International Journal of Medical Sciences And Clinical Research

VOLUME Vol.05 Issue11 2025
PAGE NO. 86-93
DOI 10.37547/ijmscr/Volume05Issue11-13

Confocal Morphometricity Of Respiratory Organ Hamartoma

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Received: 15 September 2025; **Accepted:** 08 October 2025; **Published:** 12 November 2025

Abstract: In the morphometric study of lung and bronchial hamartomas, the main features were the ratio of parenchyma and mesenchyma of this tissue, the various cellular composition of its composition, the area occupied by blood vessels, the area occupied by fibrous structures in the tissue composition, the width of the alveolar spaces in the area where the hamartoma was detected, and the diameter of the bronchioles. The main features were focused on the subunits on the occupied surface. In the morphometric study of the changes developing in the vessels, previously prepared micropreparations were scanned at 200x magnification in NanoZummer, and the obtained two-dimensional images were determined using the QuPath-0.5.0. program. The results were compared with the changes in the control group and analyzed.

Keywords: Morphometry, hamartoma, confocal morphometry.

Introduction: The urgency of the problem. In the world's population in the last decade, 60-64% of all benign tumors of the lung, mesenchymal benign tumors represent 60-69.95%.

It is most common in men over 25 years of age and is characterized by a very slow growth rate. Since the diagnosis of this disease does not have specific symptoms, it is mainly detected when the patient's condition is severe and tumors are suspected during examinations. In the USA and European countries, the frequency of hamartoma in the respiratory tract is 24.28%, while in the Russian Federation and the CIS countries this figure is 31.1%. In Asian and Eastern countries, especially in India, the incidence of this disease is 41.67%, and most often it is detected in the form of transformation into malignant tumors in 5-7.2%.

There is no clear data on the prevalence of different forms of respiratory tract hamartomas, and each of them is characterized by the presence of other tissue components in the form of various heterotopias. This requires differential diagnosis with primary or metastatic tumor foci in the diagnosis of hamartomas at present.

RESULT AND DISCUSSION

In the morphometric examination of lung and bronchial hamartomas, the main features were the ratio of parenchyma and mesenchyma of this tissue, the various cellular composition in its composition, the area occupied by blood vessels, the area occupied by

fibrous structures in the tissue composition, the width of the alveolar spaces in the area where the hamartoma was detected, and the diameter of the bronchioles. The main features were focused on the subunits on the occupied surface. In the morphometric examination of the changes developing in the vessels, previously prepared micropreparations were scanned at 200x magnification in NanoZummer, and the obtained two-dimensional images were determined using the QuPath-0.5.0. program. The results were compared with the changes in the control group and analyzed.

According to the analysis of the numerical data in the table above, one of the main points is that the average diameter of the alveolar spaces in the lungs was 275.68±12.7 µm in the control group, while in chondromatosis of the lung this indicator was 201.33±11.18 µm. This means that the morphometric decrease in comparison by 1.37 times indicates the morphofunctional immaturity of the lung tissue and its low vital capacity.

Morphometric examination of lung and bronchial tissue revealed mesenchymal proliferative hamartomas of various sizes, mainly in the area occupied by fibrous structures in the tissue composition, and in the diameter of the bronchi in the blood vessels and bronchi, which were compared with the components in the lung and bronchial tissue of people who died from other diseases. This confirmed that the hamartoma lags behind the development of most tissue structures and is characterized by metaplasia of immature cells.

Table 1.

Comparative morphometric indicators of lung tissue chondromatous hamartoma on meeting the structural structures of the tissue in µm and %. 84000 µm is presented on 2 surfaces.

No.	lung tissue	Control group	chondromatous hamartoma of the lung
1	The average diameter of lung alveolar cavities is µm	275.68±12.7*	201.33±11.18*
2	The area occupied by intrapulmonary alveolar capillary blood vessels	6.05±0.31*	3.88±0.08*
3	The average thickness of intrapulmonary alveolar walls, µm	5.34±0.01**	1.4±0.01**
4	The average diameter of small-caliber intrapulmonary artery vessels is µm	14.55±1.05**	8.88±0.12**
5	The area occupied by the stroma of the lung tissue is 84000 µm2 in % of the surface	0.55±0.01**	11.1±1.01**
6	the area occupied by the tumor tissue in % (specific to the pathology)	2.35±1.01**	12.29±3.05**
7	the area occupied by adipose tissue in the lung tissue (characteristic of pathology)	0.11±0.01	4.21±1.05
8	% of smooth muscle tissue	1.12±0.01	5.65±0.05

Note: R<0.05 *, R<0.1**

The area occupied by the alveolar capillary blood vessels in the lungs was 6.05±0.31 µm in the control group, while in the study group this indicator was 3.88±0.08 µm. This also indicates a morphological functional impairment of the lungs, which, according to the morphometric comparison index, decreased by 1.6%.

