# EFFECT OF POSTMORTEM ARTIFICIAL COOLING ON RESTORATION OF PROTEIN BIOSYNTHESIS DURING RESUSCITATION

A. S. Konikova, V. I. Nikulin, and A. V. Pogosova

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Experiments on rabbits by the use of isotope indicators showed that in animals resuscitated 60 min after death protein synthesis can be restored in organs and tissues if they are cooled artificially 10 min after death.

Previous investigations have shown that protein synthesis in homoiothermic animals takes place considerably more slowly in a state of hypothermia, and that the rate of this process during hypothermia is the same as in the organs and tissues of the cadaver. Further investigations of this phenomenon showed that the inhibition of protein synthesis is reversible and that this assimilatory process can be restored in nearly all organs and tissues under certain conditions even after its prolonged and total cessation [1, 2]. The facts discovered showed that differences between hypothermia and death are not manifested as differences in protein biosynthesis, for a practically complete cessation of assimilation may take place in both these states. The only feature distinguishing the dead organism is that after death the level of assimilatory processes approximates to zero while active breakdown, or dissimilation, is uninhibited, whereas during hypothermia not only assimilatory, but also dissimilatory processes are blocked.

With these observations in mind, an attempt was made to inhibit dissimilatory processes artificially after death of the animal and thus to create a state similar to that of hypothermia as regards blocking of metabolic processes. It thus might be possible to increase the period of time after death during which restoration of protein synthesis and other functions can take place in the organs and tissues after death. For this purpose, to slow the processes of dissimilation, rapid cooling of the cadaver of an animal which had been dead for 10 min was used.

## EXPERIMENTAL METHOD

Experiments were carried out on male rabbits weighing 3.1-3.7 kg. An artificial circulation was maintained by means of a special artificial circulation apparatus (ACA) for small laboratory animals [4]. The intensity of protein synthesis was judged from incorporation of the radioactive amino acids lysine-1-$C^{14}$ into protein. The experiment consisted of 7 principal stages.

Stage I. The animal was anesthetized with hexobarbital, the trachea was intubated, and the carotid and femoral arteries and jugular vein were catheterized. After laparotomy, a catheter was introduced via the renal vein into the inferior vena cava and the abdomen was closed. Before sacrifice, the animal was injected with heparin and listhenon.

Stage II. The animals were sacrificed under anesthesia by exsanguination (60-70 ml blood during 1-2 min). The pressure in the femoral artery fell during this procedure to zero (time to the final cardiac contraction 6-9 min).

A. V. Vishnevskii Institute of Surgery, Academy of Medical Sciences of the USSR, Moscow. (Presented by Academician of the Academy of Medical Sciences of the USSR A. A. Vishnevskii). Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 72, No. 9, pp. 44-46, September, 1971. Original article submitted December 7, 1970.

TABLE 1. Restoration of Protein Synthesis in Organs and Tissues of Rabbits Exposed to Artificial Cooling after Death

| Organs and tissues | Intact animals, specific activity | Killed and resuscitated animals | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | after 60 min | | | | | | after 10 min | | after 60 min | |
| | | cooled | | | | | | not cooled | | not cooled | |
| | | № 1 | № 2 | № 3 | № 1 | № 2 | № 3 | № 4 | № 5 | № 6 | № 7 |
| | | specific activity | | | % of recovery | | | % of recovery | | | |
| Regions of brain: | | 94 | 8 | 18 | 17 | 3 | 7 | | | | |
| corpora quadrigemina | 184 | 40 | 13 | 14 | 11 | 8 | 8 | 18 | 16 | 0,7 | 1,5 |
| cortex | 266 | 156 | 24 | 26 | 60 | 10 | 10 | 20 | 24 | 3,0 | 4,0 |
| spinal cord | 178 | 120 | 25 | 10 | 34 | 14 | 6 | 25 | 18 | 1,0 | 0,8 |
| cerebellum | | | | | | | | | | | |
| medulla | 260 | 167 | 43 | 26 | 65 | 20 | 10 | 25 | 22 | 1,2 | 0,7 |
| white matter | | 30 | 6 | 26 | | | | | | | |
| Myocardium of left ventricle | 900 | 719 | 365 | 429 | 77 | 40 | 47 | 100 | 85 | 12,0 | 6,0 |
| Liver | 688 | 617 | 192 | 500 | 90 | 30 | 72 | 75 | 67 | 0,9 | 1,5 |
| Kidney | 1 021 | 1 321 | | 380 | 120 | | 36 | 30 | 33 | 2,4 | 1,9 |
| Intestine | 2 536 | 2 659 | 472 | 430 | 100 | 27 | 25 | 47 | 44 | 4,0 | 2,5 |
| Spleen | 424 | 50 | | 15 | 11 | | 4 | 23 | | 1,5 | 0,7 |
| Pancreas | 830 | | 762 | 380 | | 92 | 46 | 100 | 78 | 7,8 | 9,0 |
| Lung | 1 676 | 1 770 | 473 | 580 | 110 | 28 | 35 | | | 3,0 | 8,0 |
| Adrenals | 2 936 | 2 173 | 246 | 1 170 | 91 | 10 | 42 | 94 | 89 | 2,5 | 0,9 |
| Thyroid | 1 624 | 1 220 | 350 | 578 | 74 | 22 | 35 | 47 | 39 | 3,1 | 2,5 |
| Skeletal muscles | 8 | 32 | 2 | 8 | 300 | 25 | 100 | 100 | 120 | 30,0 | 19,0 |

