

## **Features of the Morphological Structure of Liver and Lung Larvocysts in Experimental Animals**

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Knowing the minimum required dose of embryos to obtain an experimental model of echinococcosis, we did not expect the development of echinococcosis in animals when they are fed less than 50 eggs of the parasite. With the obvious dependence of the total number of developing relatively large and microscopic cysts on the number of embryos introduced into the stomach, we still have to state that a 200-fold decrease in the concentration of the causative agent of the disease (from 1000 individuals in sheep to 5 in lambs) leads only to sixfold reduction of macroscopically detected cysts.

**Keywords:** morphological structure, liver, lung, larvocysts, experimental animals.

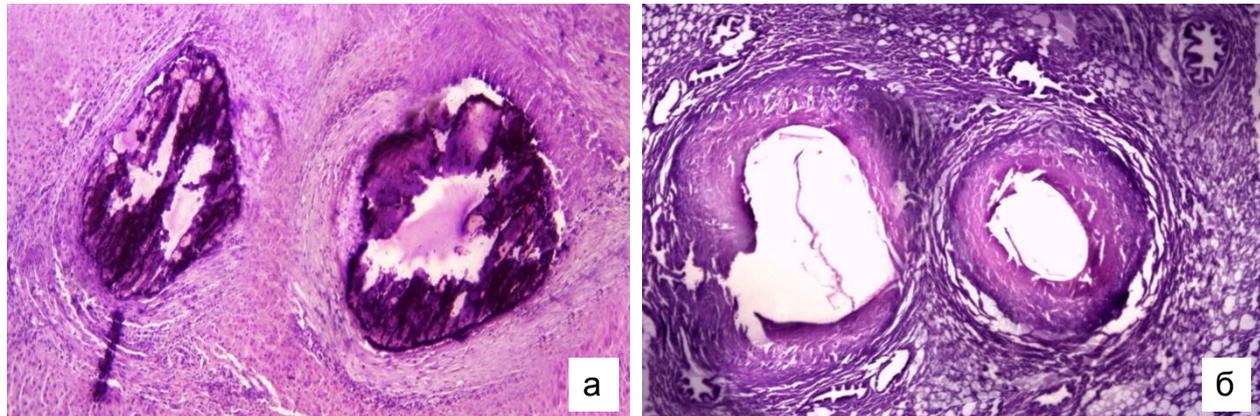
It must be admitted that, knowing the minimum required dose of embryos to obtain an experimental model of echinococcosis, we did not expect the development of echinococcosis in animals when they were fed less than 50 eggs of the parasite. With the obvious dependence of the total number of developing relatively large and microscopic cysts on the number of embryos introduced into the stomach, we still have to state that a 200-fold decrease in the concentration of the causative agent of the disease (from 1000 individuals in sheep to 5 in lambs) leads only to sixfold reduction of macroscopically detected cysts.

A similar phenomenon was noticed in the experiments of P.P. Wiebe, where the survival rate of the embryos of the parasite in animals that received 500 oncospheres was 3.3 times, and those that received 1000 oncospheres - 4.4 times less than in sheep that received 100 oncospheres. ... R.S. Shultz, G.I. Dikov wrote about this: "Undoubtedly, both cellular and humoral factors act, and from their combined action, presumably, a large number of oncospheres perish, so in experiments only a small part of them I was able to overcome all barriers and start my development."

In our observations, a certain pattern can be traced: in animals with hypoaacid acidity of gastric juice, regardless of the concentration of injected embryos, the density of distribution of microscopic foci in the studied tissues has a certain constant, not exceeding in our observations 2-3 microcysts in tissue samples identical in volume and quantity. In this regard, it can be assumed that there is a certain mechanism that rather strictly regulates the prevalence of microscopic cysts of echinococcosis. It should also be remembered that the oncospheres, once in the stomach, must

pass several difficult barriers before entering the target organs.

