

METHOD OF FORMATION AND MORPHOLOGICAL CHARACTERISTICS OF ARTIFICIAL CYSTS OF THE LIVER

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Liver cysts of nonparasitic origin are treated by surgery. Puncture methods of treatment are effective only for cysts under 3-5 cm in diameter. Puncture methods and their improvement have to contend with the absence of an adequate experimental model of a cyst. There has been only one published report [1] of a method of formation of a pseudocyst in the liver. The need to create a model of a liver cyst closely resembling in its structure a true cyst will be obvious, for such a model would enable new types of surgical and puncture treatment to be developed.

The aim of this investigation was to develop a method of forming artificial cysts of the liver, similar in structure to true cysts, and to study their morphology.

EXPERIMENTAL METHOD

Experiments were carried out on 12 male and female dogs weighing 15-25 kg. Operations were performed under general anesthesia. Cysts were formed by means of an ultrasonic surgical aspirator, with oscillating frequency of the working part of the apparatus of 26.5-39 kHz and resonance frequency of 26.5 kHz. The working mode of the apparatus remained unchanged throughout the period of cyst formation. The parenchyma was removed from one lobe of the liver up to a volume of 25-75 cm³. The time taken to form one cyst was 20-30 min. Since the ultrasonic aspirator destroys selectively the parenchyma of the liver without damaging vessels and ducts, it guarantees hemostasis in the early stages due to changes in the microcirculatory bed, and bleeding is therefore minimal. Large vessels and bile ducts are easily ligated. The inner surface of the walls of the cysts immediately after their final formation is smooth and dry, with no sign of bleeding. In some cases the inner surface was treated by means of a pneumothermocoagulator. After the end of cyst formation, the cross-linked copolymer of the monovinyl ester of ethylene-glycol was introduced into it in the ratio of 1:3 (1 volume of filler to 3 volumes of cavity). The equilibrium degree swelling of the copolymer α is 30 g/g. Once in the body tissues, the polymer is converted into a gel. The opening into the finally formed cavity, through which the filler was injected, was sutured by interrupted knotted cat gut sutures. By this method two or three models of a cyst can be formed simultaneously in different lobes of the liver. The newly formed cysts were assessed after 21, 30, 60, and 90 days. The walls of the cysts with adjacent parts of parenchyma were excised for histological investigation and fixed in 12% formalin solution. The material was embedded in paraffin wax and sections 7 μ m thick were stained with hematoxylin and eosin and by Van Gieson's method.

EXPERIMENTAL RESULTS

The macroscopic appearance of the cysts and the results of histological study of their walls at all stages of the experiment were identical. Starting with the 21st day, soft elastic formations, slightly projecting above the surface, could be palpated in the substance of the liver parenchyma. The volume of the cysts corresponded to their initial size (Fig. 1).

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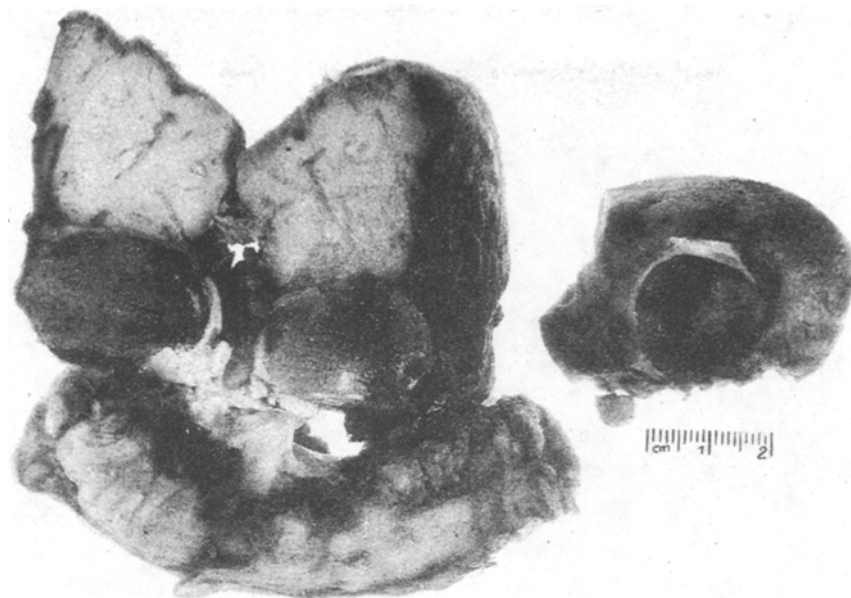


Fig. 1. Artificial cysts of the liver 3 months after formation. Cyst walls are thin, gel mass in lumen. Loop of intestine adherent to one cyst.

