in which no calcium was found, fluorine content is low.

One factor that all these patients had in common was urography. Almost all patients with calculi have had either intravenous or retrograde urography usually performed with one type or another of radio-opaque medium. In order to eliminate the iodine-containing urographic dyes as the source of the fluorine found in the calculi, samples of 3 of these materials were analyzed and found to contain no fluorine.

Summary. Fluorine has been found in high concentration in 8 out of the 10 urinary tract calculi analyzed.

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Lactic Acid Response to Epinephrine in Experimental Liver Disease.* (22209)

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Normal and partially hepatectomized rats were studied to determine whether differences in the utilization of lactic acid following the injection of epinephrine could be correlated with liver mass. Significant differences were observed and additional studies were carried out on the effect of carbon tetrachloride poisoning and bile duct ligation on the ability of rat liver to handle similar lactate loads.

Method. Sprague-Dawley albino male rats weighing 180-210 g were used. All animals were kept in a constant temperature room on a uniform diet. Animals received a subcutaneous injection of 0.02 mg/100 g body wt., of a freshly diluted solution of epinephrine with added glutathione (Adrin, Sharp & Dohme). Tail vein samples were used for lactic acid determinations. Partial hepatectomy was performed by a technic in which 70% of the liver mass was removed. Carbon tetrachloride poisoning was accomplished by the intraperitoneal injection of 0.10 cc of CCl_4/100 g body wt., a modification of a recently described technic(1).

TABLE I. Effect of Epinephrine on Blood Lactic Acid in Normal and Partially Hepatectomized Rats.

Hr after epinephrine	Normal rats	Part.-hep. rats
Resting, before epinephrine	17 ± .25*(57)	16.5± 1.3 (17)†
1	41 ± 1.7 (36)	46 ± 3.3 (16)
2	21 ± .3 (28)	37 ± 2.3 (17)
3	17 ± 2.3 (25)	36 ± 1.4 (11)
4	—	27 ± 2.3 (11)
5	—	20 ± 1.5 (13)

* S. E. † No. rats.

Results. Resting levels of blood lactic acid were the same in the normal and partially hepatectomized animals (Table I). Both

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TABLE II. Blood Lactic Acid Levels Three Hours after Epinephrine in Rats.

	No. rats	Blood lactic acid (mg %)
Normal	25	17 ± 2.3*
Part.-hep.	11	36 ± 1.4
CCl_4 2nd day	34	34 ± 3.5
" 5th "	14	20 ± 1.5
Bile-duct ligation 2nd day	8	14.5± 1
Idem 5th "	9	30 ± 2.5

* S. E.

groups exhibited a similar prompt rise in the lactic acid levels one hour after the epinephrine injection. Two hours after epinephrine, normal animals showed a rapid clearance of lactic acid and by 3 hours had returned to resting levels. Partially hepatectomized rats 1-4 days postoperatively did not return to previous resting levels of lactic acid until 5 hours after epinephrine. This difference was not present 9 days after operation. These results suggest that lactic acid determinations 3 hours after epinephrine could serve as a means of detecting liver damage. This was tested in rats by comparing CCl_4 poisoning and bile duct ligation.

The clearance of lactic acid was impaired in rats which had been injected with CCl_4 40 hours previously (Table II). These results were similar to those seen with removal of 70% of the liver mass. Determinations done 120 hours after CCl_4 poisoning, however, revealed a normal ability to handle endogenous lactic acid loads. These findings are consistent with the demonstrated regenerative capacity of the liver after CCl_4 intoxication(1).

Two days of biliary obstruction did not affect the ability to clear lactic acid in spite of obvious jaundice (Table II). Determinations done 5 days after duct ligation, however, showed impairment of this aspect of liver function probably related to the secondary cellular damage which follows prolonged bile stasis.

Discussion. When the role of the liver in lactic acid metabolism was established, investigators studied the resting blood lactic acid level in diseased liver states. Their results are equivocal(2,3). It was suggested that exogenous lactate loading might reveal impaired hepatic function, and much work has been done with this technic. These studies have proved that hepatocellular disease is detectable by this means(4,5). Few studies on endogenous lactic acid loading following epinephrine in liver disease have been reported. An early paper by Loeb *et al.* failed to show significant differences in the maximum elevation of lactic acid in patients with and without liver disease(6). Our results in rats show that while there is no difference in the maximum lactic acid elevation, there is a delayed return to normal levels following experimentally produced liver disease. These results are strikingly similar to those recorded by Nitzesco and Gontzea(7).

Theoretically the observed alteration in lactate accumulation might represent failure to destroy epinephrine by the damaged or absent hepatic tissue, since it is known that epinephrine is rapidly inactivated by the liver. In these experiments, however, the subcutaneous route of administration would minimize the opportunity for this epinephrine to pass through the liver. Furthermore, lactate disappearance curves of the same basic shape were obtained when epinephrine was injected by the intraperitoneal route despite a presumably high rate of entry into the hepatic circulation.

Summary. 1. Blood lactic acid levels were determined in rats subjected to liver damage by partial hepatectomy, carbon tetrachloride poisoning and bile duct ligation. 2. Hepatocellular loss or damage impaired the clearance rate of endogenous lactic acid after epinephrine. Biliary obstruction, *per se,* had no such effect.

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