

EFFECT OF HIGH-FREQUENCY MICROWAVES ON THE ABSORPTIVE
ACTIVITY OF THE STOMACH AND INTESTINE

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The effect of radio-frequency microwaves on animals and man has not received due attention in the literature. Examination of persons working with apparatus emitting decimeter and centimeter waves within the 3-10 cm band have shown that the blood erythrocyte count may fall and the total leukocyte and lymphocyte counts may rise [7]. According to other observers [5], after a short period of irradiation with microwaves leukopenia and erythropenia may develop and the ESR may be raised.

Our object was to study the effect of the power of a microwave field and the duration of its action (10 and 20 min), during irradiation of different parts of the body—the epigastric region, the region of the cervical sympathetic ganglia, and the hind limbs—on the absorptive activity of the stomach and intestine.

EXPERIMENTAL METHOD

Experiments were conducted on dogs with an isolated gastric pouch produced by Pavlov's method (3 dogs) or with an isolated loop of small intestine (3 dogs). The absorption of glucose was studied after introduction into the isolated gastric pouch as a 20% solution for 60 min, and into the isolated loop of bowel as a 7% solution for 30 min. The degree of absorption was determined by the difference between the amounts of sugar introduced and withdrawn. The glucose concentration in the solution and in the liquid extracted from the interior of the gastric pouch or loop of bowel was determined refractometrically or by the Hagedorn-Jensen method. A type Luch-58 microwave generator produced waves with a length of 10 cm and a frequency of 2407 Mc/s. The electrode (area 254 cm²) was at a distance of 7-8 cm from the surface of the animal's skin.

We studied the effect of microwaves with a power of 50, 70, 100, and 120 W (duration of action 10 and 20 min) during irradiation of the epigastric region, and also during irradiation of the left hind limb and neck with microwaves with a power of 50 W for 10 min, on the absorptive activity of the stomach and intestine. Altogether 420 experiments were conducted on the six dogs. Besides studying the absorptive activity of the stomach and intestine, we also investigated the changes in the temperature in the gastric pouch and isolated loop of bowel by means of an electro-thermometer with a cavity electrode.

EXPERIMENTAL RESULTS

During the action of microwaves with a power of 50 W on the epigastric region for 10 min, the absorption of glucose in the stomach and intestine increased above its normal level (Fig. 1). The glucose absorption in normal conditions in the isolated gastric pouch of the dog Kashtanka had a mean value in 10 experiments of 18.9% (11.7-23.7%), while after exposure to microwaves the mean value for the same number of experiments was 29.4% (22.0-46.2%). The difference is statistically significant ($t = 2.5$, $P < 0.02$).

The glucose absorption was also increased in the isolated loop of bowel. In the dog Sputnik the average absorption of glucose in the isolated loop of bowel in normal conditions in 10 experiments was 62.6% (42.8-67.1%), and after exposure to microwaves the average value for the same number of experiments was 72.5% (53.5-82.8%). The difference is statistically significant ($t = 2.5$, $P < 0.02$).

With an increase in the power of the microwave field to 70 W, after an exposure of 10 min the same increase in glucose absorption in the stomach and intestine was observed as with a power of 50 W. The glucose absorption in

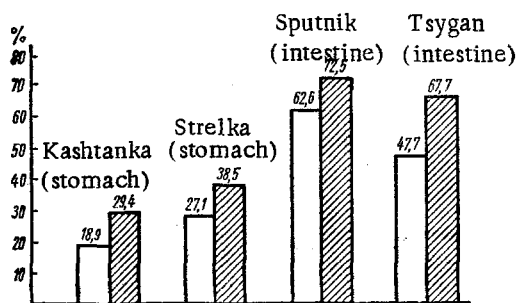


Fig. 1. Effect of microwaves with a power of 50 W, acting for 10 min, on the absorptive activity of the stomach and intestine in dogs. Unshaded columns) normal conditions; shaded columns) after exposure.

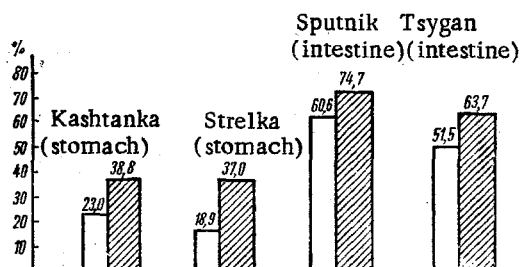


Fig. 2. Effect of microwaves with a power of 120 W, acting for 10 min, on the absorptive activity of the stomach and intestine in dogs. Legend as in Fig. 1.

