TOPIC 4: CELL JUNCTIONS, ADHESION AND THE EXTRA CELLULAR MATRIX.

TEXT CHAPTER 19, pages 593-630

TERMS:

CONNECTIVE TISSUES
EPITHELIAL TISSUES
CELL JUNCTIONS
  OCCLUDING JUNCTIONS
  TIGHT JUNCTIONS
ANCHORING JUNCTIONS
  ADHERENS JUNCTIONS (CELL-CELL & CELL-MATRIX)
  SEPTATE JUNCTIONS
  DESMOSOMES (CELL-CELL)
  HEMIDESMOSOMES (CELL-MATRIX)
COMMUNICATING JUNCTIONS
  GAP JUNCTIONS
CHEMICAL SYNAPSES
ADHESION BELT
CATENIN (α, β, γ)
VINCULIN
α-ACTININ
PLAKOGLOBIN
FOCAL CONTACTS (ADHESION PLAQUES)
CONNEXONS

TAKE HOME MESSAGE:

Many cells in tissues are linked to one another and to the extracellular matrix at specialized contact sites called cell junctions. Cell junctions fall into three functional classes: occluding junctions, anchoring junctions and communicating junctions. Tight junctions are occluding junctions that play a critical part in maintaining the concentration of differences of small hydrophilic molecules across the epithelial cell sheets by (1) sealing the plasma membranes of adjacent cells together to create a continuous, impermeable, or semipermeable barrier to diffusion of membrane transport proteins between the apical and basolateral domains of the plasma membrane.

The main types of anchoring junctions in vertebrates are adherens junctions, desmosomes and hemidesmosomes. Adherens junctions are connecting sites for bundles of actin filaments, whereas desmosomes and hemidesmosomes are connecting sites for intermediate filaments. Septate junctions also serve as connecting sites for actin filaments, but only in invertebrate tissues. Gap junctions are communicating junctions composed of clusters of channel proteins that allow molecules smaller than about 1,000 daltons to pass directly from the inside of one cell to the inside of the other. Cells connected by such junctions share many of their inorganic ions and other small molecules and are therefore chemically and electrically coupled. Gap junctions are important in coordinating the activities of electrically active cells.

CELL-CELL ADHESION MOLECULES (CAMs)
CADHERINS (N- & E-)
SELECTINS
NEURAL CELL ADHESION MOLECULE (N-CAM)
INTRACELLULAR ADHESION MOLECULES (ICAMs)

TAKE HOME MESSAGE:

Cells dissociated from various tissues of vertebrate embryos preferentially reassociated with cells from the same tissue when they are mixed together. This tissue-specific recognition process is mainly mediated by of family of calcium-dependent cell-cell adhesion proteins called cadherins, which hold cells together. Cadherins must be attached to the cortical cytoskeleton. Also present are calcium-independent cell-cell adhesion systems that mainly involve members of the immunoglobulin superfamily, which includes the neural crest adhesion molecule N-CAM.
GLYCOAMINOGLYCAN (GAG)
  HYALURONAN (HYALURONIC ACID)
  CHONDROITIN SULFATE
  DERMATAN SULFATE
  HEPARAN SULFATE
  HEPARAN
FIBROBLAST GROWTH FACTOR
TRANSFORMING GROWTH FACTOR $\beta$ (TGF-$\beta$)
AGGREGAN
SERGLYCIN
BETAGLYCAN
COLLAGENS
HYDROXYLYSINE/HYDROXYPROLINE
ELASTIN
FIBRONECTIN
RGD SEQUENCE
TENASCIN
TYPE IV COLLAGEN
LAMININ
AGRIN
METALLOPROTEASES
SERINE PROTEASES

TAKE HOME MESSAGE:

Cells in connective tissue are embedded in an intricate extracellular matrix that not only binds them together, but also influences their development, polarity and behavior. The matrix contains various proteins fibers interwoven in a hydrated gel composed of a network of glycosaminoglycan (GAG) chains. The GAGs are a heterogeneous group of negatively charged polysaccharide chains, which (except for hyaluronan) are covalently linked to protein to form proteoglycan molecules. They occupy a large volume and form hydrated gels in the extracellular space. Proteoglycans are also found on the surface of cells, where they function as co-receptors to help cells bind to the matrix and respond to growth factors.

The fiber-forming proteins can be divided into roughly two functional types: mainly structural (collagens and elastins) and mainly adhesive (such as fibronectin and laminin). Fibronectin and laminin are examples of large, multidomain, adhesive glycoproteins in the matrix; fibronectin is widely distributed in connective tissue, whereas laminin is found mainly in basal laminae.

INTEGRINS

TAKE HOME MESSAGE

Integrins are the principal receptors used by animal cells to bind to the extracellular matrix. They are heterodimers that function as transmembrane linkers that mediate bi-directional interactions between the extracellular matrix and the actin cytoskeleton. They also function as signal transducers, activating various intracellular signaling pathways when activated by matrix binding. A cell can regulate the adhesive activity of its integrins by altering either their matrix-binding site or their attachment to actin filaments.