Endocrinology (403)

Caudal Neurosecretory System (CNSS) in fish

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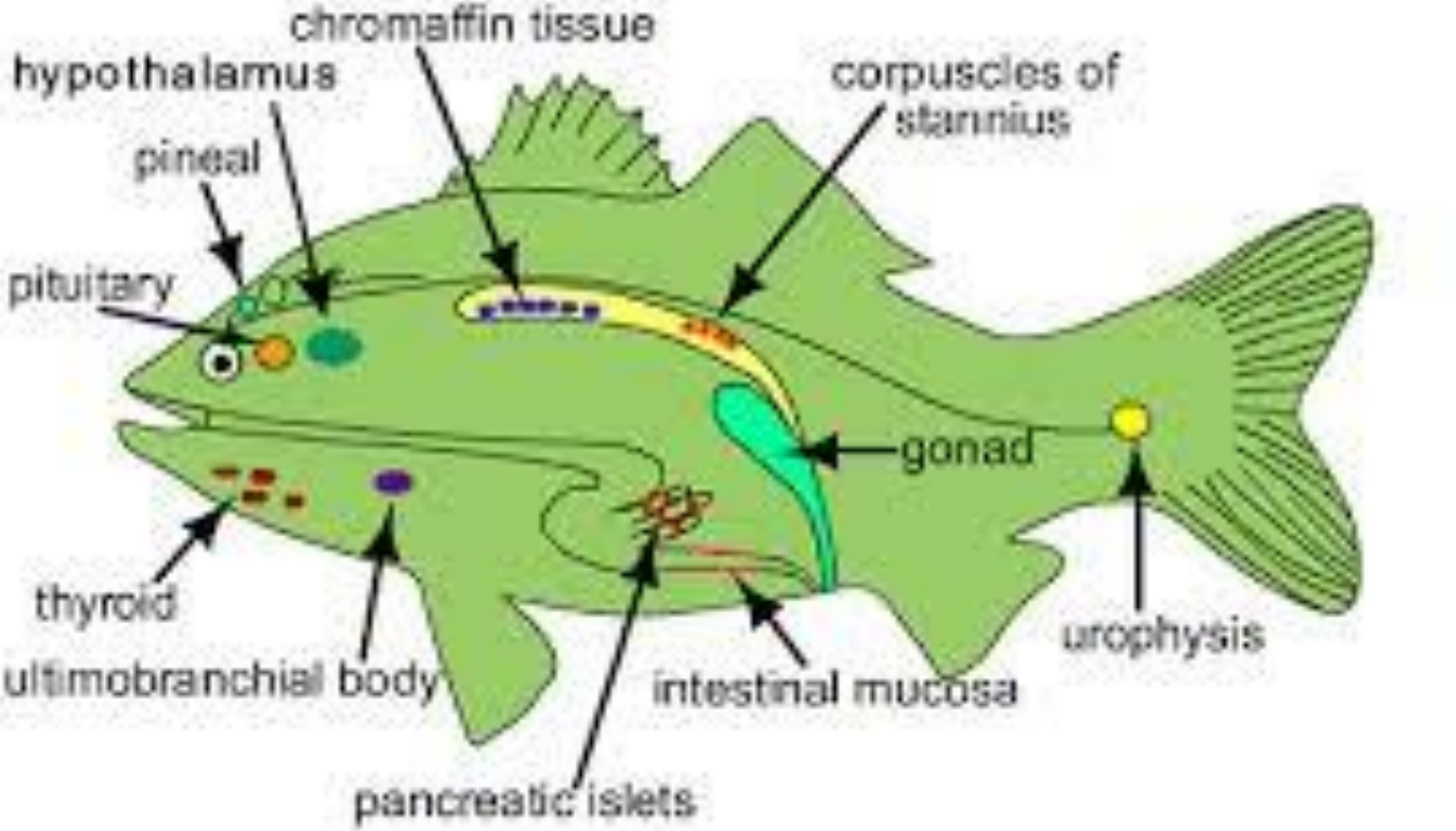
The urophysis (Caudal neurosecretory System)

