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Pathomorphological Changes in the Lungs in Patients with Comorbidity Pulmonary Tuberculosis and Diabetes Mellitus

Objective – to examine the pathomorphological changes in lung tissue in patients with pulmonary tuberculosis and diabetes mellitus.

Materials and methods. A prospective pathomorphological study was conducted of 60 cases of death of patients who died from various causes, in which pulmonary tuberculosis and type II diabetes appeared as the main disease in the final clinical and patho-anatomical diagnoses.

The patients were divided into three groups, the first subgroup consisted of 20 cases in which a diagnosis of pulmonary tuberculosis was established without pronounced accompanying pathology; the second subgroup included 20 cases of the combined pathology of tuberculosis and type II diabetes; to the third – 20 cases of patients with type II diabetes without tuberculosis. The types of patients of both groups were representative in terms of age and sex.

Results and discussion. The results of the pathomorphological examination of the lung tissue of patients with tuberculosis without accompanying diabetes showed that in 90 % of cases the capillaries of the lung parenchyma structure were not changed, except for those areas that were involved in a specific classical tuberculosis inflammation.

According to the results of the study of the histological material of the 2nd group, it was established that one of the key pathomorphological changes in the comorbidity of tuberculosis/diabetes is the development of pulmonary microangiopathy, which was characterized by a marked violation of the structure of small blood vessels of the microcirculatory channel of the lungs. Thus, the analysis of autopsy morphological material showed that there is a histological picture of a change in the structure of the capillary channel: zones of complete obliteration of capillaries appear, unevenness of the caliber of microvessels is observed, and the number of functioning capillaries decreases. It was found that in patients of the 3rd group, probably ($p < 0.05$) 85 % more often compared to 15 % in the 1st group, changes in the alveolar epithelium were observed.

Conclusions. Pathomorphological changes in the lungs in patients of the 2nd and 3rd examination groups include microangiopathy, pulmonary fibrosis, degeneration of the alveolar epithelium and, as a result, respiratory tract dysfunction. These changes contribute to the development of serious complications and require special attention in the treatment of patients with TB/DM co-infection to prevent further deterioration of lung tissue.

Keywords

Morphology, tuberculosis, diabetes, microangiopathy, fibrosis.

There has been a changing trend in the morphological pattern of pulmonary tuberculosis (TB) over the years [3]. Tuberculosis is a socially determined disease with a high prevalence in the Eastern European Region [7]. Diabetes mellitus has always

been a commonly associated co-morbid condition with TB over the years. In recent years, more and more studies are appearing that indicate changes in the pathogenetic course of the inflammatory reaction in patients with pulmonary TB and diabetes

mellitus (DM). There are few studies dedicated to the study of the mutually aggravating effect of diabetes on pathomorphological changes in the lungs during TB infection [11].

Pathomorphological changes in the lungs in TB are diverse and have many features. They range from the formation of granulomas and necrotic processes to the development of caverns and fibrosis, which together form a complex of destructive changes in lung tissue [10]. Pathomorphological changes in the lung tissue of patients with TB are important in the formation of the clinical picture, influencing its course and complicating the process of its treatment [1, 9].

Morphological changes in the structure of lung tissue in DM are characterized by a complex of structural and functional disorders associated with the long-term consequences of impaired carbohydrate metabolism of varying complexity and the formation of insulin resistance, including at the level of peripheral tissues [4, 8].

Objective – to examine the pathomorphological changes in lung tissue in patients with pulmonary TB and diabetes mellitus.

Materials and method

A prospective pathomorphological study was conducted of 60 cases of death of patients who died from various causes, in which pulmonary TB and type II diabetes appeared as the main disease in the final clinical and patho-anatomical diagnoses.

Primary medical accounting documentation was studied: medical cards of inpatients (f. No. 003/o) and protocols of pathological examinations (f. No. 103/o). The collection of autopsy material (comparison and main groups) was carried out on the basis of the Chernivtsi Regional Pathological Anatomical Clinic during 2021–2024, taking into account the «Law of Ukraine on Burials and Funeral Matters as amended according to the Law N1102-IV from 09.08.2024».

