

# CHANGES IN ANTIBODY SYNTHESIS AND THE SERUM PROTEIN SPECTRUM AFTER ULTRASONIC IRRADIATION OF THE LIVER REGION IN RABBITS

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The wide use of ultrasound in medicine for therapeutic and diagnostic purposes [2, 5, 9] justified the study of the protein-synthesizing function of the liver and the activity of antibody biosynthesis following ultrasonic irradiation of the liver.

## EXPERIMENTAL METHOD

Experiments were carried out on 51 chinchilla rabbits weighing 2.7-3.2 kg. The ultrasound generator was a type UTS-1 static apparatus. The animals were exposed to ultrasound at a constant intensity of 2.5 W/cm<sup>2</sup>, an active area of the emitting head of 10 cm<sup>2</sup>, and a frequency of 830 kc, but with different exposures. The animals were immunized immediately after irradiation by subcutaneous injection of corpuscular antigens (1 billion cells of an *Escherichia coli* suspension in a volume of 0.5 ml) and soluble antigen (0.5 ml of human blood serum) into the middle third of the thigh.

## EXPERIMENTAL RESULTS

In the experiments of series I (irradiation of the rabbits for 20 and 15 min with an interval of 24 h) marked depression of synthesis of antibodies against both antigens was found. The titers of agglutinins, determined by the agglutination reaction, were 57% lower on the 5th day of the experiment and 38% lower on the 20th day of the experiment than in the controls (see Figure, A). The mean titer of hemagglutinins [10] on the 5th day after the first immunization was  $1/69 \times 1.12$  in the experimental series and  $1/238 \times 1.82$  in the controls, although at this time precipitins could be found in the blood serum of the experimental animals. Subsequently the titers of both the hemagglutinins and the precipitins rose, but did not reach the control level (see Figure, B and C).

In the experiments of series II (exposures of 15 and 10 min) the depressant action of ultrasound on antibody synthesis was less apparent. In the first 10 days of the experiment the titers of agglutinins of both groups of animals differed only very slightly, but on the 15th and 20th days of the experiment the antibody titers of the experimental animals were lower than those of the controls (see Table). The disturbance of synthesis of antibodies against the soluble antigen as a rule was disturbed before synthesis of antibodies against corpuscular antigen. The titers of precipitins were lower in the experimental rabbits on the 10th day of the experiment than in the controls (see Table).

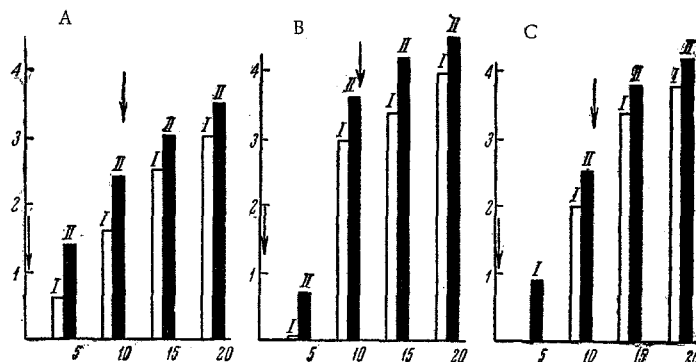
Ultrasonic irradiation of the rabbits in the region of the liver for 5 min on two occasions at an interval of 24 h caused no appreciable changes in the dynamics of the titers of antibodies against both antigens.

As a liver function test, determination of the catalase or cholinesterase activity is often employed, for example following the action of ionizing radiation on this organ [1, 7]. It was also decided to carry out these investigations in the present experimental conditions.

The tests showed that during the four days after the double exposure of the liver to ultrasound for 5 min each time the catalase index fell from 2.6 to 1.5. This showed that in an organ such as the liver, comparatively resistant to ultrasound [9], the functions were nevertheless disturbed following exposure to a small dose of ultrasound. This was confirmed to some extent by the changes in the serum protein spectrum of the animals of the first two series, and also of the control animals (exposed to ultrasound only).

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Dynamics of changes in titers of antibodies against *E. coli* determined by the agglutination reaction (A), the passive hemagglutination reaction (B), and the ring precipitation reaction (C): I) titers of agglutinins of experimental animals; II) titers of antibodies of control animals. The arrow points to the time of immunization. Ordinate—log. of titer; abscissa—days of experiment.

Group of animals	Day of experiment			
	5. th	10. th	15. th	20. th
Agglutinins				
Experimental	1/202:1,07	1/352:1,10	1/1545:1,10	1/3551:1,16
Control	1/269:1,11 >0,05	1/434:1,06 >0,05	1/4953:1,13 <0,001	1/8982:1,12 <0,001
precipitins				
Experimental	1/304:1,31	1/877:1,16	1/1754:1,18	1/17990:1,26
Control	1/463:1,17 >0,05	1/1660:1,14 <0,001	1/9945:1,21 <0,001	1/30413:1,09 <0,001

#### Changes in Titers of Antibodies Following Ultrasound Irradiation of the Liver for 15 and 10 min

animals undoubtedly indicated disturbance of the protein-synthesizing function of the liver, in agreement with reports in the literature [4, 8].

The results of these experiments may evidently also have depended on disturbances of the neuro-endocrine regulation of the processes of antibody formation and protein synthesis following ultrasonic irradiation [3, 6, 11, 12].

On the 5th day of the experiment the albumin content fell sharply: in the experimental rabbits from  $3.30 \pm 0.18$  g%, and in the controls from  $3.28 \pm 0.05$  to  $2.52 \pm 0.05$  g%. The albumin content then rose gradually, and at the end of the experiment it had almost reached its initial values.

A probable explanation of the observed depression of antibody synthesis may have been the appearance of biogenic radicals and toxic substances in the bodies of the animals following ultrasonic irradiation. These evidently interacted with the active centers of the enzymes responsible for antibody biosynthesis and blocked them. The marked decrease in the albumin content and the slight increase in the  $\alpha$ - and  $\beta$ -globulins during the 15 days of the experiment in the experimental

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