

THE ROLE OF BLOOD SUGAR LEVEL IN THE PRODUCTION OF EXPERIMENTAL GASTRIC ULCERS IN THE ALBINO RAT BY PYLORIC LIGATION*

By

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Experimental evidence was provided to demonstrate the relationship between blood sugar level and stress-induced gastric ulcers in the albino rat; the stress employed being emotional (restraint) (i). In this paper are reported the results of experiments to demonstrate the influence of blood sugar level on volume of gastric contents, acidity and ulcer production in the stomach of the albino rat following surgical pyloric obstruction.

MATERIALS AND METHODS

Thirty-five healthy albino rats were divided into three groups; in the first group pyloric ligation was done; in the second, pyloric ligation with hypoglycaemia; and, in the third, pyloric ligation with hyperglycaemia.

Pyloric ligation was performed after the method of Shay *et al.* (5) as modified by Kyle and Welbourn (4) histamine was omitted. Food was withheld from the animals for 48 hours and following the operation, water was also withheld.

Blood sugar estimations were done by the method of Hagedorn and Jensen (3).

Hyperglycaemia was induced by alloxan and hypoglycaemia by insulin as already described (1).

At the end of the experiment, the animal was killed and the stomach immediately removed, carefully opened along the greater curvature and the contents collected in a measuring cylinder. The stomach mucosae was gently cleaned and spread on a card with the mucous surface upwards; a tracing paper was superimposed, the outline of the stomach and areas of ulceration were traced. The tracing was then superimposed over millimeter paper for computing the areas. The Ulcer Index is calculated from an arbitrary scale by taking into consideration the ratio of the total area of the stomach mucosa and the area of ulceration (2).

The total acidity of the stomach content was estimated utilising alcoholic phenolphthelin as indicator.

RESULTS

The results are presented in the following table and illustrated in figures 1 and 2.

* Received 25-2-1970.

TABLE 1

*Influence of Blood Sugar Level on Gastric Secretion, Total Acidity and Ulcer Index in Pylorus-Obstructed Rats**(Values are mean \pm S.D. The figures in parenthesis indicate the number of animals employed)*

Experimental condition	Blood Sugar in mgm/100 ml.		Volume of Gastric content in ml.	Total Acidity c.c N/100 NaOH for 100 ml. of Gastric Juice	Ulcer Index
	48th Hr.	58th Hr.			
Pylorus Obstruction with Normoglycemia	79.5 \pm 6.55 (12)	83.25 \pm 5.77 (12)	4.35 \pm 0.35 (12)	123.83 \pm 24.49 (12)	0.44 \pm 0.22 (12)
Pylorus Obstruction with Hypoglycemia	82.5 \pm 3.81 (10)	54.5 \pm 6.92 (10)	5.56 \pm 0.88 (10)	162 \pm 31.93 (10)	0.65 \pm 0.14 (10)
Pylorus Obstruction with Hyperglycemia	331.23 \pm 121.45 (13)	336.31 \pm 116.92 (13)	3.01 \pm 0.37 (13)	55.77 \pm 20.07 (13)	0.1 \pm 0.1 (13)

STATISTICAL ANALYSIS

	<i>t</i> values		
	Volume of Gastric Content	Total Acidity	Ulcer Index
Between Pyloric Obstruction with normoglycemia and Pyloric obstruction with Hypoglycemia	4.39	3.1	2.6
Between Pyloric Obstruction with normoglycemia and pyloric obstruction with Hyperglycemia	9.7	8.0	5.6

All the values are significant at 1% level

In the first group, 83 per cent of the rats developed ulcers and the ulcers were found in the rumen of the stomach; in 10 per cent, the ulcer extended into the body, in 20 per cent both in the antrum and the body, and in 30 per cent the ulcers were only in the antrum. In the second group, which was rendered hypoglycaemic with insulin, all the rats in the group developed ulcers. In 60 per cent the ulcers were located in the rumen, antrum and body of the stomach, in 30 per cent in the rumen and antrum, and, in the remaining in the rumen and body. In the third group, which was made hyperglycaemic with alloxan, only 61.5 per cent developed ulcers with ulcers restricted to the body of the stomach in 62.5 per cent of those developing ulcers.

DISCUSSION

Shay *et al.* (5) produced experimental gastric ulcers in rats by pyloric ligation. According to Shay, the volume of secretion was an important factor in the production of ulcers due to exposure of the unprotected rumen of the stomach to the accumulating acid. In the experiments reported here, a relationship between the volume of gastric contents, blood sugar level and peptic ulceration has been demonstrated.

It was observed that when the volume of gastric content was less than 3ml, ulcers did not develop; and conversely, in rats developing ulcers the volume was always more than 3ml. A possible explanation could be that the stretching of the stomach wall due to accumulation of secretions acts as a mechanical stimulus for gastric secretion.

The protective effect of hyperglycaemia has been observed on the gastric mucosa by inhibiting acid secretion and, hypoglycaemia is associated with a rise in acid secretion with a concomitant rise in ulcer index. This inverse relationship is shown in figures 1 and 2. A

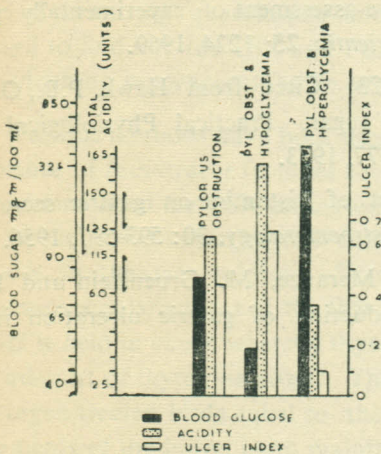


Figure 1
Fig 1

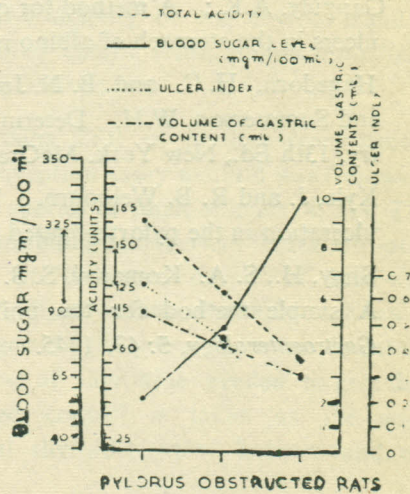


Fig 2

relationship between volume and blood glucose level was also observed; as compared to controls with a mean gastric content of 4.3 ml, it was 5.6ml. in the hypoglycaemic group, and 3 ml. in the hyperglycaemic rats. (See Table I). Concomitantly, the ulcer index was also the highest in the hypoglycaemic pyloricobstructed rats (0.65) and least in hyperglycaemic group (0.1); in the controls, the value was 0.44.

These observations not only lend support to the role of volume of gastric contents in the causation of experimental peptic ulcer, but also suggest a relation between the blood sugar level and the secretory activity of gastric mucosa. It appears that for the rat the critical volume below which ulceration does not occur is about 3 ml.

SUMMARY

(1) The pyloric-obstruction technique of Shay has been employed for the production of experimental ulcers in the stomach of albino rats.

(2) A relationship between blood sugar level and pyloric-obstructed ulceration in the stomach of the albino rat has been demonstrated; whereas hyperglycaemia has a protective role on the gastric mucosa, hypoglycaemia promotes ulcer formation.

(3) A relationship between the volume of gastric contents and the incidence of ulcers has been demonstrated and the critical volume in the case of the albino rat appears to be 3ml.

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