LABORATORY 5 EPITHELIUM, continued - CELLULAR SPECIALIZATIONS OF EPITHELIA AND GLANDULAR EPITHELIUM

OBJECTIVES: (See Laboratory 4)

ASSIGNMENT FOR TODAY'S LABORATORY

GLASS SLIDES

SL 26 (Thick skin) "intercellular bridges"
SL 20 (Bronchus) basement membrane
SL 11 (Ileum) striated border
SL 19 (Jejunum) PAS striated border with glycocalyx also goblet cells
SL 156 (Epididymis) stereocilia
SL 111 (Trachea) cilia and unicellular glands (goblet cells)
SL 92 (Submandibular gland) serous, mucous and demilune secretory units
SL 93 (Sublingual gland) mucous secretory units

ELECTRON MICROGRAPHS

EM 16 junctional complex and microvilli
EM 20-6 desmosomes
EM 22 gap junctions
EM 9 interdigitation of lateral membranes
EM 19-2 basal lamina

POSTED ELECTRON MICROGRAPHS

7 Organelles
11 Desmosomes
12 Epithelium
13 Freeze-fracture

Lab 5 Posted EMs; Lab 5 Posted EMs with some yellow labels

HISTOLOGY IMAGE REVIEW - available on computers in HSL

Chapter 4. Epithelial Membrane Specializations
Frames: 201-220

SUPPLEMENTARY ELECTRON MICROGRAPHS

Rhodin, J. A.G., An Atlas of Histology Copies of this text are on reserve in the HSL.

Epithelium	pp. 38 - 42
Glands	pp. 46 - 52
Surface specializations	pp. 9 - 13

V. CELLULAR SPECIALIZATIONS IN EPITHELIA

A. CELL ATTACHMENTS

1. CELL TO CELL CONTACT

a) JUNCTIONAL COMPLEX - (J. Figs. 4-4 to 4-7; R. Figs. 5.14 to 5.23). The junctional complex is a group of three types of cell junctions that occur at the apical perimeters of adjacent columnar and cuboidal cells. The structure of the complex is evident only by electron microscopy. Observe these junctions in EM 16: (1) zonula occludens, (2) zonula adherens and (3) macula adherens

In the light microscope the junctional complex is barely visible in sections stained with H and E. The junctional complex observed by LM is called the "terminal bar." (R. Fig. 5.13) What is the "terminal web"? (R. Fig. 5.3)

b) MACULA ADHERENS (DESMOSOMES), light microscopy. (J. Fig. 18-4; R. Plate 42)

(1) SL 26: (Thick Skin) (low, med, high). Individually, desmosomes cannot be resolved in the light microscope without special processing; however, their presence is indicated by "intercellular bridges" (fine lines crossing the space between pairs of blue lines) extensions of cells that are caused by desmosomes. During fixation the cells shrink and separate from each other except where the junctions are located. As the cells pull apart, minute projections extend from adjacent cells to each cell junction. The numerous projections give the cells a "spiny" appearance in this layer of the skin (called the stratum spinosum). (What is the complete classification of this tissue?).

(2) EM 20-6: Desmosomes are frequent along membranes of adjacent cells. (J. Fig. 4-4, 4-5, 18-4; R. 5.14, 5.21).

c) GAP JUNCTION EM 22 – Read the description of EM 22 in the key enclosed in the gray envelope. (J. Fig. 4-7; R. 5.22, 5.23).

d) INTERDIGITATION OF LATERAL MEMBRANES EM 9 (R 5.24)

2. The BASEMENT MEMBRANE (Basal attachment) (J. Figs. 4-1, 4-2, 4-3; R. 5.25, 5.26) is the interface between the epithelium and underlying tissue. It is composed of basal lamina (non-fibrillar collagen plus other material), secreted by the epithelial cells; and a layer of reticular fibers and other fibrillar material, secreted by connective tissue cells. These two layers together can be seen in the light microscope.

a) SL 20 (low): (Bronchus). Beneath the pseudostratified ciliated columnar epithelium, the basement membrane appears as an acellular, pink band (e.g., between blue arrows). This basement membrane is thicker than most other basement membranes.

b) EM 19-2: fused basal laminae of 2 epithelial cells: (in lung), endothelial cells of a capillary are separated from another epithelium by their fused basal laminae. A reticular layer is absent here.

c) HEMIDESMOSOMES (J. Fig. 4-2a; R Fig. 5.29. 5.34, 5.36). These are "half desmosomes" which anchor the basal surface of cells to the basal lamina. Hemidesmosomes are especially common in stratified squamous epithelium in areas that are subject to forces that could shear the epithelium from its underlying tissue (skin, gums).

B. SPECIALIZATIONS OF THE "FREE SURFACE"

1. MICROVILLI (J. Fig. 4-8; R. 5.2, 5.3). Most cells have a few microvilli on their apical surface. However, microvilli are numerous on the apical surface of intestinal cells in which the main function is absorption. The microvilli form an even row of projections that appears as a "striated border."

a) SL 11: (Ileum). Observe the regular arrangement of numerous microvilli at the apical surface (J. Fig. 15-28, 15-29; R. Plate 60), often referred to as the "striated border". This simple columnar epithelium also has goblet cells that secrete mucus and are called unicellular glands.

b) SL 19: (Jejunum) (J. Fig. 15-28a) (low, med). Stained with PAS. This stain is specific for glycoproteins that are major constituents of the thick glycocalyx coating the microvilli, and the mucus, which fills the goblet cells (oil). All cells have a glycocalyx; it is thicker in some cell types and on some surfaces than others. In this slide the glycocalyx on the lateral surfaces of the cells is evident (microvilli with glycocalyx, blue arrow; glycocalyx on lateral cell membranes, green arrows; goblet cell, red arrow).

c) EM 16 (J. Figs. 4-8, 15-28c, 15-29; R. Figs. 5.2, 5.3) Electron micrographs of microvilli. Relate the glycocalyx with that in the PAS-stained section (SL 19) (oil). Notice the internal structure of the microvilli.

