

Electron microscopic studies of the corpuscles of Stannius of an airbreathing teleost (*Heteropneustes fossilis*)

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The ultrastructure of the corpuscles of Stannius (CS) of *Heteropneustes fossilis* reveals a homogenous cellular composition characterized by only one cell type, with large secretory granules and abundant ribosomal endoplasmic reticulum. These cells are comparable to the type 1 cell described in the CS of other teleosts; type 2 cells, whose presence is ubiquitous in the CS of freshwater species are absent in *H. fossilis*. Our data on the CS of *H. fossilis* demonstrate that not all freshwater species possess type 2 cells in their CS and these are not essential for life in freshwater.

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1. Introduction

The corpuscles of Stannius (CS) are tiny endocrine glands located on the kidneys of holostean and teleostean fishes. The CS are involved in calcium homeostasis by a calcium lowering hormone, stanniocalcin, a homodimeric glycoprotein. The stanniocalcin effectively reduces the uptake of calcium from the ambient water via gills and gut. Recently, stanniocalcin has been localized in various tissues of mammals including human tissue. The amino acid sequence of human stanniocalcin showed ~73% homology to fish stanniocalcin and the available data imply that stanniocalcin functions as a regulator of the female reproductive system (McCudden *et al* 2001; Varghese *et al* 2002). Thus, the stanniocalcin may be more widely propagated than what is presently believed. The results of extensive research on fish CS are available in several reviews (Krishnamurthy 1976; Wendelaar Bonga and Pang 1986, 1991; Hirano 1989; Wagner 1993, 1994). In spite of renewed research on fish CS, one area still

open for debate concerns the cellular population, as two structurally different cell types have been reported in the CS of several teleosts, though it is still unclear whether these reflect different physiological conditions of a single type or represent functionally different cell types. In order to collect more information on the cellular composition of CS, we have investigated the CS of an obligatory air-breathing catfish *Heteropneustes fossilis* (Ham).

2. Materials and methods

Live catfish were collected from the local ponds and were kept in the laboratory for acclimatization for two weeks. The CS from the kidney were excised and prefixed immediately in cacodylate (buffered – 0.15 M, pH 7.2) glutaraldehyde solution (2%) at room temperature for 10 min. The tissue was then fixed in a similarly buffered solution of 1% osmium tetroxide for 2 h at 0°C and then embedded in Epon. Ultrathin sections were

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Abbreviations used: CS, Corpuscles of Stannius; RER, ribosomal endoplasmic reticulum.

stained with lead citrate and examined with a Phillips EM 300 electron microscope.

3. Results

At the ultrastructural level, cells of one type are located in the CS of *H. fossilis*. These secretory cells of Stannius are arranged in follicles (figure 1). They are characterized by oval or round nuclei with dense patches of chromatin granules (figures 2, 3), and numerous large membrane bound, electron dense secretory granules scattered all over the cytoplasm. Abundant ribosomal endoplasmic reticulum (RER), arranged as lamellar arrays in the vicinity and nucleus as well as in rest of the cytoplasm are also visible.

A few elongated filamentous mitochondria with lamellar or tubular cristae are present in the cytoplasm. The Golgi areas are well developed with some saccules containing electron dense materials. Amidst the gland cells, a mast cell packed with membrane bound electron dense bodies of variable size and a large irregular shaped nucleus is also conspicuous (figure 1).

4. Discussion

The CS of teleosts residing entirely in freshwater or euryhaline species, spending part of their life cycle in freshwater, have been shown to contain heterogeneous populations of gland cells, unlike the marine forms where the CS contain cells of only one type (Wendelaar Bonga