Material for research was collected no later than 6–12 hours after the onset of biological death. The material was fixed for 48 hours in a 10 % solution of neutral buffered formalin, dehydrated in an ascending battery of alcohols and paraffin embedded at a temperature of 54 °C. They were stained according to the following methods: hematoxylin-eosin (for inspection purposes), vanGieson's picrofuchsin with additional staining of cell nuclei with Weigert's hematoxylin (to assess the degree of development of scleroplasic processes), chromotrope-aqueous blue according to the method of N.Z. Slinchenko (for the identification of fibrin and the fibrous component of the stroma) [5].

When performing histological studies, a Delta Optical Evolution 300 Trino Plan LED biological microscope was used; magnification $\times 40$, $\times 100$,

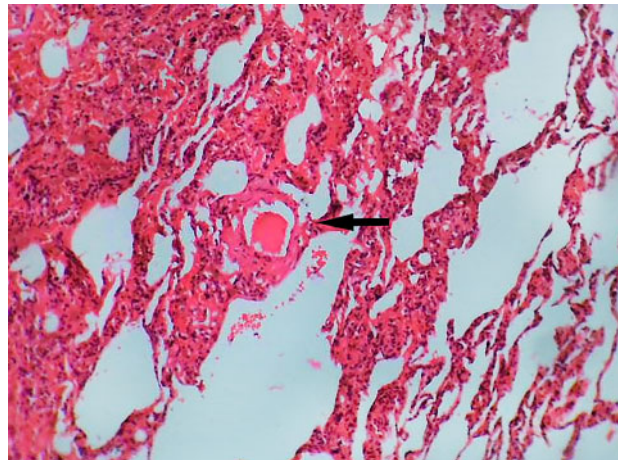


Fig. 1. Histological micropreparation

A capillary with a preserved muscular layer of the endothelium, whole blood, erythrocytes in the lumen, no pathological changes in the capillaries. Staining with hematoxylin and eosin. $\times 100$.

$\times 400$, $\times 600$, $\times 1000$ (eyepiece $\times 10$; lenses $\times 4$, $\times 10$, $\times 40$, $\times 60$, $\times 100$) [10]. Digital copies of the optical image of the sections of the microscopic preparations were obtained using an Olympus C740UZ digital camera using different microscope lenses depending on the purpose of the analysis.

The randomization of the cases selected for the study made it possible to form three groups: the first group consisted of 20 cases in which the diagnosis of pulmonary TB was established without DM; the second group included 20 cases of the combined pathology of TB and diabetes; to the third group 20 cases with diabetes but without concomitant TB. The types of cases selected for the study were representative in terms of age and sex.

Results and discussion

The results of the pathomorphological examination of the lung tissue of patients with TB without accompanying diabetes showed that in 90 % of cases the capillaries of the lung parenchyma structure were not changed, except for those areas that were involved in a specific classical TB inflammation (Fig. 1).

The results of the histological examination showed that the remodeling of the connective tissue stroma of the lung tissue, which is the cause of the emergence of various variants of residual changes in the lungs, was also detected in the vast majority of patients of the 1st group (95 %) vs (5 %) patients of the 3rd group (Fig. 2).

According to the results of the study of the histological material of the 2nd group, it was established that one of the key pathomorphological changes in the comorbidity of TB/diabetes is the development of pulmonary microangiopathy (Fig. 3), which was characterized by a marked violation of the structure of small blood vessels of the microcirculatory chan-

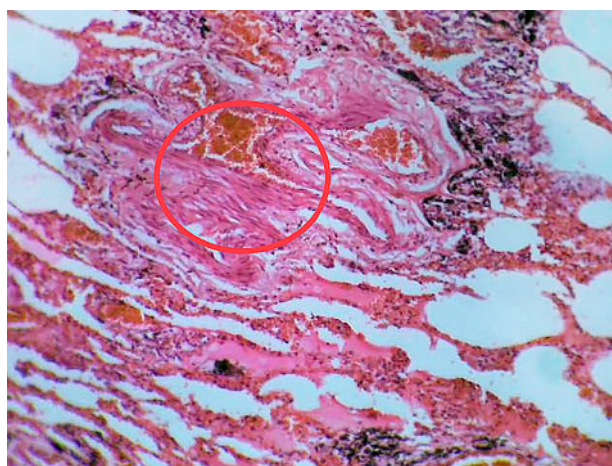


Fig. 2. Histological micropreparation

The Pirogov—Langhans cell is an epithelioid-lymphoid tubercle, is a cluster of cells, and connective tissue of various degrees of maturity is also visualized. Staining with hematoxylin and eosin. $\times 100$.

