

INSULIN SHOCK DURING SODIUM PENTOTHAL AND CYCLOPROPANE ANESTHESIA * †

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THE anesthetic management of the diabetic surgical patient includes the administration of insulin, salt solution, and glucose, pre- and post-operatively. The use of insulin always presents the possibility of insulin shock during anesthesia. Although insulin shock in the un-anesthetized subject is easily detected by symptoms such as nervousness, tremor, anxiety, irritability, and convulsions or coma, these manifestations are not present in the anesthetized patient. The present study was undertaken to establish criteria whereby insulin shock during anesthesia could be recognized.

Method: Three volunteer normal males between the ages of 25 and 32 were studied. They were admitted in an acute alcoholic episode, but were clear mentally, cooperative and exhibited no evidence of nutritional deficiency at the time of study. Tests of glucose tolerance were performed on all subjects in the conscious state by the administration of 100 Gm. of glucose intravenously. Normal responses in the levels of blood sugar and pyruvic acid were observed. Insulin shock was induced in these subjects during the course of cyclopropane, and, at another time, pentothal sodium anesthesia by an initial intravenous injection of 30 units of insulin and 20 units every half hour thereafter until a total of 90 units had been given. The first injection was given at the conclusion of a glucose tolerance test during anesthesia, two and one-half hours after the intravenous administration of 100 Gm. of glucose. Experiments in all cases were conducted seven days apart in the post-absorptive state.

Cyclopropane was administered by the to and fro carbon dioxide absorption technic utilizing an endotracheal airway. Anesthesia was maintained in second plane surgical anesthesia. Sodium pentothal was injected intravenously in 5 per cent solution in quantities sufficient to prevent muscular activity. Oropharyngeal oxygen was given throughout and a pharyngeal airway was inserted. No premedicant drugs were used.

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Glucose and pyruvic acid were determined by methods used in previous publications (1). Observations were made at one-half hour intervals for a period of two hours.

Results: The first evidence of insulin shock was moderately profuse perspiration, occurring one hour after the first dose of insulin during pentothal sodium anesthesia. When cyclopropane was used profuse perspiration occurred one and one-half hours after the first insulin had been given. This was followed in twenty minutes by an increased pulse pressure due almost entirely to a fall in diastolic blood pressure, a slight tachycardia, and a full bounding pulse of the Corrigan type. These manifestations of insulin shock are the same with both agents with the exception that the latent period is longer with cyclopropane. All these changes are immediately reversed by the administration of glucose intravenously.

TABLE 1

BLOOD GLUCOSE AND PYRUVIC ACID LEVELS FOLLOWING INSULIN ADMINISTRATION DURING PENTOTHAL AND CYCLOPROPANE ANESTHESIA

Subject	PENTOTHAL SODIUM					CYCLOPROPANE		
	Insulin Units (I. D.)	Time, min.	Blood Glucose, mg. %	Blood Pyruvic Acid		Blood Glucose, mg. %	Blood Pyruvic Acid	
				mg. %	% change		mg. %	% change
T. A.	30	0	144	1.05	—	253	0.90	—
	20	30	51	1.05	0	128	0.90	0
	20	60	26	1.32	+25	69	0.85	- 5
	20	90	19	—	—	37	0.88	- 3
	—	120	12	1.31	+24	30	0.97	+ 8
C. R.	30	0	157	1.13	—	221	1.75	—
	20	30	60	1.60	+42	134	1.75	0
	20	60	42	1.88	+66	60	1.36	-21
	—	90	31	1.70	+50	37	1.68	- 5
F. C.	30	0	105	0.89	—	148	1.17	—
	20	30	44	—	—	78	1.27	+ 9
	20	60	33	1.27	+42	38	1.11	- 6
	20	90	34	1.45	+61	34	1.03	-13
	—	120	32	—	—	28	1.23	+ 6

Table 1 contains the laboratory data obtained during the study and reveals the more rapid but similar fall to shock levels of blood glucose in pentothal sodium anesthesia as compared with cyclopropane. It will be noted also that the rise in pyruvic acid levels during pentothal anesthesia is marked, whereas during cyclopropane anesthesia pyruvic acid levels, if changed, are decreased.

Discussion: Pyruvic acid has been shown to be a normal intermediary product in carbohydrate metabolism (2) and the administration of glucose increases its level in the blood (1). However, in the uncontrolled diabetic, the increase in blood pyruvate does not occur after the

ingestion of glucose. If insulin is given with glucose to diabetics there occurs a prompt and significant rise such as is found in non-diabetic man (3) and dog (4).

It has been implied that cyclopropane has little effect on carbohydrate metabolism, since in surgical patients there was no significant change in the blood sugar levels (5). However, it should be remembered that defects in metabolism are much more easily demonstrated when the organism is placed under the strain of metabolizing relatively large amounts of carbohydrate. It has been observed that cyclopropane, while affecting the fasting blood sugar level little, causes marked changes in the glucose tolerance curve with a diabetoid type of reaction. Such impairment in carbohydrate tolerance is less marked with pentothal anesthesia.

When enough glucose is available, insulin administration causes significant rises in blood pyruvate in the conscious state. The absence of a rise during cyclopropane anesthesia suggests further that there is a defect of intermediary carbohydrate metabolism. This is of special import when it is realized that the rate of fall of glucose levels with both anesthetic agents is comparable, and that the initial blood sugar level is higher in the patient with cyclopropane anesthesia.

CONCLUSIONS

Insulin shock, occurring during anesthesia, is a real entity. The most satisfactory diagnostic aid is the sudden appearance of profuse sweating followed by circulatory changes which consist of a fall in diastolic blood pressure, forceful Corrigan type pulse, and tachycardia. This is easily distinguished from surgical shock, where there is a decreased pulse pressure, due largely to a fall in systolic pressure and a rapid thready pulse. Diastolic pressure rises initially before the ultimate fall in "decompensated shock."

If insulin shock is suspected, the logical diagnostic and therapeutic approach is the intravenous injection of glucose.

It should be pointed out that cyclopropane causes alterations in intermediary carbohydrate metabolism. Further investigation from this standpoint is needed to evaluate its application to surgery of the diabetic.

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