



PATHOLOGY

HEPATIC CIRRHOSIS IN THE BLUE WHALE, *BALAENOPTERA*
*MUSCULUS*¹⁾

BY

A. STOLK

(Histological Laboratory, Free University, Amsterdam)

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1. *Introduction*

The etiology of hepatic cirrhosis (synonyms: Laënnec's cirrhosis, portal cirrhosis, atrophic cirrhosis, multilobular cirrhosis, alcoholic cirrhosis) is rather obscure. This cirrhosis is characterised by a firm, nodular liver smaller than normal, thickening of the capsule, nodules brown or yellowish-brown, portal obstruction, enlargement of the spleen, ascites and collateral circulation. The essence of this pathological condition is the rebuilding of the tissue accompanied by extensive destruction of the hepatic cells and replacement of these cells by a dense fibrous tissue. As causal factors are mentioned: chronic alcoholism; hepatitis; hepatic poisons such as ether, chloroform and carbon tetrachloride; toxic agents such as arsphenamine, trinitrotoluene and cinchophen; high fat diet; disturbances in tissue respiration; vitamin deficiency; low intake of protein and insufficient supply of the vitamin B complex (including choline) (GYÖRGY and GOLDBLATT, 1942).

Certain poisons cause only a degeneration of the hepatic tissue without cirrhosis. So after a prolonged oral administration of alcoholic Sudan III solution (0.1 g Sudan III, 20 cc alcohol 95 per cent) to a number of specimens of the frog (*Rana esculenta* L.) and the toad (*Bufo bufo* L.) we found a lipomatosis of the hepatic tissue combined with degeneration (STOLK, 1950).

With regard to the great number of causal factors in hepatic cirrhosis it is important to study this disease in wild animals, because several factors there can be excluded. In our collection of pathological material from whales we found a case of hepatic cirrhosis in a male blue whale (*Balaenoptera musculus*) (length 22.5 m). The material was collected during the expedition 1951/1952 of the Dutch Whaler "Willem Barendsz" and was sent to us by Mr Jhr. E. W. VAN LENNEP (Utrecht).

Some pieces of the cirrhotic liver, sent to us for investigation, were fixed in formalin, some pieces in Bouin's solution. They were embedded

¹⁾ Publication of the Netherlands Whale Research Group, Organisation T.N.O., Utrecht.

in paraffin; the sections (4–6 μ) were stained with haematoxylin and eosin, and moreover, according to the Van Gieson method and the azan method.

2. Description

The deformed and roughened liver had a brownish colour and such a firm consistence, that it was hard to cut. As only pieces of the liver were fixed and sent to us, we are unaware whether the organ was smaller than normal. The surface of the liver showed the characteristic, coarsely granular, and nodular appearance, for which the term hob-nail liver is well chosen, and correspondingly the cut surface was nodular (fig. 1). The rounded or irregular nodules and granules, situated in a gray ground-work and yellowish or yellowish-brown coloured, were varying much in size. The large nodules measured about 8×11 mm, while the diameter of the small nodules was about 3×5 mm. The granules could not be measured easily.

Microscopically the granules and nodules showed the characteristic structure of the hepatic cirrhosis known from human pathology: extended growth of connective tissue; atrophic and necrotic liver tissue caused by pressure; areas with still fairly normal liver cells; tortuous bile ducts different in size; and wide, irregular blood sinuses.

The connective tissue had extremely increased: large areas of the liver consisted of waving collagenous fibers and fibroblasts with fusiform nuclei. The blood vessels were surrounded by a thickened capsule of connective tissue. The central and peripheral layer of this capsule showed connective tissue with many nuclei and few collagenous fibers and connective tissue with few nuclei and many collagenous fibers respectively.

In the areas of atrophic and necrotic liver tissue there were remainders of the nuclei and very fine brown pigment granules.

The normal arrangement of the liver cells was diminished. Sometimes the liver cells contained large vacuoles and brown pigment granules. Remainders of liver cell cords, which were not yet growing pseudo bile ducts, may be situated in the connective tissue (fig. 2).

The small and large bile ducts, which were found in the growing connective tissue, partly in groups, partly solitary, were tortuous and most of them had a lumen (fig. 3).

The wide, irregular blood sinuses were situated between the liver cell cords, the bile ducts and the connective tissue. They were very much filled with blood and had extended on account of that.

Locally these blood sinuses were developed to such a degree, that one only observed liver cell cords, blood sinuses and little connective tissue. In other places the connective tissue was predominating and only few small blood vessels were observed. Accumulations of lymphocytes and moreover some plasma cells were encountered mainly in the neighbourhood of the bile ducts.