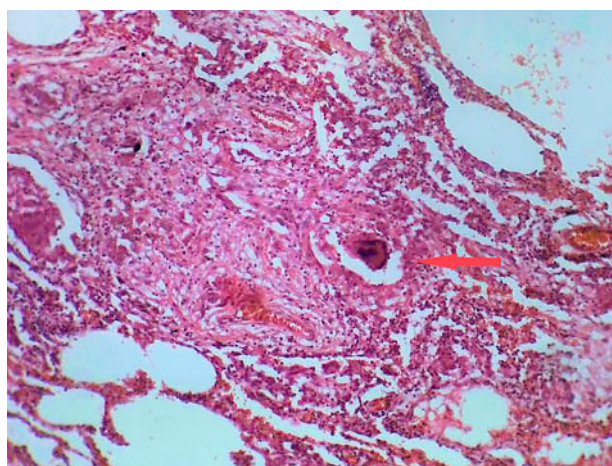


Fig. 3. Histological preparation of lung tissue — sclerosis of the capillary wall, decrease in the number of smooth muscle cells, hyalinosis of the wall, flattening of the endothelium

Staining with hematoxylin and eosin. $\times 100$.

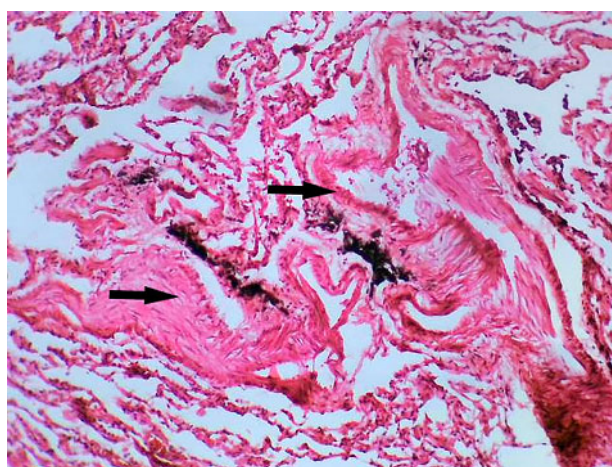


Fig. 4. Histological micropreparation

Capillary wall thickening, sclerosis, focal endothelial proliferation, congestion. Staining with hematoxylin and eosin. $\times 100$.

nel of the lungs. Thus, the analysis of autopsy morphological material showed that there is a histological picture of a change in the structure of the capillary channel: zones of complete obliteration of capillaries appear, unevenness of the caliber of microvessels is observed, and the number of functioning capillaries decreases. The changes that were found included an increase in the size and sclerosis of the capillaries, as well as the accumulation of collagen in the walls of the vessels, which is known [2] to cause a decrease in their elasticity and impaired blood circulation.

The identified changes were noted in 7 patients (35 %) of the 1st group, 19 patients (95 %) of the 2nd group, and 13 patients (65 %) of the 3rd group of the study, and it can be assumed that these changes cause the development of massive pulmonary fibrosis, which impairs the functional capacity of the lungs in case of tuberculous inflammation against the background of diabetes.

During the morphological study, we discovered various degrees of degenerative processes in the alveolar cells, which are pathogenetically the cause of gas exchange disorders and a decrease in the respiratory function of the lungs, including in the form of a decrease in the ability to oxygenate the blood and an increase in the partial pressure of carbon dioxide in the blood.

It was found that in patients of the 2nd and 3rd groups, probably ($p < 0.05$) 90 % and 85 % more often compared to 15 % in the 1st group, changes in the alveolar epithelium were observed (Fig. 4). In particular, degenerative processes in alveolar cells, which pathogenetically caused a gas exchange violation and a decrease in the respiratory function of the lungs in the form of a decrease in the ability to oxygenate the blood and an increase in the level of carbon dioxide in the body.

