BIRIKTIRUVCHI TO'QIMA
CONNECTIVE TISSUE
СОЕДИНИТЕЛЬНАЯ ТКАНЬ

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Annotatsiya

Ushbu maqolada biriktiruvchi to‘qimaning tuzilishi, tasnifi, hujayra tarkibi, hujayralararo modda va funksiyalari to‘liq yoritilgan. Biriktiruvchi to‘qima organizmning eng ko‘p tarqalgan to‘qima turi bo‘lib, u mexanik tayanch, himoya, trofik, plastik va transport vazifalarini bajaradi. Maqolada fibroblastlar, makrofaglar, mast hujayralar, plazmatik hujayralar va adipotsitlarning morfologik xususiyatlari batafsil ta‘riflangan. Shuningdek, kollagen, elastin va retikulyar tolalar hamda ekstrasellyulyar matriksning tarkibi ko‘rib chiqilgan. Biriktiruvchi to‘qima patologiyalari — sistemli autoimmun kasalliklar, irsiy kollagenopatialar va degenerativ buzilishlar ham tahlil qilingan. Maqola uch tilda — o‘zbek, ingliz va rus tillarida bayon etilgan.

Kalit so‘zlar: *biriktiruvchi to‘qima, fibroblast, kollagen, ekstrasellyulyar matriksis, gistologiya, autoimmun kasalliklar, tog‘ay, suyak to‘qimasi.*

English

Introduction and Overview

Connective tissue (Latin: textus connectivus) is the most abundant tissue type in the human body, accounting for approximately 60–80% of total body mass. It serves as the structural foundation that binds, supports, and protects other tissues and organs. Embryologically derived from mesenchyme — a loose, pluripotent embryonic tissue of mesodermal origin — connective tissue displays remarkable diversity in both structure and function across different anatomical locations.

Unlike epithelial tissue, which is characterized by close cell-to-cell contact, connective tissue is defined by a relatively sparse population of cells embedded within an abundant extracellular matrix (ECM). This matrix is produced by the resident cells themselves and provides the structural and biochemical scaffold necessary for tissue function. The composition of the ECM varies greatly between

connective tissue subtypes, reflecting their specialized roles (Ross & Pawlina, 2016).

Historical Backgroun

The systematic study of connective tissue began in the 17th century with Marcello Malpighi's microscopic observations of tissue architecture. Rudolf Virchow (1821–1902) revolutionized the field with his concept of cellular pathology (Cellularpathologie, 1858). Albert Maximow (1874–1928) proposed the unitarian theory of blood cell formation and demonstrated the mesenchymal origin of all connective tissue types (Maximow, 1927). The elucidation of collagen structure by Ramachandran and Kartha in 1955 further deepened our understanding of ECM biology.

Embryological Origin

All connective tissues originate from mesenchyme. Mesenchymal stem cells differentiate along distinct lineages:

1.Chondrogenic lineage → cartilage
2.Osteogenic lineage → bone
3.Adipogenic lineage → adipose tissue
4.Fibroblastic lineage → dense and loose connective tissue
5.Hematopoietic lineage → blood cells

Structure and Classification

Cellular Components

Fibroblasts. The principal resident cells of connective tissue, responsible for synthesizing ECM structural proteins including Type I, III, and V collagen, elastin, fibronectin, and proteoglycans. Upon tissue injury, quiescent fibrocytes reactivate, proliferate, and produce large quantities of collagen, facilitating wound repair (Gabbiani, 2003).

Macrophages. Derived from circulating monocytes, macrophages eliminate pathogens and cellular debris through phagocytosis. They also function as antigen-presenting cells (APCs), bridging innate and adaptive immunity. M1 phenotype is pro-inflammatory; M2 is anti-inflammatory and reparative (Murray & Wynn, 2011).

Mast Cells. Granule-rich cells positioned near blood vessels and nerves. Granules contain histamine, heparin, tryptase, and cytokines. Upon IgE-mediated activation, they degranulate, driving allergic responses (Galli et al., 2008).

Plasma Cells. Terminally differentiated B lymphocytes specialized for immunoglobulin secretion. Recognized histologically by eccentric 'clock-face' chromatin pattern.

Adipocytes. White adipocytes store energy as triglycerides in a single large lipid droplet. Brown adipocytes are rich in mitochondria and perform non-shivering thermogenesis via uncoupling protein 1 (UCP1) (Nedergaard et al., 2007).

Extracellular Matrix (ECM)

The ECM consists of fiber proteins and ground substance. The ground substance is composed of glycosaminoglycans (GAGs) — including hyaluronic acid, chondroitin sulfate, dermatan sulfate, keratan sulfate, and heparan sulfate — proteoglycans, and adhesive glycoproteins such as fibronectin and laminin. GAGs bind water avidly, giving the matrix gel-like consistency and enabling nutrient diffusion.

Fiber Types

Collagen fibers — Most abundant protein in the human body (~28% of total protein). Over 28 types known. Type I predominates in skin, tendons, and bone; Type II in cartilage; Type III forms reticular fibers in lymphoid organs.

Elastic fibers — Composed of cross-linked elastin and fibrillin microfibrils. Allow tissues to stretch and recoil; critical in arterial walls, lungs, and skin.

Reticular fibers — Fine Type III collagen forming supportive networks in liver, spleen, and lymph nodes.

Functions

1.Mechanical support — structural framework (bone skeleton, tendons, ligaments)

2.Protection — defense against infection (macrophages, plasma cells)

3.Trophic — nutrient delivery via capillary networks

4.Plastic — tissue repair and regeneration (wound healing)

5.Depot — water, mineral, and fat storage (adipose tissue)

6.Transport — metabolite exchange (blood and lymph)

Pathology

Systemic Connective Tissue Diseases

1.Systemic Lupus Erythematosus (SLE) — multi-organ autoimmune disease; ANA, anti-dsDNA antibodies

2.Rheumatoid Arthritis (RA) — synovial inflammation and joint destruction

3.Systemic Sclerosis (Scleroderma) — progressive fibrosis of skin and internal organs

4.Sjögren's Syndrome — exocrine gland destruction; dry eyes and mouth

5.Polymyositis / Dermatomyositis — inflammatory myopathy with skin changes

Heritable Connective Tissue Disorders

1.Marfan Syndrome — FBN1 gene mutation; aortic root dilation, lens dislocation

2.Ehlers-Danlos Syndrome — collagen gene mutations; skin hyperextensibility, joint hypermobility

3.Osteogenesis Imperfecta — COL1A1/COL1A2 mutations; brittle bones, blue sclerae

Clinical Significance

Understanding connective tissue biology is fundamental to surgery, oncology, pharmacology, and regenerative medicine. Wound healing quality depends on fibroblast activity, vascularity, and infection control. In oncology, the tumor microenvironment (tumor stroma) promotes invasion, angiogenesis, and immune evasion. Biological therapies targeting TNF-α (etanercept, infliximab), IL-6 (tocilizumab), and B cells (rituximab) have transformed treatment of rheumatoid arthritis and other autoimmune connective tissue diseases.

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