

**MORPHOLOGICAL FEATURES OF THE LUNG BRONCHUS IN CHILDREN 4 TO 7
YEARS OF AGE**

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Actual problem: Bronchial system plays role of physiological barrier for many biological active substances, also, the epithelium and connective tissue base of the airways provide a barrier-protective function when exposed to various external factors. Features of the structural organization of the lungs ensure that they perform the main gas exchange function. Meanwhile, there are few such works in the modern literature; the existing ones are fragmentary and do not allow their use in the practical activities of a pulmonologist, therapist, etc. Based on the foregoing, the purpose of this work is to establish in postnatal ontogenesis in humans the patterns of formation and involution of the vascular system, epithelial-connective tissue relationships in the pneumatic part of the lung.

Key words: Bronchi of the lung, morphology, morphometry.

Purpose: Assess morphological structure of bronchus of lung in children 4 to 7 years old.

Tasks: to study the dynamic of morphological parameters and the bronchus of the lung's structure in the first childhood.

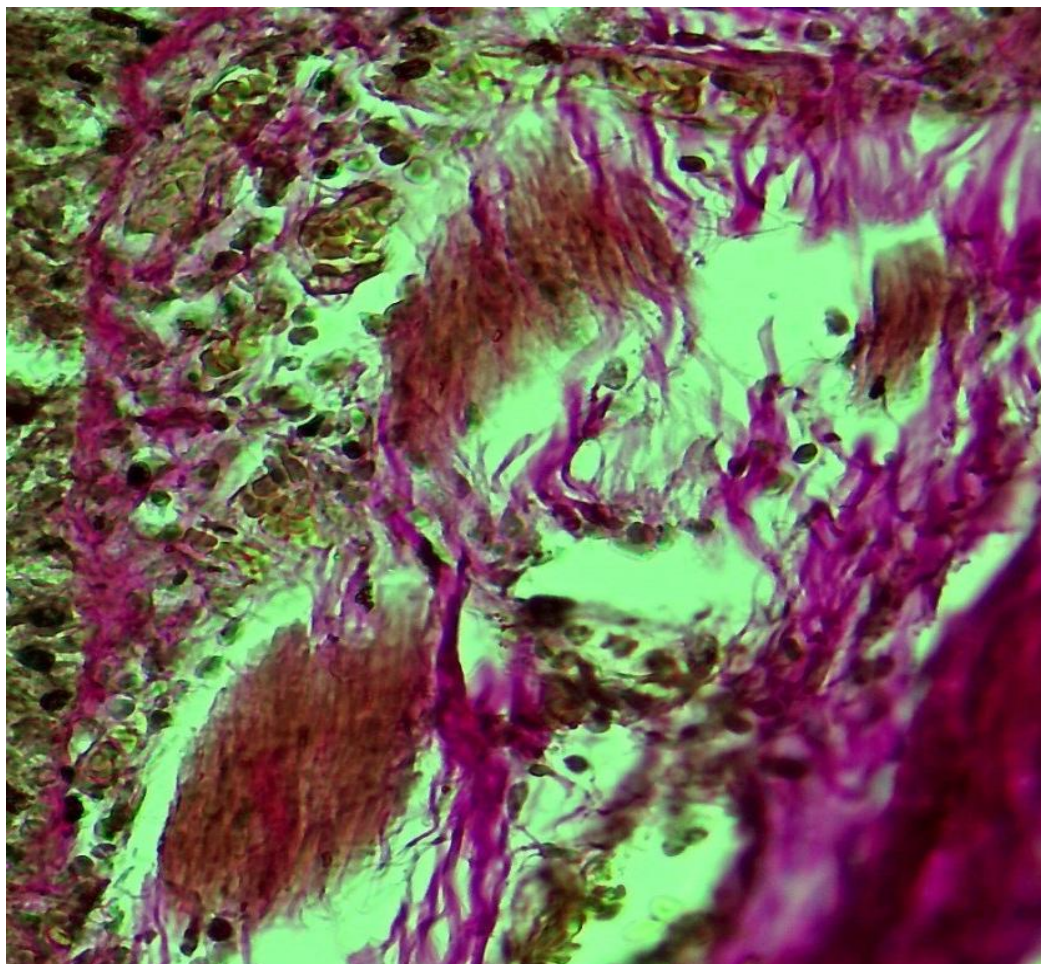
Materials and methods of research: Experiments and studies were carried out at the Republican Center for Pathological Anatomy. The study of extra- and intra-organic vessels of the bronchial lung and histological features was carried out on 16 troupes of children aged 4 years of birth to 7 years of age who died from injuries or diseases not related to the pathology of the lung or heart. In the protocols, the cause of death was established on the basis of the results of forensic autopsies and protocols of pathoanatomical studies.