The average thickness of the alveolar walls in the lungs was 5.34±0.01 µm in the control group, while in the chondromatosis hamartoma of the lung it was 1.4±0.01 µm, which means a decrease of 3.8%. This confirms that morphologically, the excessive thinning of the alveolar walls is mainly due to a sharp decrease in the cellular composition and an increase in the number of fibers in the stromal structures of the alveoli.

Table 2.

Comparative morphometric indicators of mesenchymal hamartoma of lung tissue on meeting the structural structures of the tissue in µm and %.

No.	lung tissue	Control group	lung mesenchymal hamartoma
1	The average diameter of lung alveolar cavities is µm	275.68±12.7*	181.35±8.11*
2	The area occupied by intrapulmonary alveolar capillary blood vessels	6.05±0.31*	11.05±0.05*
3	The average thickness of intrapulmonary alveolar walls, µm	5.34±0.01**	2.01±0.05**
4	The average diameter of small-caliber intrapulmonary artery vessels is µm	14.55±1.05**	11.01±0.05**
5	The area occupied by the stroma of the lung tissue is 84000 µm2 in % of the surface	0.55±0.01**	33.12±1.05**
6	the area occupied by the tumor tissue in % (specific to the pathology)	2.35±1.01**	7.42±1.16**
7	the area occupied by adipose tissue in the lung tissue (characteristic of pathology)	0.11±0.01	6.31±1.01
8	% of smooth muscle tissue	1.12±0.01	8.91±0.01

Note: R<0.05 *, R<0.1**

The average diameter of the pulmonary small-caliber arteries in the control group was 14.55±1.05 µm, while in the study group this figure was 8.88±0.12 µm. This, according to the comparative morphometric index, meant a decrease of 1.64%, which was associated with the increase in the chondromatosis process, commonly known as the premalignant process, i.e., the presence of immature connective tissue. In terms of the area occupied by the coarse fibrous structures of the lung tissue stroma, in the control group this figure was 0.55±0.01% of the 84,000 µm ^{2} surface area, while in the study group this figure was 11.1±1.01 5.

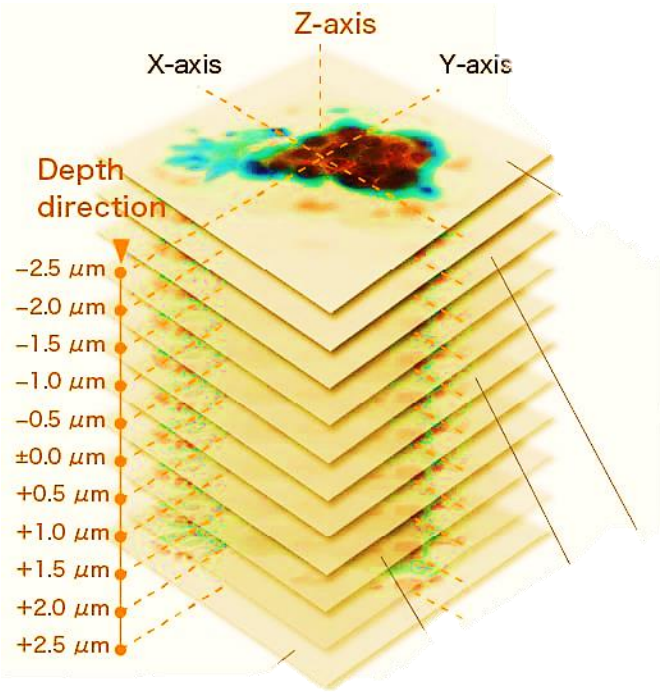

Figure 1. In order to perform the morphometry practice in the image-classical way, no less than 10 consecutive sections were taken from each tissue at an average interval of 2.5 µm and studied digitally. A total of not less than 12 sections were taken from each tissue, not less than 10-14, in the same period.

