CHANGES OF THE GALVANIC SKIN REACTION UNDER THE EFFECT OF INSULIN

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The high sensitivity of the galvanic skin reaction (GSR) when studying changes of neurodynamics under the effect of pharmacological agents is well known.

This is probably due to the fact that it is a component of the orienting reflex [1, 2], but apparently its significance is not exhausted by this. It has been demonstrated [3] that the GSR changes upon any change of the psychic state, mental stress, and emotional reactions.

Based on the high sensitivity of this reaction, we set out to study the changes of the GSR under the effect of insulin during insulin-hypoglycemia.

METHOD

The GSR was manifested in the development of skin potentials and in the drop of resistance of the skin when exposed to any stimulus. In investigating the patients we recorded the GSR by means of a two-channel ink-writing ÉKPS-3 electrocardiograph. Silver electrodes, 1.5 cm in diameter, were taped to the dorsal and palmar surfaces of the hand. A padding of several layers of gauze was soaked with physiological salt solution. At the same time we measured the resistance between the electrodes. As stimuli we used a bell, tactile irritation of the skin of the forehead, a stream of air directed into the eyes, the odor of menthol and ammonium hydroxide, pricking, and emotional stimuli.

We investigated 22 patients with various forms of psychoses who underwent treatment with comatose doses of insulin. During the investigation the insulin was injected intravenously in a dose causing in each patient a state of deep stupor with evident vegetative phenomena (sweating, tachycardia, hyperemia of the face, etc.). The GSR was investigated before injecting the insulin and every 5 min after injection up to the appearance of a clinically expressed picture of hypoglycemia.

RESULTS

In the first period after the intravenous injection of insulin we noticed a marked drop of the GSR to its complete inhibition.* In six patients the phase of complete inhibition of the GSR ensued 5 min after injection of insulin; in 12, after 10 min; and in 1 patient, after 30 min. The reactions appeared again 25-30 min after the injection of insulin. At the same time the so-called natural oscillations of the GSR arising regardless of the effect of the stimuli, appeared.

In three of our investigated patients the phase of complete inhibition of the GSR was absent, and only a drop

*Since at the maximum increase of sensitivity of our instrument, 1 mV corresponded to 25 mm deflection, we could record only fluctuations of the potential exceeding 0.1 mV. Complete inhibition of the reaction recorded by our instrument means that its magnitude was below 0.1 mV.

of its intensity was observed. In two patients the GSR was stable and practically inextinguishable. In one patient we were not able to detect the phase of inhibition of the GSR owing to the rapid onset of the second phase of expressed vegetative reactions and enhancement of the GSR. Upon replacing the intravenous injection of insulin by a subcutaneous injection, we observed a slow development of hypoglycemia and it was possible to detect the original phase of inhibition of the GSR.

Thus, we noted a distinctive phasic character of the change of the GSR upon injecting insulin: the original phase of suppression, inhibition of the reaction, which was replaced by the phase of its enhancement and development of natural oscillations.

Of greatest interest from our point of view is the first phase of inhibition of the GSR, since it develops almost immediately after the injection of insulin; i.e., even before development of any evident hypoglycemia.

However, the question arises, cannot the inhibition we observed be a consequence of extinction of the GSR under the repeated effect of the stimulus. In order to preclude this possibility we used certain stimuli only against a background of complete inhibition of the GSR. Furthermore, we carried out 11 control investigations on patients with the injection of a physiological salt solution in place of insulin (5) and studied extinction with a repeated effect of the stimulus (6). With the repeated effect of the stimulus we observed a certain drop of the GSR, but it markedly differed from the pattern of the change of the GSR under the effect of insulin, both from a qualitative and a quantitative aspect. Extinction of the GSR was characterized by a wavelike character, and never once did we note complete inhibition of the reaction in response to the effect of all stimuli. If the average magnitude of the decrease of the GSR after the insulin injection was 0.7 mV, then the average magnitude of the drop of the GSR upon its extinction was only 0.1 mV. Thus, although extinction was observed to some extent with repetition of the stimuli, it could not cause the pattern of inhibition of the GSR which we observed after the injection of insulin.

As is known, the GSR is a complex reaction performed by various divisions of the central nervous system. A relation between the GSR and the reticular formation, diencephalic region, and the cortex has been demonstrated by direct experiments on animals [5]. It was noted [4] that "natural oscillations" of the skin potential appear upon stimulation of the reticular formation. However, the changes of the GSR can be evoked also by peripheral factors—by a change of the resistance between electrodes. In order to take into account the effect of the peripheral factor on the changes of the GSR which we obtained, during the course of each investigation we measured the resistance between electrodes. In most cases during the first phase it either did not change at all or somewhat diminished, apparently, as a consequence of an improvement of the contact between electrodes and the skin and, consequently, the changes of the initial resistance could not cause the changes of the GSR which we observed.

Thus, the changes of GSR which we obtained are most easily imagined as the consequence of a change of the functional state of the central nervous system.

In recent times most researchers have been inclined to the idea of peripheral mechanisms of action of insulin and explained the changes of the functional state of the central nervous system under the effect of insulin by hypoglycemia. Our facts (the phase character of the change of the GSR and its inhibition immediately after the injection of insulin even before the development of hypoglycemia) indicates that the change of the functional state of the central nervous system need not be a consequence of hypoglycemia. These phenomena are most easily explained by the development of phasic changes of the functional state of the subcortical formations, in particular the reticular formation, under the effect of insulin.

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