Carried out histological and morphological researches to learn morphology, relationships of epithelial connective tissue and muscle formations, branching of the bronchi. Lung fixation was carried out 10% formalina, which was introduced into the main (right, left) bronchial and pulmonary artery, under pressure 25-30 mm HG. After that immersed in the same formaldehyde solution for 5-7 days. After washing in running water, the main, lobar, segmental and subsequent branching of the bronchi were prepared sequentially. Pieces for research were cut out along the above bronchi, as well as areas of their division into subsequent generations. After rubbing in alcohols of increasing concentrations and embedding in paraffin, sections 5-7 μm thick were stained with toluidine blue, hematoxylin-eosin, and fuchsilin according to Van Gieson. Based on viewing preparations stained by the above methods, the morphology of connective tissue and muscles of the mucous and submucosal membranes, their changes in the dynamics of age, and local changes in the bronchial tree were studied.

Using an ocular micrometer MOV*15 we measured the diameter of the bronchi, the thickness of membranes, and calculated the coefficient of development muscular plate and elastic structures in the lamina propria of the the mucuous membrane.

The results of researches:

The period of the first childhood (4-7 years after birth) is characterized by the further growth of lung structure. The main bronchi reaches to $3950 \pm 58 \mu\text{m}$ (min 3500 max 4200). The thickness of all layers of the bronchial wall increases from 1300 to $1850 \mu\text{m}$ in the membranous and cartilaginous parts, respectively multirow, ciliated epithelium with goblet cells does not reliably thicken (compare: 27.6 ± 0.9 and $28.4 \pm 1.4 \mu\text{m}$ at birth and at the age of 4-7 years, respectively ($P > 0.05$)). The lamina propria reaches a thickness of 74.1 ± 6.3 microns, consists of loose connective tissue, where eosophilic plasmatitis, mast cells, lymphocytes, fibroblasts, macrophages, and blood capillaries are detected along with collagen and reticular cells. The muscular plate of the mucous membrane is clearly distinguishable as a layer of circularly arranged oval-shaped smooth myocytes. Its strength is on average 115 ± 11.3 microns. In the membranous part of the main bronchus, it merges with the muscles located between the cartilages and reaches a depth of $320 \pm 17.5 \mu\text{m}$. In this part of the bronchus, along with circular muscle bundles, there are also longitudinally oriented (pic. 1).



Pic.1 Circularly and longitudinally oriented muscle bundles in the membranous part of the main bronchus of a child of second childhood. Coloring: fuchseline + Van Gieson. cir. 10, vol. 20.

The submucosa of the main bronchus in children 4-7 years of age consists of plexuses of vessels of loose connective tissue, the end sections of alveolar-tubular mixed (protein-mucosal) glands.

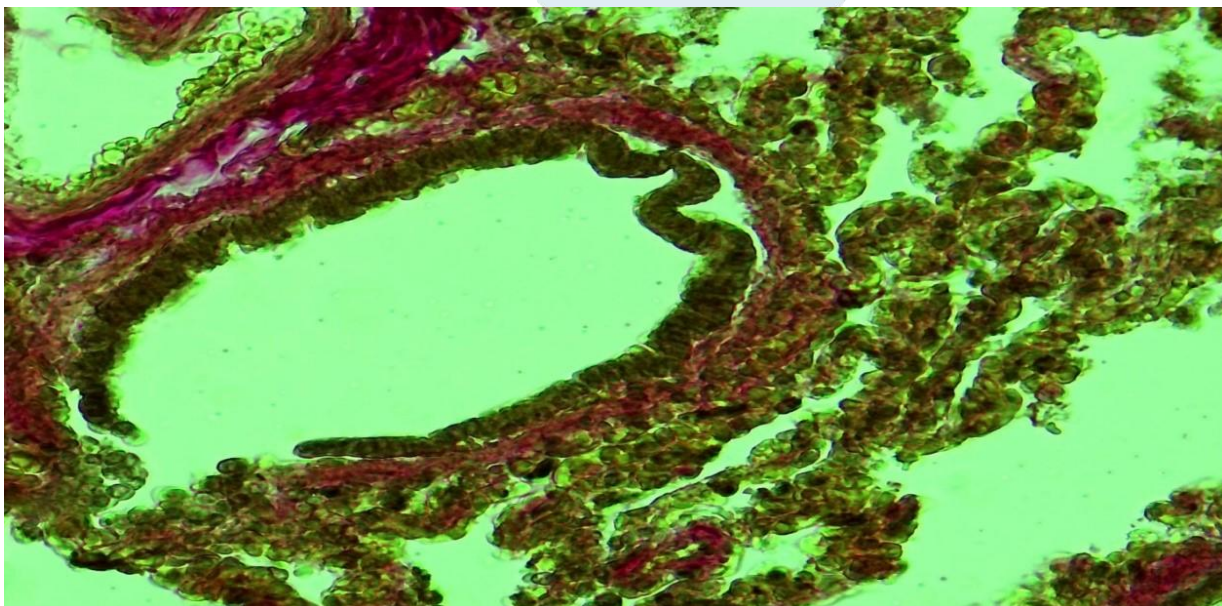
Collagen and reticular fibers intertwine the end sections of the glands and their excretory ducts in the form of a delicate network. There are relatively fewer cellular elements compared to the lamina propria. They are mainly represented by fibroblasts and lymphocytes.