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Fig. 1. Hepatic cirrhosis in a blue whale. Piece of the liver with lightly coloured nodules and granules embedded in a gray groundwork.

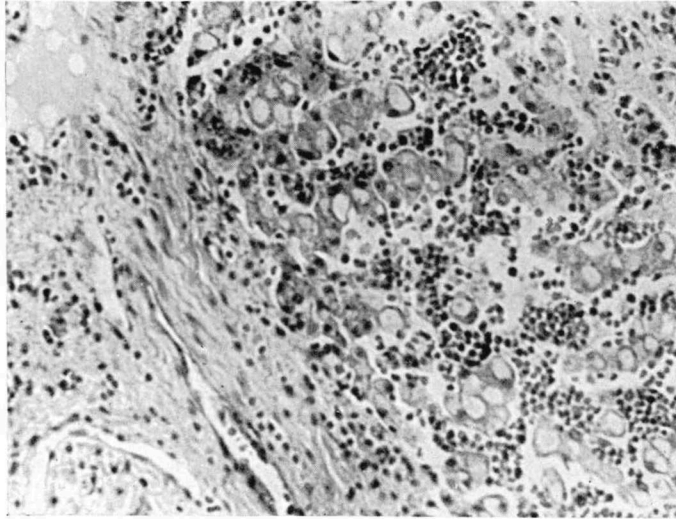


Fig. 2. Hepatic cirrhosis in a blue whale. Right on the photograph isolated liver cells with large vacuoles, and erythrocytes. Left on the photograph fibrous connective tissue with erythrocytes.

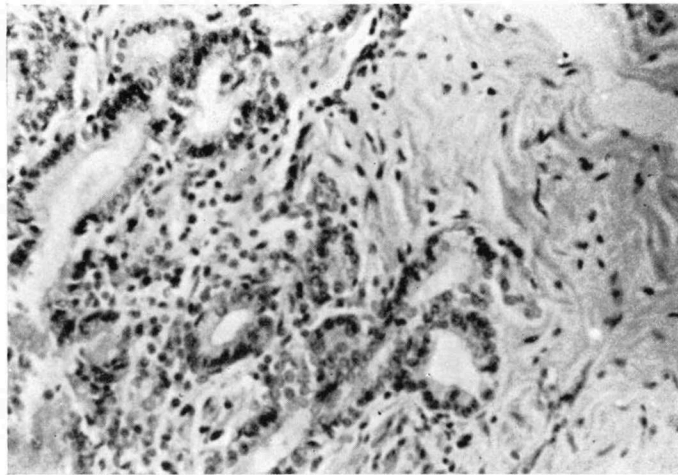


Fig. 3. Hepatic cirrhosis in a blue whale. Right on the photograph connective tissue. Left on the photograph bile ducts embedded in fibrous connective tissue.

As only part of the liver was sent to us for investigation no further peculiarities were known at autopsy.

3. Discussion

The structure of this cirrhotic liver resembled its counterpart in human pathology. There were little differences, for instance the extreme growth of the connective tissue. This is explicable to a certain extent, as the connective tissue is well developed in whales (derma!).

Probably this case must be considered as the first hepatic cirrhosis found in a whale. This disease for instance has not been reported in the summarizing publication of COCKRILL (1951). We found an adenoma of the liver in a male bottlenose dolphin (*Tursiops tursio*), which rather resembled hepatic cirrhosis (STOLK, 1952). On the strength of the characteristic structure of the bile ducts, however, the deviation must be diagnosed as adenoma of the liver. It is common knowledge, however, that there is a certain relationship between hepatic cirrhosis and adenoma of the liver. Sometimes cirrhosis leads to adenomatous growth.

The cause of the hepatic cirrhosis in the blue whale is unknown. At the autopsy no indications were found with regard to the etiology. However, we may conclude that several etiological factors, which are possible in the hepatic cirrhosis found in man, cannot have played a part, such as chronic alcoholism, hepatic poisons and toxic agents. Probably only the hepatitis, the alimentary disturbances and the vitamin deficiency can account for this disease.

The alimentary disturbances for instance may consist in a low intake of carbohydrate, protein and vitamins. The consequence is a diminished storage of glycogen in the liver and further a fatty replacement of the liver cells. Finally the doors are opened to necrosis of the tissue and to cirrhosis.

In our opinion this hepatic cirrhosis is an indication of the central position of the alimentary disturbances in etiology of this disease.

Summary

Description of a hepatic cirrhosis in a blue whale (*Balaenoptera musculus*).

In the etiology of this cirrhosis several factors, which causing hepatic cirrhosis in man, cannot have played a part.

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