

LETTER TO THE EDITOR

LOW PLASMA GLUCOSE LEVELS IN INDIAN BONNET MONKEYS COMPARED TO HUMANS, RATS AND MICE

Sir,

(Received on May 12, 2003)

This is to bring to light an interesting observation made in our laboratory during experiments on islet cell transplantation on the wild Indian bonnet monkey, (*Macaca radiata radiata*). Fasting plasma glucose was consistently found to be low in this non human primate. In view of the fact that this species of monkey has been widely used in the study of diabetes, we felt the need to plan out a detailed experiment to know more about their plasma glucose values. Was this low value maintained even in their natural environment?

The experiment was designed to estimate the fasting, post prandial and random plasma glucose in Indian bonnet monkeys. In addition to confirming the plasma glucose levels in these monkeys under different physiological conditions, this experiment also included comparison of fasting plasma glucose in the Indian bonnet monkeys with that in rats, mice and humans.

Twenty monkeys (*Macaca radiata radiata*), of either sex and various ages, weighing between 2 and 7.5 kg were used. Besides this, eight inbred Wistar albino rats weighing between 200 to 250 grams and another eight inbred Swiss albino mice weighing between 30 to 35 grams, of both sexes, from our laboratory were also employed in this study. Fasting plasma

glucose was estimated in 8 monkeys. Post prandial plasma glucose estimation was done in another set of 8 monkeys. The monkeys were maintained in individual cages in our animal house for a minimum period of 10 days before estimation of fasting and post prandial plasma glucose.

It was decided to estimate the plasma glucose level in the monkeys soon after being caught in the wild. This would give an idea of the plasma glucose level in their natural habitation. Arrangements were made to trap four monkeys individually in the nearby areas on different days after 12:00 noon. Random plasma glucose was estimated within an hour after being caught and transported to our laboratory from their natural habitat.

Eight staff members of this department with no history of diabetes volunteered to be subjects for the experiment.

The tail vein in rats and mice while the saphenous vein in monkeys was chosen for blood collection. Fasting plasma glucose in rats, mice, monkeys and humans was estimated after an overnight fast, using Randoxy glucose kits, which employ the glucose oxidase-peroxidase method. Post prandial plasma glucose was estimated at the end of one, two and three hours of

feeding the monkeys. The data was analyzed using one way analysis of variance followed by Duncan's multiple range test.

The mean fasting plasma glucose in monkeys was found to be significantly lower in wild Indian bonnet monkeys as compared to humans, rats and mice (Table I).

TABLE I: Comparison of mean fasting plasma glucose (mg/dL) in different species (Mean and SE of 8 observations).

	<i>Monkeys</i> (<i>Macaca radiata radiata</i>)	<i>Humans</i>	<i>Rats</i>	<i>Mice</i>
Mean	59.1	89.3*	85.0*	94.1*
SE	4.1	3.3	3.0	2.3

*Significantly different at 5% level from monkeys.

The mean random plasma glucose value in the 4 freshly caught monkeys was similar to the two and three hour post prandial plasma glucose (Table II). The similarity in the post prandial plasma glucose and the random plasma glucose in monkeys is a reflection of the similarity of the plasma glucose values in their natural habitat (random) and laboratory conditions (post prandial). The maximum rise in plasma glucose level after feeding was 73.7 mg/dL in the Indian bonnet monkeys. In humans the venous plasma glucose levels can go up

TABLE II: Random plasma glucose in 4 Indian bonnet monkeys and post prandial plasma glucose in another 8 Indian bonnet monkeys (Mean \pm SE, mg/dL).

<i>Random plasma glucose</i> (<i>n</i> = 4)	<i>Post-prandial plasma glucose (n = 8)</i>		
	<i>1 hour</i>	<i>2 hour</i>	<i>3 hour</i>
72.7 \pm 5.17	70.0 \pm 2.87	73.6 \pm 4.38	73.7 \pm 3.76

to 140 mg/dL 2 hours after a glucose load as estimated by oral glucose tolerance test (1). The mean two-hour post prandial plasma glucose (73.6 mg/dL) of monkeys was significantly lower than the fasting plasma glucose of humans (89.3 mg/dL), rats (85 mg/dL) and mice (94.1 mg/dL). This shows that even the normal maximum glucose values in the monkeys was lower than the normal minimum glucose values in humans, rats and mice.

The fasting plasma glucose level in Indian bonnet monkey (mean 59.1 mg/dL) was comparable to the fasting plasma glucose of Indian bonnet monkeys reported earlier (2) but less than other species of monkeys reported. The serum glucose level (mean \pm SD) before feeding in *Macaca mulata* (rhesus) was 119 \pm 23 mg/dL and in *Macaca fascicularis* (cynomologus) was 98 \pm 20 mg/dL (3). The arterial blood glucose of Colombian squirrel monkeys was 115.25 \pm 15.73 mg/dL and Bolivian squirrel monkeys was 139.75 \pm 27.92 mg/dL (4). *Galago crassicaudatus* (bushbaby) monkeys had fasting plasma glucose of 97.73 \pm 30.5 mg/dL (5). The same authors reported the fasting plasma glucose values of *Macaca mulata* to be 78.7 \pm 20.6 mg/dL, *Macaca fascicularis* to be 99.2 \pm 15.38 mg/dL and *Saimiri sciureus* (squirrel monkeys) to be 170.7 \pm 37 mg/dL (5). In nondiabetic *Macaca nigra* (Celebes black macaques) monkeys, the mean fasting plasma glucose has been reported to be 72 \pm 3 mg/dL (6).

In humans, plasma glucose level of 50 mg/dL or less will produce signs and symptoms of hypoglycemia (1). In our study out of the 8 monkeys assessed for fasting plasma glucose, 4 had a value of less than

50 mg/dL yet they did not show any effects of hypoglycemia.

The Indian bonnet monkeys studied show significantly lower plasma glucose levels in various physiological conditions, yet it does not seem to interfere with their normal life style. This low plasma glucose value was observed not only in the laboratory conditions but also in their

natural habitat. Our study shows that not only is the mean fasting plasma glucose but also the two hour post prandial plasma glucose in the monkeys is lower than the fasting plasma glucose in humans, rats and mice. It is very interesting to note that in spite of their low plasma glucose they lead a natural active life in the wild indicating that this level of plasma glucose is sufficient to maintain their glucose homeostasis.

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