STATE OF BASIC UROGENOUS PROCESSES IN PATHOLOGICAL CONDITIONS OF THE LIVER

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According to the observations of a majority of researchers, damage to the liver is accompanied clinically and experimentally by a decrease in the excretion of water through the kidneys. Certain authors attribute the inhibition of urine excretion in pathological conditions of the liver to a severe depression of glomerular filtration in the kidneys [1, 6, 9]. Other researchers have noted an increase in glomerular filtration under the same conditions [4, 5, 11]. There are also data which indicate that renal filtration remains unaltered when the liver is affected [7, 9]. The data in the literature are equally contradictory regarding the state of renal plasma flow when hepatic function is depressed [2, 3, 7, 10].

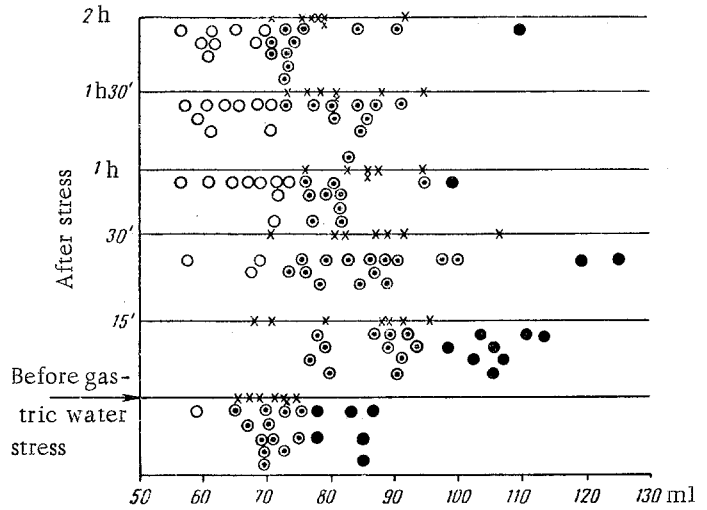

Fig. 1. Changes in glomerular filtration under the influence of water stress in the dog Lapka at various intervals after transection of the common bile duct. The crosses represent determinations made before surgery, the black dots determinations made 8-16 days after surgery (above normal), the circles containing dots determinations made 17-26 days after surgery (within normal limits), and the circles determinations made 27-32 days after surgery (below normal).

Some authors attribute the decrease in urine excretion to a change in water resorption in the renal tubules.

TABLE 1. Glomerular Filtration in Control Dogs and Dogs with Experimental Hepatic Pathology during the Period of Inhibited Diuresis (in ml/min/m^2)

Statistical index	Before water stress	After water stress				
		After 15 min	After 30 min	After 1 h	After 1 h 30 min	After 2 h
		Before surgery — control				
M±m	77.00±2.14	90.66±3.06	89.86±2.99	88.07±2.52	81.48±2.28	81.07±2.00
n	23	23	23	23	23	23
After transection of the common bile duct						
M±m	72.86±4.87	91.47±3.11	82.01±2.80	83.11±4.76	80.37±4.11	79.45±4.48
n	22	22	22	22	22	22
t	0.78	0.18	1.92	0.92	0.23	0.34
P	> 0.05	> 0.5	> 0.05	> 0.05	> 0.5	> 0.5

Certain researchers have detected an increase in tubular water resorption in the presence of hepatic pathology [2, 5], while others have found resorption to be normal [6, 8], and still others have observed a decrease [1, 3].

We studied the state of the basic urogenous processes throughout the entire pathological period in dogs with various experimental disruptions of hepatic function.

EXPERIMENTAL METHOD

We conducted 156 experiments on 8 female dogs, in which we first created gastric and vesical fistulae. We determined diuresis, glomerular filtration, and renal plasma flow (by intravenous drip infusion of insulin and para-aminohippuric acid), as well as tubular water resorption and the quantity of filtrate before application of gastric water stress (30 ml/kg) and 15, 30, 60, 90, and 120 min afterward (this method was based on the fact that diuresis is disrupted and basic urogenous processes are more marked under water stress). The dogs' serum bilirubin content was monitored (by van den Bergh's method).

After control examinations the common bile duct was severed in 5 dogs, Eck-Pavlov fistulae were inflicted on 2 dogs, and 1 animal was given a hepatotropic toxin—carbon tetrachloride. Experiments involving determination of diuresis and basic urogenesis level were conducted on dogs with pathological conditions of the liver at various intervals after surgery or poisoning. The experimental animals were kept on a carbohydrate diet and shifted to a meat diet at predetermined times.

EXPERIMENTAL RESULTS

Regardless of the type of experimental hepatic pathology, all the animals exhibited a progressive decrease in background and water-stress diuresis, which was especially marked when they were kept on a meat diet. During the period of most intensive inhibition of diuresis the dogs with transected common bile ducts (22 experiments) excreted 16.19±5.07% of the water introduced into the stomach within 2 h (m = +10.8). At the same time, the control dogs (23 experiments) excreted 10.57±14.3% of the liquid introduced within the same period (m = +2.9). The results obtained were statistically reliable ($P < 0.001$).

