

Effect of Ligation of Pancreatic Ducts on the Serum Phosphatase.

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The following experiments deal with the changes in the phosphatase of the serum of dogs in which the pancreatic ducts have been ligated and cut. That the blood diastase may be influenced by ligation of the pancreatic ducts has been shown by Pratt and his co-workers. Golden, Sieracki, Handelsman, and Pratt¹ have found that the permanent separation of the pancreas from the duodenum through tying the pancreatic ducts resulted in a persistent increase of the diastase in the blood in 3 out of 4 dogs. Bodansky and Jaffé² ligated the common bile duct of a dog and found a progressive elevation in the serum phosphatase paralleling the rise in the serum-bilirubin. These ligation experiments have been confirmed by Armstrong, King, and Harris³ in 19 dogs. After releasing the obstruction in 2 dogs these authors noted a return to normal in the phosphatase and bilirubin values.

Alkaline phosphatase has been shown to be present in pancreatic tissue. In the course of our studies on dogs with a pancreatic fistula we have found alkaline phosphatase also in the pancreatic juice ranging between 6.0 and 15.5 Bodansky units.

Regarding the above mentioned experiments of Pratt and his co-workers, of Bodansky and Jaffé, and of Armstrong, King, and Harris, we became interested in the question whether the serum phosphatase is influenced by the separation of the pancreatic gland from the duodenum through ligation of its ducts. Our findings are based on observations on 10 dogs.

Determination of alkaline serum phosphatase with Bodansky's method was con-

tinued for days and even months when the animals survived. The pancreatic ducts were dissected out under nembutal anesthesia, ligatures were applied and the ducts were then cut. The dogs were supplied with food and water each day, and no therapeutic measures were applied except that in the last 3 operated dogs we put sulfathiazole powder in the abdominal cave in order to improve the process of healing after the operation. Blood was withdrawn from the heart by puncture prior to the operation and at different days succeeding the operation for estimation of phosphatase.

The results of our examinations may be found in Table I.

We have determined the alkaline serum phosphatase 20 times in 10 dogs before the operation. The average amount was 1.94 Bodansky units. The deviation was not significant, the highest value being 3.3 units, the lowest value 1.4 units. The day following the operation the majority of the dogs had recovered satisfactorily and they were taking food. The alkaline serum phosphatase began to rise, but only in dog 8 was there a definite and marked increase from 1.4 units to 12.4 units within the first 24 hours. The serum phosphatase rose to progressively higher values each day following the ligation, reaching its peak between the fourth and the tenth day after the operation. A value 6 to 8 times higher than the initial value was found in every dog where the blood could be examined within this time. Three dogs (No. 2, 5, and 13) showed only a very moderate increase of the serum phosphatase, but these dogs died within 24 to 72 hours after the operation had been performed. Between the 10th and the 20th day after the ligation the values tended to decrease but returned to the initial value in only one dog.

Acid serum phosphatase was also determined before and after the closure of the pan-

¹ Golden, L. A., Sieracki, L. A., Handelsman, M. B., and Pratt, J. H., *Am. J. Digest. Dis.*, 1939, **6**, 327.

² Bodansky, A., and Jaffé, H. L., *Am. J. M. Sc.*, 1936, **192**, 527.

³ Armstrong, A. R., King, E. J., and Harris, R. I., *Canad. M. A. J.*, 1934, **31**, 14.

TABLE I.
Alkaline Serum Phosphatase Before and After Ligation of the Pancreatic Ducts.

Dog No.	Alkaline serum phosphatase in Bodansky units before operation				Alkaline serum phosphatase in Bodansky units after operation					
					1	2	3	4 to 10	11 to 20	Beyond 20th day
2		2.8			3.43	3.4				
3	2.2	1.95						10.5 (6)*	8.8 (11)	
5	3.3	1.7	1.5	1.9	4.94					
6†	2.0	2.5	2.2					12.5 (4)	2.13 (12)	3.5 (44)
								13.8 (7)	1.55 (18)	1.75 (55)
8	1.4	1.65			12.4		10.8			
9	1.8	1.6	1.4		5.4	12.4				
13		2.2			4.8	7.2				
14	1.8	1.6			2.2			14.2 (8)	10.8 (11)	
15		1.86				5.93		14.75 (7)	10.42 (18)	4.67 (22)
										4.90 (45)
										3.27 (70)
17	1.8	2.08			2.26			16.4 (8)	13.55 (11)	

*The number in parenthesis means the exact day after operation.

†Autopsy showed that occlusion of all ducts has not been completely accomplished.

creatic ducts. The figures before the operation ranged between 0.6 and 4.0 Armstrong units. No influence of the operation on the level of acid serum phosphatase could be found.

Ligation of the pancreatic ducts in dogs has been shown to result in a marked increase in alkaline serum phosphatase, the values reaching 6 to 8 times the initial amount in 4 to 10 days. As the liver of 3 of our dogs has been examined histologically and no signs of liver damage have been found, the increase in the values in alkaline serum phosphatase appears to be due to the occlusion of the pancreatic ducts and not to liver damage which may have developed in connection with the operation.

The results of our experiments may become significant in evaluating observations on patients with pancreatic disorders. All our cases with carcinoma of the pancreas disclosed markedly elevated values for alkaline serum phosphatase. Since all of them had jaundice the elevated figures could be explained by obstructive jaundice. But in 2 cases of

steatorrhea and low volumes for pancreatic juice and low bicarbonate values after injection of secretin we have also found elevated figures for alkaline serum phosphatase. Before a definite conclusion can be reached as to the value of the estimation of alkaline serum phosphatase in the diagnosis of pancreatic disease the experiments need to be supplemented by a larger number of observations on human cases of obstruction of the pancreatic duct.

Summary. Ligation of the pancreatic ducts in dogs resulted in the increase of the alkaline serum phosphatase in 7 out of 10 animals. The values reach their peak between the 4th and the 10th day after the operation and remain high between the 10th and 20th day after the occlusion of the ducts. They are 6 to 8 times higher than the values before the operation. The 3 dogs which showed a moderate increase of alkaline serum phosphatase died within 24 to 72 hours after the operation had been done.

Acid serum phosphatase is not influenced by the ligation of the pancreatic ducts.