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Catecholamine-containing axons and cell bodies in the hypothalamus of squirrel monkeys

par J. BARRY

Summary. High concentrations of catecholamine-containing axons have been observed with the Falck-Hillarp technique in the hypothalamus of squirrel monkeys, namely in the periventricular area, preoptic nucleus, arcuate nucleus, premammillary area and dorsal medial nucleus.

Catecholamine-containing cell bodies were not found routinely in all animals but have been observed in some of them within the medio-basal hypothalamus and the posterodorsal and rostral hypothalamic areas. This topography suggests that of the A12, A13, and A14 groups, previously described in other mammalian species.

Introduction

Monoamine distribution within the central nervous system of primates has been the subject of extensive investigations (Battista et al., 1972; Nobin and Björklund, 1973; Felten, 1973, 1976; Hoffman, Felten, and Sladek 1976; Ishikawa and Tanaka, 1977). However, very few data are available on the hypothalamic topography of monoamine-containing cell bodies.

On the other hand, numerous reactive perikarya of LH-RH neurons have been characterized in various species of monkeys, using immunsera against synthetic conjugated or unconjugated luteinizing hormone-releasing hormone (LH-RH) (Barry and Carette, 1975; Zimmerman and Antunes, 1976; Silverman et al., 1977; Hoffman et al., 1978; Barry and Croix, 1978).

The aim of the present research was to compare the distribution of reactive LH-RH neurons with that of catecholamine-containing axons and cell bodies in the hypothalamus of squirrel monkeys under physiological conditions, and the topography of catecholamine-containing cell bodies with that observed in other mammalian species.

Material and methods

Five young adult female squirrel monkeys (Saimiri sciureus) having an average weight of 500 to 600 g were supplied by Primate Imports Corp. (New York, USA) for
this study. They were killed at 2 p.m. and the brains quickly removed. The thin dissec-
ted specimens were frozen in propane, prechilled in liquid nitrogen and examined
histochemically, using the technique of Fack et al. (1972). The blocks were freeze-
dried for 2 weeks in a Pearse Speedivac Tissue Dryer and treated for 1 to 3 hrs. at
80 °C with Merck formaldehyde (relative humidity 80 p. 100). After embedding in
paraffin in vacuo, 10 to 20 μm thick specimens were cut in the sagittal plane; the
sections were then mounted on slides with Merck entellan and studied under a Zeiss-
fluorescence microscope fitted for reflection.

Results

Catecholamine-containing axons were observed in great number in the periven-
tricular area (thick varicosities), the preoptic periventricular area, the arcuate
nucleus (fine, medium and thick varicosities, fig. 1), the medial preoptic nucleus (fig. 2),
the premammillary area and the dorso-medial nucleus. Varicosity density was higher
in the caudal two-thirds of the arcuate nucleus, where the varicosities frequently
displayed a pericellular arrangement (figs. 1, 3). In the median eminence there was a
weak fluorescence at the level of the external contact zone (with a slight increase from
the rostral to the caudal part) and around the deep vessels. Some brightly fluorescent
varicosities could be seen at some distance from these vessels.

Catecholamine-containing cell bodies were not found routinely but, in 2 animals
their number was sufficient to determine their topography. The majority of these cells
(figs 3-6) were scattered within the medio basal hypothalamus, from the retrochiasmatic
area (fig. 4) to the post-infundibular eminence. Thick varicosities sometimes terminated
close to some of these cell bodies (figs. 5, 6). In our material some catecholamine-
containing cell bodies were also observed in the postero-dorsal area and in the rostral
periventricular area. All these cell bodies showed a weak to medium fluorescence of
the dopaminergic type; they were scattered throughout a wide area and could be
classified into three main groups (fig. 7).

FIG. 1. — Catecholamine-containing axons of the medio-basal hypothalamus. Note the thick varicosities
(simple arrows) and the medium sized varicosities (double arrows) around non-reactive neuronal
cell bodies. C : blood capillary. Bar : 10 μm (× 600).

FIG. 2. — Catecholamine-containing axons of the medial preoptic area. Note the branching axon (a)
whose left division (small arrows) give rise to pericellular endings. Bar : 10 μm (× 600).

FIG. 3. — Catecholamine-containing cell body of the medio-basal hypothalamic group. Note the thick
varicoses endings around non-reactive neuronal cell bodies (arrows). Bar : 10 μm (× 600).

FIG. 4. — Catecholamine-containing cell body of the retro-chiasmatic area. Note the non-reactive
nucleus (n) with superimposed fluorescent cytoplasm. Bar : 10 μm (× 1 500).

FIG. 5-6. — Catecholamine-containing cell bodies of the infundibular nucleus with thick fluorescent varico-
eistis (arrows) suggesting axo-somatic synapses. Bar : 10 μm (× 1 500).
Discussion

The presence of high densities of catecholamine-containing axons throughout the dispersion area of LH-RH reactive perikarya suggest that most of them are at least partly under catecholaminergic control (fig. 7).

In spite of the fact that catecholamine-containing cell bodies are not found routinely in adult monkeys (Felten 1973, 1976; Hoffman et al., 1976; Ishikawa and Tanaka, 1977), our observations suggest that they are not localized only within the mediobasal hypothalamus but may also be observed in other hypothalamic areas; this was recently demonstrated by Jacobowitz and McLeod in the pygmy primate, Cebuella pygmaea, where they form three main groups similar to the A12 (infundibular), A13 (incerto-hypothalamic) and A14 (anterior hypothalamic) groups, successively described in rats by Fuxe (1964, 1965), Nabin et al. (1975), Fuxe et al. (1976), Hökfelt et al. (1976) and Sladek and McNeil (1977). Taken together these results suggest that hypothalamic catecholamine-containing cell bodies of primates have the same wide dispersion and topographic organization as previously described in rats and confirmed in other mammalian species, particularly mice (Barry, 1969, 1970), guinea pigs (Barry, 1970; Leonardelli, 1971), hamsters (Hermand, Leonardelli and Tramu, 1975), rabbits (Bensch et al., 1975) and cats (Cheung and Sladek, 1975).

The presence of indoleaminergic cell bodies in the hypothalamus of squirrel monkeys as well as in that of rats (Descarries and Beaudet, 1977; Chan-Palay, 1977)
is still an unsolved question. In one of our animals a few indoleaminergic-like cell bodies were observed in the rostral hypothalamus and the retrochiasmatic area (fig. 7), but this must be confirmed by pharmacological experiments.

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Résumé. Des concentrations importantes d’axones catécholaminergiques de diamètres variables ont été observées avec la technique de Falck et Hillarp dans l’hypothalamus du singe écureuil, notamment la région pérventriculaire, le noyau pré-optique, le noyau arqué, l’aire pré-mammillaire et le noyau hypothalamique dorso-médial.

Les péricaryons de neurones catécholaminergiques ne sont pas visibles chez tous les animaux mais ont pu être observés dans l’hypothalamus médio-basal et les régions rostrale et postéro-dorsale, leur topographie rappelant celle des groupes A12, A13 et A14, décrits chez d’autres Mammifères.

References