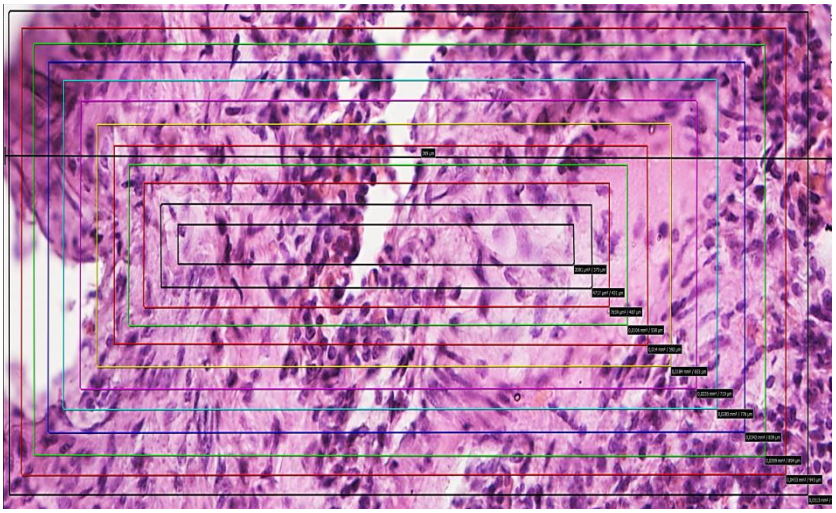

Figure 2. The surface trajectory of a hamartoma of epithelial origin in the lung parenchyma is shown, with successive tangential sections. The trajectory inside the tissue is increasingly uneven in thickness. Scanned with NanoZummer. Stain GE. Size 10x20.

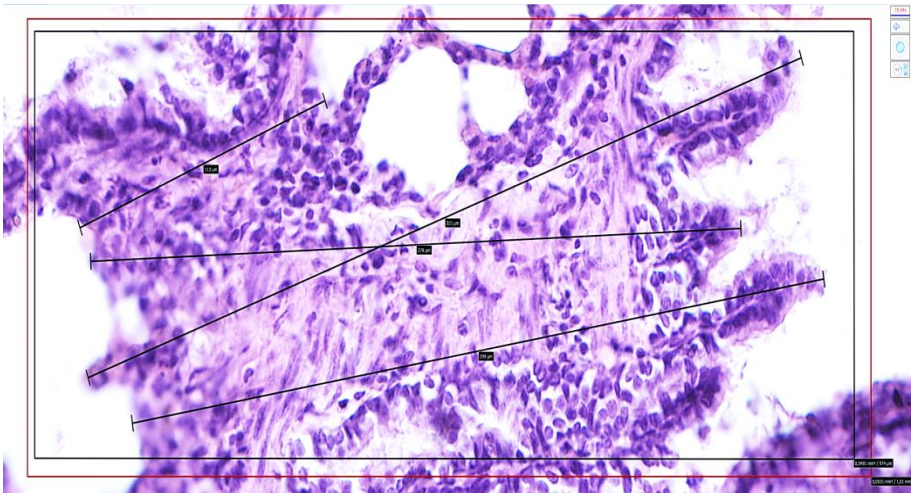

Figure 3. The composition of the epithelial hamartoma in the lung parenchyma was measured and the average value was obtained. The trajectory of the inner layer is of uneven thickness. Scanned with NanoZummer. Stain GE. Size 10x20.

