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Research report

Ultrastructural study of the pituicytes in the pituitary gland of the teleost *Diplodus sargus*

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Abstract

An electron microscopic study was performed on the pituitary gland of the Mediterranean teleost fish *Diplodus sargus* to analyse the morphological characteristics of the pituicytes. In this class of vertebrates, the pituicytes have, like other astroglial cells, a trophic and support function, but they may also play an active role in the release of neurohormones. Most of the pituicytes were of the Dark type. Their shape appeared irregular with long, thin processes protruding from the cellular body. The pituicytes protruded from the neurohypophysis as far as the adenohypophysis. Their cellular bodies were mainly located in the posterior neurohypophysis. In the adenohypophysis, pituicytic processes were intermingled with cells of the pars intermedia and pars distalis, though being more numerous in the former. These processes sometimes surrounded the whole adenohypophyseal cell. This provides further evidence for the possible role of the pituicytes in controlling the release of the pituitary hormones given that, in teleost fishes, there is no distinct portal system or true median eminence.

Keywords: Hypophysis; Teleost fish; Electron microscopy; Pituicytes

1. Introduction

The pituicytes are typical cells of the neurohypophysis, first described by Bucy [6], with astrocytic derivation found by Lederis [17] subsequently confirmed by Bergland and Torack [3]. The pituicytes in the human pars nervosa are generally elongated and irregular in shape, giving rise to slender, long cytoplasmic processes [21]. Two main types of pituicytes are present in the neural lobe of various species: protoplasmic pituicytes and fiber pituicytes [8,23], but this classification is unsatisfactory. In fact, variations in form and size of both fiber and protoplasmic pituicytes and of intermediate forms are often reported [24] with the evidence that the morphology of pituicytes varies within animals and between species and is markedly function dependent. Ultrastructural studies [10,13,21,19] divided these specialized cells into five principal forms: (1) Major pituicytes; (2) Dark pituicytes; (3) Ependymal pituicytes; (4) Oncocytic pituicytes; (5) Granular pituicytes. However, these five classes of pituicytes are considered to represent different functional forms of one cell line originating phylogenetically from the ependyma [21]. More recently, it has been demonstrated that the pituicytes could constitute a separate subclass of glial cells, belonging to the oligodendrocyte lineage but sharing major functional and phenotypic properties with astrocytes [22]. These cells, like the other glial cells, have a trophic and support function for neurons, but it has been also supposed that the pituicytes may also have an active role in the release of neurohormones [4,5]. This role would be particularly meaningful in teleost fishes where the adenohypophysis, unlike that of the other vertebrates, is directly innervated by neurosecretory fibers [20,18]. In tetrapods, the control of pituitary hormone secretion is effected by release of neuroactive substance into the pituitary circulation within the median eminence, in teleost fishes, instead, there is no distinct portal system and hence no true median eminence [2]. Their anterior neurohypophysis, homologue of the eminence median, innervates the rostral pars distalis and the proximal pars distalis [18] and the pituicytes may have an important role in the control of neurosecretion. In this paper, we report the ultrastructural study of the pituicytes in the Mediterranean teleost fish, *Diplodus sargus*, in order to analyse their morphology but also their