The fibro-cartilaginous membrane consists of open hyaline cartilaginous half-rings, which are enclosed in a fibrous membrane consisting of strands of collagen fibers. In the membranous part of the main bronchus, the ends of the cartilage are connected by circular and longitudinal bundles of smooth muscles. In the same part of the bronchus there is a bundle of collagen and elastic fibers connecting cartilage tissues. In addition, a number of fibers of this bundle are directed into the submucosal and adventitial tissue, intertwining with the fibers located in them. The adventitia consists of collagen and elastic fibers, blood and lymphatic vessels. The main bronchus is divided on the right into the 3rd, on the left into 2 lobar bronchi. The lumen of each of them ranges from 2600 to 3250 μm (on average, the upper lobe is $2710 \pm 63 \mu\text{m}$, the lower lobe is $3050 \pm 42.5 \mu\text{m}$). The wall thickness of the lobar bronchi ranges from up to 1600 μm (upper lobar); 1350-1670 μm (lower lobe). If the height of the epithelium in the mucous membrane of the upper lobe and lower lobe bronchi is the same and equals on average $27.1 \pm 1.4 \mu\text{m}$, then the lamina propria and muscular lamina of the mucous membrane of the lower lobe bronchus are thinner than in the upper lobe by 12.6 and 14.1%, respectively. The epithelium, as before, is multirowed, ciliated with goblet cells. The lamina propria of the mucous membrane also did not have any significant differences compared to the previous period of the study. The muscular plate of the mucous membrane is formed by circular muscle bundles. The submucosa consists of loose connective tissue, in which the end sections of the alveolar-tubular, protein-mucosal glands are located in groups. In the fibro-cartilaginous membrane, round plates of cartilage are enclosed in a fibrous membrane of collagen and elastic fibers. The same fibers are visible in the inter-cartilaginous spaces. Fibers extending into the submucosa and adventitia bind them into a single formation. The adventitial membrane is loose, rich in blood vessels, contains single fat cells and nerve fibers.

The segmental bronchus of the upper and lower lobes has almost the same lumen with a diameter of 1670 ± 52 and $1720 \pm 30.9 \mu\text{m}$, respectively ($P < 0.05$). If the epithelium has a height of 21.2 ± 1.2 and $20.7 \pm 1.7 \mu\text{m}$ ($P < 0.05$), then the lamina propria and muscular lamina, with the same type of structure, are thicker in the upper lobe. The glands of the submucosa are few in number, located in small groups, and retain an alveolar-tubular structure. The cells of the terminal sections are low-prismatic and contain a protein-mucus secretion.

The fibro-cartilaginous membrane consists of small cartilaginous plates enclosed in a fibrous membrane of collagen and elastic fibers. In the inter-cartilaginous areas they are woven into the fibers of the submucosal and adventitial membranes.

The adventitia is thinner than in the region of the lobar bronchi, but has an unusual structure.



Pic.2. Multirow epithelium, bundles of elastic fibers in the lamina propria of the subsegmental bronchus in a 7-year-old child. Coloring: fuchseline + Van Gieson.

The subsegmental bronchi of the upper and lower lobes have the same structure (Pic. 2), differing significantly only in the thickness of the muscular plate (48.4 ± 4.8 and 25.8 ± 2.4 μm , $P < 0.05$). At the same time, their lumen ranges from 850 to 1450 microns, wall thickness from 450 to 650 microns.

The membranous bronchi of the bronchi in question have a lumen of 200-400 μm (on average 270 ± 17.4 and 367 ± 28.1 μm , respectively, in the upper and lower lobes). Epithelial thickness 11-12 μm , goblet cells, ciliated cells are rare. The lamina propria is almost not defined; smooth muscle cells, arranged circularly, form a lamina 26-28 μm thick. Elastic fibers are arranged longitudinally, entwining muscle cells and other connective tissue cells, forms the outer and inner membrane.

Thus, at the age of 4-7 years, further growth of the bronchus is observed, thickening of its membranes throughout its generation. In the lamina propria, along with connective tissue cells, immunocytes are found, apparently performing a barrier-protective function.

Conclusions

In the dynamics of postnatal ontogenesis of children of the first childhood, the growth of the lung is accompanied by an increase in the lumen of the bronchi of all calibers, each of its constituent membranes. Collagen and elastic fibers form bundles of longitudinally oriented fibers. From 4 to 7 years of life, the bronchial mucosa has a structure typical for an adult organism: interepithelial lymphocytes are detected in the epithelial layer, the lamina propria is separated from the submucosa, thickens, and contains differentiated connective tissue cells.

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