were exposed to a bell, ringing at 109 db, again for either 2 min or 30 min.

Immediately upon termination of a given stress exposure, the animals were decapitated and trunk blood was collected for hormone determinations.