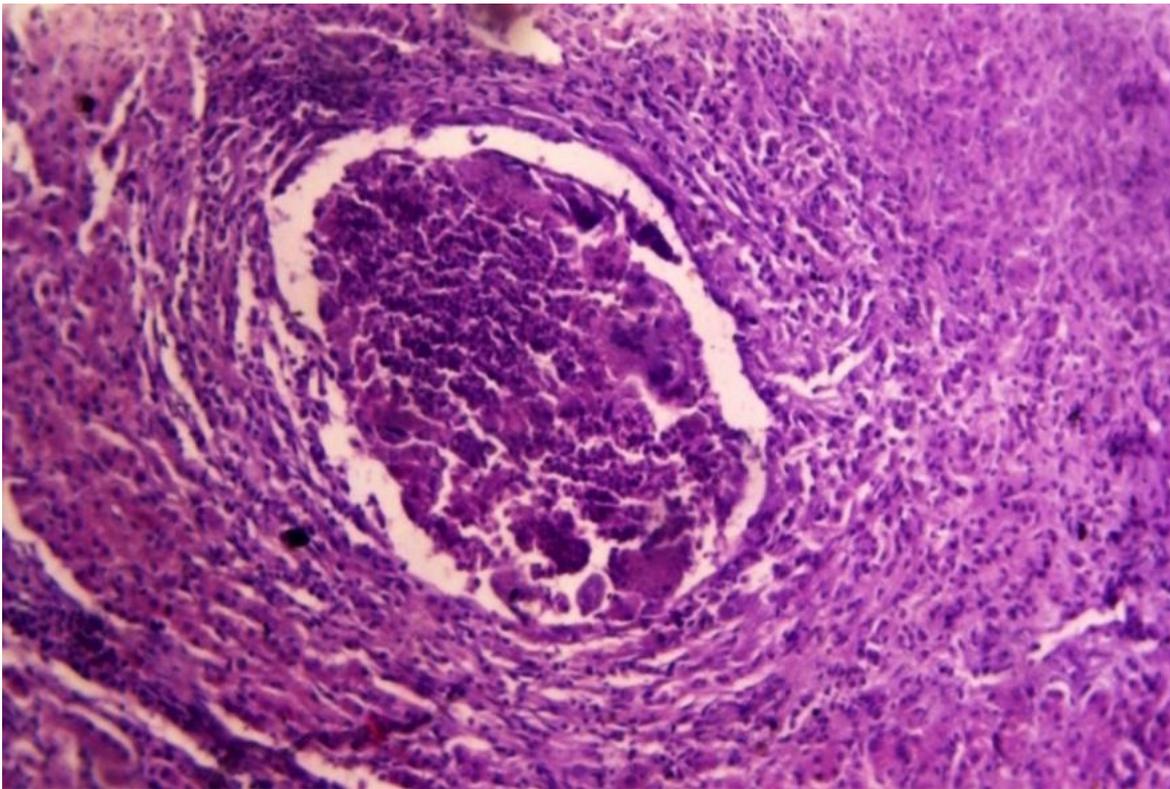
Another important feature of microscopically detected cysts (larvocysts) is their relatively uniform distribution in the liver and lung tissue without linking with the localization of the dominant large cysts. At the same time, larvocysts in the initial cycle of their development have a tendency to pairwise arrangement and development, sometimes forming a common septum from the fusion of two fibrous capsules (Fig. 1).



**Fig. 1. Closely located echinococcal cysts of microscopic size in the liver (a) and lung (b). Staining with hematoxylin and eosin. Magnification 10x25.**

Therefore, we had some doubts about the validity of the statement about the existence of the phenomenon of exogenous proliferation of an echinococcal cyst [Harnas PS. 2008], according to which, in certain cases, exogenous budding of the chitinous membrane of the echinococcal cyst into the thickness or outside of the connective tissue capsule occurs through the tears of the fibrous capsule, which requires mandatory pericystectomy. In our opinion, small "exogenous cysts" of echinococcus initially exist both in the immediate vicinity of the operated large cyst, and with a high degree of probability in distant areas of the liver and lung. Therefore, the expansion of the scope of the operation to pericystectomy does not completely solve the issues of surgical prevention of recurrence of the disease.

The microscopic larvocysts identified by us in the nearby and distant from the dominant cysts zones had sizes from 0.3 to 2.0 mm (300-2000 microns). Light-optical studies have shown that in the initial phase of the formation of a larvocyst in the liver and lungs, there were formations with an elongated oval shape, surrounded by a membrane consisting of inflammatory-altered tissue, where lymphoid cells and other types of leukocytes were distinguished. Among them, lymphocytes dominated, fibroblasts were found (Fig. 2).

