Lecture 7

Muscles

INTRODUCTION:

All cells are capable of some sort of movement the dominant function of several cell types is to generate motile forces through contraction. In these specialized contractile cells, motile forces are generated by the interaction of the proteins actin and myosin (contractile protein). Certain forms of contractile unite.

-***Myo-epithelial cell***: are an important component of certain secretory glands where they function to expel secretions from glandular acini.

-***pericyte*****:** are smooth muscles –like cells that surround blood vessels

-***Myo-fibroblasts*****:** are cells that have contractile role in addition to being able to secret collagen. This type of cell generally inconspicuous in normal tissues but comes to be a dominant cell type when tissue undergo repair after damage in the formation of a scar.

Other forms of contractile cell function by forming multicellular contractile units termed muscle such muscle cells can be divided into three types:

-***Skeletal muscle*** is responsible for the movement of the skeleton and organs such as the globe of the eye and the tongue. Skeletal muscle if often referred to as voluntary muscle since it is capable of voluntary (conscious) control

The arrangement of the contractile protein gives rise to the appearance of prominent cross – striation in some histological preparations and hence the name striated muscle is often applied to skeletal muscle.

The highly developed functions of the cytoplasmic organelles of muscle cells have led to the use of a special terminology for some muscle cell components: plasma membrane or plasma lemma ≡ sarcolemma, cytoplasm ≡ sarcoplasm, endoplasmic reticulum ≡ sarcoplasmic reticulum.

Skeletal muscles have a wide variety of morphological forms and modes of actions. Never the less all have the same basic structure. Skeletal muscles is composed of extremely elongated, multinucleated contractile cells often described as individual muscle fibers vary considerably in diameter from 10 to 100 Mm and may extend throughout the whole length of a muscle reaching up to 35 cm in length. Skeletal muscle contraction is controlled by large motor nerves, individual nerve fibers branching within the muscle to supply muscle fibers, collectively described as a ***motor unit***.

Excitation of any one motor nerve results in simultaneous contraction of all the muscle fibers of the corresponding motor unit. The vitality of skeletal muscle fibers is dependent on the maintenance of their nerve supply. Skeletal muscle contains highly specialized stretch receptors known as ***neuromuscular spindles***.

Smooth muscle: is so named because unlike other forms of muscle, the arrangement of contractile proteins does not give the histological appearance of cross-striations. This type of muscle forms the muscular component of visceral structures such as blood vessels, the gastrointestinal tract, the uterus and the urinary bladder, giving rise to the alternative name of ***visceral muscle***, since smooth muscle is under

inherent autonomic and hormonal control, it is described as involuntary muscle.

In contrast to skeletal muscle, which is specialized for relatively forceful contractions of short duration and under fine voluntary control, smooth muscle is specialized for continuous contraction of relatively low force, producing diffuse movements resulting in contraction of the whole muscle mass rather than contraction of individual motor units.

Contractility is an inherent property of smooth muscle occurring independently of neurological innervations often in a rhythmic or wave-like fashion. Super imposed on this inherent contractility are the influences of the autonomic nervous system, hormones and local metabolites which modulate contractility to accommodate changing functional demands. The cells of smooth muscle are relatively small with only a single nucleus. The fibers are bound together in irregular branching fasciculi, the arrangement varying considerably from one another according to functional requirements.

-Cardiac muscle: has many structural and functional characteristics intermediate between those of skeletal and smooth muscle and provides for the continuous, rhythmic contractility of the heart, although striated in appearance, cardiac muscle is readily distinguishable from skeletal muscle and should not be referred to by the term, ***striated muscle***.

Muscle cells of all three are surrounded by an external lamina. In all muscle cell type, contractile forces developed from the internal contractile proteins are transmitted to the external lamina via link proteins which span the muscle cell membrane. The external lamina binds individual muscle cells into a single functional mass. Cardiac muscle exhibited many structural and functional characteristics intermediate between those of skeletal and visceral muscle. Like the former, its contractions are strong and utilize a great deal of energy, and like the

latter the contractions are continuous and initiated by external autonomic and hormonal stimuli. Cardiac muscle fibers are essentially long cylindrical cell with one or at most two nuclei, centrally located within the cell. The ends of the fibers are split longitudinally into a small number of branches, the ends of which about on to similar branches of adjacent cell giving the impression of a continuous three dimensional cytoplasmic network, this was formerly described as a syncytium before the discrete intercellular boundaries were recognized.

Between the muscle fibers, delicate collagenous tissue analogous to the endomysium of skeletal muscle supports the extremely rich capillary network necessary to meet the high metabolic demands of strong continuous activity.

Cardiac muscle fibers have an arrangement of contractile proteins similar to that of skeletal muscle and are consequently striated in similar manner. However, this is often difficult to visualize with light microscopy due to the irregular branching shape of the cells and their myofibrils.

Cardiac muscle fibers have a system of T tubules and sarcoplasmic reticulum analogous to that of skeletal muscle. In the case of cardiac muscle, however, there is a slow leak of calcium ions into the cytoplasmic from the sarcoplasmic reticulum after recovery from the preceding contraction; this causes a succession of automatic contraction independent of external stimuli. The rate of this inherent rhythm is then modulated by external autonomic and hormonal stimuli.