CONTENTS

EMBRYOLOGY

GENERAL HISTOLOGY

SPECIAL HISTOLOGY. INTRODUCTION TO HISTOLOGY OF HUMAN ORGANS AND SYSTEMS

Chapter 1

HISTOLOGY, CYTOLOGY AND EMBRYOLOGY. THEIR CONTENT, OBJECTIVES AND RELATIONSHIP WITH OTHER MEDICAL AND BIOLOGICAL SCIENCES. THEIR IMPORTANCE FOR MEDICINE

The human and animal organism is an integral system, in which we can conventionally distinguish a number of interrelated, interacting and subordinate hierarchical levels of organization of living matter: cells — cell lineage — tissues — morphofunctional units of organs — organs — organ systems. Each of these levels of structural organization has morphological and functional features that distinguish it from other levels, and includes structural units of the lower levels.

Histology (from the Greek *histos* for tissue, *logos* for science) is a science that studies the patterns of development, structure and vital activity of tissues throughout historical and individual development of multicellular animals and humans.

Unlike other biological sciences, the main subject of histology is precisely tissues, which are phylogenetically formed and topographically and functionally related cellular systems and their derivatives. Tissues show general biological patterns inherent in living matter; at the same time tissues have their own features of structure, development, vital activity, interstitial (intra-level) and inter-tissue (inter-level) connections. Tissues serve as elements of development, structure and life of organs and their morphological and functional units. The main tissue systems (nervous tissue, muscle tissue, epithelial tissue, connective tissue, and blood) are characterized by inherent features of development, structure and vital functions. The subject of *general histology*, or the study of tissues proper, are general patterns characteristic for the tissue level of organization, and the distinctive features of specific tissues; the subject of *special histology* is the patterns of structure, vital activity and interaction of various tissues in organs at higher levels of organization. Special histology serves as the basis for studying the microscopic structure of morphofunctional units of organs and organs in general. As an academic discipline, histology also includes cytology — a study of the cell, and embryology — teaching of the embryo.

Cytology (from the Greek *kytos* for cell, *logos* for doctrine) is a science of the cell. It considers the issues of development, structure and functions of cells and their derivatives, as well as the mechanisms of reproduction and interaction.

Cytology is a necessary part of histology, since cells are the basis for tissue development, structure and function. The section on *general cytology* considers general principles of the structure and physiology of cellular structures. *Special cytology* studies the characteristics of specialized cells in various tissues and organs. In recent years, cytology has been enriched with many scientific discoveries that have made a significant contribution to the development of biological and medical sciences, and to clinical practice. New data on the structure of the nucleus, its chromosomal apparatus formed the basis for cytodiagnosis of hereditary diseases, tumors, blood diseases and many other conditions. Disclosure of the features of the ultrastructure and chemical composition of cell membranes serves as the basis for understanding the patterns of cell interaction in tissue systems, defense reactions, etc. Clinical cytology that uses methods of fine-needle aspiration is a part of diagnostic search in clinical examination of the population and early detection of malignancy.

Embryology (from the Greek *embryo* + *logos* for science) is a science of the regularities of embryonic development.

In embryology course taught at medical schools, emphasis is made on the patterns of human embryonic development. Familiarizing the future doctor with the specifics of human embryogenesis is of great importance for the formation of his scientific worldview and professional activity. In the course of embryology, particular importance is attached to the sources of development and the mechanisms of tissue formation (histogenesis) at a certain stage of embryogenesis. The patterns of histogenesis determine the morphofunctional features of tissue structures in postnatal ontogenesis, in particular, their ability to regenerate. Thus, incorporation of histology, cytology and embryology into one course is not formal, but reflects the internal natural connections between them. Histology with cytology and embryology, like other biological sciences, solve the main problem: elucidation of the sources of development, patterns of histogenesis, reactivity and regeneration of tissues and, in this regard, the possibility of a targeted effect. Important branches of histology are the theory of cell, theory of germ layers, tissue evolution, histogenesis and regeneration. Modern histology, cytology and embryology make essential contribution to the development of theoretical and applied aspects of modern medicine and biology.

Fundamental theoretical problems include:

- development of a general theory of histology, reflecting the evolutionary dynamics of tissues and patterns of embryonic and postnatal histogenesis;
- study of histogenesis as a complex of processes of proliferation, differentiation, determination, integration, adaptive variability, programmed cell death, etc;
- elucidation of the mechanisms of nervous, endocrine, immune regulation of tissue, as well as age-related changes in tissues;

- studying the regularities of reactivity and adaptive variability of cells and tissues under the influence of unfavorable environmental factors and under extreme conditions of functioning and development, as well as in transplantation;
- developing the problem of tissue regeneration after damaging effects, and methods of tissue replacement therapy;
- elucidating the mechanisms of molecular genetic regulation of cell differentiation, inheritance of a genetic defect in the development of human systems, developing the techniques of gene therapy and transplantation of embryonic stem cells;
- elucidating the processes of human embryonic development, critical periods of development, reproduction and the causes of infertility.

The course of histology with cytology and embryology is closely related to the teaching of other biomedical sciences — biology, anatomy, physiology, biochemistry, pathological anatomy, as well as clinical disciplines. Thus, elucidation of the basic laws of structural organization of cells serves as the basis for explaining issues of genetics in the course of biology. On the other hand, issues of evolution of living matter in the course of biology is a necessary prerequisite for studying various levels of organization of living matter in the human body. The study of the structure of organs in the course of anatomy is based on the data of histological analysis. At present, when studies of cellular and tissue structures are carried out at the subcellular and molecular levels using biochemistry and immunocytochemistry, there is a particularly close relationship between histology, cytology and embryology with biochemistry and molecular biology. Cyto-, immuno- and histochemical techniques are widely used in scientific research and clinical diagnosis. Understanding the normal structure of cells, tissues and organs is a prerequisite for understanding the mechanisms of their impairment, therefore histology with cytology and embryology is closely related to pathological anatomy and many clinical disciplines (internal medicine, obstetrics and gynecology, etc). Thus, histology with cytology and embryology occupies an important place in the system of medical education. For modern medicine, with its focus on prevention and early detection of disease, understanding structural foundations and patterns of ensuring the stability and reliability of living systems (including tissues) is especially important, since the progressive development of civilization inevitably entails emergence of new factors that adversely affect animal organisms, including humans.

Questions

- What issues are solved by modern cytology, histology and embryology?