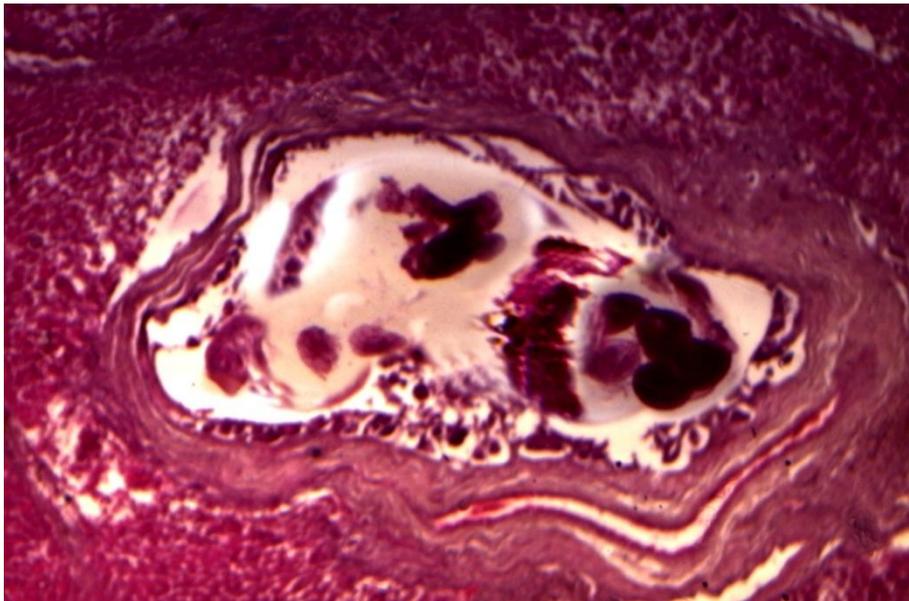


**Fig. 2. Fresh echinococcal cyst in the liver of a sheep. The initial stage of the formation of the fibrous capsule is visible. Staining with hematoxylin and eosin.**