Glomerular filtration did not remain constant throughout the entire period of hepatic pathology. This index was somewhat above normal (77.00±10.23 ml/min/m^2 for healthy dogs) in some of the animals during the first few weeks after transection of the common bile duct, but then reverted to normal and was subsequently somewhat reduced (Fig. 1).

All three periods of the change in glomerular filtration were clearly distinguishable in certain dogs (Lapka, Pal'ma, and Malyska), while in others (Kashtanka) the first period was curtailed and third set in rapidly, the animal subsequently dying. In milder hepatic affections (Eck-Pavlov fistula carbon tetrachloride poisoning, carbohydrate diet) a tendency toward increased glomerular filtration appeared (Belka, Myshka, Makyshka, and Venerka).

TABLE 2. Tubular Water Resorption in Healthy Dogs and Dogs with Transected Common Bile Ducts During the Period of Maximum Inhibition of Diuresis (in %)

Statistical index	Before water stress	After water stress				
		After 15 min	After 30 min	After 1 h	After 1 h 30 min	After 2 h
		Before surgery — control				
M±m	98.81±0.11	97.94±0.18	94.11±0.55	88.30±0.69	90.89±0.62	92.60±0.63
n	23	23	23	23	23	23
After transection of the common bile duct						
M±m	99.46±0.03	99.41±0.04	99.23±0.04	99.04±0.08	98.94±0.10	98.79±0.13
n	22	22	22	22	22	22
t	5.75	8.17	9.31	15.81	13.00	8.98
P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

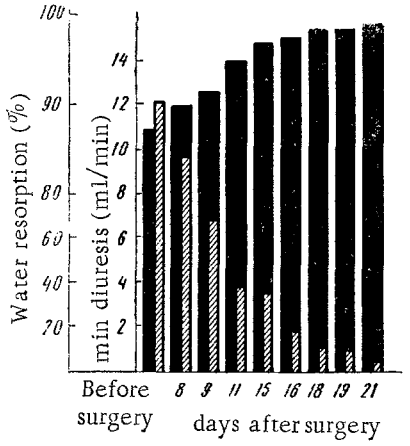

Fig. 2. Relationship between tubular water resorption and minute diuresis at various intervals after transection of the common bile duct in the dog Lapka. The shaded columns represent minute diuresis 1 h after application of water stress, while the solid columns represent water resorption.

It may be seen from the data cited that we cannot make any definite statement regarding the change in glomerular filtration in the presence of hepatic pathology. The magnitude of the change depends on the extent of the hepatic damage. The contradictory character of data in the literature regarding the state of glomerular filtration when heaptic function is depressed apparently results from the fact that different investigators studied it during different phases of the illness. During the first period of hepatic pathology they were able to detect intensified filtration, while during the second period they found filtration to be sometimes intensified and sometimes depressed, depending on the character of the fluctuations on the day of the investigation; any conclusion regarding the level of glomerular filtration was thus to a considerable extent artificial. The results of determinations made during the last period led to a theory of reduced glomerular filtration.

Renal plasma flow exhibited the same periodicity of variation as glomerular filtration. For example, in dogs with pathological conditions of the liver plasma flow was reduced during the period of depressed filtration. The filtration remained virtually unaltered in the majority of cases.

Can the decrease in glomerular filtration be explained by the inhibition of diuresis which occurs in hepatic pathology? Statistical analysis of glomerular filtration showed that it exhibits no reliable difference in control dogs with hepatic pathology, even during the period of greatest inhibition of diuresis (Table 1). In addition, the changes in diuresis and filtration in dogs with pathological conditions of the liver were frequently opposite in direction. For example, in dogs with Eck-Pavlov fistulae reduced diuresis coincided with intensified filtration.

The inhibition of diuresis which occurs in dogs with hepatic pathology is thus not associated with any change in glomerular filtration or renal plasma flow.

Study of tubular water resorption in dogs with hepatic pathology showed that the progressive decrease in diuresis was accompanied by a progressive increase in tubular resorption (Fig. 2).

The contradictory data on the state of renal water resorption were apparently associated with the fact that tubular resorption in patients with hepatic diseases was ordinarily determined under conditions of spontaneous diuresis. when it is normally maintained at a high level. The increase in resorption in hepatic pathology thus occasionally

escaped the notice of researchers. We studied the state of water resorption under water stress, which made it possible to obtain clearcut results.

In all our experiments we observed a clear relationship between the extent of inhibition of diuresis and the water-resorption level. During the period of severe inhibition of urine excretion, tubular water resorption reached especially high levels in all dogs with hepatic pathology and stress-induced diuresis actually decreased. Statistical processing of the data obtained showed that the difference between tubule water resorption in healthy dogs and that in animals with transected common bile ducts was completely reliable (Table 2).

It is conseuqently the high level of tubular water resorption rather than the change in glomerular filtration which plays the decisive role in the inhibition of diuresis in experimental hepatic pathology.

SUMMARY

There was an inhibition of urinary excretion in dogs with experimental pathology of the liver. This occured not at the expense of changes in glomerular filtration or renal plasma circulation, which may even be enhanced, but was due to considerably intensified processes of water resorption in the renal tubules.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