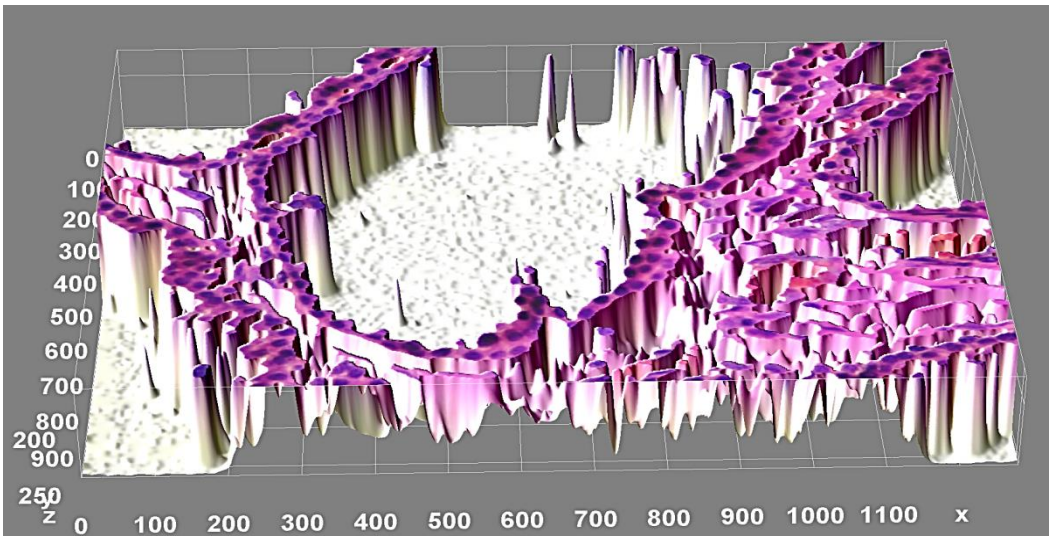

Figure 4. Lung tissue showing a confocal point image of the alveolar wall and a volumetric view of the alveolar space area. The scan was performed on NanoZummer. It was loaded into QuPath-0.5.0 Image software and the spatial shape was measured.

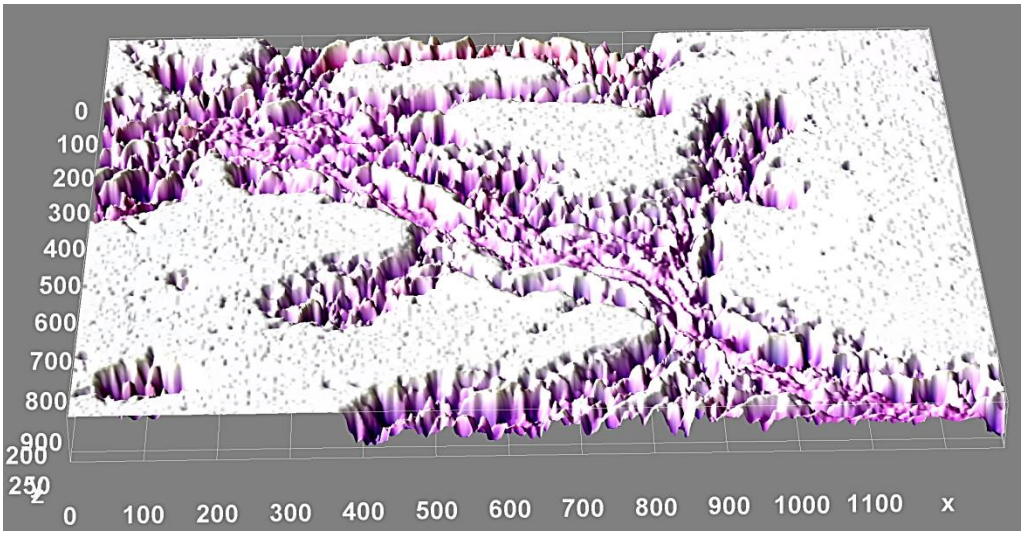

Figure 5. Confocal point image of the alveolar wall and a volumetric view of the alveolar space area of the lung tissue. The scan was performed on NanoZummer. The image was loaded into QuPath-0.5.0 Image software and the spatial shape was measured. The light pink color shows the volumetric view of the area occupied by the mesenchymal structures of the tissue.

Statistically significant differences differed by a factor of 20, confirming that the abundance of stromal fibrous structures detected in morphological examinations confirms the morphofunctional immaturity of the lungs and the high probability of tumor formation due to the rapid metaplasia and dysplasia of these mesenchymal structures.

