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Characterization of the normal gill tissue's histologic appearance utilizing certain staining methods

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Introduction

Most fish tissues resemble well-characterized comparable organs in terrestrial animals in terms of their histologic appearance. However, the fish's gill tissue has a distinctive morphological and histological trait. Fish gills' gross anatomy and histology have been extensively studied. In a nutshell, the pharyngeal area of teleost fishes contains arciform, osseous structures that make up the gills. Two rows of paired filaments, also known as primary lamellae, are supported by these arches. A hemibranch is the name for each principal lamella, while a holobranch is the collective word for the paired hemibranchs on each gill arch. The majority of teleost fish species have four holobranchs, however the medial most one is frequently directly linked to the inside of the branchial cavity.

Pavement cells are thin, non-keratinizing, squamous or cuboidal epithelial cells that make up more than 90% of the gill epithelium (PVCs). The pillar cell is a second significant cell type found within lamellae. Fish gills are the only organs that have pillar cells, which are modified endothelial cells. Mucous cells, chloride cells, and rarely mononuclear inflammatory cells and eosinophilic granular cells are other significant cell types seen inside the lamellae. Large, ovoid mucous cells feature a flattened nucleus and a lot of cytoplasm. They have a lot of mucus secretory granules in their cytoplasm.

In healthy gills, mucous cells are normally few and irregularly distributed. The efferent lamellar edge is where they are most frequently found, although they can also be found on the afferent lamellar edge, interlamellar region, base of the lamellae, or outer margin of the lamellae. Large, ovoid cells that are located around the afferent margins of filaments are the mitochondrial-rich chloride cells.

In that edema, inflammation, hyperplasia, and necrosis are frequent reactions to harmful stimuli, gills experience pathologic alterations that are comparable to those that occur in other tissues. Gills are particularly susceptible to traumatic, toxic, infectious, parasitic, and environmental shocks as a result of

being in close contact with the external aquatic environment.

The observed lesions in gill tissue include: epithelial lifting, lamellar or filament fusion, lamellar adhesions, chloride cell hyperplasia, mucous cell hyperplasia, lamellar cell degeneration and necrosis, and mucous and epithelial cell hypertrophy and hyperplasia. Clinically, specialized staining methods have been applied to help describe and identify histologic lesions in fish.

Toluidine blue stain (Fig. 2)

PVCs, chloride cells, and pillar cells had light-blue to colorless cytoplasm that appeared granular and blue nuclei. Mucous cells had purple granular cytoplasm and non-discernible nuclei. Erythrocytes had decolorized cytoplasm and blue nuclei. Collagen matrix stained light blue, and chondrocytes had dark-purple cytoplasm and blue nuclei.

Trichrome (Fig. 3)

PVCs, chloride cells, pillar cells, and mucous cells had red and purple cytoplasm and a granular appearance with dark blue nuclei. Erythrocytes had dark-pink to red cytoplasm and red-to-purple nuclei. Collagen matrix-stained light blue to light gray, and chondrocytes had light-blue to light-gray cytoplasm with blue-to-purple nuclei.

Von Kossa stain (Fig. 4)

PVCs, chloride cells, pillar cells, and mucous cells had gray pink cytoplasm and red nuclei. Erythrocytes had decolorized cytoplasm and red nuclei. Collagen matrix appeared decolorized or light pink, and chondrocytes appeared pink-to-decolorized with dark-pink to red nuclei.

Giemsa stain (Fig. 5)

PVCs and pillar cells had very light-pink cytoplasm and blue nuclei. Chloride cells and mucous cells had light-blue to gray cytoplasm and blue nuclei. Erythrocytes had dark-pink cytoplasm and blue-to-purple nuclei. Collagen matrix-stained pink, chondrocyte cytoplasm stained blue, and their nuclei stained darker purple. EGCs were accentuated with pink granules and blue-to-purple nuclei (Fig. 4C).

Periodic acid–Schiff (PAS) stain (Fig. 6)

PVCs, chloride cells, and pillar cells had blue-green cytoplasm and nuclei. Cytoplasm of the mucous cells was dark pink (magenta) and had a granular appearance; the nucleus was indiscernible (Fig. 4A). Erythrocytes had blue-green cytoplasm and nuclei. Collagen matrix stained green, chondrocyte cytoplasm-stained pink with a granular appearance, and their nuclei stained dark blue-green.

