

## INFLUENCE OF LIGATION OF PANCREATIC DUCTS OF DOGS UPON SERUM AMYLASE CONCENTRATION

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Several investigators have undertaken studies which had for their object the estimation of possible changes in amylase concentration in the serum of dogs after the pancreatic ducts had been ligated. A considerable variation is apparent in the interpretation of their results. According to the work of Elman and McCaughan<sup>1</sup> an increase in amylase concentration takes place under these circumstances. The object of the present work is to study such effects with respect to the postoperative interval in contrast with evidence of the effects of all parts of the procedure except that of ligating the pancreatic ducts.

### *Methods*

The method employed for the estimation of amylase concentration has been described by Thompson, Johnson and Hussey.<sup>2</sup> It depends upon the estimation of the time required at constant temperature for a definite change in viscosity to be produced in a mixture of enzyme solution and a starch substrate solution in definite proportion. An indication of the applicability of the method to the present work with sera of dogs is given by the following experiment. Under conditions otherwise the same as in the amylase dilution experiment of the paper mentioned above,<sup>2</sup> the symbolic representation of which will be used in the present communication, three solutions, A, B and C, of dog's serum in 0.85 per cent saline (B and C being successive dilutions to double volume of a portion of A) were employed in the same manner as similarly designated solutions of pancreatin were employed therein. The resulting mean values of  $T$  obtained were 0.781, 1.524 and 3.258 and the corresponding values of  $\alpha'$ ,  $\beta'$  and  $\gamma'$  were 0.497, 0.969 and 2.072 respectively. Accordingly, it is evident that the reciprocal

<sup>1</sup> Elman, R., and McCaughan, J. M., *Arch. Int. Med.*, 1927, 40, 58.

<sup>2</sup> Thompson, W. R., Johnson, C. E., and Hussey, R., *J. Gen. Physiol.*, 1931, 15, 1.

relation between enzyme concentration and  $T$  is approximately attained. In the work herein reported the serum amylase concentration is taken as  $\frac{1}{T} \cdot D$  where  $D$  is the dilution factor.

Serum for this estimation was obtained in the following manner: About 15 ml. of blood was withdrawn from the anterior vein of the dog's fore leg by means of a sterile 20 ml. Luer glass syringe and transferred immediately to a 30 ml. chemically clean sterile test tube. The sterile cotton plug was replaced by a rubber cap so as to prevent evaporation. This was allowed to stand and clot for 20 minutes at room temperature (18–20°C.) and then placed in a refrigerator at 1–2°C. for at least 20 minutes.

The serum was obtained by breaking up the clot with a glass rod and then centrifuging in the usual manner for 15 minutes.

It was found in several different instances that the amylolytic power of sera was markedly diminished after remaining a few hours at room temperature, whereas when such sera were kept in a refrigerator for 4 weeks and then diluted with distilled water in order to compensate for evaporation, estimation of amylase concentration made before and after showed no significant differences. Accordingly, sera which were not used promptly were stored in the refrigerator, but analyses were always made within a 3 day interval thereafter.

#### EXPERIMENTAL

The animals used in the present experiments were selected and maintained as follows: Young healthy dogs of either sex, weighing from 15 to 20 kilos, were selected. These animals were kept in cages in a separate, well ventilated room, and maintained on a balanced diet as recommended by Cowgill.<sup>3</sup> Then a period of 2 weeks or more was allowed to elapse until their body weight became stable before any observations of amylase concentration were made. Water was available to them at all times.

All blood samples were taken at 8 o'clock in the morning before feeding. One sample per day for at least 4 days preceding the operation was taken to estimate what might be called the normal amylase concentration level for each individual dog.

In preparation for operation the animal was given 1 grain of morphine sulfate subcutaneously  $\frac{1}{2}$  hour before the induction of ether anesthesia which was employed in all surgical operations. Aseptic technique was used.

Animals were prepared for operation in pairs. One of these was selected by lot, a midline incision was made through the abdominal wall, the pancreas was thus exposed and the ducts of Wirsung and Santorini and any accessory ducts were doubly ligated with black silk and then severed between these ligatures.