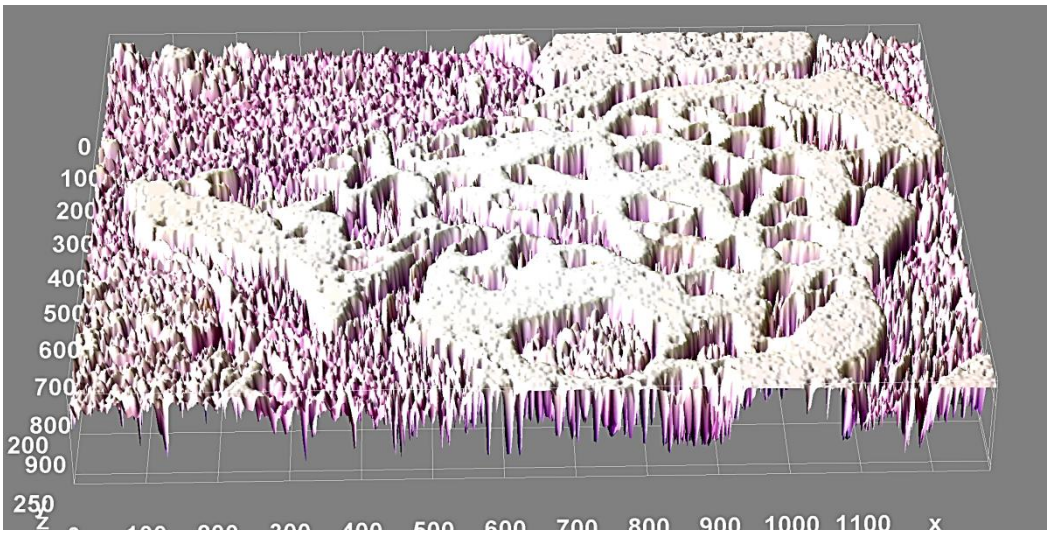

Figure 6. Confocal dot-matrix image of the alveolar wall and volumetric view of the alveolar space area of the lung tissue. The scan was performed on NanoZummer. The image was loaded into QuPath-0.5.0 Image software and the spatial shape was measured. The volumetric view of the surface occupied by the mesenchymal structures of the tissue in a fine dot texture.

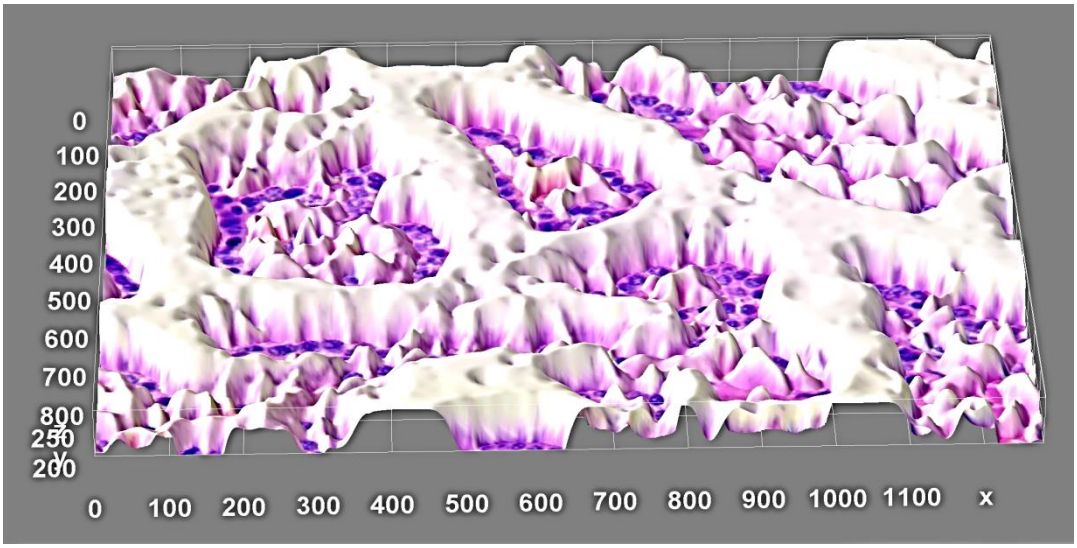

Figure 7. Confocal point image of the alveolar wall of the lung tissue and a volumetric view of the alveolar space area. The scan was performed on NanoZummer. The image was loaded into QuPath-0.5.0 Image software and the spatial shape was measured. The light pink color shows the volumetric view of the area occupied by the mesenchymal structures of the tissue.

In chondromatosis hamartoma of the lung, the area occupied by the ciliary tissue was 84,000 µm2, accounting for 2.35±1.01% in the control group, while in the study group it was 12.29±3.05%, which was an increase of 5.22%, which confirms the presence of immature and developing ciliary tissue.

It was found that the area occupied by adipose tissue within the lung tissue was 0.11±0.01% in the control group, while in chondromatosis hamartoma this indicator was 4.21±1.05%. This confirms the presence of tissues of various nature, including adipose tissue, in respiratory hamartoma.

