

EFFECT OF ENTERAL OXYGEN THERAPY ON LIVER FUNCTION
IN ACUTE DEGENERATION

N. P. Skakun and Ya. M. Nestorovich

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The effect of enteral oxygen therapy was studied in rats with acute degeneration of the liver caused by CCl_4 . Intragastric injection of oxygen foam reduced the severity of poisoning and led to more rapid and complete recovery of the intensity of bile secretion, synthesis of primary bile acids, and their conjugation with amino acids, and improved the stabilizing properties of the bile.

KEY WORDS: *carbon tetrachloride; oxygen; liver; bile acids.*

Oxygen insufficiency is an important pathogenetic factor in the development of many diseases of the liver and biliary tract [1, 8, 11, 12, 16, 19]. Enteral oxygen therapy has now been used with success for the treatment of worm infestations [7, 9] colitis [11], peptic ulcer and gastritis [2, 6, 15], and adiposity [3, 10]. Several papers have been published on the oxygen therapy of chronic diseases of the liver and biliary tract. The problem of the effectiveness of enteral oxygen therapy in acute liver diseases remains unsolved. The object of this investigation was to study the effectiveness of this type of treatment in acute degeneration of the liver.

EXPERIMENTAL METHOD

Experiments were carried out on 92 female rats weighing 160-200 g by the method described previously [14]. The intensity of bile secretion was determined from the rate of its secretion during each 4-h period of the experiment (in mg/min/100 g body weight) and the total quantity of bile obtained each hour and during the whole of the experiment (in mg/100 g body weight). The concentration (in mg%) and total quantity (in mg/100 g body weight) of bile acids, bilirubin, and cholesterol were determined in hourly portions.

The above-mentioned indices were determined in 10 control animals subjected to no other interference. Acute degeneration of the liver was produced in the other animals by subcutaneous injection of a 50% oily solution of CCl_4 in a dose of 0.4 ml/100 g body weight daily for 4 days. Forty rats remained untreated, whereas 42 animals received oxygen foam by intragastric injection [13] in a dose of 3 ml/100 g body weight. The indices of liver function were determined on the 7th, 14th, 21st, and 28th days after injection of CCl_4 .

EXPERIMENTAL RESULTS AND DISCUSSION

Acute degeneration of the liver caused by CCl_4 was accompanied by inhibition of the secretion of bile and a decrease in the concentration and total quantity of cholates excreted with the bile. The content of taurine and glycine conjugation products in the bile also was reduced. Bilirubin and cholesterol secretion were disturbed to a lesser degree. These changes were most marked during the first days; the state of the liver function then gradually returned to normal.

Enteral oxygen therapy in rats with acute degeneration of the liver caused a marked improvement in the general condition of the animals. They tolerated the poisoning better and took food and water more eagerly. Among the treated animals none died, whereas among the untreated rats 12.5% died. The intensity of bile secretion was higher in the treated than in the untreated rats at all periods of the experiment ($P < 0.05$). An earlier restoration

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TABLE 1. Indices of Intensity of Bile Secretion in Rats with Acute Degeneration of the Liver Under the Influence of Enteral Oxygen Therapy ($M \pm m$)

Experimental conditions	Number of animals	Rate of bile secretion (in mg/min/100 g body weight) on each day of experiment				Quantity of bile during 4 h of experiment, mg/100 g body weight
		1-st	2-nd	3-rd	4-th	
Control	10	4,0 \pm 0,3	3,5 \pm 0,2	3,7 \pm 0,2	3,9 \pm 0,2	906 \pm 52,4
CCl ₄ poisoning	10	2,7 \pm 0,2	2,6 \pm 0,2	2,5 \pm 0,2	2,5 \pm 0,1	624 \pm 42,2
7 days	10	3,0 \pm 0,2	2,9 \pm 0,2	2,8 \pm 0,2	2,8 \pm 0,2	690 \pm 39,6
14 days	10	3,5 \pm 0,3	3,6 \pm 0,3	3,4 \pm 0,3	3,3 \pm 0,2	828 \pm 44,7
21 days	10	3,8 \pm 0,3	3,9 \pm 0,3	3,9 \pm 0,3	3,7 \pm 0,2	918 \pm 58,6
28 days	10					
CCl ₄ poisoning + oxygen therapy	10					
7 days	10	3,3 \pm 0,2	3,5 \pm 0,1	3,3 \pm 0,1	3,1 \pm 0,1	792 \pm 62,4
14 days	11	3,5 \pm 0,2	3,6 \pm 0,1	3,4 \pm 0,1	3,2 \pm 0,2	822 \pm 56,5
21 days	10	3,9 \pm 0,2	3,7 \pm 0,2	3,6 \pm 0,2	3,6 \pm 0,2	888 \pm 44,3
28 days	11	4,0 \pm 0,2	3,9 \pm 0,1	3,7 \pm 0,1	3,6 \pm 0,2	912 \pm 60,5

of this index to normal after CCl₄ poisoning was observed correspondingly (Table 1).

Significant changes also were observed in the chemical composition of the bile. For instance, by the seventh day of observation the total cholate concentration in the bile of the treated rats reached 1550-1146 compared with 768-592 mg% in the untreated rats; by the 14th day this index in the treated animals had regained its initial level (1791 mg%), whereas in the untreated animals it was still low (942-867 mg%). The total quantity of cholates secreted also was appreciably increased as the result of treatment.

Chromatographic analysis showed that the increase in the total cholates of the bile took place on account of conjugated compounds of bile acids with taurine and glycine. The taurocholic acid concentration was increased by 1.6, 2.3, and 1.6 times respectively on the 7th, 14th, and 21st days of the investigation, whereas the glycocholic acid concentration was increased by 6.2 and 1.7 times compared with that in the untreated rats.

The quantity of cholesterol excreted with the bile fell appreciably during treatment, especially after the 14th day of investigation. For instance, the quantity of cholesterol by the 14th, 21st, and 28th days of observation was 50, 66, and 71% respectively compared with that in the untreated animals. The increase in the cholate/cholesterol ratio under the influence of treatment must be regarded as a beneficial effect, for the stabilizing properties of the bile were thereby improved [18].

No significant effect of enteral oxygen therapy on the pigment function of the liver could be found.

Intragastric injection of oxygen foam in experimental degeneration of the liver thus improves the general condition of the animals and leads to a more rapid and complete recovery of the intensity of bile secretion, synthesis of bile acids, and their conjugation with chlorine and glycine; the stabilizing properties of the bile are also improved.

Changes in oxidation-reduction processes in the liver evidently play a central role in the mechanism of the beneficial effect of oxygen on the state of the liver function. In acute virus hepatitis and experimental degeneration of the liver oxidation-reduction processes are disturbed. Energy metabolism follows the glycolytic pathway, which is less advantageous for the body. An increased oxygen supply can switch energy metabolism to the aerobic pathway, with the consequent normalization of all types of metabolism.

A comparatively small quantity of oxygen is introduced into the body by enteral oxygen therapy. It is claimed [17] that the effect of oxygen foam therapy is due to the absorption of oxygen from the intestine and an increase in its partial pressure in the portal system.

Enteral oxygen therapy, aimed at normalizing oxidation-reduction processes and improving oxygenation of the liver, is a pathogenetic method of treatment of its degenerative lesions.

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