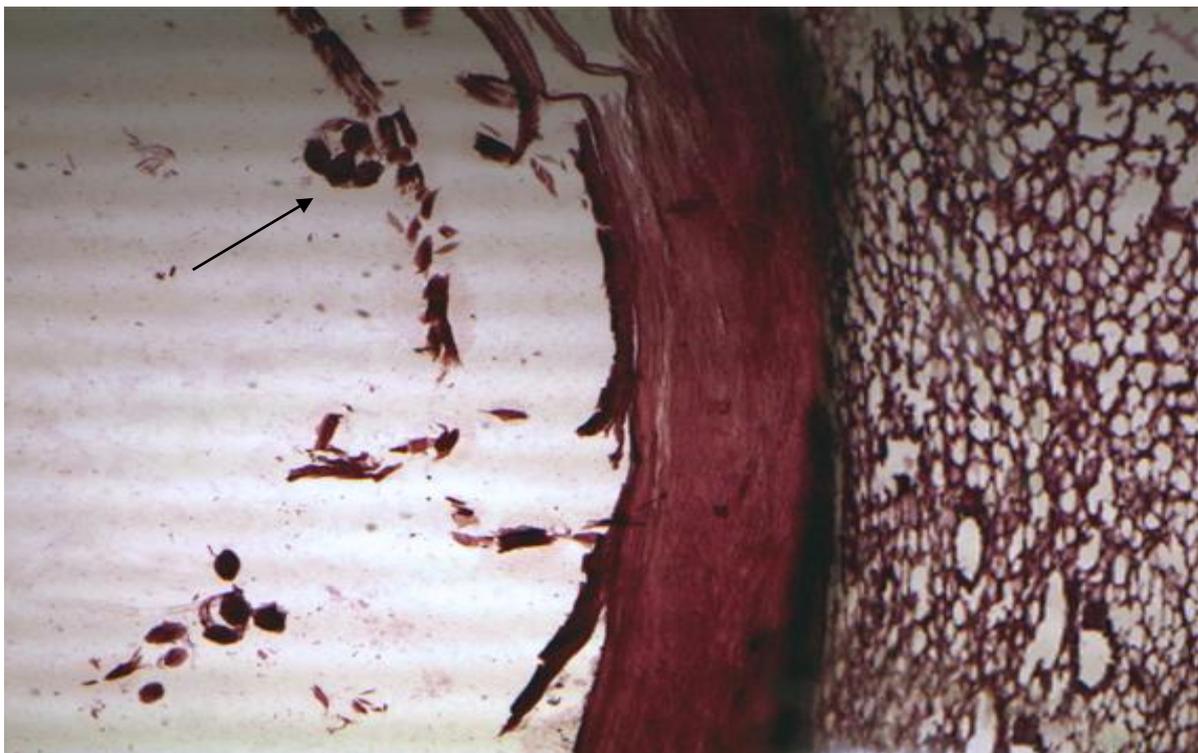
**Magnification 10x35.**

In the process of subsequent development, medium-sized larvocysts gradually acquire a structure characteristic of echinococcal bubbles: the fibrous capsule was clearly defined, its thickness reached 1500 microns. The main structural component of the capsule was collagen fibers and a large number of fibroblast-type cells. In the outer layers of the fibrous capsule, vacuolar degeneration of the parenchyma was determined. There were isolated microvessels. In the lumen of the cyst, embryonic elements and fragments of the chitinous membrane are clearly visualized (Fig. 3, 4). In the lumen of such cysts, it is possible to discern living protoscolexes (Fig. 5).

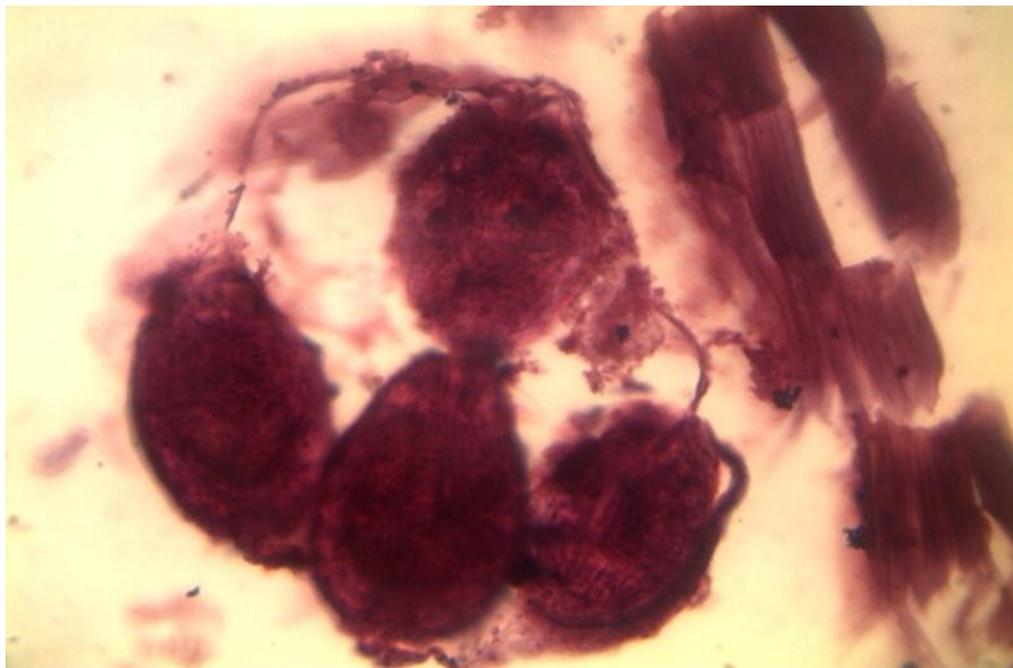
In the lumen of larvocysts, it was possible to distinguish elements of the embryonic membrane (Fig. 6). In the liver tissue located in the immediate vicinity of the fibrous capsule, the proliferation of connective tissue into the liver parenchyma was noted. In the areas of growth, single small hepatocytes remained.



**Fig. 3. Finally formed echinococcal cyst of the liver with all the main structural elements. Staining with hematoxylin and eosin. Magnification 10x30.**