Note. Radioactive amino acid (lysine-1-$C^{14}$) with specific activity 54 $\mu$Ci/g was injected into the animals in a dose of 30,000 pulses/min/g body weight. Incorporation of lysine-1-$C^{14}$ into protein of organs of intact rabbits taken as 100. Nos. 1-5) surviving rabbits, Nos. 6-7) rabbits not surviving.

Stage III. A waiting period of 10 min after the rabbit's death.

Stage IV. The animals were cooled for 25-30 min. During this time the rectal temperature fell to 26-22°C and the oral temperature to 23-19°C. This cooling took place much more rapidly than spontaneous cooling of the cadaver at room temperature.

Stage V. After cooling for 30 min, the ACA was connected for 10-12 min, and resuscitation began a total of 60 min after the animal's death. The animals were heated to 35-37°C for 2.5-3.5 h. Periodically, glucose and adrenalin were added to the blood. After perfusion for 30-40 min with blood, the heart began to beat regularly, the arterial pressure fluctuated between 80 and 110 mm, and spontaneous breathing was resumed 1.5 h after the beginning of reheating. In most resuscitated rabbits, the corneal reflex reappeared toward the end of the reheating, and individual movements of the head and limbs were made.

Stage VI. When the body temperature was 34-36°C, the amino acid lysine-1-$C^{14}$ was injected into the blood stream and perfusion continued for a further hour. In this period the animals were already breathing spontaneously, their arterial pressure was maintained at 60-80 mm Hg, and they responded by movement to stimulation.

Stage VII. After the end of perfusion of the animals with blood containing lysine-1-$C^{14}$, the rabbits were again killed by exsanguination, and samples were taken from all organs and tissues for isolation of protein and determination of free radioactivity [3].

Three groups of rabbits acted as the controls: group 1 – intact animals, group 2 – animals resuscitated 10 min after death and not cooled after death, and group 3 – animals not cooled after death and subjected, like the experimental rabbits, to resuscitation 60 min after death, but not surviving. All the control animals were perfused by the ACA for 60 min with blood to which lysine-1-$C^{14}$ had been added.

## EXPERIMENTAL RESULTS

As the results given in Table 1 show, protein synthesis in animals resuscitated 10 min after death and subjected to artificial cooling was restored to a large measure after death for 60 min in all organs and tissues. The smallest degree of recovery of the protein synthesis was observed in the cerebral cortex and spleen. Differences in the degree of restoration of protein synthesis in different organs can be attributed to the fact that in experiment No. 1 the rabbit had been reheated to 36°C at the time when the radioactive amino acid was injected, compared with 34°C in experiments Nos. 2 and 3.

In the control animals resuscitated after death for 60 min but not subjected to preliminary cooling, protein synthesis was close to zero in nearly all the organs, and metabolic activity was not restored. At the same time, the degree of restoration of protein synthesis in the experimental animals cooled 10 min after death and then resuscitated 60 min after death was similar (Table 1, Nos. 1-3) to the degree of restoration of protein synthesis in animals resuscitated immediately after death for 10 min (Table 1, Nos. 4 and 5).

It is clear from these results that inhibition of dissimilatory processes by cooling after death of the organism prolongs the period when restoration of assimilatory processes can take place.

## LITERATURE CITED


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