ISSN 3060-4567

STRUCTURAL FEATURES OF THE LARYNX IN NORMAL AND PATHOLOGIC CONDITIONS

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Abstract: *Diseases of the larynx occupy one of the leading places among the pathologies of the ENT organs. They include benign and malignant tumors, congenital and acquired pathology of ligamentous, muscular and nervous apparatus. Patients with urgent laryngeal diseases are the most severe of all ENT patients requiring emergency care. 50% of all deceased patients with urgent diseases of ENT organs are patients with laryngeal diseases.*

Keywords: *larynx, mucous membrane, morphology, lymphoid apparatus.*

The mammalian larynx is an air-conducting and sound-producing organ, it provides isolation of the respiratory tract from the digestive tract. The backbone of the larynx is made up of movably connected cartilages. On the outside, the muscles of the larynx and pharynx are attached to the cartilages. A thin, petal-shaped epiglottis adjoins the anterior edge of the thyroid cartilage. Between the ring-shaped cartilage and the thyroid cartilage are small sac-like cavities of the larynx, these are its ventricles. The vocal cords are paired folds of the mucous membrane of the larynx, rich in elastic fibers, lying between the thyroid and scoop cartilages. From the outside, the vocal muscle is attached to the ligaments. The mucous membrane in the area of the epiglottis and vocal cords is covered with multilayered squamous neorhoving epithelium, and in other areas with multilayered mesenteric epithelium [31,34].

There is a period in the development of the larynx when the intensively growing epithelium temporarily closes its cavity. Then rapid growth of the laryngeal walls begins, and the cavity is formed again [3, 29]. The epithelial cover of the vocal cords already at the beginning of development in embryogenesis is not the same in different parts of the vocal cords. The ventricular (upper) surface and partially free

ISSN 3060-4567

edge of the ligament are lined with multilinear mesenteric epithelium with 2-3 rows of cells, while the medial (lower) surface is lined with multilinear non-mesenteric epithelium. Already in human embryogenesis, the relatively thick and rich in chemical ingredients epithelium of the medial side of the vocal cords is more developed compared to the free edge. At the same time, the covering epithelium of the ventricular surface is the least differentiated in terms of structural and histochemical parameters. The dynamics of morphological and histochemical changes in the epithelium of the vocal cords in the postnatal period indicates the strengthening of its protective properties [1,6-10].

Immunohistochemical typing of laryngeal muscles - functional antagonists (constrictors, dilators, muscles that change vocal cord tension) by PAP method using monoclonal antibodies to fast myosin heavy chains in ontogenesis revealed two types of muscle fibers in them: slow and fast. The predominance of fast muscle fibers was noted, as in the muscles of the larynx their content is more than 60%. During puberty, the greatest variability in the ratio of fast and slow muscle fibers in the laryngeal muscles is determined [12, 15-18]. The ultrastructural characteristic of cells of the multi-row ciliated epithelium of the larynx has no principal differences from the respiratory epithelium of the nose and pharynx. The renewal time of the covering epithelium of the laryngeal mucosa in a normal adult is 100-150 hours, in a child it is somewhat shorter [4,31]. Stay of experimental animals in high altitude conditions (3375m above sea level) causes changes in the mucous membrane of air-conducting tracts, including the larynx. Already on the 3rd day the multilayer squamous neorhoving epithelium has unequal thickness throughout the whole length. Its surface cells are sometimes subjected to sloughing. In the basal part of the epithelium cells with light cytoplasm and nucleus, cells with hyperchromic nuclei, sometimes figures of mitosis are often seen. There is hypertrophy of mucous glands, with an increase in their functional activity, full blood vessels of all calibers. From 22-30 days, adaptation occurs, as a result of which the histologic picture of the mucous membrane approaches that of control animals [22].

ISSN 3060-4567

Microscopic examination revealed that the topography of the glands of the larynx is not uniform. There are no glands in the thickness of the vocal cords, due to this fact they have a smooth and even surface relief. The walls of the ventricles of the larynx contain a significant number of glands. Throughout postnatal ontogenesis, the number of glands located at the level of the subvocal cavity, regardless of sex, is greater than the number of glands of the interventricular section and the vestibule of the larynx. The significant saturation of glands in the walls of the subvocal cavity allows us to consider the latter as a kind of “guard post”, which, apparently, is necessary for air purification and moisturization [16-21].

The structural and dimensional indices of the glands are variable. At the age of 22-35 years the number of glands in the walls of the human larynx varies from 110 to 587. The density of glands location (their number on the area of 1cm2 of the organ wall) is from 10 to 17, the length of the secretory section of the gland is from 0.47 to 0.92μm, the width is from 0.34 to 0.59μm. The shape of glands can be ovoid, rounded, flattened, tree-shaped and mushroom-shaped. Myoepithelial cells are located between the secretory cells and the basal membrane, the contraction of which promotes secretion from the gland end sections [25-26]. The appearance of the glands can largely be explained by specific regional features of the structure of a particular section of the laryngeal wall [36]. The ratio of stroma and parenchyma of the glands of the larynx changes under the influence of mineral waters with different salt solutions [8-12].

The areas of the base and edges of the epiglottis, the scoop-anadlottal folds, and especially the walls of the laryngeal ventricles are considered as a kind of laryngeal tonsil, which is associated with their saturation with lymphoid tissue [14]. Based on the generalization of numerous studies, it has been established that in the walls of the hollow organs of the digestive and respiratory systems immune structures in the form of diffuse lymphoid tissue and lymphoid nodules are located on the way of possible introduction of foreign substances into the body [37. They are also located near numerous small glands.