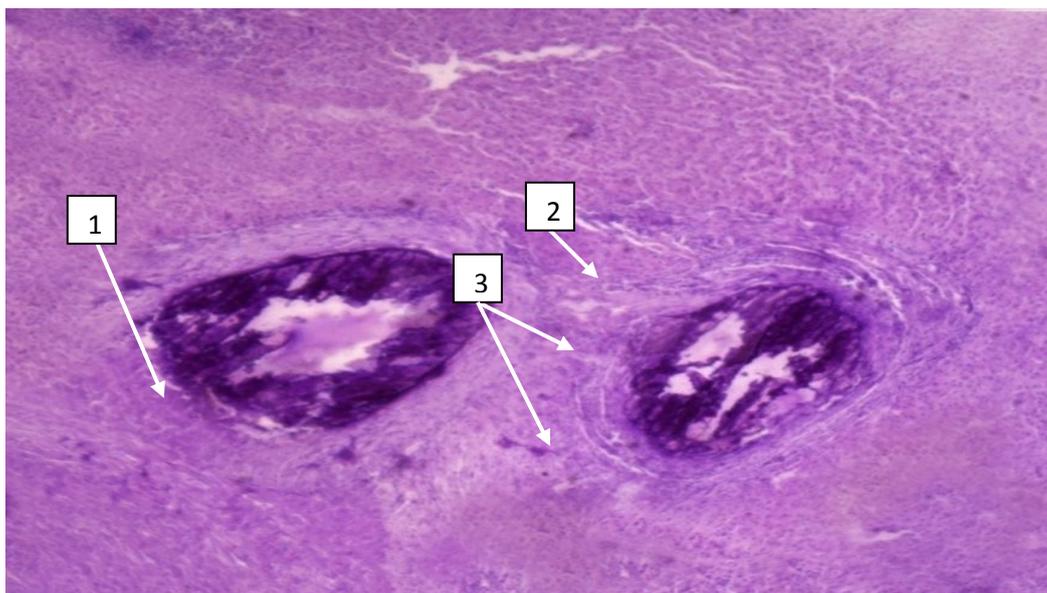


**Fig. 4. Finally formed echinococcal cyst of the lung with all the basic structural elements. The arrow indicates clusters of protoscolices. Staining with hematoxylin and eosin. Magnification 10x10.**



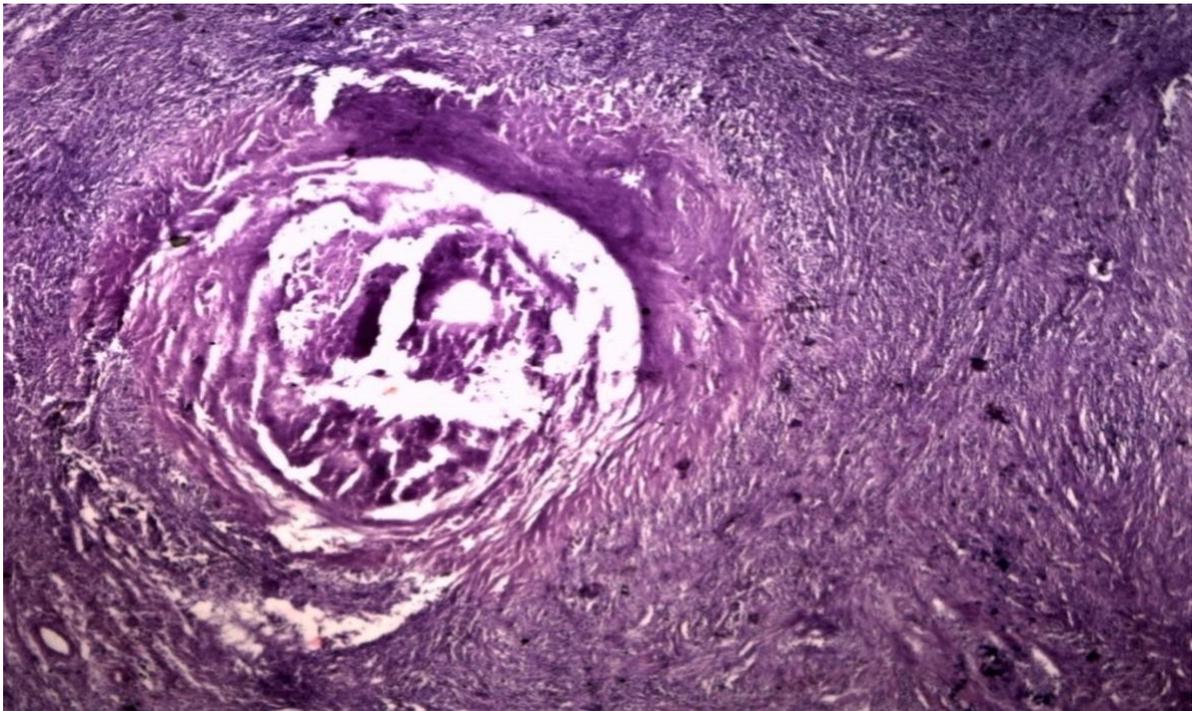
**Fig. 5. Protoscolexes in the lumen of the larvocysts, indicated by the arrow in the previous figure, at tenfold magnification. Staining with hematoxylin and eosin.**