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<sup>3</sup> Cowgill, G. R., *Am. J. Physiol.*, 1928, 85, 45.

The other animal was simultaneously treated in a manner as nearly as possible the same as the first with the exception that these ducts were neither ligated nor severed but instead the pancreas was merely examined. The abdominal incisions were then closed, the animals returned to their cages and maintained as before.

Unfortunately, two of the control animals died within a week after operation. The data are not given for these animals but roughly the same results seemed

TABLE I  
*Showing the Influence of Pancreatic Duct Ligation upon Serum Amylase Concentration in Dogs*

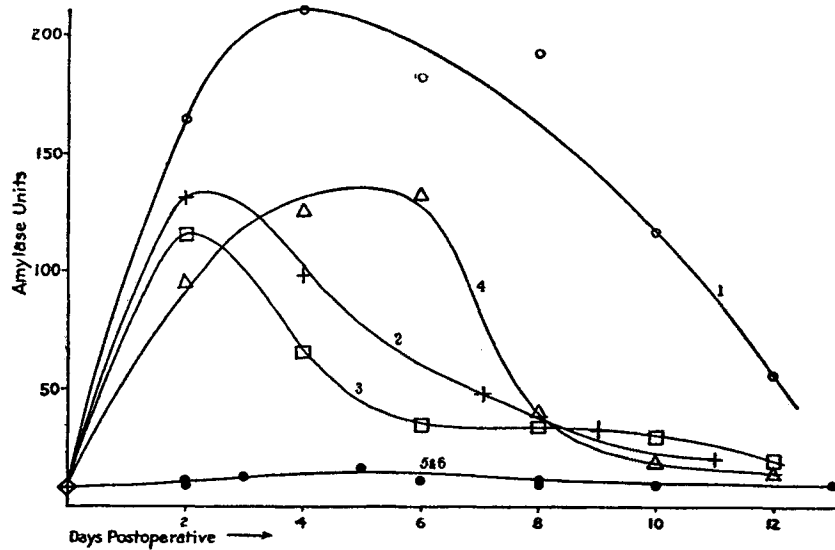
Preoperative	Dog No.					
	1	2	3	4	5	6
<i>days</i>						
3	8	8		12	7	20
2	9	10	7	9	7	11
1	9	9	7	9	6	8
0	7	8	7	11	8	8
Operation.....	Pancreatic duct ligation			Control exposure		
Postoperative						
<i>days</i>						
1						
2	165	131	116	95	10	9
3						12
4	211	98	65	125		
5					16	
6	183		34	131	10	11
7		48				
8	192		34	39	9	11
9		32				
10	116		29	17	9	
11		19				
12	55		19	13		

imminent. Otherwise, postoperatively in each instance, all dogs lost weight for about the first 3 days, after which the control animal quickly regained his normal weight. The dogs whose ducts had been tied off continued to lose weight for several days and refused a considerable amount of their food. Two such animals were kept alive for 10 weeks, having lost approximately one-third of their pre-operative weight in that time. Serum samples were taken thereafter for the

estimation of amylase at intervals of approximately 24 hours. The results of estimations made on certain of these are given in Table I and presented graphically in Text-fig. 1.

#### DISCUSSION

As can be seen in Text-fig. 1, in each instance a rise of several hundred per cent is observed in the amylase concentration of serum of the animals after an operation in which the pancreatic ducts were ligated, the high level being sustained for variable periods of several days



TEXT-FIG. 1

followed by a decline to within at least 100 per cent of the preoperative level, whereas postoperatively the animals in which the pancreatic region was merely exposed no such variation was observed.

Sections taken from the pancreas for microscopic study showed atrophy of the acinar tissue with no obvious changes in the islands of Langerhans, in those animals whose ducts had been tied.

#### SUMMARY

A sharp contrast has been demonstrated in regard to the postoperative amylase concentration of the sera of dogs, depending upon

whether ligation of the pancreatic ducts was or was not a part of an otherwise prescribed operation. The characteristic feature is a marked rise of several hundred per cent in serum amylase concentration, sustained for several days, which is observed when the pancreatic ducts have been ligated.