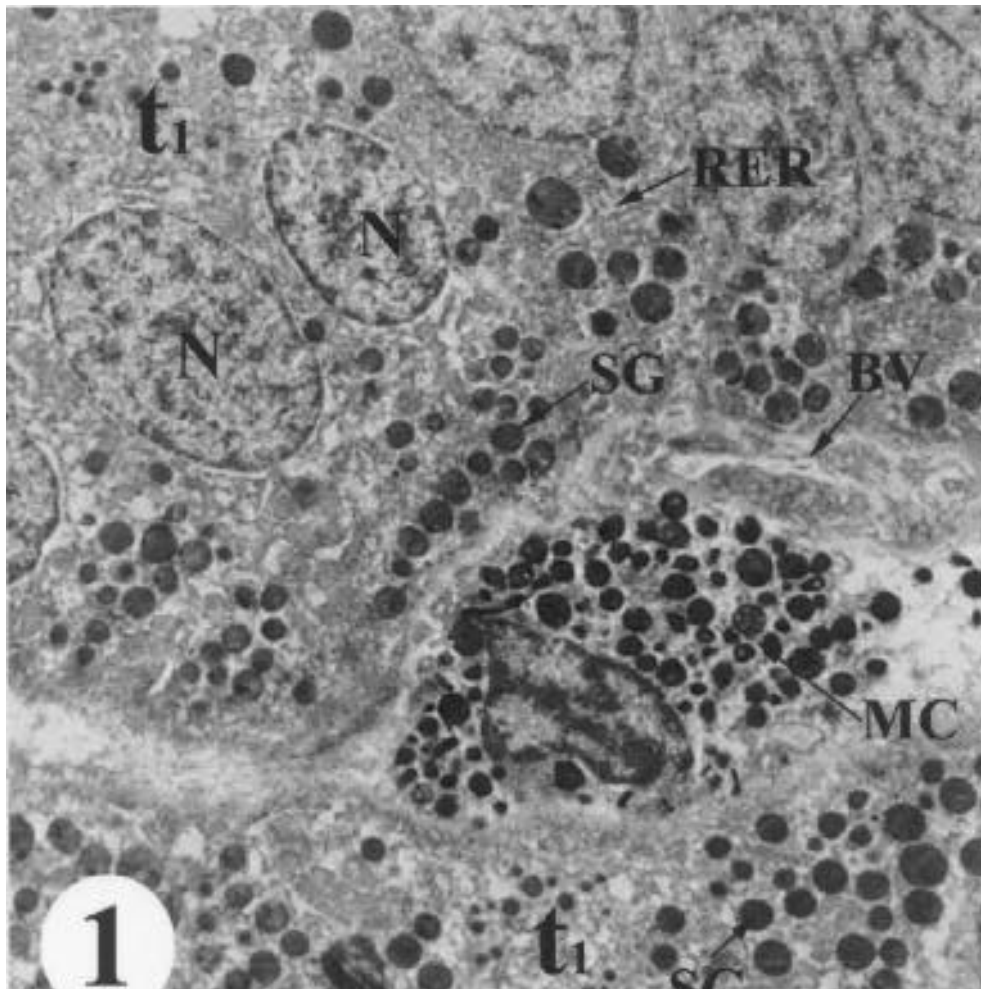


Figure 1. Sections of CS of *H. fossilis*, showing homogenous cellular population of type 1 (t1) cells; distinct, round nucleus (N), abundant ribosomal endoplasmic reticulum (RER), blood vessels (BV) and large round secretory granules (SG). Also note the Mast cells (MC) ($\times 12600$).

and Grevens 1975), *Onchorhynchus mykiss* (Krishnamurthy and Bern 1969; Meats *et al* 1978) *Fundulus heteroclitus* and *Carassius auratus* (Wendelaar Bonga *et al* 1980), *Oreochromis mossambicus* (Urasa and Wendelaar Bonga *et al* 1987) and *Onchorhynchus kisutch* (Aida *et al* 1980) have been reported to contain two structurally different cells namely type 1 and type 2. Type 1 cells numerically predominate and possess characteristically large abundant electron dense secretory granules, prominent RER and Golgi areas. On the contrary, type 2 cells possess relatively few small secretory granules, scarce Golgi and RER but long slender processes extending inbetween type 1 cells. However, the CS of the few seawater fishes studied so far, *Gadus morhua* and *Pleuronectes platessa* (Wendelaar Bonga and Greven 1975) and *Opsanus tau* (Bhattacharyya and Butler 1978), confirm the presence of only type 1 cells, with their characteristic features.