2. STEREOCILIA (J. Fig. 4-9; R. Fig. 5.4, 5.5). SL 156 (Testis): Locate the ducts of the epididymis (scan, low, high,). Cells in the pseudostratified columnar epithelium have long projections that are elongated and branched and are modified microvilli, called stereocilia (blue circle). Their function apparently is absorption.

3. CILIA (J. Figs. 2-30, 4-10; R. 5.6 to 5.9) SL 111: (Trachea). The structure with the largest lumen in this section is lined by ciliated pseudostratified columnar epithelium. Other ciliated epithelia are found in the uterine tube and uterus (low, high).

4. FLAGELLA are found in spermatozoa in humans. (J. Fig. 21-10; R. 22.12). Note their structure is similar to cilia, but they are longer and usually limited to 1 per cell.

VI. GLANDULAR EPITHELIUM

Glandular epithelium is specialized for the production and secretion of products. The cells that form glands are usually cuboidal or columnar in shape. Glandular epithelium will be studied in great detail throughout the course. We have already looked at a variety of glandular epithelium. In this exercise we are emphasizing morphological differences with respect to secretory products.

A. UNICELLULAR GLANDS: SL 111 (low, high), (Trachea); SL 19 (oil), (Jejunum) (PAS), for review. Goblet cells may be few or numerous and are found in epithelia of the respiratory and alimentary systems. The secretory product is emptied into the lumen of the organ rather than into ducts (J. Fig. 4-17, 15-28; R. 5.38, Plate 60)

B. MULTICELLULAR GLANDS: In general these glands are formed by invagination, proliferation, and differentiation of the epithelium from which they are derived. Exocrine glands have maintained a connection with the surface epithelium through ducts. Endocrine glands have lost this connection. At this time we will consider only exocrine glands. The secretory products of glands are quite varied. In simplest form, we will distinguish between the morphology of

mucus-secreting and serous-secreting cells by studying salivary glands (J. Fig. 4-24, 4-25; R. Fig. 5.40, 5.41).

1. SL 92: (Submandibular gland). (J. Fig. 16-6a, R. Plate 51) This gland has mostly groups of serous-secreting cells arranged in acini (like a bunch of grapes: the grapes = acini, a group of secretory cells; the stem = ducts which carry the secretory product) (acini within blue circles). Each acinus contains a number of serous-secreting cells that have a round nucleus located in the basal half of the cell; the secretory granules occupy the apical portion of the cell. Scattered among these acini are mucous-secreting acini which have these characteristics: the nucleus is flattened against the basal membrane, and the remainder of the cell appears "empty" or washed out because mucus is often partially removed by tissue preparation and does not stain well with H & E. Some of these mucous acini have a row of serous-secreting cells at their periphery. These are called serous demilunes and their secretory product passes between the mucus-secreting cells into the duct (serous demilunes, outlined by blue lines; mucous acinus, green circle, serous acinus, red circle). Thus, the ducts in this gland carry mixed serous and mucous secretions.

2. SL 93: (Sublingual gland). (J. Fig. 16-6b; R. Plate 53) This gland consists primarily of mucous acini. Compare the appearance of the two types of acini. This tissue also has fat-storing cells which appear empty with a very thin, flat nucleus against the cell membrane; these are not arranged in acini, and you will readily distinguish them from the mucous-secreting (red circles) cells

OBJECTIVES FOR LABORATORY 5: SPECIALIZATIONS OF EPITHELIA, GLANDULAR TISSUE

1. Using the light microscope or digital slides, identify:

    Terminal bar
    Intercellular bridges
    Basement membrane
    Microvilli (seen as striated or brush border)
    Cilia
    Stereocilia
    Goblet cells (in H&E, and they are PAS positive)
    Glycocalyx (PAS positive)
    Unicellular glands
    Multicellular glands
        Mucus glands
        Serous glands
            Serous demilunes

    Recognize PAS stained slides (e.g. SL 19), what structures in the cell are PAS positive, etc.

2. On electron micrographs, identify:

    Junctional complex
        Zonula occludens (tight junction)
        Zonula adherens (belt desmosome)
        Macula adherens (spot desmosome, or just desmosome)
    Gap junction
    Hemidesmosome
    Interdigitation of lateral membranes
    Basal lamina
        Lamina lucida
        Lamina densa
        Reticular layer (see lecture notes and subsequent EMs)
    Microvilli
        Microfilament core
    Cilia
        Microtubule core
    Glycocalyx

    Understand the freeze-fracture technique

REVIEW QUESTIONS ON EPITHELIA AND EPITHELIAL SPECIALIZATIONS

1. Suggest a major function for each of the following types of epithelium:

    a. simple squamous epithelium

    b. simple columnar epithelium

    c. stratified squamous epithelium

2. Compare the structure of pseudostratified columnar epithelium with stratified columnar epithelium.

3. What is the difference between basal lamina and basement membrane?

4. What components of the junctional complex, a) prevent(s) flow of material through the epithelium? b) have primary function of adhesion between cells?

5. In an electron micrograph how could one tell that a free surface projection was a cilium, a microvillus or a stereocilium?

6. In a section with mixed serous and mucous glandular epithelium, which secretory cells should be more basophilic?