

Kidney Microcirculation Condition in Extrahepatic Cholestasis Dynamics

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Abstract In the next 15 years, an increase in the global incidence of the biliary system by 30-50% is predicted, which is explained by lifestyle and nutrition, hereditary factors [2]. Over the past 10 years, there has been a steady increase in diseases accompanied by the development of extrahepatic cholestasis.

Keywords Experimental cholestasis, «LUMAM-IZ», Kidneys, Laparotomy, Endotoxycosis, Bile duct, Biomicroscopy

1. Introduction

The mechanism of kidney damage in cholestasis is largely due to the toxic effect of bilirubin secreted through the glomerular membrane. Unconjugated bilirubin accumulates in large quantities in the interstitium, disrupting the function of the tubules and interstitium, which causes destruction of the papillary zone [5]. Mortality in the group of patients with acute renal failure on the background of cholestasis is 57%. The frequency of deaths correlates with the level of hyperbilirubinemia. Thus, with a serum bilirubin content of more than 342 $\mu\text{mol/l}$, lethality was 85%, and below 171 $\mu\text{mol/l}$ - 33% [5].

Thus, with hyperbilirubinemia, there is severe endotoxycosis, hemodynamic disorders, as well as a direct effect of bilirubin on the renal tissue, causing severe local toxic damage. Conducted studies indicate the effect of the duration of jaundice on the severity of impaired renal function. The effectiveness of preoperative preparation directly depends on the duration of cholestasis, contributing to the improvement of the course of the postoperative period with the restoration of liver and kidney functions in patients with 10-day cholestasis and a significant improvement in these indicators with prolonged obstructive jaundice.

2. Purpose of the Study

To examine the microhemodynamics of the kidneys in the dynamics of the extrahepatic cholestasis.

3. Materials and Methods of the Study

The experiments were carried out on 48 outbred male rats of a mixed population with an initial weight of 180-200 g, kept in a laboratory diet in a vivarium. Extrahepatic cholestasis was reproduced in rats by ligation of the common bile duct [1]. The total lethality in this group was 29.%. The control was provided by false collated animals (16 rats), which was carried out only laparotomy in aseptic conditions. In these groups lethality was not observed. The intact group was 8 rats. The studies were carried out 1, 3, 7 and 15 days after the models were reproduced. The choice of terms of the study is related to the development of significant morpho-functional changes in the liver at experimental cholestasis [2]. An outline of the experience is presented in table 1.

Table 1

Experiment	Time of the experiment, days				Total	Lethality %
	1	3	7	15		
Intact	2	2	2	2	8	-
Control	4/4	4/4	4/4	4/4	16/16	
Extrahepatic cholestasis	6/5	6/4	6/4	6/4	24/17	29,2

Note: in the numerator the initial number of animals in the groups; in the denominator is the number of animals taken into consideration for lethality.

The biomicroscopic study of the microcirculatory bed of the kidney of the experimental animals was carried out by a luminescent microscope "Lumam-IZ" using a contact lens 10x0.40 and 25x0.40 [3]. Live biomicroscopy was performed under general thiopental anesthesia at a dose of 70 mg/kg animal body weight. The abdomen was opened by a circular incision below the rib arch. Anesthetized animals were fixed on the manipulation table with a heating device that maintains a constant temperature (37°C). To reduce the liver, the diaphragm between the liver and the diaphragm was provided with a special fixable mirror. To maintain the

moisture of the examined surface, the organs were constantly irrigated with a physiological solution of 0.9% NaCl. The results of the study were photographed.

4. The Results of the Research

It is well known that the liver and kidneys have a close functional relationship, which is mainly expressed in the biotransformation of the endo- and xenobiotics, as well as eliminates of metabolites and biological oxidation products. Issues related to changes in the peripheral blood circulation system of the kidneys in the event of various types of bile outflow are virtually unexplored. Studies of such a plan, in our view, would be of great practical importance from the point of view of preventing possible complications on the excretory activity of the kidneys.