Unlike the previous reports on freshwater species the CS of *H. fossilis*, contain a homogenous cell population and the cells exhibit structural features, very similar to those of type 1 cells of other freshwater teleosts. The type 2 cells which have been thought to be a ubiquitous feature of CS of all freshwater teleosts are absent in *H. fossilis*. It is well established that type 1 cells are the source of stanniocalcin, while the nature and function of type 2 cells is not clear. Many investigators believe that type 1 and type 2 cells are structurally different forms of one functional type and are responsible for producing the same hormone (Lopez *et al* 1984; Lafeber and Perry 1988; Flik *et al* 1989; Wendelaar Bonga *et al* 1989). On the other hand several observations lend support to the view that type 2 cells are a specific cell type, functionally different from type 1 cells, and secrete an unknown hormone essential for life in freshwater (Meats *et al* 1978; Urasa and Wendelaar Bonga 1987).

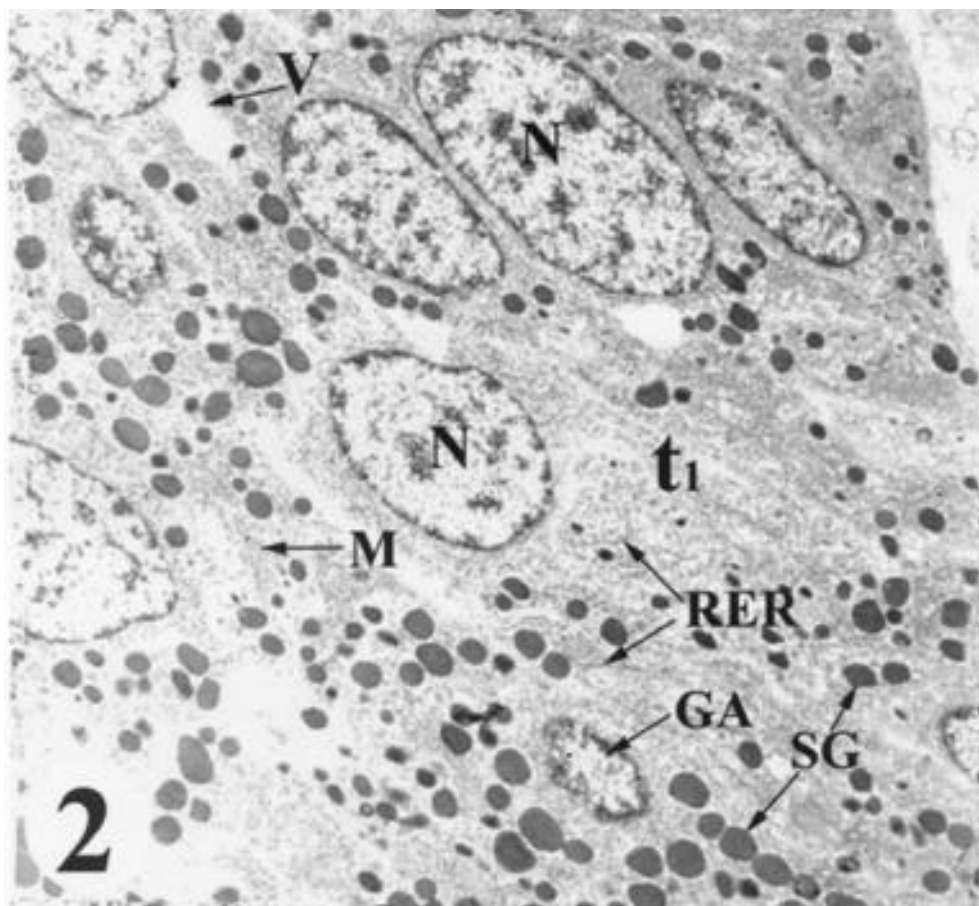


Figure 2. Sections of CS of *H. fossilis*, showing a population of similar cells (t1) with distinct nucleus (N), large secretory granules (SG), Golgi apparatus (GA), vacuoles (V) and mitochondria (M) ($\times 12600$).