- Most fish also possess a urophysis, a neural secretory gland very similar in form to the posterior pituitary, but located in the tail and associated with the spinal cord
- The hormones of urophysis are called “urotensins” and four kinds of them are identified
- These are urotensin I, II, III and IV
- These are peptides and all the 4 may not be present in the same fish
- However, urotensin I and II are commonly found in a fish and their release is controlled by the central nervous system


chromaffin tissue
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corpuscles of stannius
pineal
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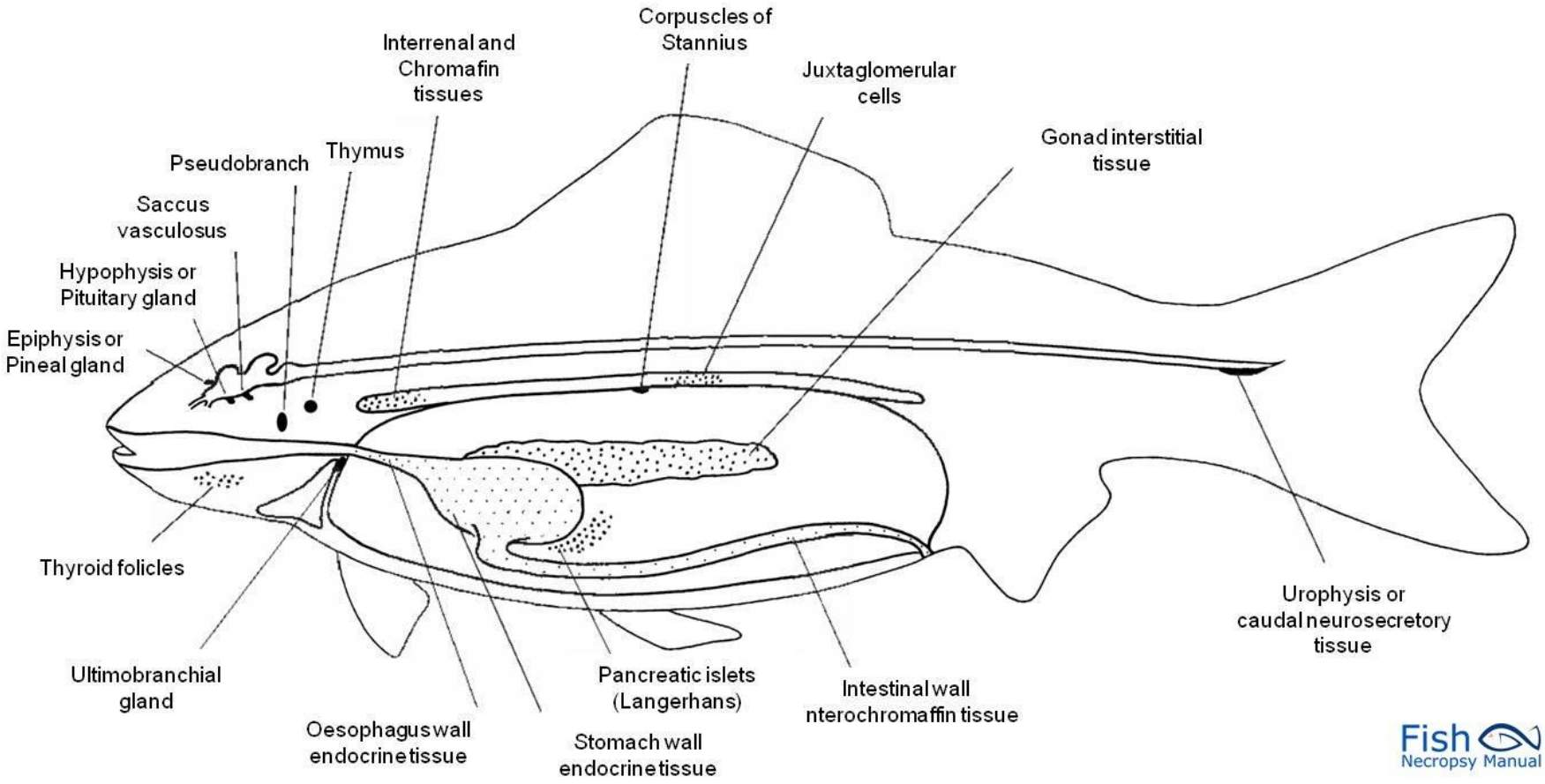
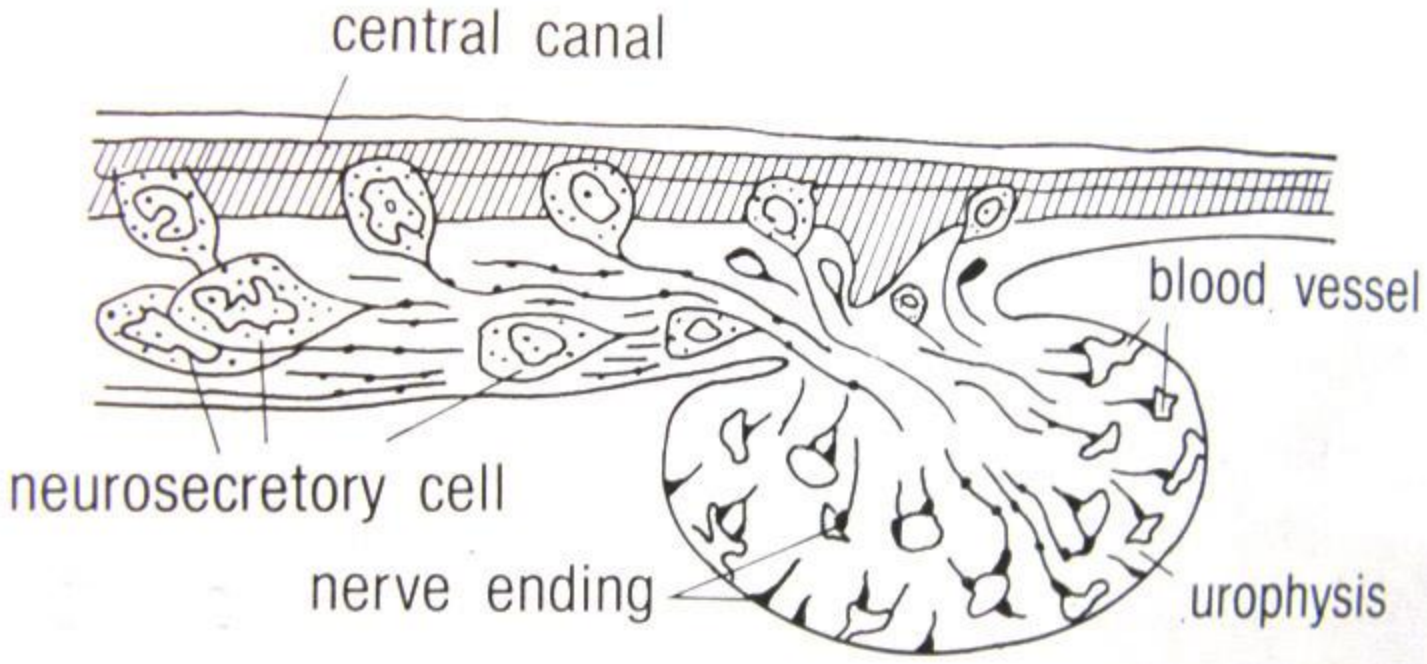
ultimobranchial body
intestinal mucosa
urophysis
pancreatic islets