Focal sclerosis and hyalinosis of the vessel wall, flattening of the endothelium, focal areas of inflammation, single lymphocytes, uneven thickening of the capillary wall — all these changes are typical for most patients of the 2nd and 3rd study groups. However, in patients with TB, without accompanying diabetes, damage to blood vessels was observed extremely rarely. The majority of pathomorphological changes in histological preparations in such patients indicated the presence of a muscle layer in the vessel, with normal-sized endothelium, and the absence, in the vast majority of cases, of excess connective tissue in the vessel wall. These changes contribute to the development of serious complications and require special attention in the treatment of patients with TB/DM coinfection to prevent further deterioration of lung tissue.

Conclusions

1. The results of the histological examination showed that the remodeling of the connective tissue stroma of the lung tissue, which is the cause of the appearance of various variants of residual changes in the lungs, was detected in the vast majority of patients of the 1st group (95 %), compared to 5 % of patients in the 3rd group.

2. Pathomorphological changes in the lungs in patients of the 2nd and 3rd examination groups include microangiopathy, pulmonary fibrosis, and degeneration of the alveolar epithelium. Also, we have

established changes in the structure of the capillary channel: zones of complete obliteration of capillaries appear, there is an unevenness of the caliber of microvessels, the number of functioning capillaries decreases. The changes that were found included an increase in the size and sclerosis of the capillaries, as well as the accumulation of collagen in the walls of the vessels.

3. It was found that in patients of the 3rd group, probably ($p < 0.05$) 85 % more often compared to 15 % in the 1st group, changes in the alveolar epithelium were observed.

No conflict of interest.

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Патоморфологічні зміни в легенях у хворих на коморбідність туберкульоз легень та цукровий діабет

Мета роботи — визначити патоморфологічні зміни легеневої тканини в пацієнтів із туберкульозом та супутнім цукровим діабетом.

Матеріали та методи. Проведено проспективне патоморфологічне дослідження 60 випадків смерті хворих, що померли з різних причин та в яких в остаточному клінічному та патологоанатомічному діагнозі як основне захворювання зазначено туберкульоз легень і цукровий діабет 2 типу.

Хворих розподілили на три групи: перша — 20 випадків туберкульозу легень без виразної супутньої патології, друга — 20 випадків поєднання туберкульозу та цукрового діабету 2 типу, третя — 20 випадків цукрового діабету 2 типу без туберкульозу. Усі групи були репрезентативними за віком та статтю.

Результати та обговорення. Результати патоморфологічного дослідження легеневої тканини пацієнтів із туберкульозом без супутнього цукрового діабету свідчили про те, що в 90 % випадків капіляри структури легеневої паренхіми були не змінені, окрім ділянок, залучених у специфічне класичне туберкульозне запалення.

Дослідження гістологічного матеріалу другої групи виявило, що однією з основних патоморфологічних змін при коморбідності туберкульоз/цукровий діабет є розвиток легеневої мікроангіопатії, яка характеризувалася виразним порушенням структури дрібних кровоносних судин мікроциркуляторного русла легень. Аналіз автопсійного морфологічного матеріалу показав, що має місце гістологічна картина зміни структури капілярного русла: з'являються зони повної облітерації капілярів, спостерігається нерівномірність калібру мікросудин, зменшується кількість капілярів, що функціонують. У хворих третьої групи достовірно на 85 % частіше порівняно з пацієнтами першої спостерігалися зміни альвеолярного епітелію.

Висновки. Патоморфологічні зміни легень у пацієнтів другої та третьої груп представлені мікроангіопатіями, легневим фіброзом, дегенерацією альвеолярного епітелію, що призводить до порушення функції дихальних шляхів. Зазначені зміни спричинюють розвиток серйозних ускладнень і потребують особливої уваги при лікуванні пацієнтів із поєднанням туберкульозу та цукрового діабету для запобігання подальшому погіршенню стану легеневої тканини.

Ключові слова: морфологія, туберкульоз, цукровий діабет, мікроангіопатії, фіброз.

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