ISSN 3060-4567

When studying the cellular composition of lymphoid tissue in the larynx of rats, mainly small lymphocytes were found, the number of blasts, large lymphocytes and macrophages was small. Under the influence of diamond dust in the experiment, the number of not only small lymphocytes, but especially poorly differentiated cells (blasts and large lymphocytes) and macrophages increases [30, 41]. Exposure of white rats to acetaldehyde vapors leads to a decrease in the number of poorly differentiated and plasma cells by 1.3 times compared to the norm. Along with this, the number of macrophages increases. The content of degeneratively changed and destroyed cells is 3 times higher than in the control [14]. Meanwhile, application of immunostimulant (polyoxidonium) results in significant activation of the immune system of mice, including in the larynx [27-31].

The mucous membrane of the airways is very rich in blood vessels, the degree of blood filling and the speed of blood flow through them regulate the temperature of inhaled air. In the thickness of the laryngeal wall there are lymphatic networks connected with each other by anastomoses. In men, the number of extra-organic lymphatic vessels decreases from adolescence and adolescence. In women, the number of extra-organic lymphatic vessels increases until the 2nd period of adulthood, after which their number decreases [1-3].

Sex differences in the larynx begin to be noted from the age of three: girls always have a shorter and smaller larynx than boys. The anteroposterior diameter of the larynx in boys increases markedly from 3-5 years of age. This difference persists in the adult. The true vocal cords in boys are always longer than in girls. The growth rate of the larynx in boys during puberty is faster than in girls. This causes the larynx to be larger in males than in females [4].

Inflammatory diseases of the larynx, as well as of the upper respiratory tract, occupy one of the leading places in otorhinolaryngologic practice. These diseases are fraught with various complications. They can take a chronic form with exacerbations, participate in the emergence and progression of lung diseases, and also affect the immune system [1, 2, 42]. Against the background of chronic inflammatory processes in the larynx, malignant tumor processes often occur. Chronic inflammatory

ISSN 3060-4567

infiltration, along with other factors, is a frequent companion of pseudoepitheliomatous hyperplasia, cysts and polyps [6-9].

In pseudoepitheliomatous hyperplasia, there is a deep invasion of proliferating epithelial cells into the underlying tissue, often with keratinization resembling “cancer pearls”. Pseudoepitheliomatous hyperplasia usually develops as a reaction to damage to the covering epithelium, so its formation is characteristic of areas of ulceration. However, in this disease, the basal membrane is preserved, there is almost no cellular atypism. There are up to 12 types of laryngeal pathologies that can be attributed to precancerous diseases [14-19]. Tumor disruption of mucosal integrity leads to dysgammaglobulinemia [13, 14].

In women aged 18 to 50 years, according to a number of authors, “nodules” (true and false) are in the first place among nodose formations of vocal folds. Contact granuloma may occur in vocalists. In the histomorphological study of postoperative material, malignization of the epithelium occurs at an early stage of the disease [37]. Papillomatosis is one of the frequent diseases of the larynx. Papillomas of the larynx consist of a connective tissue base, poor in cells and usually containing wide vessels. Their entire surface is covered with multilayered squamous epithelium, sometimes reaching a high degree of keratinization as a result of metaplasia. Papillomas can also develop in areas of the larynx covered with multilayered epithelium. The most frequent primary localization of laryngeal papillomas is the area of the anterior commissure and the anterior third of the vocal folds [25, 28, 33, 42]. According to other authors, papillomas were most often (82.7%) localized in the area of the vestibule and vocal folds, and less frequently (17.3%) in the subvocalic region of the larynx and the cervical trachea [35].

Papillomas in children and adolescents are characterized by uniform proliferation of epithelial and connective tissue. This is expressed in the presence of numerous mitoses in the epithelium, numerous vessels and infiltrates in the loose fibrous connective tissue stroma. Papillomas in adults were characterized by less pronounced growth of squamous epithelium with more intense keratinization, the stroma was compact but with a large number of infiltrates [8, 16, 24].

ISSN 3060-4567

Increased vocal loads and other damaging factors of external and internal environment, dysfunctions of the autonomic nervous system can cause inadequate changes in hemodynamics and trophic supply of laryngeal tissues, which constitutes the neurovegetative pathologic component of hyperplastic changes of vocal folds [15, 16, 22, 24, 25, 38].

Among chronic inflammatory diseases accompanied by changes in the mucous membrane, hypertrophic laryngitis is characterized by the most persistent course [4, 18]. According to the authors, men suffer from chronic hypertrophic laryngitis more often, and the incidence increases with age. Along with tissue and cellular changes, thickening of the basal membrane of the epithelium is noted [26, 28, 29]. A prolonged presence of a foreign body in the larynx leads to pronounced inflammatory changes [20, 24]. In experimental damage of vocal cords in rabbits, complete regeneration of their epithelium occurs already on the 5th day. However, such pathology can lead to fibrosis of the vocal cords and atrophy of their muscles [17, 19, 26].

A continuous cycle of inflammatory reaction due to auto-intoxication of the respiratory tract is observed in the treatment of laryngeal injuries. Some types of trauma can lead to deep damage to the cartilaginous base of the organ with pronounced phenomena of chondroperichondritis with subsequent development of chondromalacia. Often, hyperproduction of connective tissue is observed during regeneration [13, 17, 18, 20, 32, 25].

Analysis of the literature shows that the available information is mainly devoted to the study of clinical material. There is very little information about histologic features of the larynx and changes in its tissue structures in experimental animals. Although many authors emphasize the importance of detailed and consistent study of the most common inflammatory diseases of the larynx, their etiology and pathogenesis are still not sufficiently developed. The study of inflammatory processes in the larynx in the dynamics of their development under experimental conditions can play an important role in solving some questions of pathogenesis of acute and chronic laryngitis.

ISSN 3060-4567

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