The Ultrastructure of the Adenohypophysis of *Myxine glutinosa*

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Summary. The ultrastructure of adenohypophysial cells in the Atlantic hagfish (*Myxine glutinosa*) is described and the morphological evidence for secretory activity is discussed. A scarcity of secretory granules is characteristic of the adenohypophysis of *Myxine*. Two cell types having the appearance of protein hormone producing cells can be identified. Type 1 has dense membrane-bound granules with a calculated mean diameter of 88 nm while type 2 has larger granules with a mean diameter of 176 nm. The release of secretory granular material follows mainly the “membrane-release” pattern. It is suggested that cell type 1 may produce a hormone which is similar to ACTH/MSH and type 2 another hormone similar to STH/LTH. The basophilic cells contain a secretory material which is similar to the mucus produced in the epithelial mucus cells.

Several structural modifications are considered to represent functional compensations for the absence of vascular elements in the gland. Among these are a cytoplasmic tubular system, certain long agranular cells together with long granule-containing projections from cell types 1 and 2, and foliate or finger-like invaginations of the basal lamina.

Key words: Adenohypophysis — *Myxine glutinosa* — Cell types — Ultrastructure.

Introduction

A number of light microscopical investigations have been undertaken on the adenohypophysis of *Myxine glutinosa* (Olsson, 1959; Matty, 1960; Adam, 1960, 1963; Fernholm and Olsson, 1969). The results of these investigations are not conclusive. One reason for this is the difficulty encountered in separating the different cell types because of their poor stainability with the conventional techniques. Other vertebrates investigated seem to have several tinctorially and functionally distinct cell types in the adenohypophysis (reviewed by Herlant, 1964). In the *Myxine* adenohypophysis most cells appear chromophobie although a few single chromophilic cells can be distinguished (Fernholm and Olsson, 1969). All these cell types are not consistently found in all animals and many animals may be lacking some of them. They also vary considerably in number and size.

Here I will only give a summary of the general morphology of the gland, but it has been extensively studied and for a more detailed description the mentioned

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references are pertinent. The adenohypophysis of *Myxine* is composed of cell groups which are enclosed by thin connective tissue capsules. These groups lie close together in the thick fibrous connective tissue which separates the brain floor from the roof of the nasopharyngical duct. The neurohypophysis is a flat hollow projection of the *diencephalon* and usually has no contact with the adenohypophysis (Fernholm, 1972).

The ultrastructure of adenohypophysial cell types has been described for representatives of all the major vertebrate groups except for the *Cyclostomata*. The two subgroups of *Cyclostomata* each have a unique morphology of the pituitary complex. The most aberrant forms are the hagfishes, *Myxonidea*, where the adenohypophysis usually has no morphological contact and probably no functional connection with the central nervous system (Fernholm, 1972, cf. Kobayashi and Uemura, 1972). Two short abstracts and three electron micrographs have been published on hagfish adenohypophysial ultrastructure (Matty, 1965, 1966; Fernholm, 1967, 1972). An attempt was made by cytopharmacological methods to distinguish different functional cell types in the hagfish adenohypophysis (Fernholm and Olsson, 1969). This and a subsequent study (Aler et al., 1971) failed to establish some of the well known pituitary hormone activities of higher vertebrates in the hagfish pituitary. The aim of the present investigation is to describe the fine structure of the different cell types in the adenohypophysis of *Myxine* and to discuss the morphological signs of secretory activity of these cells.

**Material and Methods**

**Electron Microscopy**

Adult specimens of the Atlantic hagfish, *Myxine glutinosa* L. were used for this investigation. 24 females in different stages of gonadal development and one male were examined. The pituitaries with some of the surrounding connective tissue were dissected out from the opened nasopharyngical duct, and immediately put into fixative. In some cases the pituitaries were divided along the midsagittal plane. Different fixatives have been tried: 1. 2.5-5.0% glutaraldehyde buffered at pH 7.8 with phosphate or cacodylate buffer (Sabatini et al., 1963) followed by postfixation for 2 hours with 1% osmium tetroxide buffered at pH 7.4 with Millonig’s phosphate buffer (Millonig, 1961). 2. Formaldehyde-glutaraldehyde according to Karnovsky (1965) with or without an addition of 10% dextrose followed by the same postfixation as in 1. 3. 2% osmium tetroxide containing 2.5% sodium bicarbonate in 0.1 N hydrochloric acid (Wood and Luft, 1965). The tissues were dehydrated in an ethanol series and embedded in Epon or Maraglas. Sections picked up on formvar covered grids were stained with uranyl acetate (Stempak and Ward, 1964) and lead citrate (Reynolds, 1963) and examined with a Zeiss EM 9A.

**Histochemistry**

Four of the pituitaries were fixed in glutaraldehyde and tested for acid phosphatase activity using the methods by Miller and Palade (1964). 40-50 μm thick sections of the fresh tissues were made with a “tissue chopper”. Control sections were incubated in an identical, but substrate-free, Gomori medium.

**Measurement of Granules**

1045 granules from 21 micrographs having a final enlargement of 26250 were measured with a Zeiss TGZ3 (particle size analyzer). The micrographs were made of material obtained from three animals and the granules were classified according to diameter size in 48 equal intervals between 0.4 mm and 9.24 mm. The granules were measured separately from cell type 1 (591 granules) and cell type 2 (454 granules). All recognizable secretory granules in the