EXTRA CELLULAR MATRIX (ECM)

→ Constitutes the non-cellular component of all tissues and organs.

→ Important role in the development, differentiation and maintenance of the tissue and organ.

→ Major components are water, proteins and polysaccharides.

→ The two main components are proteoglycans (GAG + Protein) and fibrous proteins (collagen, elastin, fibrillin and fibronectin, are adherence proteins).

Collagen

→ Major structural protein in connective tissue

→ Very strong and tensile protein

→ Made up of 3 polypeptide chains. These 3 polypeptide chains are again wound into a right handed superhelix (triple helix) forming a rod-like structure.

→ every 3rd amino acid is glycine.

→ contain proline, hydroxy proline and hydroxy lysine in good proportion.

→ The repetitive amino acid sequence represented as (Gly-X-Y)n

Intracellular Synthesis

→ The collagen is synthesized by fibroblasts as a large precursor intracellularly, called procollagen.

→ Hydroxylation of proline and lysine residues (post-translational modification) by prolyl hydroxylase and lysyl hydroxylase, requires vit C and α-KG as co-factors.

→ glycosylation of hydroxy lysine occurs

Extracellular Synthesis

→ After the synthesis, procollagen is secreted outside the cell.

→ The extracellular procollagen is cleaved by specific peptidases to form tropocollagen

→ Multiple tropocollagen molecules assemble into collagen fibres.

→ Collagen fibres are arranged in a 'quarter staggered array'

→ The collagen fibres are strengthened by covalent cross-links between lysine and hydroxy lysine residues.

→ The cross-links are formed by lysyl oxidase, a copper containing enzyme.

Functions

→ Type II is mainly seen in cartilage and vitreous humor.

→ Type III is in skin, lung and vascular tissue.

→ Type IV is seen in the basement membranes.

→ Give support to organs.

→ Help in proliferation and differentiation of cells.

Elastin

→ Protein in connective tissue.

→ Major component of elastic fibres

→ Allows many tissues in the body to resume their shape after stretching or contracting.

→ Composed of the protein fibrillin and aminoacids such as glycine, valine, alanine, lysine and proline.

→ Cross-links are formed from 4 lysine residues.

→ Found in ligaments and in the walls of blood vessels (eg: aorta)

Osteogenesis Imperfecta

→ Otherwise called brittle bone disease.

→ Abnormality in collagen structure

→ Due to genetic mutations in single amino acid.

→ Here glycine is replaced by cysteine in the polypeptide chain

→ Polypeptides excessively hydroxylated and ~~hydroxylated~~ glycosylated

→ Unfolding the helix results in brittle bones.

Ehlers-Danlos Syndrome

→ The condition results from defective type III collagen formation due to defective lysyl oxidase or lysyl hydroxylase.

→ characterised by weakening of collagen, loose skin.

Marfan Syndrome

→ This disease is produced by a defect in the gene, coding for a connective tissue protein fibrillin.

→ It is a component of microfibrils, which normally gives the substratum for deposition of elastin

→ So, fibrillin and elastin are deposited at lower concentrations

Contractile Proteins

→ The myofiber is the functional unit of skeletal muscle and is multinucleated

→ The cytoplasm (sarcoplasm) of a myofiber contains a regular array of contractile units composed of actin (thin filament) and myosin (thick filament).

→ The myosin molecules are large, each with 6 polypeptide chains; 2 identical heavy chains and 4 light chains.

→ Myosin molecules assemble into filaments

→ Myosin acts as the enzyme ATPase

→ Myosin binds to actin polymer.

→ Sliding and shortening of actin and myosin is the basis of muscle contraction

→ During muscle contraction, myosin moves over actin filament.

Actin

→ It is the major protein of the thin filaments

→ It can polymerize into a fibrous form, called F-actin, which is a helix of actin monomer.

→ The muscle contraction results from the interaction of the actin and myosin to form actomyosin with energy provided by ATP.