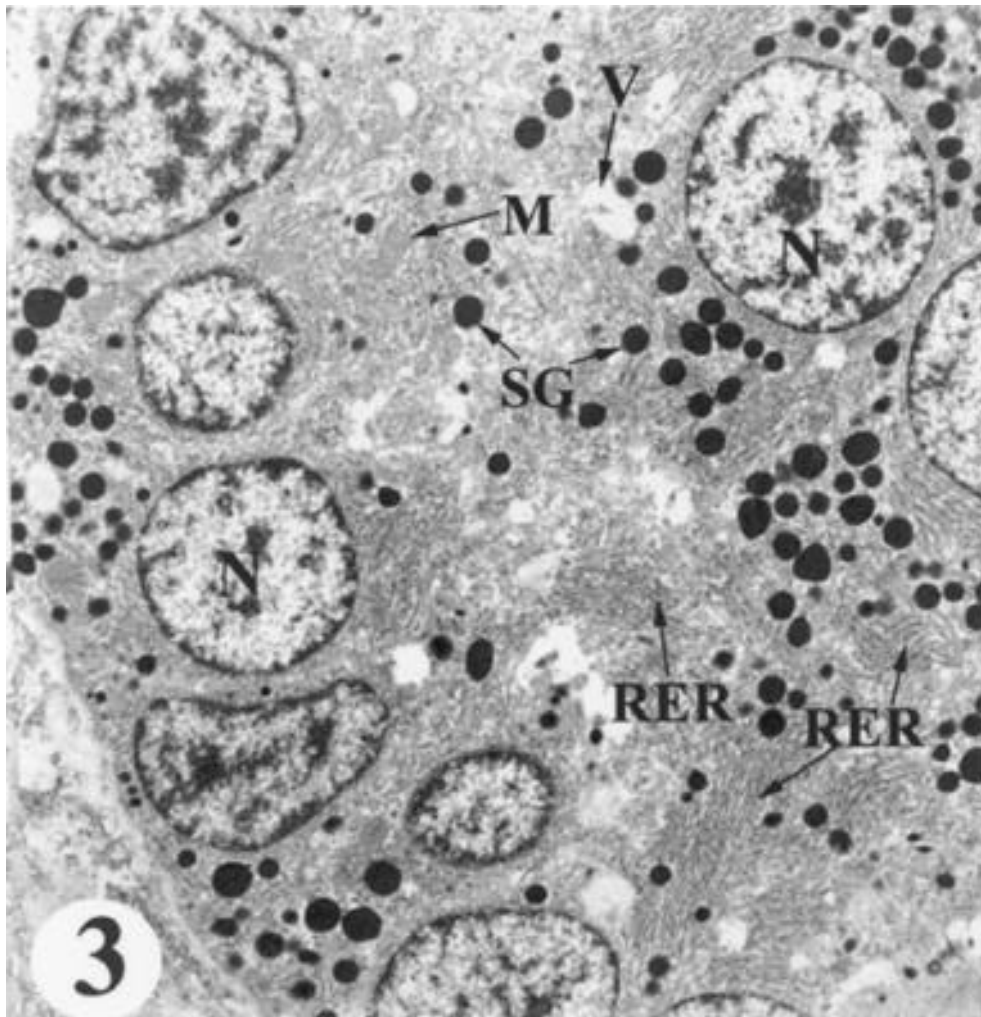


Figure 3. Sections of CS of *H. fossilis*, showing Stannius cells with distinct nucleus (N), large secretory granules (SG), patches of ribosomal endoplasmic reticulum (RER), mitochondria (M) and vacuoles (V) ($\times 12600$).

The present study thus demonstrate only type 1 cells in the CS of *H. fossilis*, contradicting the general view so far that the presence of type 2 cells is mandatory for life in freshwater.

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