

Lowered Glucose Tolerance in the Sand Rat (*Psammonys obesus*) Resulting from Esophageal Intubation¹ (36369)

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Previous work from this laboratory has shown that an abnormality in the carbohydrate metabolism of the sand rat can be elicited by the *ad libitum* feeding of a commercial rat food but not by an all-vegetable diet (1). Attempts to control the dietary intake of these animals by tube feeding resulted in an alteration in glucose tolerance. The following study demonstrates that this alteration occurs in the sand rat but not in Sprague-Dawley rats.

Materials and Methods. The sand rats used in this experiment were 7–14 months of age and bred at Duke University. They were maintained in individual cages in a room kept at 25–27° and 40–44% relative humidity. All animals were fed the following fresh vegetables: spinach, beet roots, beet leaves, and carrots *ad libitum*, and were also given 5% saline to drink. They had access to vegetables and saline until the start of the experimental procedures.

Glucose-tolerance tests were performed on each sand rat with a sample of tail blood drawn as the initial step. Then, saline or dextrose was administered according to the plan outlined in Table I, and tail blood samples were drawn 30 min and 2 hr thereafter. Similar tolerance tests were performed on male and female Sprague-Dawley white rats as outlined in Table II.

The dextrose load was administered in a dose of 1.5 g per kg body weight and the 0.85% NaCl solution was given in a volume equal to that of the dextrose solution. Blood

samples were drawn directly from the tail into 20-lambda pipets for the blood-glucose determination and into heparinized hematocrit tubes for plasma insulin levels. Blood samples were analyzed for glucose concentration by the glucose oxidase method (2). Plasma insulin assays were performed by a radioimmunoassay method using a sand rat insulin standard (3).

Results and Discussion. The results of the sand rat studies are summarized in Table I. The group III glucose-tolerance tests represent a “normal” response with return of blood glucose to the control level by 120 min. Group II responded to intragastric saline with no significant changes in circulating glucose levels. In contrast the procedures employed in groups I and IV resulted in tolerance curves that were similar to each other, with glucose levels that remained elevated at 120 min. The insulin levels did not change significantly from group to group or from one sample period to the next.

A similar series of tests on white laboratory rats is summarized in Table II. These results show that in group II in which saline was administered by esophageal intubation, the blood glucose levels did not vary markedly and at 120 min were statistically not different from the control period, as in the sand rat experiment. The responses to the Group I and III procedures in which dextrose was given by different routes, show blood glucose increases after 30 min, but, in contrast to the results in sand rats, the 120-min levels are not significantly different from those of the control period.

Using the elevation of the 2-hr glucose level over that of the control period as indicative of an abnormality, it is clear that the Sprague-Dawley rats do not respond abnor-

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TABLE I. Summary of Sand Rat Studies (mean \pm SE of mean).^a

Group	Test	No. of sand rats	No. of tests	Blood glucose (mg/100 ml)			Difference between 120 min and control
				Control	30 min	120 min	
I Dextrose by tube	Glu	3	9	64 \pm 2.6	143 \pm 16.3	114 \pm 5.9	50 \pm 4.7
	Ins	3	3	10 \pm 5.6	18 \pm 8.4	6 \pm 2.5	-4 \pm 3.9
II Saline by tube	Glu	4	6	72 \pm 4.4	81 \pm 7.1	84 \pm 1.7	12 \pm 4.3 ^b
	Ins	3	3	4 \pm 1.2	5 \pm 1.5	5 \pm 1.9	1 \pm 0.7
III Dextrose ip	Glu	4	8	82 \pm 3.7	183 \pm 15.9	86 \pm 5.4	4 \pm 4.9 ^b
	Ins	4	8	3 \pm 1.4	7 \pm 3.0	18 \pm 10.0	15 \pm 14.6
IV Dextrose ip and saline by tube	Glu	4	12	65 \pm 2.7	196 \pm 16.2	111 \pm 8.1	46 \pm 6.8 ^c
	Ins	4	4	4 \pm 2.2	1 \pm 0.8	3 \pm 1.6	-1 \pm 1.7

^a Abbreviations: ip = intraperitoneally; tube = esophageal intubation; Glu = blood glucose mg/100 ml; Ins = plasma insulin μ U/ml.

^b A significant difference, with $p < .001$, when comparing this group with group I. ^c No significant difference, when comparing this group with group I but a significant difference, with $p < .001$, when comparing this group with groups II and III.

TABLE II. Summary of Sprague-Dawley Rat Studies (mean \pm SE of mean).^a

Group	No. of rats	No. of tests	Blood glucose (mg/100 ml)			Difference between 120 min and control
			Control	30 min	120 min	
I Dextrose by tube	3	3	90 \pm 6.4	161 \pm 18.1	103 \pm 4.5	12 \pm 6.7
II Saline by tube	5	5	90 \pm 4.0	99 \pm 2.4	102 \pm 7.1	11 \pm 6.6
III Dextrose ip	4	12	94 \pm 4.3	125 \pm 4.1	90 \pm 4.2	-4 \pm 7.2

^a Abbreviations: ip = intraperitoneally; tube = esophageal intubation.

mally to the intubation procedure in contrast to the sand rats that do exhibit an abnormality. It is interesting to note that in nondiabetic human patients examined by Dupre *et al.* (4) glucose administered by tube directly into the stomach resulted in a normal glucose tolerance and an increase in the circulating immunoreactive insulin levels. These studies are in contrast with the results obtained in the sand rat in which an abnormal glucose tolerance and lack of increased serum insulin immunoreactivity was found after esophageal intubation.

It is apparent that the sand rat is especially sensitive to the stress of esophageal intubation. Since tube feeding by itself can affect the glucose tolerance of sand rats, it is obviously important to take this factor into consideration in interpreting the results of

studies employing this technique.

Summary. Dextrose or saline was administered to sand rats by either intraperitoneal injection, esophageal intubation, or by a combination of these routes. Unlike Sprague-Dawley rats, sand rats responded to the stress of intubation with decreased tolerance to the glucose load.

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