Morphofunctional characteristic of the liver at its vascular isolation without and on the background of fabric antihypoxant (experimental and clinical study)

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ABSTRACT

The survey was aimed at studying the morphological changes of liver observed during different time intervals of hepatoduodenal ligament occlusion with and without administration of antihypoxant FDP both clinically and experimentally.

Occurrence of the evident morphological signs of ischemia resulted from occlusion of hepatoduodenal ligament made intraoperative liver protection with antihypoxic preparations immediately prior to hepatoduodenal ligament clamping necessary. Introduction of FDP before applying a tourniquet as well as during release of hepatoduodenal ligament is reasonable regardless the duration of ischemia period.

Key words: liver hypoxia, antihypoxant, FDP

INTRODUCTION

The problem of postoperative acute hepatic failure is a key issue during the liver resection, especially the extensive resection. Massive uncontrollable hemorrhage is one of the major predisposing factors leading to development of this threatening complication. In order to prevent and suppress the bleeding the intraoperative obstruction of afferent hepatic blood supply is always used [1, 2]. Currently, the maximal duration of hepatoduodenal ligament (HDL) occlusion applied in the surgical treatment of numerous diseases is approximately 60 minutes with successive cycles of 15 to 20 minutes of hepatic vascular inflow occlusion separated by periods of 3-5 minutes of reperfusion [3]. However, the duration of safe normothermic hepatic ischemia was assessed mainly basing on the results of hemodynamic and biochemical characteristics of hepatic failure [4]. The maximal duration of safe liver exclusion from blood circulation is still to be assessed at the morphological level [5].

According to the available literature references [6], fructose-1.6-diphosphate (FDP) is widely used for myocardial infarction, depressed case, ischemia of kidneys, small intestine and cerebral ischemia, yet it is poorly studied as a protector for ischemic liver.

Aim of the survey included study of the morphofunctional liver condition during its vascular occlusion and assessment of the intraoperative method of ischemic liver protection with FDP both experimentally and clinically.

MATERIALS AND METHODS

Thirty rabbits weighing from 2.1 to 2.7 kg were used in experiments. The control group consisted of 15 rabbits subjected to 60 minutes of HDL clamping. The second group included 15 rabbits subjected to HDL clamping with FDP introduction. Intravenous drip-feed of FDP solution was made at the main group of animals 20 minutes prior to HDL occlusion. The dosage
of introduced preparation constituted 200.0 mg per 1 kg of animal weight with the rate of administering 50 mg/min.

In order to study morphofunctional state of liver under occlusion of afferent blood flow the biopsy specimens of animal liver were sampled prior to HDL clamping and 20, 40 and 60 minutes after clamping and 20 and 40 minutes after tourniquet removal. Biopsy pieces of liver, 30 biopsy specimens in total were taken in vivo 7-10 cm from the node of a liver focal disease (parasitic lesion, benign tumors) prior to clamping and 5, 10, 15, 20-25 minutes after clamping and 5 minutes after HDL clamp removal with and without use of antihypoxant, namely PDF.

The material was subjected to traditional histology and electron microscopy with hematoxylin and eosin staining, van Gieson's staining, Schiff reaction, alcian blue, methylene blue, azure-II and basic fuchsin staining of histological and semifine sections (C.Humphrey, F.Pittman, 1974).

Morphological survey was carried out with use of LEICA MB4000B microscope with LEICA DFC320 digital camera, electron microscopy was conducted by EVM – 100L electron microscope.

RESULTS

Histological, histochemical and electron microscopy surveys conducted by our group in all three zones of hepatic acinus in experimental models demonstrated that HDL occlusion for 20 minutes did not result in occurrence of significant histological and electron microscopy changes in liver. The pronounced morphological signs of ischemia appeared after 40 minutes of HDL clamping, while 60 minutes long ischemia was hazardous and irreversible.

Intraoperative FDP administration produced an apparent antihypoxic effect reducing the morphological changes in liver during both ischemia and reperfusion periods. Sufficiently stable content of glycogenic and Schiff-positive inclusions in hepatic cells cytoplasm indicated the appropriate course of anaerobic glycolysis which is known to be suppressed during ischemia period. Optimal hepatocytes supply with energy resources (FDP) prevented development of edema, necrobiosis and necrosis of hepatocytes after 60 minutes of HDL occlusion and during reperfusion period.

Morphologically, the models’ liver had signs of the low-grade reactive hepatitis at the distance of 7-8 cm from the node of focal lesion.

The initial sings of hepatocytes hydration appeared 5 minutes after occlusion of hepatoduodenal ligament. Sinusoidal endothelial cells had a pronounced cellular hyperhydratation. The signs of cellular hyperhydratation become more expressed in 10 minutes after HDL clamping. Hydropic degeneration of hepatocytes developed after 15 minutes of hypoxia. Significant mitochondrial swelling with distinct clarification of matrix, and vacuolated canaliculi of rough endoplasmic reticulum (RER) were detected during electron microscopy. In 20-25 minutes, microfoci of necrobiosis in periportal tracts appeared on histological sections. Mosaic structure of liver with the symptoms of severe dystrophy and partial necrosis of some hepatocytes as well as the signs of incipient intracellular regeneration processes were observed during reperfusion.

In case of FDP administration prior to HDL clamping and after clamp removal, the liver morphology was characterized by the lack of distinct pathological changes both in light hepatocytes and sinusoidal endothelial cells most sensitive to hypoxia. Submicroscopic changes in hepatocyte mitochondria reflected the structural functional display of adaptive increase of oxidative phosphorylation processes. Partial degranulation and vacuolization of some RER canaliculi was registered in sinusoidal endothelial cells.

Therefore, light-optical morphological and electron microscopy data indicate the effectiveness of intraoperative hepatic protection of the models with FDP in case of the liver exclusion from the blood circulation during the extensive organ resection at the patients with major focal lesions of liver. In addition to energy-supply characteristics of FDP, its anti-edema action should be
considered as a positive pharmacological action as well.

REFERENCES

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