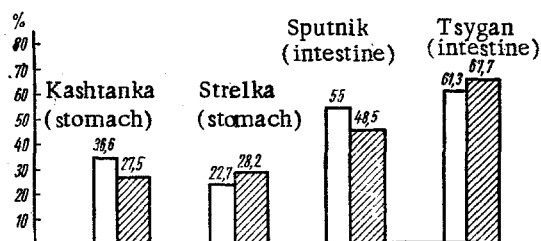


Fig. 3. Effect of microwaves with a power of 50 W, acting for 20 min, on the absorptive activity of the stomach and intestine in dogs. Legend as in Fig. 1.

the isolated gastric pouch and in the isolated loop of bowel rose slightly more when the power of the microwave field was increased to 120 W and the duration of exposure was 10 min.

It will be clear from Fig. 2 that in the dog Kashtanka the glucose absorption in the gastric pouch increased from 18.9 in normal conditions (mean value of 10 experiments, range from 18 to 31%) to 37% (mean value of 10 experiments, range from 34.7 to 42.5%, $t = 3.1$, $P < 0.02$). Similar results were obtained with the other experimental dogs.

Later an attempt was made to discover the effect of the duration of the action of centimeter microwaves on the absorptive activity of the stomach and intestine. Investigations showed that after exposure to microwaves with a power of 50 W for a period of 20 min, the glucose absorption in the stomach and intestine followed no regular rule. In some animals it fell below the normal level while in others, on the contrary, it was slightly higher than normal (Fig. 3).

During irradiation of the region of the cervical sympathetic ganglia with waves with a power of 50 W for 10 min, the glucose absorption in both the stomach and intestine increased, and no marked difference could be bound between the degree of the increase in absorption in this experiment and after irradiation of the epigastric region for the same duration of exposure.

After irradiation of the posterior aspect of the left thigh with microwaves with a power of 50 W for a period of 10 min, an increase in the glucose absorption in the stomach and intestine was observed, and again no significant difference was found between the degree of increase of absorption of glucose in this case and after irradiation of the epigastric or cervical regions.

After irradiation of the epigastric region the temperature inside the isolated gastric pouch and loop of bowel rose by 1.5-2.0°, and after irradiation of the distant receptor zones (neck, lower limb) it rose by 0.8-1.0°.

The results obtained in this investigation agree with our previous observations regarding the effect of certain high-frequency physical agents on the absorptive activity of the stomach and intestine. Like UHF waves and inductothermy, centimeter microwaves raise the temperature inside the gastric pouch and loop of bowel, leading to an increased flow of blood into these organs which, in turn, stimulates the processes of absorption [6].

A. R. Livenson [3] previously observed a considerable increase in the temperature inside the hollow viscera during irradiation with VHF waves.

The increase in glucose absorption in the gastro-intestinal tract during irradiation of the neck and limb with microwaves may be explained by reflex influences. Some workers [4] have observed intensification of the processes of excitation in the central nervous system in a weak VHF field.

The decrease in glucose absorption in the gastro-intestinal tract during irradiation with waves with a power of 50 W for 20 min may be explained by the onset of inhibition in the central nervous system. Two opinions are held

in the literature on the question of the mode of action of the VHF field on the organism. Some writers hold that centimeter waves produce a thermal effect [8, 10], while others [1, 2, 9] describe a specific action on the body. Having discovered that microwaves act on the processes of absorption in the gastro-intestinal tract to approximately the same degree as other high-frequency waves (UHF, inductothermy, diathermy), to settle these differences of opinion we studied the effect of d'Arsonval waves, with a purely oscillatory action, on the absorptive activity of the gastro-intestinal tract.

Our investigations showed that d'Arsonval waves cause an increase in the glucose absorption in the gastric pouch and loop of bowel, but to a lesser degree than physical agents having both a thermal and an oscillatory action [6].

It may accordingly be concluded that both thermal and oscillatory factors are concerned in the mechanism of action of centimeter microwaves on absorption in the stomach and intestine.

SUMMARY

Glucose absorption was studied on dogs with an isolated stomach pouch (after Pavlov) and with an isolated loop of the small intestine. Glucose was introduced into the pouch in a 20% solution for 60 min, and into the isolated intestine in a 7% solution for 30 min.

A study was made of the influence of the power of the field of centimeter waves and of the length of action, as well as of the effect produced on the receptor zones located far from the epigastric area on the absorptive capacity of the stomach and intestine.

The action of the centimeter waves of 50 and 70 W power on the epigastric area for 10 min increased absorption; this phenomenon was even more pronounced with a power of 120 W and the same duration of the experiment.

In irradiation of the cervical sympathetic ganglia area and of the posterior surface of the left hip by means of centimeter waves (50 W) for 10 min there is a rise in the glucose absorption in the stomach and in the intestine. With a 20 min action of centimeter waves (50 W) glucose absorption in the ventricle and intestine is irregular. In some of the animals absorption decreased, whereas in others it was somewhat over the normal level.

Examination of temperature inside the stomach and intestine during the action of centimeter waves, as well as control experiments on the effect of d'arsonvalization of the absorptive activity of the stomach and intestine have shown that both thermal and the oscillatory factors are concerned in the mechanism of the centimeter wave cited.

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