Fish Necropsy Manual


central canal
blood vessel
neurosecretory cell
nerve ending
urophysis

Urophysis

This is a neurosecretory organ found on the ventral aspect of the distal end of the spinal cord. These bodies are composed of unmyelinated axons terminating on a capillary wall. The function of the urophysis is unknown

Most fish also possess a urophysis, a neural secretory gland very similar in form to the posterior pituitary, but located in the tail and associated with the spinal cord. Urophysis consists of neurosecretory cells.

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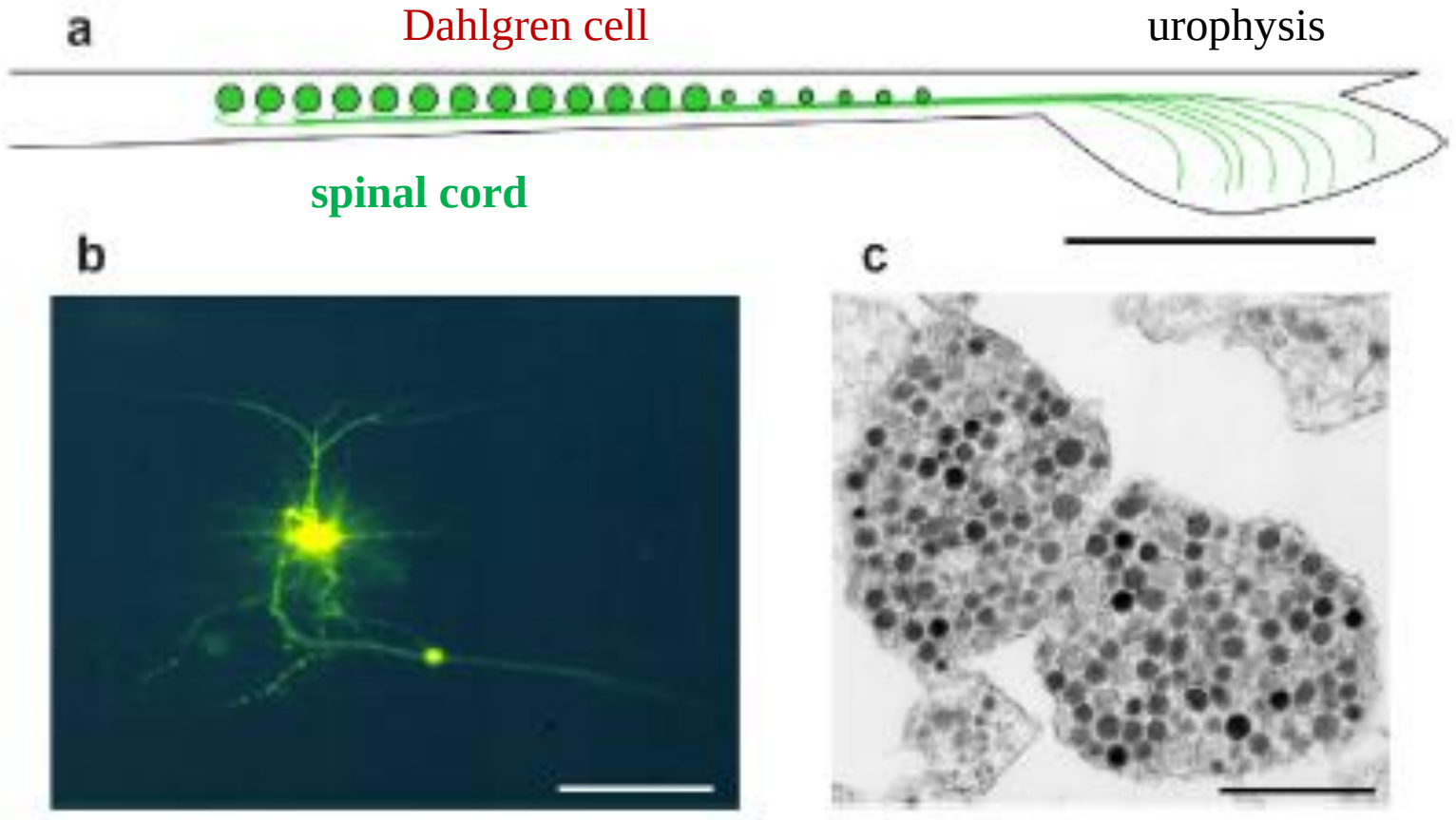

(a) Schematic of the Xounder CNSS showing large Dahlgren cell somata in terminal segments of the spinal cord, with axons projecting to the terminal neurohaemal swelling, urophysis.
(b) Light micrograph of Dahlgren cell injected intracellularly with the Xuorescent dye Lucifer Yellow, showing large cell body with extensive dendritic arborisation and caudally projecting axon.
(c) Electron micrograph of terminals in the urophysis packed with electron dense peptidergic granules. Scale bars: (a) 1.5 mm, (b) 200 m and (c) 1 m.