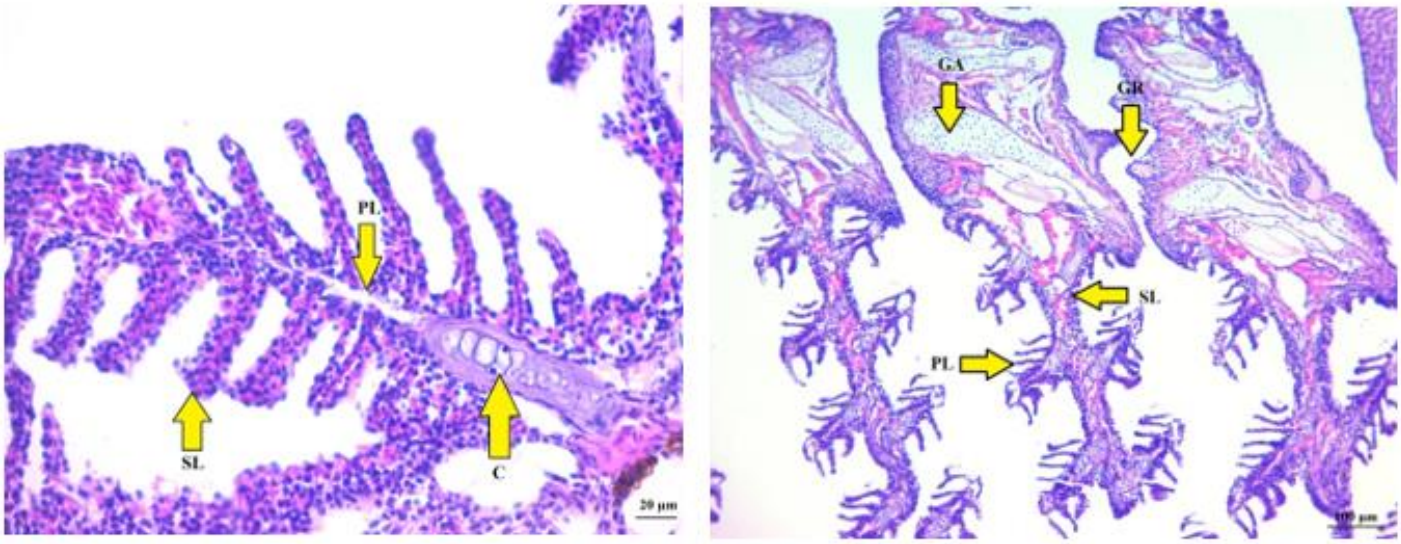

Figure 1: Normal gill tissue of a zebrafish. H & E.

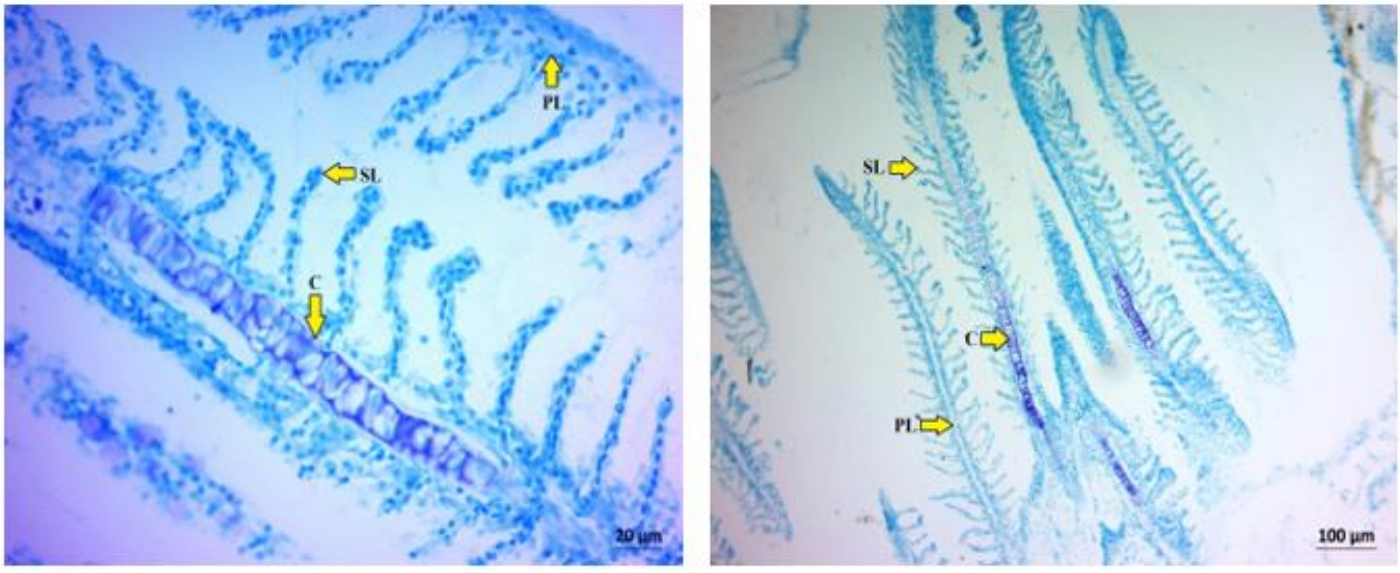

Figure 2: Normal gill tissue of a zebrafish. Toluidine blue.