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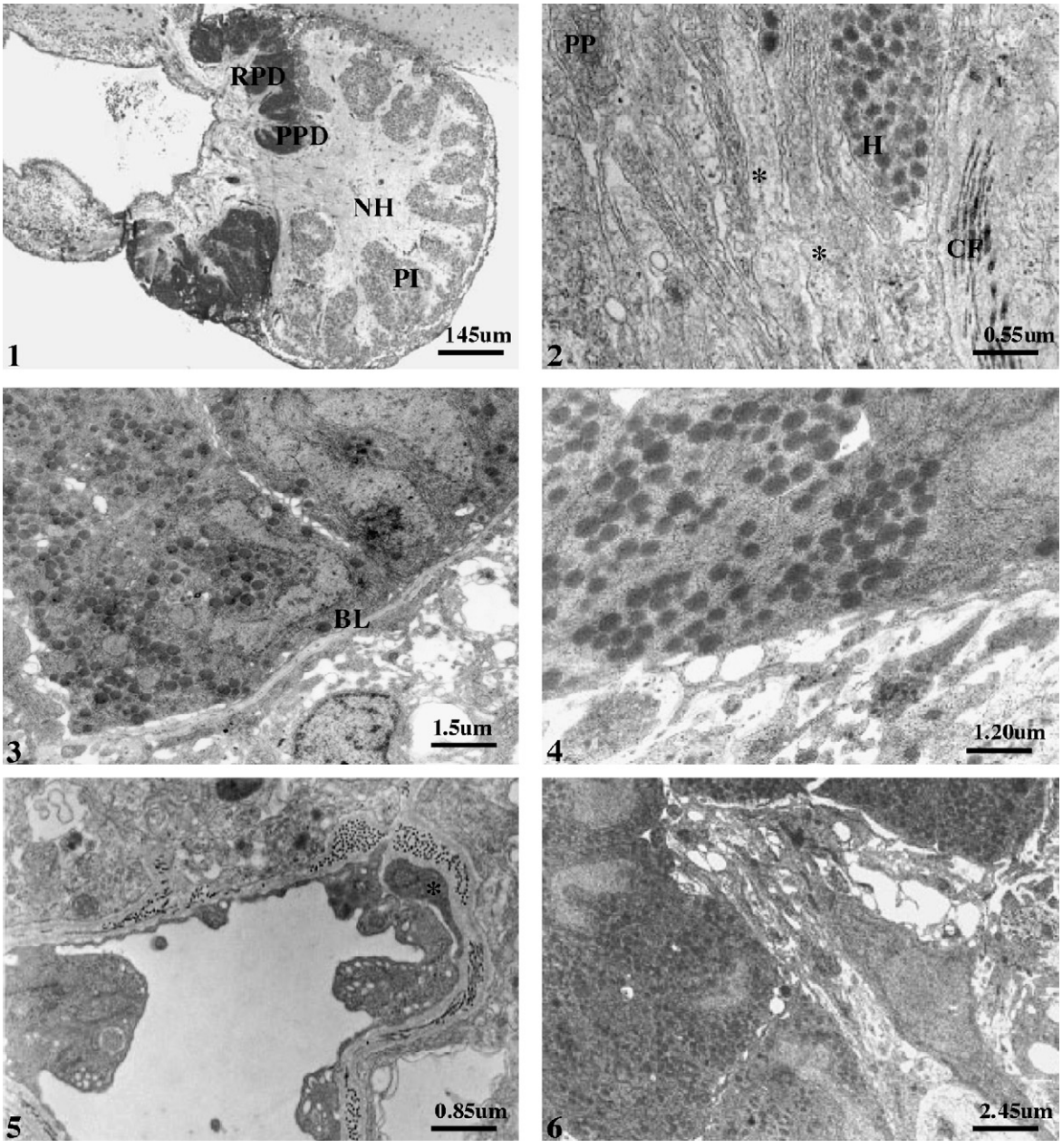
connections with all the regions of the pituitary gland in this class of vertebrate which provides a unique model for neuroendocrine studies.

2. Material and methods

A total of eight specimens of *D. sargus* (120–250 g in body weight) was collected from the Bay of Naples (Italy) and provided by the local Anton Dohrn Zoological Station. The experiments were performed under the approval of institutional committees; all efforts were made to avoid suffering and to minimize the number of the animals used. The fishes were killed by decapitation, after anesthesia with 62.5 mg/l of MS222 (Sigma, USA). The pituitary glands were immediately taken and fixed in Karnovsky's liquid (4% paraformaldehyde in PBS 0.01M with 2.5% glutaraldehyde and 8% sucrose addition) for 1 h, post-fixed in 0.1% osmium tetroxide for 45 min and dehydrated in graded ethanols for a total of 1 h. After 5 min of propylene oxide the pituitary glands were then enclosed in Epon 812. Ultrathin sections of 0.05–0.07 μm were collected on nickel grids, without supporting films of formvar, and were stained with 2% uranyl acetate for 8 min and 0.65% lead citrate for 8 min. The observations were carried out with a Philips EM 301S electron microscope.



Figs. 1–6. (1) Light microscopy. Horizontal section of *D. sargus* pituitary gland showing the various regions of the gland: the rostral pars distalis (RPD), the proximal pars distalis (PPD) and the pars intermedia (PI). Note that the neurohypophysis (NH) interdigitates not only with the PI but also with the pars distalis subdivisible in a RPD and in a PPD. (2) In the NH are present nerve fibres (*), a large amount of neurosecretory substance like Herring bodies (H) intermingled with collagen fibres (CF) and the pituicytes of which are evident only their processes (PP). (3) An evident basal lamina (BL) is always present between the NH and the PD. PD, compared to NH, is clearly recognizable for the presence of granulated cells. (4) The basal lamina often lacks between the NH and the PI. PI is on the upper area with the granulated cells. (5) In the NH the pituicytes have also been observed around the blood vessels. Note the body of a pituicyte (*) by which is evident a process. (6) A major pituicyte observed in the NH, near the PI. Note the irregular shape and the large central nucleus with a cytoplasm less contrasted and relatively abundant.