The caudal neurosecretory system (CNSS) is unique as is reported by Dahlgren (1914) which is specifically found in teleost & elasmobranch.

The caudal neurosecretory system is defined in teleosts as a complex of secretary neurones (Dahlgren cells) in the caudal spinal cord leading by a tract to neurohaemal tissue organized as a typical neurosecretory storage-release organ,the urophysis.

Magnocellular neuroendocrine -Dahlgren cells, located in the terminal segments of the spinal cord, project to a neurohaemal organ, theurophysis, from which neuropeptides are released.

The presence of homologues of urotensins throughout the vertebrates has sparked homeostatic roles in osmoregulation and reproduction

the urophysis.

The teleost urophysis is generally a distinct, easily recognizable, lobate structure of variable external form.

The elasmobranch caudal system is composed of large cells with short axons projecting to a diffuse vascular bed; there is no organized urophysis.

The caudal neurosecretory system and its urophysis appear late in post larval development by comparison with the hypothalamic neurosecretory system.

The Dahlgren cells originate from the ependyma in development and also during regeneration of the caudal system in adult life.

The elasmobranch system may represent the more primitive condition, and stages in the evolution of the advanced urophysial types can be visualized. The particular histology shown by the caudal system appears to have taxonomic significance.

The cytology of the Dahlgren cell and its neurosecretory material is described.
neurosecretory granules, 800–2500A diameter, which originate from Golgi centres. The possible participation of preterminal axonal regions–and tubular systems evident therein—in the formation of neurosecretory material is considered.
The structure of the axon terminals raises questions about the way in which neurohormone may be released into the blood. Small vesicles have been variously interpreted as cholinergic synaptic vesicles and as products of the fragmentation of membranes of elementary neurosecretory granules.
Functional role in ionic regulation. Increased Na uptake by the gills of goldfish has been reported, as a result of administration of urophysial extract, and electrophysiological studies indicate a responsiveness of the system to variations in blood Na ion concentration. buoyancy regulation.

The hormones of urophysis are called “urotensins” and four kinds of them are identified. These are urotensin I, II, III and IV. These are peptides and all the 4 may not be present in the same fish. However, urotensin I and II are commonly found in a fish and their release is controlled by the central nervous system. The exact function of urophysis is still not definitely known. However, the extract of urophysis produced the following effects.

Urotensin I: increases the blood pressure of fish but is less potent than urotensin II.

Urotensin II: It is involved in the contraction of smooth muscles such as urinary bladder, causes a marked increase in blood pressure and enhances urine flow.

Urotensin III: It induces the sodium intake across the gills (osmoregulation) of gold fish. But effect of this component is not observed in other fishes.

Urotensin IV: It shows activity like antidiuretic hormones of pituitary gland.

Conclusion

- The most primitive organization of the caudal neurosecretory system is met with in *Squalus acanthias*, *Raia batis* and *Raia radiata*, in which the terminals are situated within the nervous tissue immediately under the meninx. This is characteristic also of the early stages of development of the primitive urophysis in the pike. A more advanced form of organization occurs in *Torpedo ocellata*, where the neurosecretory processes enter the meninx of the ventromedian part of the spinal cord.
- The secretion, which is a protein, with possibly a low lipid content, is subject to morphological variations identical with those described in teleosts. The presence of the secretion in the form of submicroscopic granules is assumed, and these granules may coalesce to form larger granules and droplets visible in the light microscope.
- It is suggested that the Dahlgren cell is a specialized type of glandular cell of great phylogenetic age, developed independently out of primitive glandular cells which may have been present is the neural epithelium of ancestral vertebrates.