The presence of smooth muscle tissue in the lung tissue, which was mainly detected in the walls of small-caliber bronchi and blood vessels, accounted for 1.12±0.01% of the 84,000 µm2 surface area in the control group, while in the case of chondromatosis hamartoma of the lung this indicator accounted for 5.65±0.05%, confirming the increase in the difference in morphometric indicators by 5.0%.

Thus, the fact that the majority of chondromatosis hamartomas of the lung are less numerous and smaller than those in the control group confirms the morphological immaturity along with the developmental anomaly.

The average diameter of alveolar spaces in mesenchymal hamartoma of the lung tissue was 275.68±12.7 µm in the control group, while in chondromatosis hamartoma of the lung this indicator was 181.35±8.11 µm. This means that the comparison is 1.52 times less morphometrically, which indicates the morphofunctional immaturity of the lung tissue and its low viability.

The area occupied by the alveolar capillary blood vessels in the lungs was 6.05±0.31 µm in the control group, while in the study group this indicator was 11.05±0.05 µm. This also indicates a morphological functional impairment of the lungs, and most of them, according to the morphometric comparison index, increased by 1.83 times, indicating an increase in mesenchymal tissue.

The average thickness of the alveolar walls in the lungs was 5.34±0.01 µm in the control group, while in the chondromatosis hamartoma of the lung it was 2.01±0.05 µm, which means a decrease of 2.66%. This confirms that morphologically, the thinning of the alveolar walls in comparison with the chondromatosis hamartoma of the lung is mainly due to a sharp decrease in the cellular composition and an increase in the number of fibers in the stromal structures of the alveoli.

The average diameter of the pulmonary small-caliber arteries in the control group was 14.55±1.05 µm, while in the study group this indicator was 11.01±0.05 µm. This means that, according to the comparative morphometric index, it decreased by 1.32 times, indicating that the process in mesenchymal hamartomas is relatively mature compared to chondromatosis hamartomas and immature compared to the control group.

In terms of the area occupied by coarse fibrous structures of the lung tissue stroma, this indicator in the control group was 0.55±0.01% of the surface area of 84,000 µm2, while in mesenchymal hamartoma this indicator was 33.12±1.05.

Differences in statistical significance differ by 60 times, indicating a sharp increase in fibrous structures

compared to chondromatous hamartomas. This confirms that pneumofibrosis and pneumosclerosis are strongly developed in the lung tissue.

In mesenchymal hamartoma of the lung, the area occupied by the fibroblast tissue was 84,000 µm2, accounting for 2.35±1.01% in the control group, while in the study group it was 7.42±1.16%, which was an increase of 3.15 times compared to the control group, which confirms the slow development of the fibroblast tissue compared to chondromatosis hamartoma, but an increase of 3.15 times compared to the control group.

The area occupied by adipose tissue in the lung tissue was 0.11±0.01% in the control group, while in chondromatous hamartoma this indicator was 6.31±1.01%. This confirms that respiratory hamartoma is distinguished by a greater content of adipose tissue compared to the chondromatous form and the presence of adipose tissue of various natures in its composition.

The presence of smooth muscle tissue in the lung tissue, which is mainly found in the walls of small-caliber bronchi and blood vessels, accounts for 1.12±0.01% of the 84,000 µm2 surface area in the control group , while in chondromatosis hamartoma of the lung this indicator accounts for 8.91±0.01%, confirming an 8-fold increase in the difference in morphometric parameters.

Thus, in the majority of cases of mesenchymal hamartoma of the lung, compared with the control group, morphofunctional tissue elements were characterized by a decrease in parenchymatous components and an increase in mesenchymal tissue structures (fat, muscle, various fibrous structures, blood vessels, etc.).

CONCLUSIONS

In terms of the area occupied by coarse fibrous structures of the lung tissue stroma, this indicator in the control group was 0.55±0.01% of the 84,000 µm2 surface area, while in mesenchymal hamartoma this indicator was 33.12±1.05.

It was found that the clinical history of respiratory tract hamartoma is 3.4 times more common in males than in females, with chondromatosis hamartoma being more common in people over 27 years of age;

The small size and reduced number of morphofunctional tissue elements in the majority of pulmonary chondromatosis hamartomas compared to the control group confirms the morphological immaturity along with developmental anomalies.

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