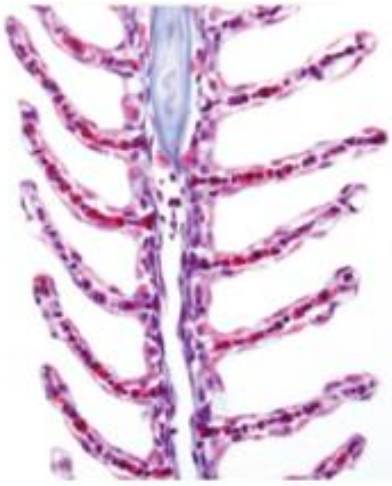

Figure 3: Trichrome

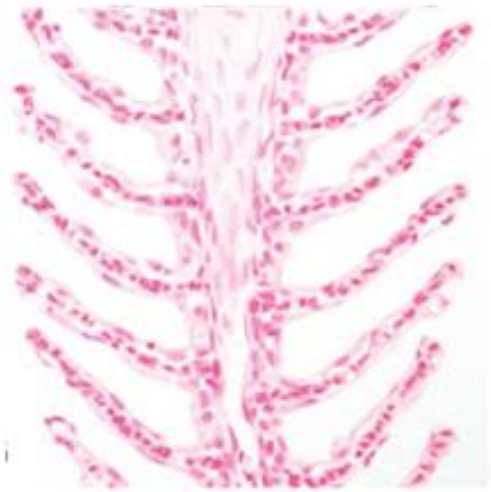

Figure 4: Von Kossa stain

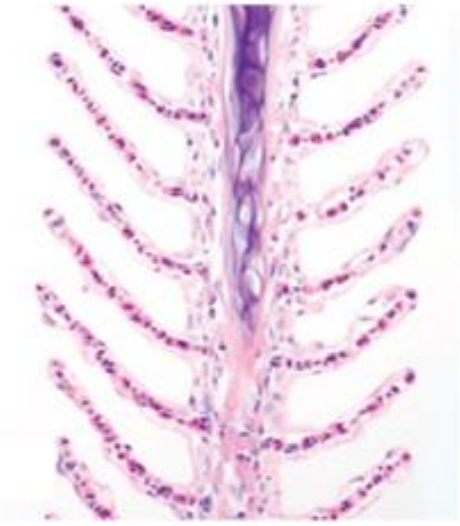

Figure 5: Giemsa stain

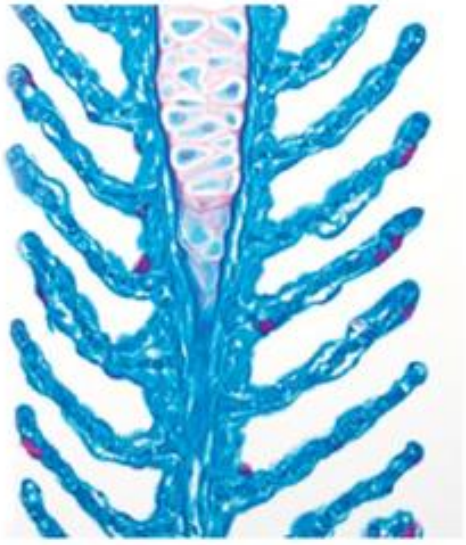

Figure 6: Periodic acid–Schiff (PAS) stain

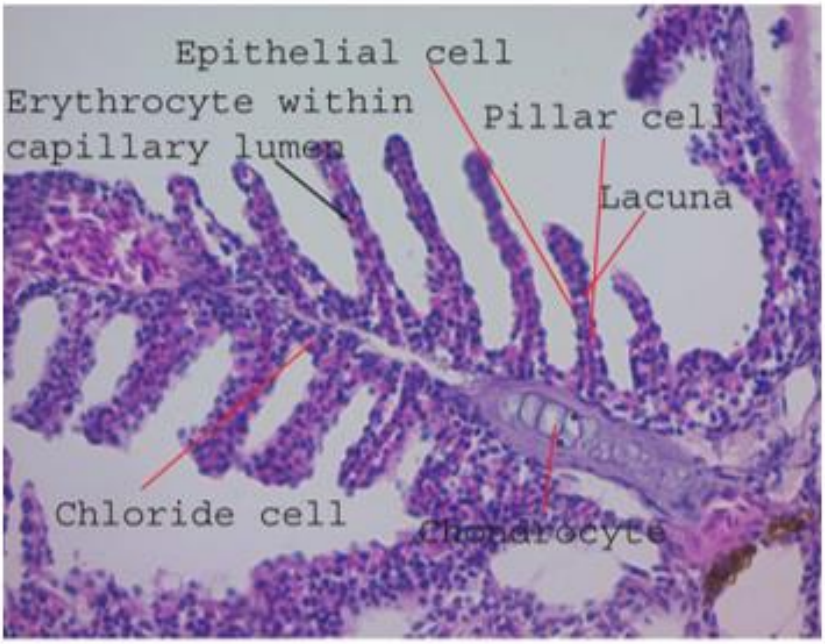

Figure 7: Normal gill tissue of zebrafish (*Denio rerio*). H&E. Original objective 40×. Higher magnification depicting pillar cells (P), chloride cells(C), and erythrocytes (E), chondrocyte(C), Epithelial cell(E) H&E.