**Magnification 10x100.**



**Fig. 6. Formed liver larvocysts: 1) elements of the chitinous membrane; 2) proliferation of connective tissue; 3) accumulations of hepatocytes. Staining with hematoxylin and eosin. Magnification 10x25.**

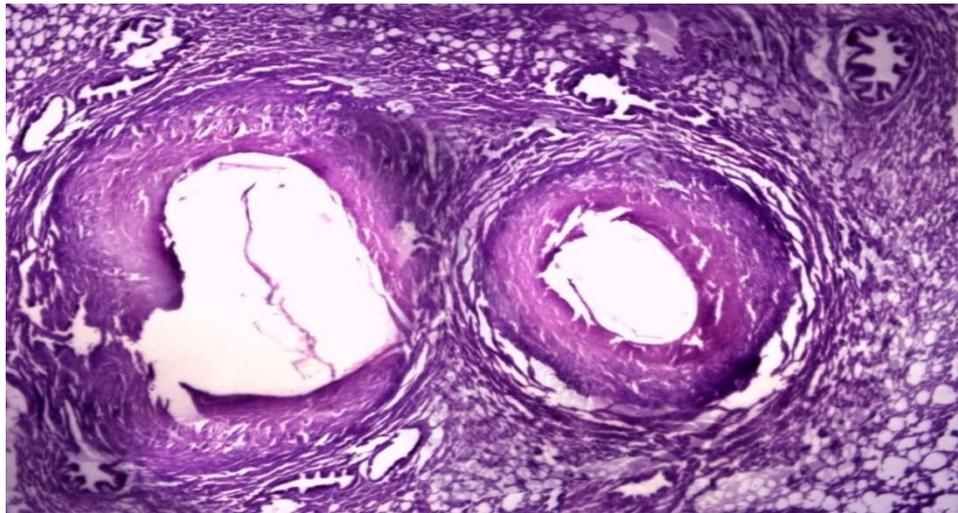
Often in the adjacent liver tissue, one can see the expansion of the sinusoids and bile capillaries, the phenomenon of stagnation of bile (Fig. 7). The pattern of cholestasis is often accompanied by the destruction of the adjacent portion of the fibrous capsule.



**Fig. 7. Echinococcal cyst with a disintegrating fibrous membrane in the liver of a sheep (item 08702). Staining with hematoxylin and eosin. Magnification 10x10.**

In the formed larvocysts of the lung, the fibrous capsule was looser, it squeezes and narrows the adjacent alveoli and bronchioles. Already at an early stage of the formation of echinococcal cysts of the lung, the lumen of some bronchioles is connected to the wall of the fibrous capsule, which is a morphological prerequisite for a greater tendency of pulmonary cysts to break into the airways (Fig. 8). Another characteristic feature of the fibrous capsule of lung cysts was the presence of a large number of microvessels compared to the capsules of the liver larvocysts. As a rule, the larvocysts of the lung are somewhat larger than the liver.

At the very edge of the fibrous capsule, the pulmonary alveoli are atelectasized. In the walls of the nearby bronchi, pronounced round-cell infiltration took place. Desquamated cells and mucus were determined in the lumen of the bronchi. Somewhat deviating from the fibrous capsule, the presence of exudate with individual lymphocytes was determined in the lumen of the dilated pulmonary alveoli. The interalveolar septa were thickened and infiltrated with round cell elements.



**Fig. 8. Two separate echinococcal cysts of a sheep's lung (1.07809) are located close to each other, a well-defined fibrous capsule and a bronchiole are visible, located in the thickness of the cyst wall. Staining with hematoxylin and eosin. Magnification 10x10.**

Thus, in experimentally infected animals with formed solitary or multiple cysts of the liver and lung of large sizes, microscopic examination of tissue samples of these organs obtained from macroscopically unchanged zones reveals microscopic cysts ranging in size from 300 to 2000  $\mu\text{m}$  with all morphological structures characteristic of echinococcal cysts.

In this case, the number of echinococcal cysts formed directly correlates with the number of injected eggs of the parasite. When developing measures for intra- and postoperative prevention of recurrence of echinococcosis, one should take into account the newly identified phenomenon of multiple lesions of internal organs in the form of a dominant cyst of macroscopic size and multiple foci of microscopic lesions.

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