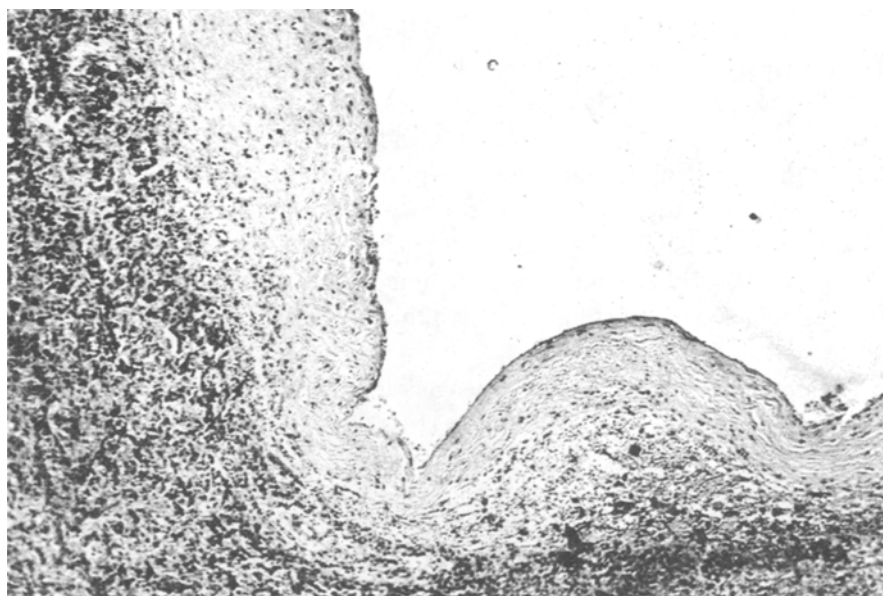


Fig. 2. Walls of artificial cyst 3 months after formation consist of a layer of collagenized connective tissue; no blood vessels or inflammatory infiltration present. Gel appears as homogeneous masses. Stained with hematoxylin and eosin, 90 \times .

Elements of the omentum, loops of intestine, and pancreatic tissue were adherent to the surface of the cysts. The cyst walls were 1 mm thick and rigid, with no sign of collapse. The inner surface of the cysts was smooth and pale gray in color. On histological examination the cyst walls were formed of collagenized connective tissue with a moderate number of fibrocytes; blood vessels and inflammatory infiltration were absent throughout the thickness of the walls (Fig. 2). Epithelization of the cysts could not be seen. On the inner surface of the cysts at the boundary with the filler total concentrations of macrophages with empty foamy cytoplasm were present and were arranged in one or more layers. The outer surface of the cyst

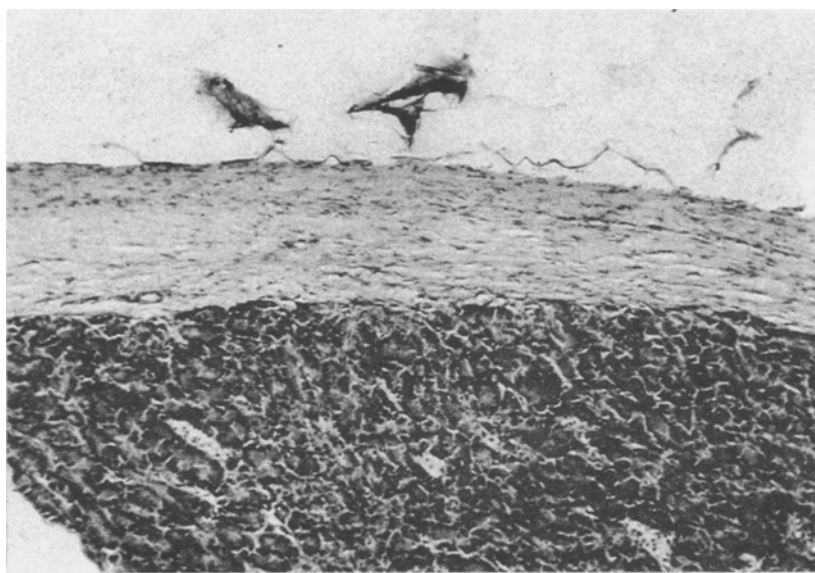


Fig. 3. Pancreatic tissue adherent to wall of artificial liver cyst is normal in structure. Period of observation 3 months, stained with hematoxylin and eosin. 90 \times .

wall was bounded both immediately by the liver parenchyma and by concentrations of macrophages loaded with hemosiderin situated between them. Sclerotic changes were observed only along the course of the portal tracts and central veins lying next to the cyst wall. On the boundary with the cyst were focal degenerative changes in the hepatocytes with dilatation of the sinusoids. Areas of the pancreas, loops of intestine, and the omentum were adherent to the outer surface of the cyst, but showed no signs of necrosis, sclerosis, or inflammatory changes, i.e., their structure was normal (Fig. 3). In some places marked signs of angiomatosis were observed in the liver parenchyma in the deep regions bounding the walls of the cyst. This picture was the result of the fact that after long-term ultrasonic irradiation of the liver parenchyma the hepatocytes died but the triads, central veins, and carcass of the sinusoidal vessels were preserved. The lumen of the sinusoids was dilated and congested, and deposits of hemosiderin granules could be seen in the stroma. Changes in the physical properties of the filler were noted. Until the 21st day the filler was easily removed from the lumen of the cysts and it had the appearance of a thick translucent gel, light brown in color. By the 90th day it had liquified, it glistened, and was easily removed from the cavity of the cyst by puncture.

By the use of an ultrasonic surgical aspirator, large cavities with a dry inner surface can be formed rapidly in the substance of the parenchyma. Filling these cavities with the cross-linked copolymer of the monovinyl ester of ethylene-glycol (1 volume of filler to 3 volumes of cavity) leads to the formation of thin-walled cysts with stable assigned dimensions. Proper aspiration of necrotic tissues promotes the rapid formation of thin-walled cysts. The model of cysts described above, close in structure to true cysts of the liver, can be used to develop new puncture methods of treatment.

LITERATURE CITED

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