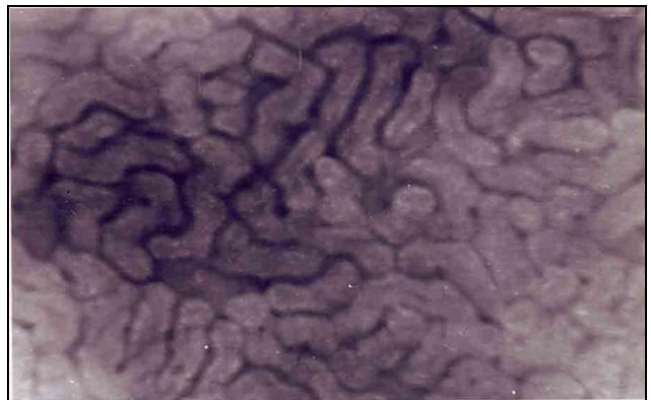
Renal circulation is unique in its structure, which allows each segment of the renal capillary bed to play its special functional role: filtration takes place in glomerulus; cortical peritubular capillary network is specialized for reabsorption, medullary circulation provides the needs of the renal concentration mechanism [3]. When entering the kidney, the renal artery is divided into numerous branches, which initially go perpendicular to the kidney surface, then bending at the level of the cortico-mullar boundary and further follow the parallel surface. These arc arteries give rise to branches that pass through the cortical layer to the surface of the kidneys. The interlobular arteries are connected to the vascular loops of the glomerulus through arterial vessels, so-called afferent arterioles, and with peritubular capillaries through efferent vessels, usually having an arteriolar structure. This structure is typical of the kidneys of all mammals.

Available for vital microscopy are the peritubular capillaries of the cortical layer of the kidneys. The only area in which an efferent vessel of the ball perfuses the canal of the same ball is located in the proximal duct of the surface cortical layer of the kidneys. Thus, the condition of the microcirculatory channel of the cortical part of the kidneys to some extent reflects the dynamics of changes in the glomerular capillary. In intact rats with luminescent biomicroscopy, the kidney tissue is presented greenish brown, parenchyma consists of proximal winding tubules and peritubular capillaries, which have a dark gray shade against the background of a whitish color of the epithelium tubules. There are normally single efferent arterioles and peritubular capillaries. The blood flow in the efferent arteries is rapid, jet, continuous flow. Peritubular capillaries departing from the arteriolar, widely anastomosing among themselves form a dense network with polygonal cells, stretched along the canals (pic.1). The boundaries of the duct apparatus and capillaries are clearly delineated due to the whitish luminescent strips that appear when light is refracted by the tubule epithelium.



Picture 1. Autofluorescence in the capillaries of the proximal convoluted tubules of the cortical layer of the kidney of intact animals magnification x 75

Studies in the control animal group have shown that laparotomy has no significant effect on the kidney microhemodynamic parameters. Only by the end of the first day after laparotomy there is a slight increase in the lumen of the peritubular capillaries and reduced blood flow in them. In subsequent periods, the microcirculation of the kidneys functioned without features (pic.2).



Picture 2. Autofluorescence in the capillaries of the proximal convoluted tubules of the cortical layer of the kidney of control animals magnification x 75

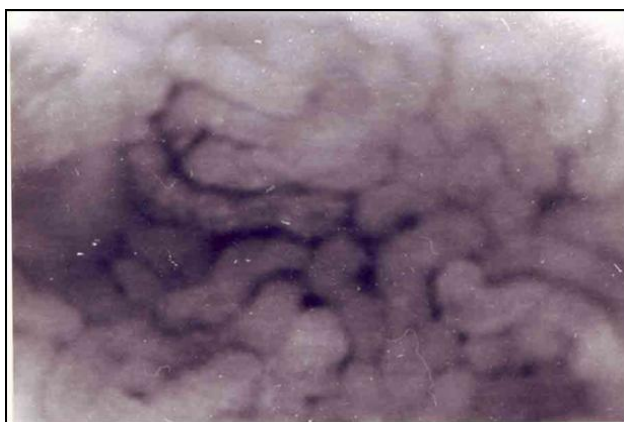
In contrast to the control 24 hours after ligation of the common bile duct in a group of experienced animals changes microcirculation in the cortical layer of the kidneys are characterized by intravascular aggregation of shaped blood cells, intermittent and slow blood flow. [4]

The angioarchitectonics of the cortical kidney are characterized by heterogeneity of the parenchymes due to the presence of separate groups of dysfunctional capillaries. Vascular and tubular contours preserved except parenchyma, where the luminescent glow of the tubule epithelium has been erased. (pic.3). The third day of the experiment was characterized by an increase in dissipative shifts, which showed the mosaic of angioarchitectonics. The number of inactive capillaries increased slightly compared to the previous study.

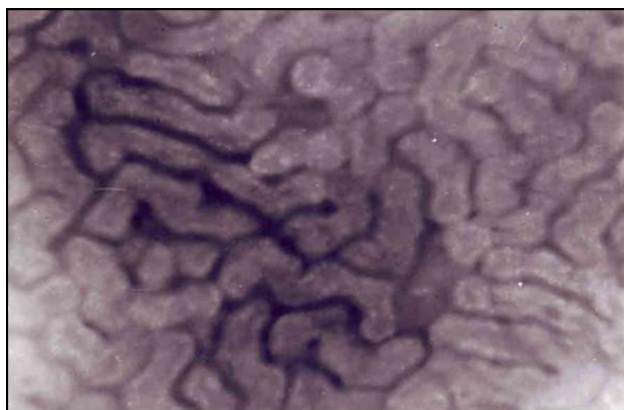


Picture 3. Autofluorescence of the capillaries of the proximal convoluted tubules of the cortical layer of the kidney 1 day after ligation of the common bile duct magnification x 75

The boundaries of the canals around the non-functioning capillaries are smoothed, probably due to plasma impregnation of their walls. Perivascular diapedic hemorrhages have been identified around the non-functioning capillaries. (pic.4). The blood flow in the capillaries is slow, is fine-grained, in some cases intermittent.



Picture 4. Autofluorescence of the capillaries of the proximal convoluted tubules of the cortical layer of the kidney 3 days after ligation of the common bile duct magnification x 75



Picture 5. Autofluorescence of the capillaries of the proximal convoluted tubules of the cortical layer of the kidney 7 days after ligation of the common bile duct magnification x 75

Seven days after ligation of the common bile duct of the cortical angioarchitectonic region of the kidneys is characterized by slight destruction, mainly due to perivascular changes, plasma impregnation and deformation of the walls of proximal winding tubules. Tubular epithelial luminescence was absent on almost the entire surface of the kidneys, available for biomicroscopy (pic.5).

The latter can most likely be explained by the sedimentation of protein precipitate on the inner surface of tubules and and imbibing blood cells into their walls. The blood flow pattern remained almost unchanged from the previous period, remaining slow, intermittent.

The final period of research in the group of experimental animals was characterized by the persistence and slight aggravation of the violations identified. So, blood flow became coarse-grained, intermittent by that time, which slowed his speed even further. There were capillaries with a pendulum-like blood flow. The mosaic angioarchitectonics of the cortical layer of the kidneys are preserved.

5. Conclusions

1. Thus, studies have shown that microcirculation, and, therefore, kidney activity is involved in the circle of pathological changes in the development of cholestasis syndrome.
2. The development of extrahepatic cholestasis disrupts systemic kidney microcirculation at almost all levels of the organization. Violations increase with the duration of cholestasis.

REFERENCES

- [1] Sekas G. A technique for creating partial obstruction of the common bile duct in the rat. *Lab Anim.* 1990; 24(3): 284-7.
- [2] А.А. Натальский, С.В. Тарасенко, О.В. Зайцев, О.Д. Песков СОВРЕМЕННЫЕ ПРЕДСТАВЛЕНИЯ О ПЕЧЕНОЧНОЙ НЕДОСТАТОЧНОСТИ В ХИРУРГИИ Российский медико-биологический вестник имени академика И.П. Павлова, №4, 2014 г. С 138-147.
- [3] ИРИСКУЛОВ Б. У. НАРУШЕНИЕ РЕОЛОГИЧЕСКИХ СВОЙСТВ КРОВИ И МИКРОЦИРКУЛЯЦИИ ВНУТРЕННИХ ОРГАНОВ ПРИ ЭКСПЕРИМЕНТАЛЬНОМ САХАРНОМ ДИАБЕТЕ.: ДИС. КАНД.МЕД.НАУК., ТАШКЕНТ. – 1993. – 123 С.
- [4] И.М. Мамонтов, И.В. Ивахно, Т.И. Тамм, В.О. Панасенко, В.И. Падалко, И. Зульфугаров МОРФОЛОГИЧЕСКИЕ ПРИЗНАКИ ДЕКОМПЕНСАЦИИ ФУНКЦИИ ПЕЧЕНИ ПРИ ЭКСПЕРИМЕНТАЛЬНОЙ ПОЛНОЙ ОБСТРУКЦИИ ВНЕПЕЧЕНОЧНЫХ ЖЕЛЧНЫХ ПРОТОКОВ 2019; 1(67): 162-166.
- [5] М.Д. КАШАЕВА, Д.Г. КОНДРАТЬЕВ, Б.М. ШАХАБУТДИНОВА, Д.А. ШВЕЦОВ НАРУШЕНИЯ ФУНКЦИИ ПОЧЕК ПРИ НЕОПУХОЛЕВЫХ ХОЛЕСТАЗАХ 2017

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